
TEST 1



Math Test - No Calculator

25 MINUTES, 20 QUESTIONS

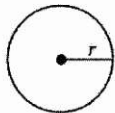
DIRECTIONS

For each question from 1-15, choose the best answer choice provided in the multiple choice bank and fill in the appropriate circle in the provided answer key. Alternatively, for questions 16-20, answer the problem and enter your answer in the grid-in section of the answer key. Refer to the directions given before question 16 as to how to enter your answers for the grid-in questions. You may complete scratch work in any empty space in your test booklet.

NOTES

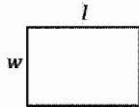
- Calculator usage **is not allowed** in this section.
- Variables, constants, and coefficients used represent real numbers unless indicated otherwise.
- All figures are created to appropriate scale unless the question states otherwise.
- All figures are two-dimensional unless the question states otherwise.
- The domain of any given function is all real numbers x for which the function, $f(x)$, is a real number unless the question states otherwise.

REFERENCE

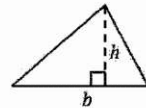


$$A = \pi r^2$$

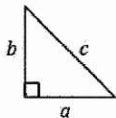
$$C = 2\pi r$$



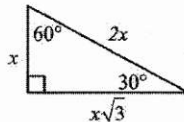
$$A = lw$$



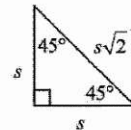
$$A = \frac{1}{2}bh$$



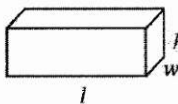
$$c^2 = a^2 + b^2$$



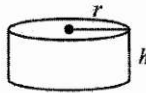
Special
Right
Triangle



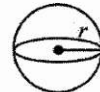
Special
Right
Triangle



$$V = lwh$$



$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

There are 360° in a circle.
There are 2π radians in a circle.
There are 180° in a triangle.

3



3

1

$$\begin{aligned}4x &= 2y + 10 \\ 2x - 2y &= 7\end{aligned}$$

If (x, y) is the solution to the system of equations above, what is the value of y ?

- A) -2
- B) -1
- C) $-\frac{1}{2}$
- D) $\frac{1}{2}$

2

$$\frac{3(2x+5)}{(6x+5)(6x+15)}$$

Given $x \neq -\frac{5}{2}$ and $x \neq -\frac{5}{6}$, which of the following is an equivalent form of the expression above?

- A) $\frac{1}{3x+1}$
- B) $\frac{1}{2x+5}$
- C) $\frac{1}{6x+15}$
- D) $\frac{1}{6x+5}$

3

Billy has been spending a half of an hour each night using a cell phone app to help keep his brain stimulated. In the app, he is presented with 100 words with which he must correctly identify the definition from four answer choices. When the round is done, Billy's score is calculated by the number of incorrect definitions that he chose. The goal is to get a score of zero. Billy had a score of 64 on his third night and a score of 48 on his seventh night. If Billy's score reduces by the same amount each night, on which of the following nights will Billy receive a perfect score of 0?

- A) The 4th night
- B) The 10th night
- C) The 19th night
- D) The 20th night

4

Which of the following expressions is nonpositive for all values of x ?

- A) $1 - x^2$
- B) $1 - |x - 1|$
- C) $(-|x|)^3$
- D) $-(-|x|)^3$



5

In the function $f(x) = Kx^2 + 1$, K is a constant. If $f(8) = 33$, what is the value of $f(4)$?

- A) 3
- B) 9
- C) 17
- D) 33

6

$$f(x) = 3x + 5$$

Given the function above, which of the following is equal to $\frac{1}{3}x + 5$ for all values of x ?

- A) $f\left(\frac{1}{27}x\right)$
- B) $f\left(\frac{1}{9}x\right)$
- C) $f\left(\frac{1}{3}x\right)$
- D) $f(-3x)$

7

$$\frac{a(b+a)}{2a} = 5$$

If the equation above is true, which of the following must also be true?

- A) $\frac{b}{2} + a^2 = 5$
- B) $b + \frac{a}{2} = 5$
- C) $b = a - 10$
- D) $a = 10 - b$

8

Which of the following systems of linear equations represent two lines that are perpendicular to each other?

- A) $y + 2x = 4$
 $y - 2x = 6$
- B) $2y + 2x = 13$
 $-2y - 2x = 3$
- C) $3y + 6x = 12$
 $-6y + 3x = 9$
- D) $8y + 4x = 20$
 $4y + 8x = 20$



9

The function $f(x) = x^2 + 7$ passes through the points $(a, 16)$ and $(b, 16)$, where the sum of a and b is 0. What is the value of $|a - b|$?

- A) 0
- B) 3
- C) 6
- D) 8

10

$$x - 2 = \sqrt{x}$$

When solved as a quadratic equation, which of the following values of x is an extraneous solution to the equation above?

- A) -1
- B) 1
- C) 2
- D) 4

11

$$\frac{4m}{m + \frac{1}{24}} = 8$$

What is the value of m in the equation above?

- A) $-\frac{4}{3}$
- B) $-\frac{3}{4}$
- C) $-\frac{1}{12}$
- D) $-\frac{1}{96}$

12

A package of 4 muffins is priced at x dollars and a package of 8 muffins is priced at $x + 3$ dollars. Angela purchased one package of 4 muffins at 50% off the marked price and Rachel purchased one package of 8 muffins at 50% off the marked price. If Rachel, Angela, and 10 of their friends decided to split the overall price of the 12 muffins evenly, which of the following expressions represents the amount, in dollars, each of them paid in terms of x ?

(Assume that there is no sales tax.)

- A) $x + \frac{3}{2}$
- B) $2x + 3$
- C) $\frac{2x + 3}{12}$
- D) $\frac{2x + 3}{24}$

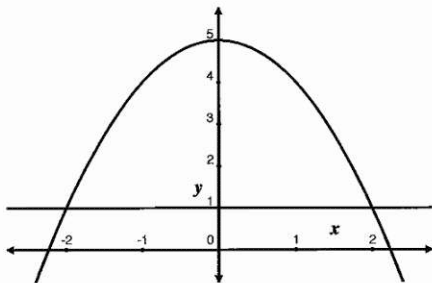


13

In the quadratic equation $x^2 - a^2 = ax$, a is a constant.
What are the solutions for x ?

- A) $a \pm a\sqrt{5}$
 B) $\frac{a \pm a\sqrt{5}}{2}$
 C) $a \pm \sqrt{-3a}$
 D) $\frac{a \pm a\sqrt{-3}}{2}$

14



The relations $y = 1$ and $y = 5 - x^2$ are graphed in the xy -plane above. How many ordered pairs (x, y) , where both x and y have integer values, would satisfy the system of inequalities defined by $y > 1$ and $y < 5 - x^2$?

- A) 7
 B) 8
 C) 14
 D) 15

15

$$\frac{(16 + 3i)(1 + 4i)}{i}$$

If the expression above is rewritten in the form $a - bi$, where a and b are positive integer constants, what is the remainder when a is divided by b ?

- A) 3
 B) 4
 C) 5
 D) 6

**DIRECTIONS**

For each question from 16-20, solve and enter your answer in the grid-in section of your answer sheet as described below.

- A. Write out your answers in the boxes at the top of each column in order to help you fill in the circles accurately. Remember, you will only receive credit for the circles that are filled in correctly, not for the written answer at the top of the columns.
- B. Mark only a single circle in each column.
- C. There are no negative answers.
- D. If the problem has more than one correct answer, grid only one of the correct answers.
- E. When your answer is a **mixed number**, such as $1\frac{1}{2}$, it should be entered as 1.5 or $3/2$. You cannot enter a mixed number because there is no room to fill in a circle that represents a space.
- F. If you enter a **decimal answer** with more digits than the grid can handle, the answer may be rounded or truncated, but it absolutely must fill the entire grid.

Answer: $\frac{8}{21}$

Written answer →

8	/	2	1
●	●	●	●
0	0	0	0
1	1	1	●
2	2	●	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
●	8	8	8
9	9	9	9

Decimal point →

← Fraction line

Answer: 6.4

6	.	4	
●	●	●	●
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	●
5	5	5	5
6	●	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Answer: 102 – both positions are correct

REMEMBER:
You can begin writing your answers in any column as long as there is enough space. Leave unused columns blank.

	1	0	2	
●	●	●	●	●
0	●	0	0	
1	●	1	1	
2	2	2	●	
3	3	3	3	

	1	0	2	
●	●	●	●	●
0	●	0	0	
1	●	1	1	
2	2	2	●	
3	3	3	3	

The ways to correctly grid $\frac{7}{9}$ are:

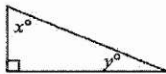
	7	/	9	
●	●	●	●	●
0	0	0	0	
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	
5	5	5	5	
6	6	6	6	
7	●	7	7	
8	8	8	8	
9	9	9	●	

.	7	7	7	
●	●	●	●	●
0	0	0	0	
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	
5	5	5	5	
6	6	6	6	
7	●	●	●	
8	8	8	8	
9	9	9	9	

.	7	7	8	
●	●	●	●	●
0	0	0	0	
1	1	1	1	
2	2	2	2	
3	3	3	3	
4	4	4	4	
5	5	5	5	
6	6	6	6	
7	●	●	●	
8	8	8	●	
9	9	9	9	



16



In the triangle above, the cosine of y° is $\frac{12}{13}$. What is the cosine of x° ?

17

$$\begin{aligned} Ax + 2y &= 12 \\ 8x + 32y &= 144 \end{aligned}$$

For what value of A will the system of equations above have no solutions?

18

Truck A leaves a loading dock and averages 40 miles per hour until it makes a stop in Dover County. Truck B leaves the same loading dock two hours after Truck A and averages 60 miles per hour until it makes a stop in Dover County as well. If both trucks arrive in Dover County at the same time, how many miles is Dover County from the loading dock?

19

$$x^3 - 2x^2 - 9x + 18 = (x - a)(x - b)(x + c)$$

If the equation above is true for all values of x and a , b , and c are all positive constants, what is the value of abc ?



Math Test - Calculator

55 MINUTES, 38 QUESTIONS

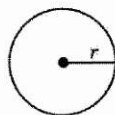
DIRECTIONS

For each question from 1-30, choose the best answer choice provided in the multiple choice bank and fill in the appropriate circle in the provided answer key. Alternatively, for questions 31-38, answer the problem and enter your answer in the grid-in section of the answer key. Refer to the directions given before question 31 as to how to enter your answers for the grid-in questions. You may complete scratch work in any empty space in your test booklet.

NOTES

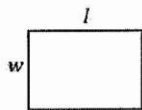
- A. Calculator usage is **allowed**.
- B. Variables, constants, and coefficients used represent real numbers unless indicated otherwise.
- C. All figures are created to appropriate scale unless the question states otherwise.
- D. All figures are two-dimensional unless the question states otherwise.
- E. The domain of any given function is all real numbers x for which the function, $f(x)$, is a real number unless the question states otherwise.

REFERENCE

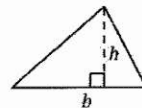


$$A = \pi r^2$$

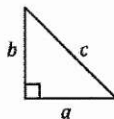
$$C = 2\pi r$$



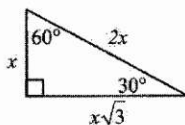
$$A = lw$$



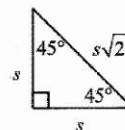
$$A = \frac{1}{2}bh$$



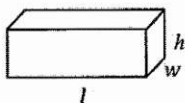
$$c^2 = a^2 + b^2$$



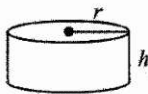
Special
Right
Triangle



Special
Right
Triangle



$$V = lwh$$



$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$

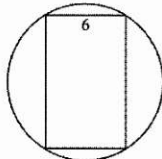


$$V = \frac{1}{3}lwh$$

There are 360° in a circle.
There are 2π radians in a circle.
There are 180° in a triangle.

3**3**

20



A rectangle that has one side measuring 6 inches is inscribed in a circle with an area of 25π square inches. What is the area of the rectangle in square inches?

STOP

If you finish before time is called, you may check your work on this section only.

Do not turn to any other section.

37

4



4

1

Melvin created a daily spending budget for the vacation that he is taking in Florida. Melvin plans to spend no more than \$85 each day that he is on vacation. If Melvin has \$600 in his vacation account, which of the following expressions represents the remaining amount of money in his vacation account d days from the beginning of his vacation given that Melvin spends his maximum daily spending budget each day?

- A) $600 + 85d$
- B) $600 - 85d$
- C) $85 + 600d$
- D) $85 - 600d$

2

In a population of 20,000 Americans, 4,000 prefer to park their cars inside of a garage. If a random sample of 100 Americans from this population were selected, how many people in the sample could one expect to prefer parking inside of a garage?

- A) 2
- B) 4
- C) 10
- D) 20

3

Juan and Amelia raised a total of \$2,800 for cystic fibrosis research. If Juan raised \$100 more than half of the amount that Amelia raised, how much money did Amelia raise for cystic fibrosis research?

- A) \$900
- B) \$1,000
- C) \$1,800
- D) \$1,900

4

Line k in the xy -plane only has points in Quadrants I and II. Which of the following is not true?

- A) Line k has a slope of 0.
- B) Line k has a positive y -intercept.
- C) Line k has a positive x -intercept.
- D) Line k is parallel to the x -axis.



5

Brandon pays \$36 for a yearly membership to a digital music streaming service. If Brandon would like to purchase a song, it costs an additional \$0.98. If Brandon's total annual payment for the music service was \$71.28, on average, how many songs did Brandon purchase per month?

- A) 2
- B) 3
- C) 12
- D) 36

6

Six yards of rope were divided evenly among 9 people. How many inches of rope did each person receive? (1 yard = 36 inches)

- A) 2
- B) 4
- C) 24
- D) 48

7

If pressure, measured in pascals, is equal to the force of an object in newtons divided by the contact area in square meters, which of the following combinations of force and area creates closest to 10,000 pascals of pressure?

- A) 200,000 N and 20,000 m^2
- B) 20,000 N and 10,000 m^2
- C) 5,000 N and 5 m^2
- D) 2,000 N and 0.2 m^2

8

Camera and Cell Phone Sales in 2010

Sales Period	Camera Sales	Cell Phone Sales	TOTAL
Jan.-Mar.	20	120	140
Apr.-June	28	120	148
July-Sept.	30	94	124
Oct.-Dec.	42	66	108
TOTAL	120	400	520

In the table above, cell phone sales from January to June account for what proportion of the total sales?

- A) $\frac{3}{13}$
- B) $\frac{6}{13}$
- C) $\frac{3}{5}$
- D) $\frac{5}{6}$



9

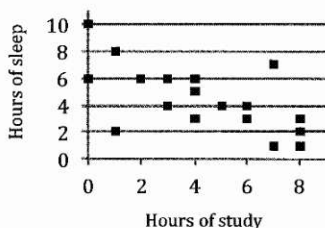
In the xy -plane, the graph of a function has only one x -intercept and one negative y -intercept. Which of the following could be the function?

- A) $y = -x^2$
 B) $y = x^2 - 1$
 C) $y = x^2 - 2x + 1$
 D) $y = -x^2 - 4x - 4$



Questions 10 and 11 refer to the following information.

Hours of Sleep versus Hours of Study



A recent sleep study was conducted on high-school seniors to determine if there is an association between the number of hours of sleep and the number of hours of study that each student averages per weeknight. The collected data for a random sample of 18 students is presented in the scatterplot above.

10

The student with the highest ratio of hours of study to hours of sleep had how many hours of sleep?

- A) 1
 B) 6
 C) 8
 D) 10

11

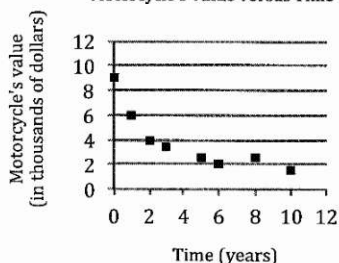
Which of the following linear functions using h for hours of study could most reasonably estimate $f(h)$, the number of hours of sleep?

- A) $f(h) = \frac{1}{4}h + 6$
 B) $f(h) = \frac{3}{4}h + 8$
 C) $f(h) = -\frac{3}{4}h + 8$
 D) $f(h) = -\frac{5}{3}h + 10$



12

Motorcycle's Value versus Time



The value of a motorcycle was assessed periodically over the first 10 years of its existence. Which of the following models would best represent the relationship between time and the motorcycle's estimated value?

- A) A linear growth model
 B) A linear decay model
 C) An exponential decay model
 D) An inverted quadratic model



13

$$S(x) = I\left(1 + \frac{r}{100}\right)^x$$

The equation above can be used to determine the overall account balance, $S(x)$, of a savings account x years from the opening of the account given an initial account balance, I , and an annual interest rate of $r\%$. Which of the following gives r in terms of $S(x)$, I , and x ?

- A) $r = 100\sqrt[x]{\frac{S(x)}{I}} - 100$
- B) $r = 100\sqrt[x]{\frac{S(x)}{I}} - 1$
- C) $r = 100\sqrt[x]{I\sqrt[x]{S(x)}} - 100$
- D) $r = 100\sqrt[x]{I\sqrt[x]{S(x)}} - 1$

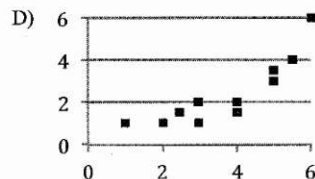
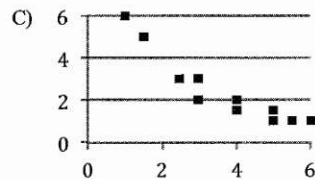
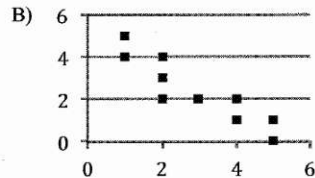
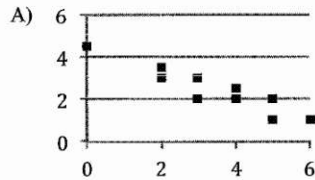
14

Ankit has a block of ice in the shape of a cube that has a volume of 27 ft^3 . Ankit plans to cut the ice block into small ice cubes that measure 2 inches in all directions. How many such ice cubes can Ankit create? (Note: There are 1728 cubic inches in 1 ft^3 .)

- A) 5,832
- B) 11,664
- C) 23,328
- D) 46,656

15

Which of the following scatterplots would best be modeled by an equation in the form $y = mx + b$, where b is a positive constant and m is a negative fractional constant?





Questions 16 and 17 refer to the following information.

$$C_1(h) = 640 + 12mh$$

$$C_2(h) = 400 + 15mh$$

Mrs. Jamerson is having all of the rooms on the first floor of her house painted. She has received the two quotes shown above where $C_1(h)$ represents the total cost for having the job completed with Company 1, $C_2(h)$ represents the total cost for having the job completed with Company 2, m represents the number of men on the job, and h is the estimated number of hours to complete the job.

16

If one extra man is needed for the job than initially quoted, which of the following is true?

- A) The hourly cost for Company 1 will increase by more than the hourly cost for Company 2.
- B) The hourly cost for Company 2 will increase by more than the hourly cost for Company 1.
- C) The hourly cost for the two companies will increase equally.
- D) The increase in hourly cost for each company cannot be determined.

17

If it is determined by both companies that ten men are necessary to complete the job, what is the least integer number of hours, h , where the total cost to have the house painted by Company 1 would be less than the total cost to have the house painted by Company 2?

- A) 8
- B) 9
- C) 35
- D) 80

18

$$6m \leq 2$$

If the equation above is true, what is the greatest possible value for $2m + 1$?

- A) $\frac{1}{3}$
- B) $\frac{2}{3}$
- C) 1
- D) $\frac{5}{3}$

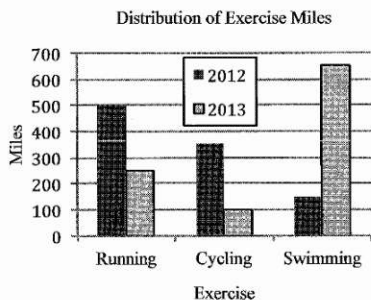
19

A clear jar is filled with black, red, and green marbles. There are 6 black marbles and each marble is uniquely marked with a number 1 through 6. There are also six red marbles and six green marbles numbered the same way. Given that a black or a red marble is randomly selected, what is the probability that it is marked with a number greater than 4?

- A) $\frac{1}{9}$
- B) $\frac{1}{3}$
- C) $\frac{4}{9}$
- D) $\frac{2}{3}$



Questions 20 and 21 refer to the following information.



Jackson exercises regularly and attempts to accumulate 1000 miles of cardiovascular exercise each year by means of running, cycling, and swimming. The bar graph above shows how Jackson's 1000 miles of exercise were distributed in the years 2012 and 2013.

20

Which of the following forms of exercise had the greatest percentage decrease in miles from 2012 to 2013?

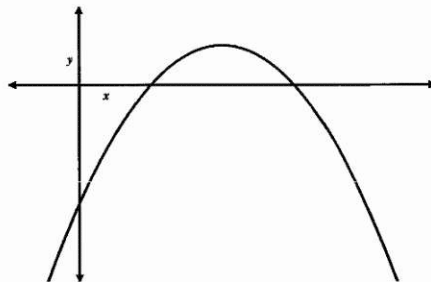
- A) Running
- B) Cycling
- C) Swimming
- D) Running and Cycling equally

21

What percentage of Jackson's total miles of exercise for 2012 and 2013 was accounted for by swimming?

- A) 22.5
- B) 37.5
- C) 40
- D) 65

22



Which of the following equations could represent the parabola graphed in the xy -plane above?

- A) $y = -x^2 - 4$
- B) $y = -x^2 + 4x - 3$
- C) $y = -x^2 - 4x - 3$
- D) $y = x^2 - 4x + 3$

23

$$0 = x^3 - 4x^2 - 9x + 36$$

Which of the following values of x is *not* a solution to the equation above?

- A) -4
- B) -3
- C) 3
- D) 4



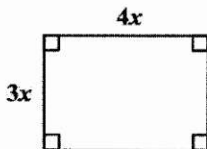
24

If a and b are numbers such that $|a - b| > 10$, which of the following must be true?

- I. $a - b > 0$
- II. $|a + b| > 10$
- III. $ab > 0$

- A) None
- B) I only
- C) II only
- D) I and III only

25



The perimeter of the rectangle shown above is 56 inches. What is the length of a diagonal of the rectangle in inches?

- A) 10
- B) 12
- C) 16
- D) 20

26

$$G(x) = 10 + 0.55x$$

In the equation above, $G(x)$ represents the increased value of a renovated home in thousands of dollars, given x , the amount of money spent on renovations by the homeowner in thousands of dollars. Which of the following best describes the value of the constant 0.55 in the context of the equation?

- A) The value of a home will increase by \$5,500 dollars for every \$1,000 the homeowner invests into renovations.
- B) The value of a home will increase by \$550 dollars for every \$10,000 the homeowner invests into renovations.
- C) The value of a home will increase by 55 cents for every dollar the homeowner invests into renovations.
- D) The total value of a home will be equivalent to 55% of the money that the homeowner invests into renovations.

27

The average weight of four bags of concrete is 85 pounds. If two additional bags of concrete are added, the average weight of all of the bags increases to 92 pounds. What is the average weight in pounds of the two additional bags of concrete that were added to the original four bags of concrete?

- A) 3.5
- B) 7
- C) 99
- D) 106



28

The polynomial function f follows the form $x^2 + bx + c$, and has two roots at $(-1, 0)$ and $(2, 0)$. Which of the following is an equivalent form of the polynomial in which the coordinates of the vertex appear as constants in the equation?

- A) $f(x) = (x - \frac{1}{2})^2 - \frac{9}{4}$
- B) $f(x) = (x - \frac{1}{2})^2 - 2$
- C) $f(x) = (x - 1)^2 - 2$
- D) $f(x) = (x - \frac{3}{2})^2 - 5$

29

$$f(x) = 1 - x^3$$

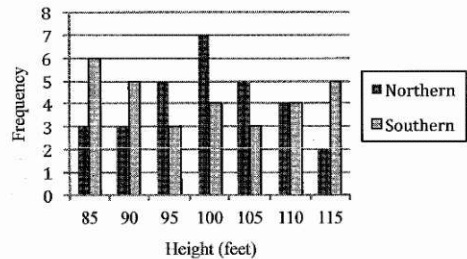
$$f(x) = mx + b$$

Line h follows the form $f(x) = mx + b$. If line h and the function $f(x) = 1 - x^3$ are to be graphed in the xy -plane, what is the greatest integer value of m for which the system of equations will have 3 distinct solutions?

- A) -4
- B) -1
- C) 0
- D) 1

30

Distribution of Pine Tree Heights



The bar graph above gives the distribution of the heights of pine trees for 30 randomly selected trees in the northern part of a county and 30 randomly selected trees in the southern part of the county. Which of the following is true about the data presented in the bar graph?

- A) The standard deviation of pine tree heights in the northern part of the county is less than the standard deviation of pine tree heights in the southern part of the county.
- B) The standard deviation of pine tree heights in the northern part of the county is greater than the standard deviation of pine tree heights in the southern part of the county.
- C) The standard deviation of pine tree heights in the northern part of the county is approximately the same as the standard deviation of pine tree heights in the southern part of the county.
- D) The standard deviations of the heights of pine trees cannot be calculated with the given data. Therefore, a comparison between the standard deviations of pine tree heights in the northern and southern parts of the county cannot be determined.



31

$$T_{HR} = (220 - \text{Age})(\text{Intensity})$$

A person can calculate his or her target heart rate, T_{HR} , in beats per minute, using the equation above, where intensity is a percentage in decimal form. According to the model, at an intensity of 60%, a 5-year increase in age would correspond to a decrease in the target heart rate of how many beats per minute?

32

Jonathan is using an international shipping service to ship a box of medical supplies. The company requires that the package have a volume of less than 120 cubic centimeters. If Jonathan's box of supplies has a base that measures 3 inches by 4 inches, what is the greatest height that the box can measure, rounded to the nearest tenth of an inch?

(1 inch = 2.54 centimeters)

33

Nadia is having some friends over to eat a pizza and to watch a movie. She invited 8 friends, but only expects half to attend. Nadia plans to cut the pizza into a number of slices that is equal to the number of friends that arrive. If 6 of Nadia's friends attend, the central angle that defines each slice will be how many degrees fewer than the number of degrees she expected for each slice?

34

A Koi fish pond that holds 2200 quarts of water was just completed. If one hose can fill the pond at 30 quarts per minute and a second hose can fill the pond at 20 quarts per minute, how long will it take to fill the pond, in minutes, if both hoses are running the entire time?

4



4

35

A bowl is filled with a total of 140 red and green candies. If $\frac{4}{7}$ of the candies are red, how many green candies must be removed from the bowl such that $\frac{2}{3}$ of the remaining candies are red?

36

$$PV = nRT$$

The Ideal Gas Law is shown above where the four gas variables are: pressure (P), volume (V), number of moles of gas (n), and temperature (T). The final variable, R , is the gas constant. If pressure remains constant and both the number of moles of gas and the temperature are reduced by half, by what percent will the volume be reduced?



Questions 37-38 refer to the following information.

$$A_{\text{Value}} = I\left(1 + \frac{r}{100}\right)^t$$

A savings account follows the model above where the account's current value, A_{Value} , can be calculated at any time based on the initial account value, I , the percentage growth rate, r , and the number of years that have passed since the opening of the account, t .

37

If the initial deposit in the account was \$1,000 and in the first year the account's value increased by \$5, what is the correct value for r ?

38

Let K represent the account's value after 4 years have passed using the percentage growth rate, r , calculated in problem 37 and the initial account value of \$1,000. To the nearest dollar, what amount of money should have been initially deposited into the account to attain an account value of K after only one year?

STOP

If you finish before time is called, you may check your work on this section only.
Do not turn to any other section.

Answer Key: TEST 1



SECTION 1—READING

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. B | 11. C | 22. D | 33. B | 43. C |
| 2. C | 12. C | 23. B | 34. D | 44. B |
| 3. B | 13. A | 24. B | 35. B | 45. A |
| 4. A | 14. B | 25. A | 36. D | 46. A |
| 5. C | 15. D | 26. B | 37. A | 47. C |
| 6. B | 16. A | 27. C | 38. C | 48. D |
| 7. B | 17. B | 28. C | 39. D | 49. B |
| 8. D | 18. B | 29. D | 40. A | 50. A |
| 9. A | 19. D | 30. C | 41. B | 51. D |
| 10. B | 20. A | 31. C | 42. D | 52. A |
| | 21. B | 32. A | | |

SECTION 2—WRITING

- | | | | |
|-------|-------|-------|-------|
| 1. A | 12. B | 23. D | 34. B |
| 2. B | 13. B | 24. D | 35. D |
| 3. D | 14. C | 25. A | 36. A |
| 4. B | 15. D | 26. B | 37. B |
| 5. A | 16. D | 27. B | 38. C |
| 6. C | 17. A | 28. D | 39. D |
| 7. B | 18. C | 29. C | 40. D |
| 8. A | 19. B | 30. C | 41. A |
| 9. C | 20. A | 31. A | 42. B |
| 10. D | 21. B | 32. B | 43. C |
| 11. C | 22. B | 33. B | 44. A |

SECTION 3—MATH

- | | |
|-------|-------------------------|
| 1. A | 12. D |
| 2. D | 13. B |
| 3. C | 14. A |
| 4. C | 15. A |
| 5. B | |
| 6. B | Fill-Ins: |
| 7. D | 16. .384, .385, or 5/13 |
| 8. C | 17. .5 or 1/2 |
| 9. C | 18. 240 |
| 10. B | 19. 18 |
| 11. C | 20. 48 |

SECTION 4—MATH

- | | | | |
|-------|-------|-------|------------------|
| 1. B | 13. A | 24. A | Fill-Ins: |
| 2. D | 14. A | 25. D | 31. 3 |
| 3. C | 15. A | 26. C | 32. .6 or 3/5 |
| 4. C | 16. B | 27. D | 33. 30 |
| 5. B | 17. B | 28. A | 34. 44 |
| 6. C | 18. D | 29. B | 35. 20 |
| 7. D | 19. B | 30. A | 36. 75 |
| 8. B | 20. B | | 37. .5 or 1/2 |
| 9. D | 21. C | | 38. 1015 |
| 10. A | 22. B | | |
| 11. C | 23. A | | |
| 12. C | | | |

TEST 1

Answer Key: TEST 1

SAT

SECTION 1—READING

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. B | 11. C | 22. D | 33. B | 43. C |
| 2. C | 12. C | 23. B | 34. D | 44. B |
| 3. B | 13. A | 24. B | 35. B | 45. A |
| 4. A | 14. B | 25. A | 36. D | 46. A |
| 5. C | 15. D | 26. B | 37. A | 47. C |
| 6. B | 16. A | 27. C | 38. C | 48. D |
| 7. B | 17. B | 28. C | 39. D | 49. B |
| 8. D | 18. B | 29. D | 40. A | 50. A |
| 9. A | 19. D | 30. C | 41. B | 51. D |
| 10. B | 20. A | 31. C | 42. D | 52. A |
| | 21. B | 32. A | | |

SECTION 2—WRITING

- | | | | |
|-------|-------|-------|-------|
| 1. A | 12. B | 23. D | 34. B |
| 2. B | 13. B | 24. D | 35. D |
| 3. D | 14. C | 25. A | 36. A |
| 4. B | 15. D | 26. B | 37. B |
| 5. A | 16. D | 27. B | 38. C |
| 6. C | 17. A | 28. D | 39. D |
| 7. B | 18. C | 29. C | 40. D |
| 8. A | 19. B | 30. C | 41. A |
| 9. C | 20. A | 31. A | 42. B |
| 10. D | 21. B | 32. B | 43. C |
| 11. C | 22. B | 33. B | 44. A |

SECTION 3—MATH

- | | |
|-------|-------------------------|
| 1. A | 12. D |
| 2. D | 13. B |
| 3. C | 14. A |
| 4. C | 15. A |
| 5. B | |
| 6. B | Fill-Ins: |
| 7. D | 16. .384, .385, or 5/13 |
| 8. C | 17. .5 or 1/2 |
| 9. C | 18. 240 |
| 10. B | 19. 18 |
| 11. C | 20. 48 |

SECTION 4—MATH

- | | | | |
|-------|-------|-------|------------------|
| 1. B | 13. A | 24. A | Fill-Ins: |
| 2. D | 14. A | 25. D | 31. 3 |
| 3. C | 15. A | 26. C | 32. .6 or 3/5 |
| 4. C | 16. B | 27. D | 33. 30 |
| 5. B | 17. B | 28. A | 34. 44 |
| 6. C | 18. D | 29. B | 35. 20 |
| 7. D | 19. B | 30. A | 36. 75 |
| 8. B | 20. B | | 37. .5 or 1/2 |
| 9. D | 21. C | | 38. 1015 |
| 10. A | 22. B | | |
| 11. C | 23. A | | |
| 12. C | | | |

Section 3: Math Test - No Calculator

QUESTION 1.

Choice A is correct. The first equation can be rewritten as $4x - 2y = 10$. If the second equation is then multiplied by -2 , the second equation gives $-4x + 4y = -14$. Then, if both equations are added together, the x variable is eliminated leaving $2y = -4$, or $y = -2$.

Choices B, C, and D are incorrect and may have resulted from errors in computation or conceptual understanding of when solving the linear system.

QUESTION 2.

Choice D is correct. Distributing the 3 in the numerator will yield the expression $6x + 15$ which also appears in the denominator. Simplifying the overall expression by canceling the $6x + 15$ in the numerator and the denominator gives the expression $\frac{1}{6x + 5}$.

Choices A is incorrect and may result from attempting to simplify the $2x$ in the numerator with the pair of $6x$'s in the denominator and likewise, the 5 with the 5 and 1 in the denominator. Choice B is incorrect and may result from accidentally cancelling $2x + 5$ with the $6x + 5$. Choice C is incorrect and may be the result of only distributing the 3 in the numerator to the $2x$ and not the 5, which would then cancel with the $6x + 5$ in the denominator.

QUESTION 3.

Choice C is correct. Billy's score on the 3rd night was 64 and his score on the 7th night was 48. Billy's score was reduced by 16 over the course of 4 nights. Since Billy's score reduces by the same amount each night, the change in score, 16, divided by the change days, 4, gives a reduction of 4 points each night. To get from 48 to zero, it will take $\frac{48}{4}$ or 12 nights to achieve a score of zero. 12 nights from the 7th night is the 19th night.

Choice A is incorrect because Billy's score was 48 on the 7th night which is already past the 4th night. Choices B and D are incorrect because neither of those days allows for a linear decrease with a score of 64 on the 3rd night and a score of 48 on the 7th night.

QUESTION 4.

Choice C is correct. In the expression $(-|x|)^3$, besides 0 which is the greatest possible solution, every number is the cube of a non-zero negative value, which is negative.

Choices A and B are incorrect because if you enter a value of 0 for x in both cases you will get a positive value of 1. Choice D is incorrect because it makes every value in Choice C the opposite. So, in Choice D, 0 is the lowest value and every non-zero value of x yields a positive solution.

QUESTION 5.

Choice B is correct. Since $f(x) = Kx^2 + 1$ and $f(8) = 33$, substituting 6 for x and 33 for $f(x)$ gives $33 = K(8)^2 + 1$. Then, solving the equation for K gives $32 = 64K$ which makes $K = \frac{1}{2}$. Substituting this value for K and evaluating $f(4)$ by substituting 4 for x gives $f(4) = \frac{1}{2}(4)^2 + 1$, or $f(4) = \frac{1}{2}(16) + 1$. Thus, $f(4) = 8 + 1 = 9$.

Choice A is incorrect because it is the answer if the 4 is input, but not squared. Choice C is incorrect because it assumes the constant K is 1. Choice D is incorrect because it assumes the constant K is 2.

QUESTION 6.

Choice B is correct. If one evaluates $f(\frac{1}{9}x)$ using $f(x) = 3x + 5$ by substituting $\frac{1}{9}x$ for every instance of x , the equation yields $f(\frac{1}{9}x) = 3(\frac{1}{9}x) + 5$, which simplifies to $\frac{1}{3}x + 5$.

Choices A, C, and D are incorrect because none will produce a coefficient of $\frac{1}{3}$ when substituted appropriately.

QUESTION 7.

Choice D is correct. The equation $\frac{a(b+a)}{2a} = 5$ can be rewritten as $\frac{b+a}{2} = 5$. It follows that $b+a = 10$, or $a = 10 - b$.

Choices A, B, and C are incorrect and most likely result from miscalculations when rewriting the original equation $\frac{a(b+a)}{2a} = 5$. For example, choice A may be the result of a distribution error in which the a is distributed and reduced properly with the first term, but distributed and not reduced with the second term.

QUESTION 8.

Choice C is correct. In order for two lines to be perpendicular when in the form $y = mx + b$, their slopes, m , must have opposite reciprocal values. In choice C, if $3y + 6x = 12$ is rewritten in the form $y = mx + b$, it yields $y = -2x + 4$. Likewise, if $-6y + 3x = 9$ is rewritten in the form $y = mx + b$, it yields $y = \frac{1}{2}x - \frac{3}{2}$. In this form it is easy to see that -2 and $\frac{1}{2}$ are opposite reciprocals.

Choices A, B, and D are incorrect and may be the result of confusing perpendicular slopes with parallel slopes or of other potential miscalculations, such as a missed sign.

QUESTION 9.

Choice C is correct. One can see that the two solutions $(a, 16)$ and $(b, 16)$ share a common y -value of 16. If this value is substituted for $f(x)$ in the quadratic equation $f(x) = x^2 + 7$, the equation yields $16 = x^2 + 7$, or $9 = x^2$. Thus the solutions $x = \pm 3$. Substituting the two x -values into the expression $|a - b|$ yields a value of 6 regardless of which value you substitute for a or b .

Choices A, C, and D are incorrect and may be the result of calculation errors in solving for a and b . For example, choice A may be the result of mistaking $|a - b|$ for $|a + b|$.

QUESTION 10.

Choice B is correct. To solve for x , square each side of the equation, which gives $(x - 2)^2 = (\sqrt{x})^2$, or $(x - 2)^2 = x$. Then by expanding the left side $(x - 2)^2$ the equation becomes $x^2 - 4x + 4 = x$, or $x^2 - 5x + 4 = 0$. From here, factoring the left hand side gives $(x - 4)(x - 1) = 0$, and so $x = 1$ or $x = 4$. Substituting 1 for x in the original equation gives $1 - 2 = \sqrt{1}$, which yields $-1 = 1$, which is an extraneous solution.

Choices A and C are incorrect because -1 and 2 could only arise as solutions from calculation errors. Choice D is incorrect because if 4 is substituted into the original equation, $4 - 2 = \sqrt{4}$, or $2 = 2$, which is true and not extraneous.

QUESTION 11.

Choice C is correct. Multiplying each side of the equation $\frac{4m}{m + \frac{1}{24}} = 8$ by $m + \frac{1}{24}$ gives $4m = 8(m + \frac{1}{24})$. Distributing 8 over the parentheses gives the equation $4m = 8m + \frac{1}{3}$, or $-4m = \frac{1}{3}$. Solving for m , one gets $m = -\frac{1}{12}$.

Choices A, B, and D are incorrect and may be the result of calculation errors or improper use of the distributive property.

QUESTION 12.

Choice D is correct. The price of Rachel's package was x dollars and the price of Angela's package was $x + 3$ dollars. Thus, the total price of all muffins without discount was $2x + 3$ dollars. However, since both purchases were made at 50% off the marked prices, the actual price was $0.5(2x + 3)$, or $x + \frac{3}{2}$. Since the cost was split evenly among Rachel, Angela, and 10 other friends, we must divide this total by 12, yielding

$$\frac{x + \frac{3}{2}}{12}, \text{ or } \frac{2x + 3}{24}.$$

Choice A is incorrect because the total price was not divided evenly among the 12 friends. Choices B and C are incorrect because neither expression accounts for the 50% discount on the final purchase price.

QUESTION 13.

Choice B is correct. The equation $x^2 - a^2 = ax$ can be rewritten in the form

$x^2 - ax - a^2 = 0$. Applying the quadratic formula, $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, to this equation with $a = 1$, $b = -a$, and $c = -a^2$ gives $\frac{-(-a) \pm \sqrt{(-a)^2 - 4(1)(-a^2)}}{2(1)}$, or $\frac{a \pm a\sqrt{5}}{2}$.

Choices A, C, and D are incorrect and may be the result of applying the quadratic formula inappropriately.

QUESTION 14.

Choice A is correct. In the graph, $y > 1$ represents the region strictly above the horizontal line at 1. $y < 5 - x^2$ represents the region strictly below the parabola. Plotting every coordinate point with integer coordinates that falls in this region yields the following 7 points: $(-1, 2)$, $(0, 2)$, $(1, 2)$, $(-1, 3)$, $(0, 3)$, $(1, 3)$, and $(0, 4)$.

Choices B, C, and D are incorrect and may be the result of misinterpreting the constraints of the inequalities. For example, Choice D is incorrect because 15 would be the correct number of coordinate points with integer coordinates that satisfy the system of inclusive inequalities defined by $y \geq 1$ and $y \leq 5 - x^2$.

QUESTION 15.

Choice A is correct. To rewrite $\frac{(16 + 3i)(1 + 4i)}{i}$ in the form $a - bi$, one must first expand the numerator which gives $\frac{16 + 64i + 3i + 12i^2}{i}$, or $\frac{4 + 67i}{i}$. Multiplying the numerator and the denominator by i gives $\frac{4 + 67i}{i} \cdot \frac{i}{i} = \frac{4i + 67i^2}{i^2}$. Since $i^2 = -1$, this expression is equivalent to $\frac{4i - 67}{-1}$, or $67 - 4i$. Since the question asks for the remainder

when a is divided by b , if one divides 67 by 4, one is left with a remainder of 3.

Choices B, C, and D are incorrect and may be the result of errors in expanding the numerator or errors in converting to the form $a - bi$.

QUESTION 16.

The correct answer is .384, .385, or $\frac{5}{13}$. The cosine of y° is $\frac{12}{13}$ the ratio of the side adjacent to the y° angle and the hypotenuse is $\frac{12}{13}$. One can use this ratio in the right triangle to recognize the pythagorean triple 5-12-13. Then, it follows that the ratio of adjacent to hypotenuse for the x° angle would be $\frac{5}{13}$.

QUESTION 17.

The correct answer is $.5$ or $\frac{1}{2}$. In order for a system of linear equations to have no solutions using the elimination method, both variables must be eliminated. Multiplying the first equation $Ax + 2y = 12$ by 16 gives $16(Ax + 2y = 12)$, or $16Ax + 32y = 192$. This makes the y -coefficient in both equations the same. In order for the system to have no solutions, the x -coefficient must be the same in both equations. Setting $16A = 8$ gives $A = \frac{1}{2}$.

QUESTION 18.

The correct answer is 240. Knowing $D = rt$, Truck A's trip can be represented by the equation $D = 40t_1$, where D represents the distance between the loading dock and Dover County and t_1 represents the time that Truck A spent traveling to Dover County. Truck B's trip can be represented by the equation $D = 60(t_1 - 2)$, where D represents the same distance between the loading dock and Dover County that Truck A had traveled and $t_1 - 2$ represents the two hours less that Truck B traveled to get to Dover County. Setting the equations equal to each other yields $40t_1 = 60(t_1 - 2)$. Distributing the 60 gives $40t_1 = 60t_1 - 120$ and through solving yields $-20t_1 = -120$, or $t_1 = 6$. Substituting 6 for time in Truck A's equation gives $D = 40(6) = 240$.

QUESTION 19.

The correct answer is 18. The polynomial on the left-hand side can be factored by grouping into the form on the right-hand side of the equation. On the left-hand side of $x^3 - 2x^2 - 9x + 18 = (x - a)(x - b)(x + c)$, one can group the first two terms together and the last two terms together and factor both groups which yields the expression $x^2(x - 2) - 9(x - 2)$, which can be further simplified to $(x^2 - 9)(x - 2)$. Factoring the binomial $x^2 - 9$ and rearranging the order of the factors yields $(x - 2)(x - 3)(x + 3) = (x - a)(x - b)(x + c)$. Since a , b , and c are positive constants, $a = 2$, $b = 3$, and $c = 3$. Therefore, $abc = (2)(3)(3) = 18$.

QUESTION 20.

The correct answer is 48. When a rectangle is inscribed in a circle, the connection between the circle and the rectangle is that the diameter of the circle is the diagonal of the rectangle. If the area of the circle is 25π and the formula for finding the area of a circle is πr^2 , solving $\pi r^2 = 25\pi$ yields $r^2 = 25$, or $r = 5$. It follows that the diameter is 10 inches. Since the diagonal of a rectangle splits the rectangle into two right triangles and these triangles each have one side length measuring 6 inches and a hypotenuse measuring 10 inches, recognizing the Pythagorean triple 6-8-10 gives us the length of the rectangle, 8 inches. Using the area formula for a rectangle $A = lw$, $A = (8)(6) = 48$ square inches.

Section 4: Math Test - Calculator

QUESTION 1.

Choice B is correct. Melvin will spend the budgeted \$85 each day for d days. Therefore, Melvin will spend a total of $85d$ dollars. Because his vacation account had \$600 to start and Melvin has spent $85d$ dollars, Melvin will have $600 - 85d$ dollars left in his account.

Choices A and C are incorrect because both expressions indicate that his account will be growing in size which cannot happen because he is spending money. Choice D is incorrect because it indicates that his vacation account started with \$85 and that he would be spending \$600 each day.

QUESTION 2.

Choice D is correct. Since the population data is known, it is reasonable to estimate that a random sample from that population will follow the same proportion as the population. 4,000 out of 20,000 people prefer to park inside of a garage, or 20%. So, it follows that 20% of the random sample of 100 people from that population, or $100(.20) = 20$, should prefer parking in a garage.

Choices A, B, and C are incorrect and may be the result of miscalculating the appropriate percent of the sample.

QUESTION 3.

Choice C is correct. Let x be the amount of money, in dollars, that Amelia raised for cystic fibrosis research. Since Juan raised \$100 more than half of the amount of money that Amelia raised, Juan raised $\frac{1}{2}x + 100$ dollars. Since they raised a combined total of \$2,800, the equation $x + \frac{1}{2}x + 100 = 2800$ must be true. Simplifying, $\frac{3}{2}x + 100 = 2800$ yields $\frac{3}{2}x = 2700$, or $x = 1800$. Therefore, Amelia raised \$1,800 for cystic fibrosis research.

Choice A is incorrect because \$900 is half of the amount of money Amelia raised, but not \$100 more than half. Choice B is incorrect because it is the amount of money that Juan raised for cystic fibrosis research. Choice D is incorrect and may be the result of incorrectly adding 100 when solving for Amelia's total.

QUESTION 4.

Choice C is correct. Quadrants I and II together are defined to be the area above the x -axis. If Line k only has solutions above the x -axis, it must be a horizontal line, which by definition has a slope of 0. In order to be in quadrants I and II, it must be above the x -axis as defined above. This means that Line k must have a positive y -intercept. Therefore, if Line k has a slope of 0 and a positive y -intercept, it will have no x -intercept.

Choice A is incorrect because Line k does have a slope of 0. Choice B is incorrect because Line k does have a positive y -intercept. Choice D is incorrect because Line k has a slope of 0 and the x -axis has a slope of 0, which does make them parallel.

QUESTION 5.

Choice B is correct. Let s represent the number of songs that Brandon purchased in a year. Since the annual membership fee for the digital music streaming service is \$36 and each song purchase costs \$0.98, the total of the annual membership fee and all of the song purchases in a year can be represented by the expression $36 + 0.98s$. Since Brandon's annual dues were \$71.28, the equation $36 + 0.98s = 71.28$ must be true. Therefore, $0.98s = 35.28$, or $s = 36$. If Brandon purchased 36 songs in one year, then his average monthly song purchases are $36 \div 12$, or 3.

Choices A and C are incorrect and may be the result of errors in solving the appropriate equation. Choice D is incorrect because it gives the total number of song downloads for the year, not the monthly average.

QUESTION 6.

Choice C is correct. Because there are 36 inches in 1 yard, 6 yards of rope have a measure of $6(36) = 216$ inches. If these 216 inches are distributed evenly to 9 people, each person will receive $216 \div 9 = 24$ inches of rope.

Choices A, B, and D are incorrect and are most likely the result of errors in properly applying the unit conversion and dividing.

QUESTION 7.

Choice D is correct. Pressure is equivalent to force divided by the area of an object

that makes contact with another surface. This can be expressed as $Pressure = \frac{Force}{Area}$.

Substituting 2,000 newtons of force and a contact area of 0.2 m^2 , $Pressure = \frac{2,000N}{0.2m^2}$ which yields a pressure of 10,000 pascals of pressure.

Choices A, B, and C are incorrect because when force is divided by area in each case, the result is well below 10,000 pascals of pressure.

QUESTION 8.

Choice B is correct. According to the table, of the 520 total sales, 120 are cell phone sales from January to March and another 120 are cell phone sales from April through June. Therefore, there were a total of 240 cell phone sales from January through June. This leaves the proportion of total sales that were cell phone sales between January and

June as $\frac{240}{520}$, or $\frac{6}{13}$.

Choice A is incorrect because $\frac{3}{13} = \frac{120}{520}$, which is the proportion of total sales that were

from cell phone sales in January through March or April through June, but not both.

Choice C is incorrect because $\frac{3}{5} = \frac{240}{400}$, which is the proportion of all cell phone sales

that took place in the period from January to June. Choice D is incorrect because

$\frac{5}{6} = \frac{240}{288}$, which is the proportion of total sales in the period from January to June that

were cell phone sales.

QUESTION 9.

Choice D is correct. All of the answer choices are quadratic equations and in order for a quadratic equation to have only one x -intercept, it must be the square of a single factor and that x -intercept must be a maximum or a minimum of the function. Further, if the function has a negative y -intercept, the function must be an inverted parabola and the x -intercept must be a maximum. Since $y = -x^2 - 4x - 4$ is the only solution that is an inverted parabola that can be written as the square of a single factor, $y = -(x + 2)^2$, it is the only function that fits the required criteria.

Choice A is incorrect because it has a y -intercept of 0, which is not negative. Choices B and C are incorrect because they are parabolas that are concave upward, a form which does not allow for a single root and a negative y -intercept.

QUESTION 10.

Choice A is correct. In order to have the highest ratio of hours of study to hours of sleep, one looks for the student that had the highest number of hours of study and the lowest number of hours of sleep. This student, who had studied for 8 hours, had 1 hour of sleep.

Choices B and D are incorrect because 6 hours and 10 hours of sleep were attained by the students with the *lowest* ratio of hours of study to hours of sleep. Choice C is incorrect because 8 hours is the number of hours studied by the student with the highest ratio of hours of study to hours of sleep, not the number of hours slept.

QUESTION 11.

Choice C is correct. If one removes the student who studied for one hour and slept for 2 hours and removes the student who studied for 7 hours and slept for 7 hours, a general trend is present in the data points. The number of hours of sleep ranges from 6 to 10 when hours of study is at 0 and falls to 0 to 3 hours of sleep when the study hours reach 8. Using these ranges, we can see that the y -intercept should be at approximately 8 and the number of hours of sleep falls by approximately 6 hours over the course of the 8 hours of study. This gives a slope of $-\frac{6}{8}$, or $-\frac{3}{4}$.

Choices A and B are incorrect because the slopes are positive. Choice C is incorrect and may result from an error in calculating the y -intercept, which is too high.

QUESTION 12.

Choice C is correct. The value of the motorcycle starts at \$9,000 and drops quickly to \$4,000 over the course of two years. The value of the motorcycle then drops by approximately \$2,000 over the next 8 years. This non-linear decay follows an exponential decay model in the form $y = 9,000(r)^t$, where r is a fractional constant that is greater than 0 but less than 1.

Choices A and B are incorrect due to the fact that the scatterplot clearly does not follow linear model. Choice D is incorrect because in an inverted quadratic model, the value of the motorcycle would decay slowly at first and decay more rapidly as time went on.

QUESTION 13.

Choice A is correct. Solving $S(x) = I(1 + \frac{r}{100})^x$ for r first yields $\frac{S(x)}{I} = (1 + \frac{r}{100})^x$,

or $\sqrt[x]{\frac{S(x)}{I}} = 1 + \frac{r}{100}$. By subtracting 1 from both sides and multiplying by 100,

$$r = 100 \left(\sqrt[x]{\frac{S(x)}{I}} - 1 \right).$$

Choices B, C, and D are incorrect and may be the result of errors in isolating the appropriate variable.

QUESTION 14.

Choice A is correct. Since 1728 in^3 are equivalent to 1 ft^3 and Ankit has a cube of ice with a volume of 27 ft^3 , multiplying gives $(\frac{1728 \text{ in}^3}{1 \text{ ft}^3})(27 \text{ ft}^3) = 46,656 \text{ in}^3$. Each cube

Ankit cuts will measure 2 inches X 2 inches X 2 inches. Since the volume of a cube is given by s^3 , we know that the volume of a single smaller cube is $(2)^3$, or 8 in^3 . Then, dividing the volume of the larger cube by the volume of a single smaller cube, one gets

$$\frac{46,656 \text{ in}^3}{8 \text{ in}^3} = 5,832 \text{ cubes.}$$

Choices B, C, and D are incorrect and may result from calculation errors when dividing up the volume of the large cube. For example, choice D is incorrect because carving 46,656 cubes from a single cube whose volume is $46,656 \text{ in}^3$ would make the volume of each smaller cube 1 in^3 , not 8 in^3 .

QUESTION 15.

Choice A is correct. An equation in the form $y = mx + b$ where b is a positive constant and m is a negative fractional constant, has a positive y -intercept and a slope that gently

decreases from left to right. The scatterplot shown in answer choice A is the only one that would best be modeled by this equation.

Choice B is incorrect because it would best be modeled by a linear model with a slope of exactly -1 . Choices C and D are incorrect because they would best be modeled by exponential decay and growth models, respectively.

QUESTION 16.

Choice B is correct. Given that one extra man is needed to complete the job and assuming that the initially quoted hours stay the same, if m is increased by 1 in the equation for Company 1, $C_1(h)$ will increase by one multiple of $12h$. In the equation for Company 2, if m is increased by 1, $C_2(h)$ will increase by one multiple of $15h$. Given that h is the same in both equations, the quote for Company 2 will increase by more.

Choices A and C are incorrect and may result from misinterpreting the coefficients and the slope of each linear equation. Choice D is incorrect since h occurs in both equation and nothing implies that h has a different value for both equations. Therefore, if h is the same in both quotes, hourly cost can be calculated from the number of men on the job, m .

QUESTION 17.

Choice B is correct. Given that both jobs require ten men, the least number of hours, h , where the total cost to have the house painted by Company 1 would be less than the total cost to have the house painted by Company 2 can be calculated by solving $640 + 12(10)h < 400 + 15(10)h$. Simplifying the equation gives $640 + 120h < 400 + 150h$ and after combining like terms the equation simplifies to $240 < 30h$. Therefore, $8 < h$. So, the least value for h is 9.

Choice A is incorrect and may result from misreading and trying to determine when the two companies will cost the same. Choice C is incorrect and may result from a calculation error while solving. Choice D is incorrect and may result from substituting one man in each equation rather than 10 men.

QUESTION 18.

Choice D is correct. Dividing both sides of the inequality $6m \leq 2$ by 3 gives $2m \leq \frac{2}{3}$.

Adding 1 to both sides of $2m \leq \frac{2}{3}$ yields $2m + 1 \leq \frac{2}{3} + 1$, or $2m + 1 \leq \frac{5}{3}$. Therefore, the

greatest possible value of $2m + 1$ is $\frac{5}{3}$.

Choice A is incorrect because it gives the greatest possible value of m , not of $2m + 1$. Choice B is incorrect because it gives the greatest possible value of $2m$, not of $2m + 1$. Choice C is incorrect because it gives the greatest integer value of $2m + 1$, which was not required by the question.

QUESTION 19.

Choice B is correct. There are a total of 18 marbles in the jar. However, the question dictates that a black or a red marble will be selected at random. This reduces the total to 12. There are two black marbles marked with a number greater than 4 and two red marbles marked with a number greater than 4. This is a total of 4 marbles. So, the probability of randomly selecting a marble with a number greater than 4 given that the marble is black or red is $\frac{4}{12}$, or $\frac{1}{3}$.

Choice A is incorrect and may result from multiplying the probability of randomly selecting a black marble with a number greater than 4, $\frac{1}{3}$, with the probability of randomly selecting a red marble with a number greater than 4, $\frac{1}{3}$. $\frac{1}{3} \times \frac{1}{3} = \frac{1}{9}$. Choices

C and D are incorrect and may result from errors in calculating the probability of selecting numbers that are 4 or less.

QUESTION 20.

Choice B is correct. One must calculate by what percent of its original value each form of exercise was reduced. This can be calculated by taking the initial value and multiplying by a decay factor $(1-x)$, where x is percent decrease in decimal form, which results in a final value. In the case of Cycling, the initial value in 2012 is 350 miles which gets multiplied by a decay factor and results in a value of 100 miles in 2013. So, the equation $350(1-x) = 100$ yields $1-x = 0.285$. Simplifying further gives $x = 0.714$ or a 71.4% decrease which is the largest decrease of the 3 exercise types.

Choices A and C are incorrect and may be the result of a conceptual error in understanding the concept of percent decrease. Choice D is incorrect and may result from finding the decrease in mileage, not the *percentage* decrease in mileage.

QUESTION 21.

Choice C is correct. Jackson's total miles of exercise for 2012 and 2013 is 2,000 miles 1,000 miles for each year. Adding the number of miles he swam each year, 150 and 650, gives 800 miles. Finding the percentage of his overall miles for 2012 and 2013 accounted for by swimming can be calculated by dividing the miles swum by the total miles: $\frac{800 \text{ miles}}{2,000 \text{ miles}} = 0.40$, or 40%.

Choices A, B, and D are incorrect and may be the result of errors in calculating the percentage or misinterpreting the question. For example, choice D is incorrect because 65% is the percentage of Jackson's total miles accounted for by swimming in 2013 only.

QUESTION 22.

Choice B is correct. Since the graph shows an inverted parabola with a negative y -intercept and a two positive x -intercepts, the function whose graph is shown must have those characteristics. Factoring $y = -x^2 + 4x - 3$ gives $y = -(x-3)(x-1)$, a function

whose graph is an inverted parabola with a negative y -intercept and two positive x -intercepts.

Choice A is incorrect because it has *no* x -intercepts. Choice C is incorrect because it has two *negative* x -intercepts. Choice D is incorrect because its graph is *not* an inverted parabola and the function has a *positive* y -intercept.

QUESTION 23.

Choice A is correct. The polynomial, with four terms, can be factored by grouping the first two terms together and grouping the second two terms together.

$0 = x^3 - 4x^2 - 9x + 36$ becomes $0 = (x^3 - 4x^2) + (-9x + 36)$ which factors to $0 = x^2(x - 4) - 9(x - 4)$. Factoring out the $(x - 4)$ gives $0 = (x - 4)(x^2 - 9)$ which can ultimately be fully factored to $0 = (x - 4)(x - 3)(x + 3)$. In this form, it is clear that the solutions are 4, 3, and -3 . The only answer that is not a solution to the equation is -4 .

Choices B, C, and D are incorrect because they are all solutions to the equation and the question asked for the answer that is *not* a solution.

QUESTION 24.

Choice A is correct. If a and b are numbers such that $|a - b| > 10$, absolute value rules state that a and b are more than 10 apart. This however does not dictate whether these numbers are positive or negative. A counterexample to statement I could have $a = -12$ and $b = 1$. Substituting these values gives $a - b = (-12) - (1) = -13$ which is *not* greater than 0. A counterexample to statement II could have $a = -6$ and $b = 6$. Substituting these values gives $|(-6) + (6)| = 0$ which is *not* greater than 10. A counterexample for statement III could use the same values for a and b used in the counterexample for statement II. Substituting these values gives $(-6)(6) = -36$ which is *not* greater than 0. The three counterexamples prove that *none* of the statements are true.

Choices B, C, and D are incorrect and may result from errors in generating counterexamples that disprove some of the statements.

QUESTION 25.

Choice D is correct. The perimeter can be represented by the equation

$3x + 4x + 3x + 4x = 56$ which can be simplified to $14x = 56$, or $x = 4$. Since $x = 4$, the length of the rectangle is $3(4) = 12$ and the width of the rectangle is $4(4) = 16$. In the diagram, the diagonal forms a pythagorean triple with the length and the width, $3x : 4x : 5x$. So, the diagonal, or hypotenuse in the pythagorean triple, is equal to $5(4) = 20$.

Choice A is incorrect and may result from miscalculating the value of x . Choices B and C are incorrect and may result from misreading the question and solving for the length or width of the rectangle, respectively.

QUESTION 26.

Choice C is correct. In order to interpret the value of the coefficient 0.55 in the equation, one must first understand the context of the equation. The equation gives the increase in value of a home based on the amount of money that the homeowner invests in renovations. Since the equation is linear, $10 + 0.55x$, the y -intercept may represent the increased value of the home regardless of home improvements. This may be due to an improvement in the housing market. The slope, 0.55, is directly attached to x , the amount of money in thousands of dollars that the homeowner invests in home improvements. The coefficient 0.55 can be considered as a percentage, 55% to be exact. So, in the context of the question, any money invested in home improvements by the homeowner will return 55% of the investment. In choice C, 55 cents is returned on every dollar spent which is 55%.

Choices A, B, and D are incorrect because they do not represent a 55% return for each dollar that is invested by the homeowner toward home improvements.

QUESTION 27.

Choice D is correct. Since average can be calculated by dividing the sum of a set of numbers by the number of numbers, the sum of four bags of concrete divided by 4

must equal 85, $\frac{a+b+c+d}{4} = 85$. Multiplying by 4 on both sides gives the sum of

the four bags, $a+b+c+d = 340$. When two additional bags are added, the average

increases to 92, which gives the equation $\frac{a+b+c+d+(e+f)}{6} = 92$, which produces

the sum $a+b+c+d+(e+f) = 552$. In order to calculate the average of the two additional bags, one must find the sum of the two additional bags and divide by 2.

Substituting $a+b+c+d$ with 340 in the equation $a+b+c+d+(e+f) = 552$ gives $340+(e+f) = 552$ which gives the sum $(e+f) = 212$. Finally, dividing by 2 gives the

average weight of the two additional bags, $\frac{(e+f)}{2} = 106$.

Choices A, B, and C are incorrect and may be the result of a misinterpretation of the question or a conceptual error in understanding the concept of averages

QUESTION 28.

Choice A is correct. The coordinates of the vertex appear as constants in a quadratic equation when it is written in vertex form. Using the given roots $(-1,0)$ and $(2,0)$, one can expand the multiplied binomial factors $(x+1)(x-2)$ and get the equation in standard form, $f(x) = x^2 - x - 2$. The quadratic equation in standard form can be rewritten in vertex form by completing the square:

$$f(x) = x^2 - x - 2 = \left(x^2 - x + \frac{1}{4}\right) - \frac{1}{4} - 2 = \left(x - \frac{1}{2}\right)^2 - \frac{9}{4}$$

In the form above, the quadratic equation displays the vertex, $\left(\frac{1}{2}, -\frac{9}{4}\right)$, as coefficients.

Choices B, C, and D are incorrect and may result from errors in completing the square to convert from the standard form of a quadratic function to vertex form.

QUESTION 29.

Choice B is correct. Since the question asks about the slope of a line that intersects the function $f(x) = 1 - x^3$, it may be easier to look at the function $f(x) = -x^3$, since the y -intercept has no bearing on the slope of a line. Looking at the graph of $f(x) = -x^3$, one can see that the only way to attain 3 points of intersection with the cubic function and the line is if the line has a negative slope. Since the question asks for the greatest integer value of the slope and the greatest negative integer is -1 , one should try the linear equation with a slope of -1 , $y = -x$. Using the substitution method to solve the system of equations yields $-x = -x^3$, or $x^3 - x = 0$. Completely factoring the binomial gives $x(x+1)(x-1) = 0$ which displays three distinct roots 0 , -1 , and 1 . Since -1 is the greatest negative integer possible, it is the greatest slope for which the system has three distinct solutions.

Choices A is incorrect because, although it intersects $f(x) = 1 - x^3$ three times, it is not the greatest integer slope that does. Choices C and D are incorrect because the graphs of the linear equations with slopes of 0 and 1 , respectively, do not intersect the function $f(x) = 1 - x^3$ three times.

QUESTION 30.

Choice A is correct. The standard deviation is a measure of the spread of a distribution and can be thought of as the average distance from the mean. If a distribution has a low standard deviation, the average distance from the mean is low. This is a scenario where more data is collected closer to the mean, or closer to the center of the distribution. On the other hand, if a distribution has a high standard deviation, the average distance to the mean is high. This is a scenario where data is more spread out or appears farther from the center of the distribution. A normal distribution, or a typical bell curve, would generally have a lower standard deviation than a distribution that is flat across or even higher on the outer edges because it has more data closer to the center which is closer to the mean of the distribution. Looking at the distributions of trees from the northern and southern parts of the county, it appears that the trees from the northern part of the county follow a normal distribution, or bell-curved shape, whereas the trees from the southern part of the county seem more spread out. This implies that the standard deviation of pine tree heights in the northern part of the county is less than the standard deviation of pine tree heights in the southern part of the county.

Choices B, C, and D are incorrect and may result from a misunderstanding of the visual attributes of the standard deviations of distributions presented in bar graphs.

QUESTION 31.

The correct answer is 3. Substituting $.60$ for *intensity* the equation yields $T_{HR} = (220 - \text{Age})(.60)$ and by distributing the $.60$, the equation becomes $T_{HR} = 132 - .60(\text{Age})$. This equation follows a linear model with a slope of $-.60$. This signifies a reduction of $.60$ beats per minute for every age increase of one year. So, an increase of 5 years would yield $-.60(5) = -3$, or a reduction of 3 beats per minute.

QUESTION 32.

The correct answer is .6 or $\frac{3}{5}$. First, one must convert the units so that they all match. Since the question is asking for an answer in inches, one should first convert 120 cubic centimeters into cubic inches. One cubic inch measures $1in. \times 1in. \times 1in.$ which is equivalent to $2.54cm \times 2.54cm \times 2.54cm$, or $16.387cm^3$. Dividing 120 by 16.387 gives $7.32in^3$. The volume of a rectangular solid is calculated using the formula $V = lwh$. Substituting 3 for length, 4 for width, and 7.32 for volume, gives the equation $(3)(4)h = (7.32)$ which simplifies to $12h = 7.32$, or $h = 0.61$. 0.61 rounded to the nearest tenth is .6. Either the fraction $\frac{3}{5}$ or its decimal equivalent, .6, may be gridded as the answer.

QUESTION 33.

The correct answer is 30. Since Nadia expects 4 people to attend, she plans to cut the pizza into 4 slices. Since a full pizza is 360° , dividing by 4 yields $\frac{360^\circ}{4} = 90^\circ$. Nadia expected the central angle that defines each slice to be 90° . Since 6 people actually attend, the pizza will be cut into six slices which gives $\frac{360^\circ}{6} = 60^\circ$. The difference between the central angle she expected and the central angle that actually occurred is $90^\circ - 60^\circ = 30^\circ$.

QUESTION 34.

The correct answer is 44. If one hose can fill the pond at 30 quarts per minute and the other hose can fill the pond at 20 quarts per minute, if both hoses are filling the pond for m minutes, the equation $30m + 20m = 2200$ can be solved to find m , the number of minutes that the hoses take to fill the pond together. Simplifying, one gets $50m = 2200$, or $m = 44$.

QUESTION 35.

The correct answer is 20. If there are 140 red and green candies in a bowl and $\frac{4}{7}$ of the candies are red, one can calculate the number of red candies, $\frac{4}{7}(140) = 80$, and the number of green candies, $\frac{3}{7}(140) = 60$. Since only green candies will be removed, the 80 red candies will remain untouched. To achieve a red to total ratio of $\frac{2}{3}$, the proportion $\frac{2}{3} = \frac{80}{total}$ can be solved to find the total number of candies that must remain in the bowl. Cross-multiplying gives $2total = 240$, or $total = 120$. In order to have the total reduced from 140 to 120, 20 green candies must be removed.

QUESTION 36.

The correct answer is 75. In the equation $PV = nRT$, if pressure remains constant and

the number of moles of gas and the temperature are reduced to half, one can substitute

$\frac{1}{2}n$ for n and $\frac{1}{2}T$ for T which yields the equation $PV_1 = (\frac{1}{2}n)R(\frac{1}{2}T)$, which simplifies

to $PV_1 = \frac{1}{4}nRT$. Substituting PV for nRT yields $PV_1 = \frac{1}{4}PV$, or $V_1 = \frac{1}{4}V$. The new

volume, V_1 , must become $\frac{1}{4}$ of the old volume. Reducing to $\frac{1}{4}$ of the old volume is

equivalent to a reduction of 75%.

QUESTION 37.

The correct answer is .5 or $\frac{1}{2}$. Since the account value increased by \$5 in the first year,

the account value at the end of one year is $\$1,000 + \$5 = \$1,005$. Substituting 1,005 for

the account value after 1 year, 1,000 for the initial account value, and 1 for the number of

years into the equation $A_{value} = I(1 + \frac{r}{100})^t$ yields the equation $1,005 = 1,000(1 + \frac{r}{100})^1$.

Dividing by 1,000 yields $1.005 = 1 + \frac{r}{100}$ and subtracting 1 gives $.005 = \frac{r}{100}$. Solving

for r gives $r = .5$. Either the fraction $\frac{1}{2}$ or its decimal equivalent, .5, may be gridded as

the answer.

QUESTION 38.

The correct answer is 1015. Calculating the account value after 4 years have passed,

K , using an initial value of \$1,000 and a growth rate of .5% yields $K = 1,000(1 + \frac{.5}{100})^4$

which is equivalent to $K = 1,000(1.005)^4$. Raising 1.005 to the fourth power and

multiplying by 1,000 gives $K = 1,000(1.02) = 1,020$. Then, substituting 1,020 for the

account value, .5 for r , and 1 for t yields $1,020 = I(1 + \frac{.5}{100})^1$ which can be simplified

to $1,020 = I(1.005)$, or $I = 1,014.93$. Rounding to the nearest dollar gives \$1,015. An

initial account value of \$1,015 will yield the same account value after one year as a

\$1,000 initial account value will yield after four years at the same growth rate. Disregard the comma when gridding your answer.

TEST 2



Math Test - No Calculator

25 MINUTES, 20 QUESTIONS

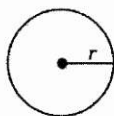
DIRECTIONS

For each question from 1-15, choose the best answer choice provided in the multiple choice bank and fill in the appropriate circle in the provided answer key. Alternatively, for questions 16-20, answer the problem and enter your answer in the grid-in section of the answer key. Refer to the directions given before question 16 as to how to enter your answers for the grid-in questions. You may complete scratch work in any empty space in your test booklet.

NOTES

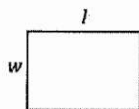
- A. Calculator usage is **not allowed** in this section.
- B. Variables, constants, and coefficients used represent real numbers unless indicated otherwise.
- C. All figures are created to appropriate scale unless the question states otherwise.
- D. All figures are two-dimensional unless the question states otherwise.
- E. The domain of any given function is all real numbers x for which the function, $f(x)$, is a real number unless the question states otherwise.

REFERENCE

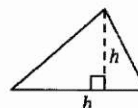


$$A = \pi r^2$$

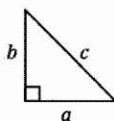
$$C = 2\pi r$$



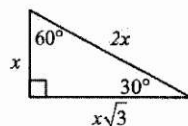
$$A = lw$$



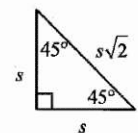
$$A = \frac{1}{2}bh$$



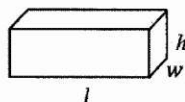
$$c^2 = a^2 + b^2$$



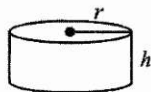
Special
Right
Triangle



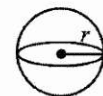
Special
Right
Triangle



$$V = lwh$$



$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

There are 360° in a circle.
There are 2π radians in a circle.
There are 180° in a triangle.



- 1 If $4x = 12$, what is the value of $2x - 1$?

- A) 5
- B) 7
- C) 23
- D) 25

- 2

$$f(v) = 75 - 12.50v$$

The balance on a gift certificate for a gym, $f(v)$, is given by the equation above. If v represents the number of visits to the gym, which of the following is the best interpretation of the number 75 in the equation?

- A) The gym charges \$75 per visit.
- B) The gym charges \$75 per day.
- C) The gift certificate allows for 8 total visits to the gym.
- D) The gift certificate had an initial value of \$75.

- 3 Line k is perpendicular to the line $y = -4x + 2$ and goes through the points $(0, -2)$ and $(20, m)$. What is the value of m ?

- A) 1
- B) 3
- C) 38
- D) 78

- 4

$$\frac{\theta}{360}(2\pi r)$$

The expression above is used to calculate the length of an arc given θ , the measure of the central angle that defines the arc in degrees, and r , the measure of the circle's radius in inches. If an arc measures 22π inches and its central angle measures at most 45° , what is the shortest possible measure of the circle's radius in inches?

- A) $\frac{11}{2}$
- B) 11
- C) 88
- D) 176



5

$$\begin{aligned}6x - 2y &= 10 \\ -3x + y &= -10\end{aligned}$$

How many ordered pairs (x, y) satisfy the system of equations above?

- A) 0
- B) 1
- C) 2
- D) Infinitely many

6

$$(3a + 3b)(a - b)$$

Which of the following is equivalent to the expression shown above?

- A) $3a^2 + 6ab - 3b^2$
- B) $3a^2 - 6ab + 3b^2$
- C) $3a^2 + 3b^2$
- D) $3a^2 - 3b^2$

7

In the equation $(x - 3)^2 = h$, if $h = 25$ and $x > 0$, what is the value of x ?

- A) -2
- B) 2
- C) 5
- D) 8

8

$$f(x) = \frac{x^a x^b}{x^3}$$

If $a + b = 12$, what is the value of $f(2)$?

- A) 16
- B) 128
- C) 512
- D) 1,024



9

Which of the following equations has solutions in all four quadrants of the xy -plane?

- A) $f(x) = x^2 + 1$
 B) $f(x) = x^3$
 C) $f(x) = 2 - |x - 1|$
 D) $f(x) = -|x - 3| - 7$

10

$$P = \frac{2(s - c)}{5}$$

A craftsman's net pay, P , is calculated using the equation above given the sale price of the item that is sold, s , and c , the cost to produce the item. Which of the following gives the cost to produce an item, c , in terms of P and s ?

- A) $c = s - \frac{2P}{5}$
 B) $c = s - \frac{5P}{2}$
 C) $c = \frac{2(s - P)}{5}$
 D) $c = \frac{5(s - P)}{2}$

11

Line k contains the points $(-4, 0)$ and $(3, 2)$. Line m contains the points $(-3, 2)$ and $(4, 0)$. If line k is written in the form $y = m_1x + b_1$ and line m is written in the form $y = m_2x + b_2$, what is the value of $m_1b_2 + m_2b_1$?

- A) $-\frac{2}{7}$
 B) 0
 C) $\frac{2}{7}$
 D) $\frac{4}{7}$

12

$$i(3 + 2i)(12 - 8i)$$

Which of the following complex numbers is equivalent to the expression above? (Note: $i = \sqrt{-1}$)

- A) $16 + 36i$
 B) $36 + 16i$
 C) $20i$
 D) $52i$



13

A 55 kilogram fallen tree branch decays at a rate of 25% per year. Which of the following equations could be used to determine $f(t)$, the remaining mass of the tree branch t years after it has fallen?

- A) $f(t) = 55(0.25)^t$
- B) $f(t) = 55(0.75)^t$
- C) $f(t) = 55 - 0.25t$
- D) $f(t) = 55 - 0.75t$

14

$$\frac{x^3 - 2x^2 + 4x + 6}{x - 4}$$

If the expression above is written in the form

$$ax^2 + bx + c + \frac{k}{x - 4}, \text{ where } a, b, \text{ and } c \text{ are nonzero}$$

constants, what is the value of k ?

- A) -22
- B) -10
- C) 54
- D) 66

15

What is the product of all of the solutions of the equation $2x^2 + 10x + 1 = 0$?

- A) $\frac{1}{2}$
- B) $\frac{1}{8}$
- C) $\frac{1}{16}$
- D) $-\frac{5}{2}$



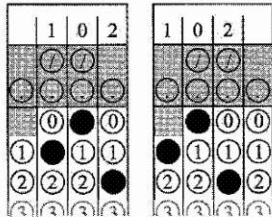
DIRECTIONS

For each question from 16-20, solve and enter your answer in the grid-in section of your answer sheet as described below.

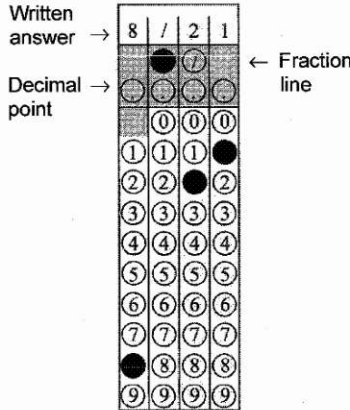
- A. Write out your answers in the boxes at the top of each column in order to help you fill in the circles accurately. Remember, you will only receive credit for the circles that are filled in correctly, not for the written answer at the top of the columns.
- B. Mark only a single circle in each column.
- C. There are no negative answers.
- D. If the problem has more than one correct answer, grid only one of the correct answers.
- E. When your answer is a **mixed number**, such as $1\frac{1}{2}$, it should be entered as 1.5 or $3/2$. You cannot enter a mixed number because there is no room to fill in a circle that represents a space.
- F. If you enter a **decimal answer** with more digits than the grid can handle, the answer may be rounded or truncated, but it absolutely must fill the entire grid.

Answer: 102 - both positions are correct

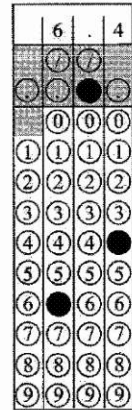
REMEMBER: You can begin writing your answers in any column as long as there is enough space. Leave unused columns blank.



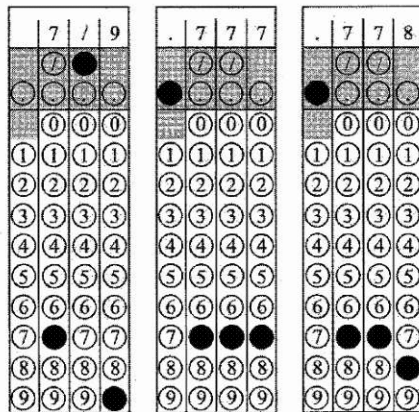
Answer: $\frac{8}{21}$



Answer: 6.4

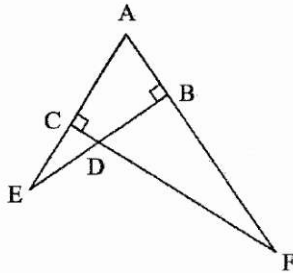


The ways to correctly grid $\frac{7}{9}$ are:





16



In the figure above, if \overline{AB} measures 4 and \overline{AC} measures 6, what is the measure of \overline{BE} if \overline{CF} measures 15?

17

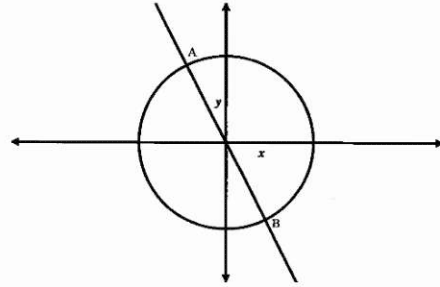
At a large family birthday party, there were mini pumpkin pies and blocks of chocolate fudge for dessert. Each mini pumpkin pie could feed four people and each block of fudge could feed two people. If 16 people ate dessert at the party and at least one pie and one block of fudge were eaten, what is the greatest number of mini pumpkin pies that could have been consumed if no partial pies were eaten?

18

$$(ax - c)(bx + c) = 5x^2 - 49$$

If the equation above is true for all values of x and a , b , and c are all positive constants, what is the value of abc ?

19



If the equation of the above circle is given in the form $x^2 + y^2 = D$ and the length of \overline{AB} is $10\sqrt{5}$ inches, what is the value of D ?



$$K^2x + 8y = 30$$

$$\frac{K}{2}x + 4y = 5$$

In the system of equations above, both K and x are positive integers. What is a value of K^2 that makes the system of equations true?

STOP

**If you finish before time is called, you may check your work on this section only.
Do not turn to any other section.**



Math Test - Calculator

55 MINUTES, 38 QUESTIONS

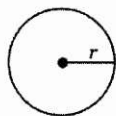
DIRECTIONS

For each question from 1-30, choose the best answer choice provided in the multiple choice bank and fill in the appropriate circle in the provided answer key. Alternatively, for questions 31-38, answer the problem and enter your answer in the grid-in section of the answer key. Refer to the directions given before question 31 as to how to enter your answers for the grid-in questions. You may complete scratch work in any empty space in your test booklet.

NOTES

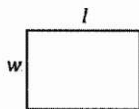
- A. Calculator usage is **allowed**.
- B. Variables, constants, and coefficients used represent real numbers unless indicated otherwise.
- C. All figures are created to appropriate scale unless the question states otherwise.
- D. All figures are two-dimensional unless the question states otherwise.
- E. The domain of any given function is all real numbers x for which the function, $f(x)$, is a real number unless the question states otherwise.

REFERENCE

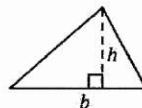


$$A = \pi r^2$$

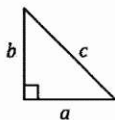
$$C = 2\pi r$$



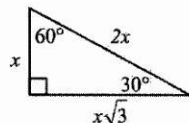
$$A = lw$$



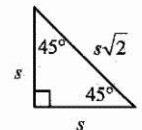
$$A = \frac{1}{2}bh$$



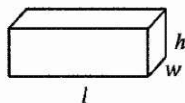
$$c^2 = a^2 + b^2$$



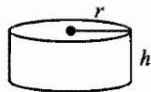
Special
Right
Triangle



Special
Right
Triangle



$$V = lwh$$



$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

There are 360° in a circle.
There are 2π radians in a circle.
There are 180° in a triangle.



1

A Goodwill store donates 5 of every 120 donated articles of clothing that it receives to a local shelter. If the Goodwill store donated 24 articles of clothing to the shelter this past month, how many articles of clothing were donated to the Goodwill store?

- A) 1
- B) 10
- C) 576
- D) 600

2

If $6x + 2 = 8$, what is the value of $6x - 2$?

- A) -1
- B) 1
- C) 4
- D) 12

Questions 3 and 4 refer to the following information.

18 people are stranded at sea on a lifeboat. The number of days of emergency food rations aboard the lifeboat is inversely proportional to the number of passengers on board. There is currently enough food for the 18 passengers to eat for 4 days.

3

If 6 more stranded people were helped onto the lifeboat, how many days worth of food would be available for all passengers?

- A) $\frac{4}{3}$
- B) 2
- C) 3
- D) 12

4

If the number of rations of food that remained with the initial 18 passengers was only 25% of all of the rations that were initially packed on the lifeboat, how many additional days could the 18 passengers have survived if all of the initial food rations were still intact?

- A) 16
- B) 12
- C) 4
- D) 3



5

A tailor is paid \$8 for each shirt that he repairs, \$10 for each pair of pants that he repairs, and \$22.50 for each suit that he modifies. Which of the following equations represents M , the amount of money in dollars that the tailor receives for repairing s shirts and modifying u suits?

- A) $M = 8s + 22.5u$
- B) $M = 10s + 22.5u$
- C) $M = 8s + 10u$
- D) $M = 8s + 10p + 22.5u$

6

$$P(h, v) = 28h + .0001v$$

A webmaster is paid based on the equation above. The webmaster is paid \$28 for each hour that he works and receives a stipend of \$0.0001 for each time someone visits the website. Which of the following is closest to the number of hours that the webmaster worked in a week in which his total paycheck was \$860 and the website had 200,000 visitors?

- A) 24
- B) 30
- C) 31
- D) 38

7

During a fitness test in gym class, a gym teacher gives every student 5 points for every minute of continuous physical activity and 1 point for every jumping-jack that the student completes. If a student's final score was 95 and the student completed 80 jumping-jacks, for how many minutes did the student perform continuous physical activity?

- A) 2
- B) 3
- C) 10
- D) 15

8

$$f(x) = x - g(x)$$

$$g(x) = x - 1$$

Given the system of equations above, what is the value of $f(g(x))$?

- A) -1
- B) 0
- C) 1
- D) $2x - 3$



9

Which of the following equivalent forms of the linear equation $y = 2x - 1$ gives both coordinates of a point that lies on the line as coefficients or constants in the equation?

- A) $y - 2x = -1$
- B) $y + 1 = 2x$
- C) $y + 1 = 2(x + 1)$
- D) $y - 1 = 2(x - 1)$

10

$$a + b \leq 200$$

$$15a + 10b \leq 2500$$

A custodial worker at a high-rise apartment complex is using a service elevator to transport 15-pound boxes of toilet paper and 10-pound boxes of paper towels to the upper levels of the building. The elevator is large enough to transport 200 total boxes or a maximum of 2500 pounds. Given the system of inequalities above, which of the following is true?

- A) The elevator can transport a total of 250 boxes of paper towels in a single trip.
- B) The elevator can transport a total of 200 boxes of toilet paper in a single trip.
- C) The elevator can be filled to capacity and transport an equal number of boxes of toilet paper and boxes of paper towels.
- D) The elevator must always transport more boxes of paper towels than boxes of toilet paper.

11

	Daily Hours of Driving	Days of Driving per Week	Average Speed (mph)
Meryl	6	5	50
Dana	8	4	40
Randy	10	3	60

Given the table above, how many more miles does Meryl drive in a week than Dana?

- A) 220
- B) 300
- C) 1280
- D) 1500

12

A research study was conducted during the holiday season to determine whether people in a large metropolitan area preferred to shop for holiday gifts online or in person at a store. Two hundred randomly selected customers exiting a mall in the metropolitan area were asked whether they preferred to shop in person or online and only 24 responded that they preferred to shop online. Which of the following statements can best be inferred from this research study?

- A) 12% of all people living in the metropolitan area prefer to shop for holiday gifts online.
- B) 12% of all people living in the metropolitan area prefer to shop for holiday gifts in person.
- C) Nothing reliable can be inferred. The location of the survey made the results biased.
- D) The study's results are unreliable due to a sample size that is too small.



13

The moon is approximately 240,000 miles from Earth. If a rocket leaves Earth and takes one day to reach the Moon, which of the following is the closest to the average speed of the rocket in kilometers per hour?

(1 mile \approx 1.609 kilometers)

- A) 622
- B) 1,610
- C) 6,215
- D) 16,100

14

The largest domesticated breed of cat is the Maine Coon. An adult male Maine Coon is 125% larger than its female counterpart. If an adult female Maine Coon weighs 12 pounds, the weight in pounds of an adult male Maine Coon is most likely which of the following?

- A) 5.3
- B) 9.6
- C) 15
- D) 27

15

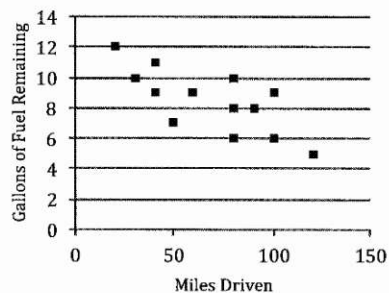
$$p(x) = -x^2 + 12x - 20$$

In the function above, $p(x)$ represents a company's profits x years after 1980. For how many years did the company break even or return a positive profit?

- A) 0
- B) 2
- C) 8
- D) 10

16

Gallons of Fuel Remaining as Compared to Miles Driven

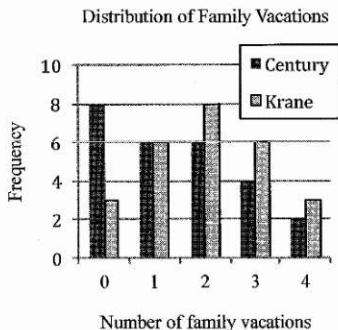


A line of best fit is calculated from the data in the scatterplot above to estimate the number of remaining gallons of fuel based on the number of miles driven. The line of best fit that models the data has the equation $G(x) = 13.8 - 0.06x$, where x represents the number of miles driven and $G(x)$ is the estimated number of gallons remaining. Based on the model, which of the following would be the best estimate for the number of remaining gallons of fuel given that 150 miles were driven?

- A) 4
- B) 5
- C) 6
- D) 7



Questions 17 and 18 refer to the following information.



A random sample of 26 students from both Century High School and Krane High School were asked about the number of family vacations they take during a given school year. The results are displayed in the bar chart above. There are a total of 1,820 students in Century High School and 2,600 students in Krane High School.

17

What is the average number of family vacations taken by all of the randomly selected students?

- A) 1.46
- B) 1.73
- C) 2.00
- D) 2.12

18

Estimating from the data collected in the bar chart, how many more students are expected to take 1 vacation in Krane High School than in Century High School?

- A) Approximately 180 more students are expected to take 1 family vacation in Krane High School than in Century High School.
- B) Approximately 600 more students are expected to take 1 family vacation in Krane High School than in Century High School.
- C) The number of students taking 1 family vacation in Krane High School is the same as the number of students taking 1 family vacation in Century High School.
- D) The number of students taking 1 family vacation in Krane High School is less than the number of students taking 1 family vacation in Century High School.

19

	Blue Tint	Red Tint
pH of 1-4	2	8
pH of 5-10	4	4
pH of 11-14	9	1

A group of science students are classifying sample solutions by the color of the liquid and the pH level of the liquid. The data is collected in the table above. If a solution with a pH level of 1-4 is randomly selected, what is the probability that the solution has a blue tint?

- A) $\frac{1}{4}$
- B) $\frac{1}{5}$
- C) $\frac{2}{15}$
- D) $\frac{1}{14}$



Questions 20 and 21 refer to the following information.

$$A_p = (2\pi r + 2)(h + 2)$$

A print company uses the formula above to calculate the necessary print area, including bleed margins, for printing labels for cylindrical cans based on r , the radius of the can, and h , the height of the can.

20

If the company wanted to calculate the height of a can from a given radius, r , and print area, A_p , which of the following equations would be used?

- A) $h = \frac{A_p}{2\pi r + 2} - 2$
- B) $h = 2 - \frac{A_p}{2\pi r + 2}$
- C) $h = \frac{A_p - 2}{2\pi r + 2}$
- D) $h = A_p(2\pi r + 2) - 2$

21

Cylinder A has a height of 4 inches and a radius of 1 inch. Cylinder B has a height of 8 inches and the same radius as Cylinder A . The print area required for Cylinder A is what percent smaller than the print area required for Cylinder B ?

- A) 40
- B) 60
- C) 200
- D) 250

22

When advertising job opportunities, a large corporation opted to list the median salary for all of its employees rather than advertise the average salary. In recent hiring cycles, the company discovered through internal surveys that newly hired employees were under the impression that their starting salaries would be higher given the average salaries they read about in former employment ads. The corporation most likely chose to list the median salary instead of the average salary for which of the following reasons?

- A) A few employee salaries are much lower than the rest of the employee salaries, which skews the average salary downward.
- B) A few employee salaries are much higher than the rest of the employee salaries, which skews the average salary upward.
- C) The salaries of the employees are extremely scattered and spread out.
- D) The salaries of the employees are very close together with very little difference from employee to employee.

23

A cereal manufacturer is selling large boxes of cereal. The manufacturer would like to keep the target weight of each box between 17.5 ounces and 19.5 ounces. Which of the following inequalities could be used to determine whether the weight of a randomly selected box of cereal, x , meets the target weight requirement set forth by the manufacturer?

- A) $|x - 18.5| < 1$
- B) $|x + 18.5| \leq 1$
- C) $|x - 1| < 18.5$
- D) $|x - 1| \leq 18.5$

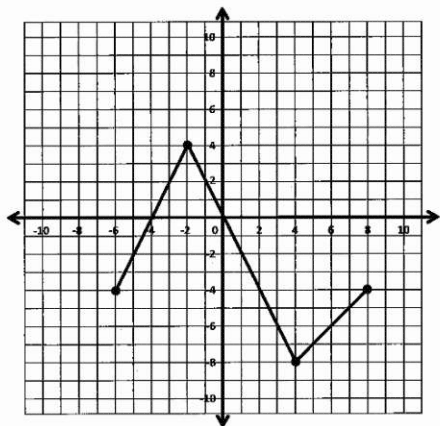


24

The graph of a quadratic function f has x -intercepts at $(d,0)$ and $(e,0)$, where d is greater than e . The x -coordinate of the vertex of the parabola is equivalent to $2e+d$. If d and e are integers, which of the following could be the equation of f ?

- A) $f(x) = x^2 - 4x + 2$
- B) $f(x) = x^2 - 4x - 12$
- C) $f(x) = -x^2 + 8x - 12$
- D) $f(x) = -x^2 + 6x - 9$

25



The complete graph of the function f is shown in the xy -plane above. Which of the following values is not equal to $f(-6)$?

- A) $-f(-2)$
- B) $f(2)$
- C) $f(4) + 2$
- D) $f(8)$

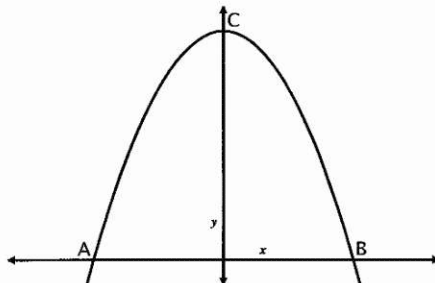
26

$$x^2 + y^2 - 8y = 9$$

The equation above is of a circle in the xy -plane that has an area of what?

- A) 9π
- B) 16π
- C) 25π
- D) 81π

27

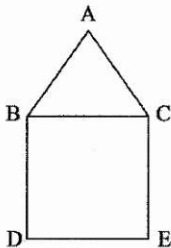


The graph of the function $y = -2x^2 + 18$ is shown above. The function intercepts the x -axis at the points A and B . The function intercepts the y -axis at the point C . If point D lies on the x -axis and is one-fourth of the distance from A to B , what is the slope of the line that goes through points C and D ?

- A) -27
- B) 6
- C) 12
- D) 27



28



If $\triangle ABC$ is equilateral and has an area of $16\sqrt{3}$, what is the area of the pentagon $ACEDB$?

- A) 64
- B) $80\sqrt{3}$
- C) $16 + 16\sqrt{3}$
- D) $64 + 16\sqrt{3}$

29

$$(x^2 + bx) + c(x + d) = x^2 + 5x + 12$$

If the equation above is true for all values of x and b , c , and d are all positive integer constants, which of the following cannot be the value of d ?

- A) 2
- B) 3
- C) 4
- D) 6

30

$$\text{Moped's Value: } V_1(t) = 10,000 - 1,000t$$

$$\text{Dirt Bike's Value: } V_2(t) = 10,000(0.9)^t$$

The value of a moped t years after its purchase follows the linear decay model defined above. The value of a similarly priced dirt bike t years after its purchase follows the exponential decay model defined above. Within which of the following intervals is the value of the moped greater than the value of the dirt bike?

- A) 0 to 1 years
- B) 1 to 2 years
- C) 2 to 3 years
- D) The value of the moped is never higher than the value of the dirt bike.



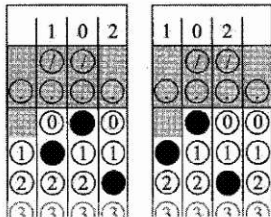
DIRECTIONS

For each question from 31-38, solve and enter your answer in the grid in section of your answer sheet as described below.

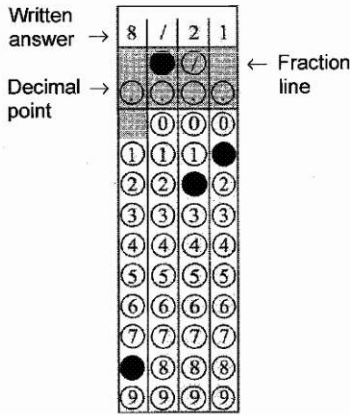
- A. Write out your answers in the boxes at the top of each column in order to help you fill in the circles accurately. Remember, you will only receive credit for the circles that are filled in correctly, not for the written answer at the top of the columns.
- B. Mark only a single circle in each column.
- C. There are no negative answers.
- D. If the problem has more than one correct answer, grid only one of the correct answers.
- E. When your answer is a **mixed number**, such as $1\frac{1}{2}$, it should be entered as 1.5 or 3/2. You cannot enter a mixed number because there is no room to fill in a circle that represents a space.
- F. If you enter a **decimal answer** with more digits than the grid can handle, the answer may be rounded or truncated, but it absolutely must fill the entire grid.

Answer: 102 - both positions are correct

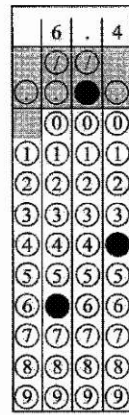
REMEMBER:
You can begin writing your answers in any column as long as there is enough space. Leave unused columns blank.



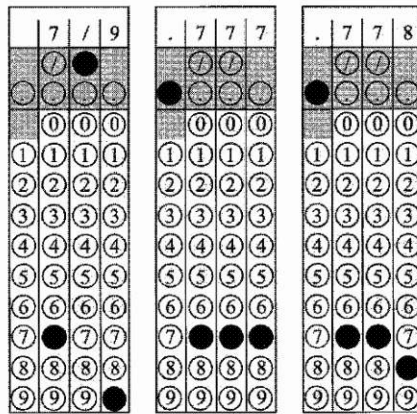
Answer: $\frac{8}{21}$



Answer: 6.4



The ways to correctly grid $\frac{7}{9}$ are:





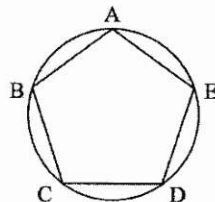
31

A man stands 77 inches tall and states that he is, “ F feet I inches tall,” where I is less than 12. What is the value of $F + I$?

32

Enrique and Sadie took a total of 122 photos while they were on vacation. If Enrique had 20 more than half the number of photos on his cell phone than Sadie had on her cell phone, how many photos were on Sadie’s cell phone?

33



A regular pentagon is inscribed in a circle with an area of 121π . If the length of arc \widehat{ABC} is written in the form $D\pi$, what is the value of D ?

34

A college professor has noted that his freshman environmental design class has steadily grown to a size of 122 students. If the class size was only 54 students when he started teaching the course 17 years ago, the course enrollment has had an average increase of how many students per year?



35

Line k crosses the x -axis at 5 and is parallel to the line with equation $5y - 12x = 5$. What is the distance between the x -intercept and the y -intercept of Line k ?

36

$$B = 3,520(0.8)^m$$

Polly is spending a semester studying abroad in Spain. The equation above models the remaining balance in euros of Polly's spending account after m months have passed. By what percent does Polly's spending account balance decrease over the course of three months?



Questions 37-38 refer to the following information.

$$A_{\text{Current}} = 1.05 \left(\frac{P_{\text{Current}}}{P_{\text{Last}}} \right) (A_{\text{Last}})$$

A small manufacturer and supplier of bookshelf audio systems spent \$5,200 last year on advertising. The manufacturer calculates its current advertising budget in dollars each year, A_{Current} , using the formula above where P_{Current} represents the net profit from the current year's sales, P_{Last} is the net profit from last year's sales, and A_{Last} is the advertising budget from last year in dollars.

37

If the company were to have a current net profit that was 20% larger than last year's, how many dollars could the company expect to spend on advertising in the current year?

38

If the company's current net profit were actually \$142,500 and the current advertising budget had to be reduced to \$5,187, how much larger was last year's net profit than this year's net profit?

STOP

If you finish before time is called, you may check your work on this section only.
Do not turn to any other section.

Answer Key: TEST 2



SECTION 1—READING

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. C | 11. B | 22. B | 33. C | 43. C |
| 2. C | 12. D | 23. B | 34. A | 44. C |
| 3. A | 13. C | 24. A | 35. A | 45. D |
| 4. B | 14. B | 25. A | 36. B | 46. B |
| 5. B | 15. D | 26. C | 37. B | 47. D |
| 6. A | 16. C | 27. C | 38. C | 48. B |
| 7. C | 17. D | 28. D | 39. C | 49. A |
| 8. B | 18. A | 29. D | 40. A | 50. C |
| 9. D | 19. A | 30. C | 41. B | 51. A |
| 10. B | 20. C | 31. B | 42. D | 52. B |
| | 21. D | 32. D | | |

SECTION 2—WRITING

- | | | | |
|-------|-------|-------|-------|
| 1. C | 12. A | 23. B | 34. A |
| 2. A | 13. B | 24. C | 35. D |
| 3. D | 14. A | 25. A | 36. C |
| 4. C | 15. D | 26. B | 37. A |
| 5. B | 16. B | 27. D | 38. C |
| 6. D | 17. C | 28. B | 39. C |
| 7. D | 18. A | 29. D | 40. C |
| 8. C | 19. B | 30. B | 41. B |
| 9. C | 20. C | 31. B | 42. C |
| 10. A | 21. C | 32. C | 43. B |
| 11. C | 22. D | 33. A | 44. A |

SECTION 3—MATH

- | | |
|-------|------------------|
| 1. A | 12. D |
| 2. D | 13. B |
| 3. B | 14. C |
| 4. C | 15. A |
| 5. A | |
| 6. D | Fill-Ins: |
| 7. D | 16. 10 |
| 8. C | 17. 3 |
| 9. C | 18. 35 |
| 10. B | 19. 125 |
| 11. B | 20. 25 or 4 |

SECTION 4—MATH

- | | | | |
|-------|-------|-------|-------------------|
| 1. C | 13. D | 24. B | Fill-Ins: |
| 2. C | 14. D | 25. C | 31. 11 |
| 3. C | 15. C | 26. C | 32. 68 |
| 4. B | 16. B | 27. C | 33. $44/5$ or 8.8 |
| 5. A | 17. B | 28. D | 34. 4 |
| 6. B | 18. A | 29. A | 35. 13 |
| 7. B | 19. B | 30. A | 36. 48.8 |
| 8. C | 20. A | | 37. 6552 |
| 9. D | 21. A | | 38. 7500 |
| 10. C | 22. B | | |
| 11. A | 23. A | | |
| 12. C | | | |

TEST 2

Answer Key: TEST 2

SAT

SECTION 1—READING

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. C | 11. B | 22. B | 33. C | 43. C |
| 2. C | 12. D | 23. B | 34. A | 44. C |
| 3. A | 13. C | 24. A | 35. A | 45. D |
| 4. B | 14. B | 25. A | 36. B | 46. B |
| 5. B | 15. D | 26. C | 37. B | 47. D |
| 6. A | 16. C | 27. C | 38. C | 48. B |
| 7. C | 17. D | 28. D | 39. C | 49. A |
| 8. B | 18. A | 29. D | 40. A | 50. C |
| 9. D | 19. A | 30. C | 41. B | 51. A |
| 10. B | 20. C | 31. B | 42. D | 52. B |
| | 21. D | 32. D | | |

SECTION 2—WRITING

- | | | | |
|-------|-------|-------|-------|
| 1. C | 12. A | 23. B | 34. A |
| 2. A | 13. B | 24. C | 35. D |
| 3. D | 14. A | 25. A | 36. C |
| 4. C | 15. D | 26. B | 37. A |
| 5. B | 16. B | 27. D | 38. C |
| 6. D | 17. C | 28. B | 39. C |
| 7. D | 18. A | 29. D | 40. C |
| 8. C | 19. B | 30. B | 41. B |
| 9. C | 20. C | 31. B | 42. C |
| 10. A | 21. C | 32. C | 43. B |
| 11. C | 22. D | 33. A | 44. A |

SECTION 3—MATH

- | | |
|-------|------------------|
| 1. A | 12. D |
| 2. D | 13. B |
| 3. B | 14. C |
| 4. C | 15. A |
| 5. A | |
| 6. D | Fill-Ins: |
| 7. D | 16. 10 |
| 8. C | 17. 3 |
| 9. C | 18. 35 |
| 10. B | 19. 125 |
| 11. B | 20. 25 or 4 |

SECTION 4—MATH

- | | | | |
|-------|-------|-------|------------------|
| 1. C | 13. D | 24. B | Fill-Ins: |
| 2. C | 14. D | 25. C | 31. 11 |
| 3. C | 15. C | 26. C | 32. 68 |
| 4. B | 16. B | 27. C | 33. 44/5 or 8.8 |
| 5. A | 17. B | 28. D | 34. 4 |
| 6. B | 18. A | 29. A | 35. 13 |
| 7. B | 19. B | 30. A | 36. 48.8 |
| 8. C | 20. A | | 37. 6552 |
| 9. D | 21. A | | 38. 7500 |
| 10. C | 22. B | | |
| 11. A | 23. A | | |
| 12. C | | | |

Section 3: Math Test - No Calculator

QUESTION 1.

Choice A is correct. Dividing both sides of $4x = 12$ by 2 yields $2x = 6$. Subtracting 1 from both sides yields $2x - 1 = 5$.

Choice B is incorrect and may result from adding 1 to both sides after dividing by 2 instead of subtracting 1 from both sides. Choice C is incorrect and may result from multiplying both sides by 2 then subtracting 1 from each side. Choice D is incorrect and may result from multiplying both sides by 2 and adding 1 to each side.

QUESTION 2.

Choice D is correct. The remaining value on the gift card is calculated using the equation $f(v) = 75 - 12.50v$, where 75 is a fixed dollar value and $-12.50v$ is the expression that represents the amount of money removed for v visits to the gym. Substituting 0 for v in the original equation gives $f(0) = 75 - 12.50(0)$, or $f(0) = 75$. With 0 visits to the gym, the remaining balance on the gift card is \$75. Thus, the initial value of the gift card is \$75.

Choice A is incorrect because the coefficient 75 is neither negative nor attached to the variable v , which represents the number of visits. Choice B is incorrect because the equation is built around the number of visits, v , not the number of days at the gym. Choice C is incorrect because if you substitute 8 for v in the original equation, it yields $f(8) = 75 - 12.50(8)$, or $f(8) = -25$. This results in a negative gift card balance, which is impossible.

QUESTION 3.

Choice B is correct. Since line k is perpendicular to the line $y = -4x + 2$, line k has an opposite reciprocal slope of $\frac{1}{4}$. Additionally, since the y -intercept is given, $(0, -2)$, the equation for line k can be written as $y = \frac{1}{4}x - 2$. Substituting the point $(20, m)$ into the equation for line k gives $m = \frac{1}{4}(20) - 2$, or $m = 3$.

Choices A, C, and D are incorrect and may result from errors in conceptual understanding or errors in calculation.

QUESTION 4.

Choice C is correct. Given an arc length of 22π , one can create the equation

$$22\pi = \frac{\theta}{360}(2\pi r). \text{ Solving this equation for } \theta \text{ yields } \frac{360(22\pi)}{(2\pi r)} = \theta, \text{ or more simply } \frac{3960}{r} = \theta. \text{ Since } \theta \text{ is at least } 45^\circ, \text{ then } \frac{3960}{r} \leq 45. \text{ Solving for } r \text{ yields } r \geq 88. \text{ The}$$

shortest possible measure of r is 88.

Choices A and B are incorrect because the values of $\frac{11}{2}$ and 11 are both less than 88

which is the lowest possible value for the radius. Choice D is incorrect. 176 could be the measure of the radius, but it is not the shortest possible measure of the radius.

QUESTION 5.

Choice A is correct. Multiplying each side of $-3x + y = -10$ by 2 gives the equation $-6x + 2y = -20$. Adding $-6x + 2y = -20$ to $6x - 2y = 10$ gives $0 = -10$. Since both variables are eliminated and the final statement makes no sense, the two lines are parallel, which yields 0 solutions.

Choices B, C, and D are incorrect and may result from computational errors when solving the system of linear equations.

QUESTION 6.

Choice D is correct. Factoring a 3 out of the binomial $(3a + 3b)$ yields the expression $3(a + b)(a - b)$. From this form, one can see the factors of the difference of perfect squares which, when multiplied, give the expression $3(a^2 - b^2)$, or $3a^2 - 3b^2$.

Choices A and B are incorrect and may result from errors in expanding the expression $(3a + 3b)(a - b)$. Choice C is incorrect and may result from errors in conceptual understanding of the difference of perfect squares.

QUESTION 7.

Choice D is correct. Since $(x - 3)^2 = h$ and $h = 25$, one can substitute h with 25 which yields $(x - 3)^2 = 25$. Taking the square root of both sides of the equation $(x - 3)^2 = 25$ yields $x - 3 = \pm 5$. Since $x > 0$, one would solve the equation $x - 3 = 5$ which gives $x = 8$.

Choice A is incorrect because -2 is less than 0 and $x > 0$. Choices B and C are incorrect because substituting 2 or 5 into the expression $(x - 3)^2$ is not equivalent to 25.

QUESTION 8.

Choice C is correct. By the laws of exponents, the equation $f(x) = \frac{x^a x^b}{x^3}$ can be rewritten as $f(x) = \frac{x^{a+b}}{x^3}$, which can be further simplified to $f(x) = x^{(a+b)-3}$. Substituting 2 for x and 12 for $a + b$ gives $f(2) = 2^{(12)-3}$, or $f(2) = 2^9$. Therefore, $f(2) = 512$.

Choices A, B, and D are incorrect and may result from errors in applying the laws of exponents. For example, Choice A is incorrect because if one applies the exponent division rule incorrectly and divides the power of 12 by 3 instead of subtracting 3, the equation would give $2^4 = 16$.

QUESTION 9.

Choice C is correct. Since the absolute value makes every value inside greater than or equal to 0, the equation $f(x) = |x-1|$ would only have solutions greater than or equal to zero. Inverting the equation and making it $f(x) = -|x-1|$ would only give solutions that are less than or equal to zero. These solutions would all occur at or below the x -axis, or in Quadrants III and IV. By adding 2 and creating the equation $f(x) = 2 - |x-1|$, the graph of the function $f(x) = -|x-1|$ is shifted vertically creating solutions in both Quadrants I and II as well. Therefore, $f(x) = 2 - |x-1|$ has solutions in all four quadrants of the xy -plane.

Choice A is incorrect because its graph in the xy -plane only has solutions in Quadrants I and II. Choice B is incorrect because its graph in the xy -plane only has solutions in Quadrants I and III. Choice D is incorrect because it is an inverted absolute value function with a negative y -intercept and its graph in the xy -plane only has solutions in Quadrants III and IV.

QUESTION 10.

Choice B is correct. Multiplying both sides of $P = \frac{2(s-c)}{5}$ by 5 yields $5P = 2(s-c)$.

Distributing the 2 gives $5P = 2s - 2c$ which can be further simplified $5P - 2s = -2c$.

Dividing both sides by -2 yields $-\frac{5P}{2} + s = c$. Finally, rearranging the equation gives the solution $c = s - \frac{5P}{2}$.

Choices A, C, and D are incorrect and may result from errors in calculation or errors in mental math when attempting to manipulate the form of the given equation.

QUESTION 11.

Choice B is correct. Since line k goes through $(-4,0)$ and $(3,2)$, one can use the

slope formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ to calculate the slope. Therefore, $m = \frac{(2) - (0)}{(3) - (-4)} = \frac{2}{7}$. Then,

substituting the point $(-4,0)$ into $y = \frac{2}{7}x + b$ yields $(0) = \frac{2}{7}(-4) + b$, which gives

$b = \frac{8}{7}$. The equation for line k is $y = \frac{2}{7}x + \frac{8}{7}$. Similarly, since line m contains $(4,0)$ and

$(-3,2)$, one can use the slope formula to get $m = \frac{(2) - (0)}{(-3) - (4)} = -\frac{2}{7}$. Then, substituting the

point $(4,0)$ into $y = -\frac{2}{7}x + b$ yields $b = \frac{8}{7}$. The equation for line m is $y = -\frac{2}{7}x + \frac{8}{7}$.

Finally, substituting into $m_1b_2 + m_2b_1$ yields $(\frac{2}{7})(\frac{8}{7}) + (-\frac{2}{7})(\frac{8}{7})$, or 0.

Choices A, C, and D are incorrect and may be the result of errors in calculating the appropriate y-intercepts for the equations of line k and line m .

QUESTION 12.

Choice D is correct. In order to simplify $i(3+2i)(12-8i)$, multiply the binomials first, which yields $i(3(12)+3(-8i)+2i(12)+2i(-8i))$, or $i(36-16i^2)$. Substituting -1 for i^2 yields $i(36-16(-1))$, which simplifies to $52i$.

Choices A, B, and C are incorrect and may be the result of errors in expanding the portion of the complex expression $(3+2i)(12-8i)$.

QUESTION 13.

Choice B is correct. Every year, the mass of a fallen tree branch decays by 25 percent from the previous year's mass. So, each year, 75 percent of the previous year's amount remains. Since the initial mass of the fallen tree branch is 55 kilograms, the remaining amount after one year is equivalent to $55(.75)$. After two years, the remaining amount would be equivalent to $55(.75)(.75)$, or $55(.75)^2$. Therefore, after t years have passed, the remaining mass of the fallen tree branch is $55(.75)^t$. So, $f(t) = 55(.75)^t$.

Choice A is incorrect and may result from multiplying the initial mass by the percent of decay rather than the decay factor of $1 - .25 = .75$. Choices C and D are incorrect because they are both linear models and not exponential as defined by the context of the problem.

QUESTION 14.

Choice C is correct. Dividing $x^3 - 2x^2 + 4x + 6$ by $x - 4$ yields:

$$\begin{array}{r} x^2 + 2x + 12 \\ x-4 \overline{)x^3 - 2x^2 + 4x + 6} \\ \underline{-(x^3 - 4x^2)} \\ 2x^2 + 4x \\ \underline{-(2x^2 - 8x)} \\ 12x + 6 \\ \underline{-(12x - 48)} \\ 54 \end{array}$$

Therefore, the expression $\frac{x^3 - 2x^2 + 4x + 6}{x - 4}$ can be rewritten as $x^2 + 2x + 12 + \frac{54}{x - 4}$. So, in the form $ax^2 + bx + c + \frac{k}{x - 4}$, k is equivalent to 54.

Choices A, B, and D are incorrect and may result from finding the incorrect remainder when using long division.

QUESTION 15.

Choice A is correct. In order to find the product of all of the solutions of the equation

$2x^2 + 10x + 1 = 0$, one must substitute into the quadratic formula, $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Substituting $a = 2$, $b = 10$, and $c = 1$ yields $\frac{-(10) \pm \sqrt{(10)^2 - 4(2)(1)}}{2(2)}$, or

$\frac{-10 \pm \sqrt{92}}{4}$. This simplifies to $\frac{-5 \pm \sqrt{23}}{2}$. So, multiplying the two roots yields

$$\frac{-5 + \sqrt{23}}{2} \cdot \frac{-5 - \sqrt{23}}{2} = \frac{25 - 23}{4} = \frac{1}{2}.$$

Choices B, C, and D are incorrect and may result from errors in applying the quadratic formula or errors when multiplying the roots of the equation.

QUESTION 16.

The correct answer is 10. Given that $\triangle ACF$ and $\triangle ABE$ are both right triangles and share a common angle at A , the two triangles are similar and thus have sides of proportional length. In $\triangle ACF$, \overline{AC} measures 6 and \overline{CF} measures 15. In $\triangle ABE$, \overline{AB}

measures 4 and the measure of \overline{BE} is the unknown. Using the proportion $\frac{\overline{AC}}{\overline{CF}} = \frac{\overline{AB}}{\overline{BE}}$,

one can solve for \overline{BE} . Substituting gives $\frac{6}{15} = \frac{4}{\overline{BE}}$. Cross-multiplying yields

$$6\overline{BE} = 60, \text{ or } \overline{BE} = 10.$$

QUESTION 17.

The correct answer is 3. Let p be the number of mini pumpkin pies consumed and let f be the number of blocks of fudge consumed. Since 16 people ate dessert, each pie feeds 4 people, each block of fudge feeds 2 people, and at least one pie and one block of fudge were consumed, one can conclude that p and f are positive integers and the equation

$4p + 2f = 16$ is true. Solving for p yields $p = 4 - \frac{1}{2}f$. Since the question is asking for

the greatest number of pies, p , that could have been consumed and p is a positive integer, one must substitute the lowest positive integer value for f that gives a positive value of p .

This is 2. Substituting 2 for f yields $p = 4 - \frac{1}{2}(2)$, or $p = 3$.

QUESTION 18.

The correct answer is 35. Since $(ax - c)(bx + c) = 5x^2 - 49$ is true for all values of x , the two sides of the equation must be equal to each other. Expanding the left

hand side gives $(ab)x^2 + (ac)x - (bc)x - c^2 = 5x^2 - 49$, which can be rewritten as

$(ab)x^2 + (ac - bc)x - c^2 = 5x^2 - 49$. Given that both sides of the equation are equal, one

can see that $ab = 5$, $ac - bc = 0$, which only means that a and b are equal, and $c^2 = 49$.

Solving $c^2 = 49$ for a positive value of c yields $c = 7$ and substituting 5 for ab and 7 for c yields the product $abc = (5)(7) = 35$.

QUESTION 19.

The correct answer is 125. If a circle is centered on the origin, its equation follows the form $x^2 + y^2 = r^2$. Since the question states that the circle's equation follows the form $x^2 + y^2 = D$, then $D = r^2$. Given that \overline{AB} measures $10\sqrt{5}$ and \overline{AB} is a diameter, the radius is equivalent to $5\sqrt{5}$. Substituting $5\sqrt{5}$ for r yields $D = (5\sqrt{5})^2$, which is equivalent to 125.

QUESTION 20.

The correct answer is 25 or 4. Since the system of equations has only one solution, one can eliminate y , find K , and finally square to get K^2 . Multiplying the second equation

by -2 yields $-2\left(\frac{K}{2}x + 4y\right) = -2(5)$, or $-Kx - 8y = -10$. Adding $K^2x + 8y = 30$

to $-Kx - 8y = -10$ yields $K^2x - Kx = 20$. Factoring out a K and an x gives

$K(K-1)x = 20$. One can see that K and $K-1$ are two numbers that are one apart, and since K and x are positive integers, K , $K-1$, and x must be three factors of 20 that have a product of 20, two of which are one apart. Since K and $K-1$ are the two numbers that are one apart, if x is 1, K and $K-1$ are 5 and 4. If x is 10, K and $K-1$ are 2 and 1. Therefore, it follows that if K is 5 or 2, $K^2 = 25$ or $K^2 = 4$.

Section 4: Math Test - Calculator

QUESTION 1.

Choice C is correct. If a Goodwill store donates 5 of every 120 donated articles of clothing it receives to a local shelter and the store donated 24 articles of clothing to the local shelter, one can solve the proportion $\frac{5}{120} = \frac{24}{x}$, where x represents the total number of articles of clothing donated to the goodwill store. Cross-multiplying yields $5x = 2880$ and then dividing both sides of the equation by 5 gives $x = 576$.

Choices A, B, and D are incorrect and may result from errors in setting up the appropriate proportion or errors in calculation. For example, Choice A is incorrect because it is the solution to the proportion $\frac{5}{120} = \frac{x}{24}$, an error in which the 24 articles of clothing are assumed to be the donations made to the Goodwill store, not the denotations made by the Goodwill store to the local shelter as was stated in the question.

QUESTION 2.

Choice C is correct. If $6x + 2 = 8$ and the question asks for the value of $6x - 2$, one can simply subtract 4 from both sides of $6x + 2 = 8$, which yields $(6x + 2) - 4 = (8) - 4$. Simplifying gives the answer $6x - 2 = 4$.

Choice B is incorrect because 1 is the answer if one were to solve for x . Choices A and D are incorrect and may result from errors in calculating the value of $6x - 2$.

QUESTION 3.

Choice C is correct. The number of days worth of emergency food rations is inversely proportional to the number of passengers aboard the lifeboat. By the definition of an inversely proportional relationship, $R = \frac{k}{P}$, where R is the number of days of emergency food rations and P is the number of passengers aboard the lifeboat. However, this can be rewritten as $RP = k$, which shows that the number of days of emergency food rations multiplied by the number of passengers must always equal the same constant. Therefore, the number of current days worth of rations, 4, times the number of current passengers, 18, must be equal to the unknown number of days worth of emergency rations, x , times the new number of passengers, $18 + 6 = 24$. This yields $4(18) = x(24)$, or simply $x = 3$.

Choice A is incorrect and may result from using a directly proportional relationship, $R = kP$, instead of the inversely proportional relationship defined by $R = \frac{k}{P}$. Choice B is incorrect and may result from a calculation error when solving for the unknown number of days worth of emergency rations. Choice D is incorrect and may result from calculating the inverse relationship with 6 passengers instead of 24 passengers on the lifeboat.

QUESTION 4.

Choice B is correct. If the current amount of emergency food rations allows the 18 passengers on the lifeboat to survive for 4 days and this is only 25% of the original amount of food rations, then 75% of the initial amount of rations have already been used or lost at sea. Since 75% is three times 25%, the 18 passengers could have survived for $3(4) = 12$ additional days.

Choices A, C, and D are incorrect and may result from errors in calculation or comprehension of the question. For example, Choice A is incorrect because 16 days would have been the total number of days the 18 passengers could have survived with all of the initial emergency food rations, not the *additional* number of days that the passengers could have survived.

QUESTION 5.

Choice A is correct. Since the tailor receives \$8 for each shirt that he repairs, the tailor will earn $8s$ dollars if he repairs s shirts. In addition, since the tailor receives \$22.50 for each suit that he repairs, the tailor will earn $22.50u$ dollars if he repairs u suits. So, the amount of money that they tailor makes, M , for repairing s shirts and u suits is represented by the equation $M = 8s + 22.5u$.

Choice B is incorrect because the fee for repairing a pair of pants, \$10, was substituted for the fee for repairing a shirt. Choice C is incorrect because the fee for repairing a pair of pants, \$10, was substituted for the fee for repairing a suit. Choice D is incorrect because it includes the money the tailor would have earned for also repairing p pairs of pants, which was not stated in the question.

QUESTION 6.

Choice B is correct. The number of hours worked, h , can be found by substituting the \$860 earned by the webmaster for $P(h, v)$ and substituting 200,000 for v , the number of visits to the website. Making these substitutions into the equation $P(h, v) = 28h + .0001v$ yields $860 = 28h + .0001(200,000)$, or $860 = 28h + 20$. Subtracting 20 from each side and dividing by 28 yields $h = 30$ hours

Choice A is incorrect and may result from calculating $.0001(200,000)$ as 200 instead of 20. Choice C is incorrect and may result from adding 20 to each side instead of subtracting 20 from each side. Choice D is incorrect and may result from calculating $.0001(200,000)$ as 200 instead of 20 and adding it to both sides instead of subtracting.

QUESTION 7.

Choice B is correct. Since a student receives 5 points for every minute of physical activity and 1 point for every jumping jack that is performed, using m for minutes of continuous exercise, j for the number of jumping jacks, and P for total points, one can solve the equation $P = 5m + 1j$ to find the number of minutes of continuous physical activity the student performed. Substituting 95 points for P and 80 for j yields the expression $(95) = 5m + 1(80)$. Subtracting 80 from both sides of the equation yields $15 = 5m$, which simplifies to $m = 3$ minutes.

Choices A, C, and D are incorrect and may result from calculation errors when solving or errors in solving for the appropriate value. For example, Choice D is incorrect because 15 is the total number of points earned for the minutes of continuous physical activity, not the number of minutes for which the student had continuous activity.

QUESTION 8.

Choice C is correct. Given that $f(x) = x - g(x)$ and $g(x) = x - 1$, substituting $x - 1$ for $g(x)$ in the first equation yields $f(x) = x - (x - 1)$, or $f(x) = 1$. $f(x) = 1$ is a constant function which means that regardless of the input, the output will always be 1. Therefore, $f(g(x)) = 1$.

Choices A, B, and D are incorrect and may result from errors in substitution or calculation errors involved in distributing the negative sign when $x - 1$ is substituted for $g(x)$.

QUESTION 9.

Choice D is correct. Linear equations can be written in three forms: slope-intercept form ($y = mx + b$), point-slope form ($y - y_1 = m(x - x_1)$), and standard form ($Ax + By = C$). The question asks for the equation of a line that has both the x and y coordinates of a point that lies on the line as constants in the equation. This would be an equation in point slope form. Looking at the equation in point-slope form given in answer choice D, $y - 1 = 2(x - 1)$, one can distribute the 2 which yields $y - 1 = 2x - 2$, and after adding 1 to both sides, the equation yields our original linear equation $y = 2x - 1$. $y - 1 = 2(x - 1)$ is an equivalent form of $y = 2x - 1$ that has the constants of the point (1, 1), within the equation.

Choices A and B are incorrect because they are not linear equations in point-slope form. Choice C is incorrect because it is not equivalent to the given equation $y = 2x - 1$.

QUESTION 10.

Choice C is correct. The inequality $a + b \leq 200$, where a represents the number of boxes of toilet paper and b represents the number of boxes of paper towels, dicatates that the elevator is filled to capacity when it is carrying a total of 200 boxes. In order for the elevator to be filled to capacity and have an equal number of boxes of toilet paper and paper towels, there would have to be 100 boxes of each. If the elevator were carrying 100 boxes of toilet paper and 100 boxes of paper towels, the overall weight could be checked using the other equation, $15a + 10b \leq 2500$. Substituting 100 for a and 100 for b yields $15(100) + 10(100) \leq 2500$, or $1500 + 1000 \leq 2500$. Since this is also a true statement, answer choice C is correct.

Choice A is incorrect because the elevator can only transport a maximum of 200 boxes of any type. Choice B is incorrect because 200 boxes of toilet paper would weigh $15(200) = 3000$ pounds. This is heavier than the maximum 2,500 pounds. Choice D is incorrect because the elevator can transport just boxes of toilet paper as long as the weight of those boxes does not exceed 2,500 pounds

QUESTION 11.

Choice A is correct. The total number of miles driven in a week for any person can be calculated by multiplying the total number of hours of driving by the average speed in miles per hour ($D = rt$). If Meryl drives 6 hours a day and 5 days a week, her total weekly hours of driving are $6(5) = 30$ hours. Multiplying Meryl's weekly hours of driving by her average speed of 50 miles per hour yields $30(50) = 1500$ miles. If Dana drives 8 hours a day and 4 days a week, her total weekly hours of driving are $8(4) = 32$ hours. Multiplying Dana's weekly hours of driving by her average speed of 40 miles per hour yields $32(40) = 1280$ miles. Subtracting Dana's total miles from Meryl's total miles yields $1500 - 1280 = 220$ miles. Meryl drives 220 more miles per week than Dana.

Choices B, C, and D are incorrect and may be the results of a comprehension error in solving for the incorrect difference in mileage. For example, Choice B is incorrect because 300 miles is the number of additional miles that Randy drives over Meryl.

QUESTION 12.

Choice C is correct. The research study is attempting to get an idea through sampling as to the true percentage of people in this large metropolitan area that prefer to shop online rather than in person. Although the survey selected people randomly, the location of the selection creates bias. The only people surveyed were exiting a mall. These are people who were shopping "in-person" already. This means that the results of the surveyed would be skewed towards shopping in person, since the only people selected were already shopping in person. Hence, the location of the survey creates bias.

Choices A is incorrect because an inference can only be made if the sampling was conducted appropriately. Choice B is incorrect because it is the opposite of the result that was attained, regardless of sampling error. Choice D is incorrect because a sample size of 200 is sufficiently large.

QUESTION 13.

Choice D is correct. First, one must convert to the units that the question requires. Since the question is asking for the speed of the rocket in kilometers per hour, one must convert miles to kilometers. Multiplying 240,000 miles by 1.609 kilometers will yield $240,000(1.609) = 386,160$ kilometers. Dividing 386,160 kilometers by 24 hours will give the speed of the rocket in kilometers per hour which is $\frac{386,160}{24} = 16,090$ kilometers per hour.

Choices A, B, and C are incorrect and may result from calculation errors when converting from miles to kilometers.

QUESTION 14.

Choice D is correct. If an adult male Maine Coon is 125% larger than its female counterpart, it is $(1 + 1.25) = 2.25$ times the size of its female counterpart. Therefore, if a female Maine Coon weighs 12 pounds, its male counterpart weighs $12(2.25) = 27$ pounds.

Choice A is incorrect and may result from a error in solving for the size of a female Maine Coon when the male weighs 12 pounds. Choice B is incorrect and may result from calculating the size of a female Maine Coon when assuming the male Maine Coon is 12 pounds and only 25% larger. Choice C is incorrect and may result from calculating the size of a male Maine Coon at only 25% larger than the female, not 125% larger.

QUESTION 15.

Choice C is correct. Factoring the right hand side of the function $p(x) = -x^2 + 12x - 20$ yields $p(x) = -(x - 2)(x - 10)$. Looking at the new function, one can see that the zeros occur at 2 and 10. Checking a value in between 2 and 10, such as 3, yields $p(3) = -((3) - 2)((3) - 10)$, or $p(3) = 7$. Since this is positive, all values that fall between 2 and 10 make the equation positive. Therefore, the company broke even or returned a positive profit during the duration from 1982 to 1990. Subtracting 1982 from 1990 yields 8 years.

Choices A, B, and D are incorrect and may result from errors in factoring and/or solving for the incorrect quantity.

QUESTION 16.

Choice B is correct. Given that the model $G(x) = 13.8 - 0.06x$ can be used to estimate the number of gallons remaining, $G(x)$, given x , the number of miles driven, one must simply substitute 150 miles for x to estimate the number of remaining gallons of gas. Substituting 150 for x yields $G(x) = 13.8 - 0.06(150)$, or $G(x) = 13.8 - 9$. Therefore, the estimated number of remaining gallons given 150 miles driven is $G(x) = 4.8$ gallons, or approximately 5 gallons.

Choices A, C, and D are incorrect and may result from calculation errors while utilizing the equation for the line of best fit or through estimating the remaining gallons of gas visually as opposed to using the best fit model.

QUESTION 17.

Choice B is correct. In order to calculate the average number of family vacations taken during a school year for all 52 students surveyed, one must add up the total number of vacations taken and divide by 52. Looking at the bar chart and accounting for both bars in each category, one can see that $8 + 3 = 11$ students took 0 vacations, $6 + 6 = 12$ students took 1 vacation, $6 + 8 = 14$ students took 2 vacations, $4 + 6 = 10$ students took 3 vacations, and $2 + 3 = 5$ took 4 vacations. Multiplying the number of students in each category by the number of vacations taken, then summing the results yields $11(0) + 12(1) + 14(2) + 10(3) + 5(4) = 90$ total vacations. Dividing the 90 total vacations by the 52 total students yields an average of $\frac{90}{52} = 1.73$ vacations per student.

Choice A is incorrect because it is the average number of family vacations per year for the students from Century High School only. Choice C is incorrect because it is the average number of family vacations for the students from Krane High School only. Choice D is incorrect and may result from errors in calculation.

QUESTION 18.

Choice A is correct. In Krane High School, 6 of the 26 surveyed students reported that they take 1 family vacation per year. Given that there are 2,600 students in Krane High School, one can estimate that $\frac{6}{26}$, or $\frac{3}{13}$ of the students at Krane High School will take one family vacation in a school year. Therefore, one can estimate that $\frac{3}{13}(2,600) = 600$ students from Krane High School will take one vacation in a school year. In Century High School, similarly, 6 of the 26 students reported that they take 1 vacation per year. Given that there are 1,820 students in Century High School, one can estimate that $\frac{6}{26}$, or $\frac{3}{13}$ of the students at Century High School will take one family vacation in a school year. Therefore, one can estimate that $\frac{3}{13}(1,820) = 420$ students from Century High School will take one vacation in a school year. So, the number of students who take one family vacation in Krane High School exceeds the number of students who take one family vacation in Century High School by $600 - 420 = 180$ students.

Choice B is incorrect because it is the number of total students that are estimated to take one family vacation at Krane High School, not the number of additional students over Century High School. Choice C is incorrect because the two schools have the same percent of students in the survey that take one family vacation, but not the same number of total students estimated to take one family vacation. Choice D is incorrect because Krane High School clearly has more students estimated to take one family vacation in a school year than Century High School.

QUESTION 19.

Choice B is correct. If a solution with a pH level of 1-4 is selected at random, the population has changed to only solutions with pH levels between 1 and 4. This means our total population is 10, two with blue tint and eight with red tint. The probability of randomly selecting one with a blue tint is $\frac{\text{blue}}{\text{pH} \rightarrow 1-4} = \frac{2}{10} = \frac{1}{5}$.

Choice A is incorrect because $\frac{1}{4}$ are the odds of selecting blue as opposed to red given a pH level of 1-4. Choice C is incorrect because $\frac{2}{15}$ is the probability of selecting a pH of 1-4 given that a blue tint was chosen. Choice D is incorrect because $\frac{1}{14}$ is the probability that a solution with a pH level of 1-4 and a blue tint is selected from all of the solutions.

QUESTION 20.

Choice A is correct. Calculating height, h , from a given radius, r , and a given print area, A_p , can be achieved by solving the equation $A_p = (2\pi r + 2)(h + 2)$ for h . First, divide

both sides of the equation by the expression $2\pi r + 2$, which yields $\frac{A_p}{2\pi r + 2} = h + 2$.

Subtracting 2 from both sides yields $h = \frac{A_p}{2\pi r + 2} - 2$.

Choices B, C, and D are incorrect and may result from calculation errors or errors in correctly applying the order of operations.

QUESTION 21.

Choice A is correct. Calculating the print area for Cylinder A by substituting 4 for h and 1 for r yields $A_p = (2\pi(1) - 2)((4) + 2)$, which can be simplified to $A_p = (2\pi - 2)(6)$, or $A_p = 12\pi - 12$. Calculating the print area for Cylinder B by substituting 8 for h and 1 for r yields $A_p = (2\pi(1) - 2)((8) + 2)$, which can be simplified to $A_p = (2\pi - 2)10$, or $A_p = 20\pi - 20$. In order to calculate what percent smaller the print area required for Cylinder A is compared to Cylinder B, one can multiply the print area for the larger cylinder, Cylinder B, by an unknown decay factor, x , to get to the print area for Cylinder A, and then subtract from one. Therefore, $(20\pi - 20)x = (12\pi - 12)$ which simplifies

to $x = \frac{12\pi - 12}{20\pi - 20} = \frac{12(\pi - 1)}{20(\pi - 1)} = \frac{12}{20} = \frac{3}{5}$. This means that the print area required for

Cylinder A is $\frac{3}{5}$, or 60% of the print area required for Cylinder B. Therefore the print

area required for Cylinder A is $1 - \frac{3}{5} = \frac{2}{5}$, or 40% smaller than the print area required for Cylinder B.

Choices A, B, and C are incorrect and may result from calculation errors or errors in comprehension of the question. For example, choice B is incorrect because 60% is the percent of Cylinder B's print area required by Cylinder A, not the percent *smaller*.

QUESTION 22.

Choice B is correct. An average can be strongly affected by an outlier. For example, the average of the consecutive numbers 1, 2, 3, 4, and 5 is 3. However, if the top number, 5, is changed to a 10, the average jumps to 4. Now, look at the median. The median of the consecutive numbers 1, 2, 3, 4, and 5 is 3. However, when the top number, 5, is changed to a 10, the median is still 3. Therefore, averages are more strongly effected by outliers. If the company in question advertised its average salary, this average salary could be skewed based upon a few employees that have very high salaries. A new hire may begin work for the company seeing that there is a very high average salary, but the average salary may only be that high because of a few employees, maybe the owners of the company, who have very high salaries. The company may change to reporting the median salary because the median would be affected much less by the outliers pulling the average salary upward, which would give new hires a more realistic idea about the salaries they may receive.

Choice A is incorrect because if a few employees were paid much less than the rest, the average salary would be skewed downward; a case in which new employees would most likely be happier with the salaries they receive. Choices C and D are incorrect because the spread of the data has little bearing on the difference between the average and the median unless there are outliers. If anything, highly scattered data with no outliers would be better represented by an average due to potentially large gaps between different employee salaries that could make the median jump sufficiently in either direction.

QUESTION 23.

Choice A is correct. One way to see if an absolute value meets the criteria is to check the extremes of each end of the weigh range and see if the statement is true. Substituting 17.5 into the equation $|x - 18.5| < 1$ yields $|(17.5) - 18.5| < 1$, or $1 < 1$. This statement is not true, which means that a value greater than 17.5 must be input to make the statement true. Substituting the other extreme value, 19.5, into the equation yields $|(19.5) - 18.5| < 1$, or $1 < 1$. This statement is not true. However, this time it means that a value lower than 19.5 must be entered. Combining the two statements yields $17.5 < x < 19.5$ which is what the manufacturer requires.

Alternatively, one can use the formula $|Variable - Middle| < or \leq \frac{Range}{2}$. One would elect to use $<$ because the manufacturer requires that the weights are strictly *between* 17.5 and 19.5. Then substituting x for the randomly selected box's weight, substituting 18.5 for the middle, and substituting $19.5 - 17.5 = 2$ for the range yields $|x - 18.5| < 1$.

Choices B, C, and D are incorrect because for each equation there are input values that satisfy the equation, but do not meet the criteria defined by the manufacturer. For example, choice C is incorrect because if one inputs a weight of 17 ounces, the equation yields $|(17) - 18.5| < 18.5$, or $16 < 18.5$. The statement is true, however, that a cereal box that weighs 17 ounces is not accepted by the manufacturer.

QUESTION 24.

Choice B is correct. Factoring the right side of the equation $f(x) = x^2 - 4x - 12$ yields $f(x) = (x-6)(x+2)$. Substituting 0 for $f(x)$ yields $0 = (x-6)(x+2)$ which gives the x -intercepts of $(6,0)$ and $(-2,0)$. Since d is greater than e , d is equivalent to 6 and e is equivalent to -2 . Substituting 6 and -2 for d and e in the expression $2e + d$ yields $2(-2) + (6) = 2$. The x -coordinate of the vertex of any quadratic equation is the average of its roots. The average of 6 and -2 is 2. Therefore, $2e + d$ is equivalent to the average of 6 and -2 making $f(x) = x^2 - 4x - 12$ a possible definition of f .

Choices A, C, and D are incorrect and may result from calculation errors, errors in factoring, and/or errors in substituting.

QUESTION 25.

Choice C is correct. Going to -6 on the x -axis and tracing downward yields $f(-6) = -4$. Going to 4 on the x -axis and tracing downward yields $f(4) = -8$. Adding 2 to both sides yields $f(4) + 2 = -6$. Therefore, since $f(4) + 2 = -6$ and $f(-6) = -4$, $f(4) + 2 \neq f(-6)$.

Choices A, B, and D are incorrect because all three expressions yield the same value as $f(-6)$, -4 .

QUESTION 26.

Choice C is correct. The equation $x^2 + y^2 - 8y = 9$ must be written in the form of a circle that is not centered on the origin: $(x-a)^2 + (y-b)^2 = r^2$, where (a,b) is the coordinate center of the circle. This can be accomplished by completing the square for the y expressions in the equation:

$$\begin{aligned}x^2 + y^2 - 8y + \underline{\quad} &= 9 + \underline{\quad} \\x^2 + y^2 - 8y + \underline{16} &= 9 + \underline{16} \\x^2 + (y^2 - 8y + 16) &= 25 \\x^2 + (y-4)^2 &= 25\end{aligned}$$

$$(x-0)^2 + (y-4)^2 = 25$$

Given that $(x-0)^2 + (y-4)^2 = 25$ follows the form $(x-a)^2 + (y-b)^2 = r^2$, $r^2 = 25$. This yields a radius of $r = 5$. Therefore, using the area formula for a circle, $A = \pi r^2$, yields an area of of the circle is $A = \pi(5)^2 = 25\pi$.

Choice A is incorrect and may result from neglecting to complete the square before calculating the circle's area. Choice B is incorrect and may result from incorrectly calculating the radius after completeing the square. Choice D is incorrect and may result from neglecting to complete the square and also misinterpreting the equation of a circle as $x^2 + y^2 = r$, rather than r^2 .

QUESTION 27.

Choice C is correct. In the equation $y = -2x^2 + 18$, the y -intercept occurs at the point $C(0,18)$. In order to calculate the x -intercepts, substitute 0 for y and solve for x in the equation $y = -2x^2 + 18$. Doing so yields $0 = -2x^2 + 18$, which simplifies to $-18 = -2x^2$, or $9 = x^2$. Taking the square root of both sides yields $x = \pm 3$, which reveals the two x -intercepts $A(-3,0)$ and $B(3,0)$. D is the point that is one fourth of the distance from A to B . One fourth of the distance from A to B can be calculated by simplifying the expression $\frac{|3 - (-3)|}{4}$, which yields 1.5. The point that is 1.5 units to the right of $(-3,0)$ is $D(-1.5,0)$. The slope of the line that goes through the points C and D can be calculated by substituting the points $(0,18)$ and $(-1.5,0)$ into the slope equation $m = \frac{y_2 - y_1}{x_2 - x_1}$ which yields $m = \frac{(0) - (18)}{(-1.5) - (0)} = \frac{-18}{-1.5} = 12$.

Choices A, B, and D are incorrect and may result from calculation errors resulting in an incorrect value for the coordinates of point D .

QUESTION 28.

Choice D is correct. The area of an equilateral triangle can be calculated using the formula $A = \frac{s^2\sqrt{3}}{4}$. Substituting $16\sqrt{3}$ for the area yields $16\sqrt{3} = \frac{s^2\sqrt{3}}{4}$. Multiplying by 4 on either side gives $64\sqrt{3} = s^2\sqrt{3}$ and dividing by $\sqrt{3}$ yields $64 = s^2$, or $s = 8$. If the side length of $\triangle ABC$ is 8, it follows that the area of square $BCED$ is $8 \times 8 = 64$. The area of the pentagon $ACEDB$ is the sum of the area of $\triangle ABC$, $16\sqrt{3}$, and square $BCED$, 64, which is $64 + 16\sqrt{3}$.

Choices A, B, and C are incorrect and may result from errors in calculating the side length of $\triangle ABC$ and ultimately the area of square $BCED$.

QUESTION 29.

Choice A is correct. Expanding the left side of the equation $(x^2 + bx) + c(x + d) = x^2 + 5x + 12$ yields $x^2 + bx + cx + cd = x^2 + 5x + 12$. Factoring out an x from $bx + cx$ on the left hand side yields $x^2 + (b + c)x + cd = x^2 + 5x + 12$. Looking at both sides of the equation, one can see that $b + c = 5$ and $cd = 12$. If d were equal to 2, then c would have to equal 6 so that $cd = 12$. However, if c were equal to 6 then b would have to equal -1 in order for $b + c = 5$. Since b , c , and d must be positive integers, -1 cannot be a value of b . Therefore, d cannot be equal to 2.

Choices B, C, and D are incorrect because all three values for d yield values of b and c that are positive integers.

QUESTION 30.

Choice A is correct. Substituting a value of 0.5 for t into the moped's value equation $V_1(t) = 10,000 - 1,000t$ yields $V_1(0.5) = 10,000 - 1,000(0.5)$, or $V_1(0.5) = 9,500$. Substituting a value of t into the dirt bike's value equation $V_2(t) = 10,000(0.9)^t$ yields $V_2(0.5) = 10,000(0.9)^{(0.5)}$, or $V_2(0.5) = 9,486.83$. Therefore, between 0 and 1 years the value of the moped is higher than the value of the dirt bike.

Choices B and C are incorrect and may result from calculation errors while substituting values for t . Choice D is incorrect and may result from substituting only integer values for t .

QUESTION 31.

The correct answer is 11. There are 12 inches in every foot. Using the equation $N = Dx + R$, where N is the larger number, D is the divisor, and R is the remainder when N is divided by D , one can see that $77 = 12(6) + 5$ is a true statement. Since there are 6 feet with a remainder of 5 inches in a total of 77 inches, 77 inches can be written as, "6 feet, 5 inches." This would make $F + I = (6) + (5) = 11$.

QUESTION 32.

The correct answer is 68. Using S for the number of photos that Sadie had on her cell phone and E for the number of photos Enrique had on his cell phone, if Enrique had 20 more than half the number of photos on his cell phone that Sadie had on her cell phone,

this can be written as $E = \frac{1}{2}S + 20$. If Sadie and Enrique sold a total of 124 photos, then $S + E = 122$. Substituting E with $\frac{1}{2}S + 20$ yields $S + (\frac{1}{2}S + 20) = 122$. Combining like terms yields $\frac{3}{2}S + 20 = 122$ and subtracting 20 from both sides yields $\frac{3}{2}S = 102$. Finally, multiplying both sides by $\frac{2}{3}$ yields $\frac{2}{3}(\frac{3}{2}S) = \frac{2}{3}(102)$, or $S = 68$.

QUESTION 33.

The correct answer is 8.8 or $\frac{44}{5}$. Since the area of the circle is 121π , setting 121π equal to πr^2 yields $\pi r^2 = 121\pi$. Dividing both sides by π and taking the square root of each side reveals the length of the radius, $r = 11$.

A regular pentagon that is inscribed in a circle divides the circle into 5 arcs of equal length. \widehat{ABC} is visibly $\frac{2}{5}$ of the circumference of the circle. Using the equation

$\frac{2}{5}(2\pi r)$ to find the length of \widehat{ABC} and substituting 11 for r yields $\frac{2}{5}(2\pi(11))$, or $\frac{44}{5}\pi$.

Therefore, D is equivalent to $\frac{44}{5}$.

QUESTION 34.

The correct answer is 4. If the freshman class grows steadily over the course of 17 years, it follows a linear model in the form of $y = mx + b$, where x is the number of years that have passed since the professor began teaching and y is the enrollment in the class. If the enrollment was 54 students at a time of 0 years, that corresponds to the coordinate point $(0, 54)$, which is the y -intercept of the model. At a time of 17 years, the enrollment grew to 122, which corresponds to the coordinate point $(17, 122)$. The average increase in enrollment per year would be equivalent to m , the slope of the line. Substituting into

the slope formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ yields $m = \frac{(122) - (54)}{(17) - (0)} = \frac{68}{17} = 4$. Therefore, the course enrollment had an average increase of 4 students per year.

QUESTION 35.

The correct answer is 13. The linear equation $5y - 12x = 5$ can be rewritten to the

form $y = \frac{12}{5}x + 1$. If line k is parallel to $y = \frac{12}{5}x + 1$, it has the same slope, which is $\frac{12}{5}$. Since line k intercepts the x -axis at 5, the x -intercept is $(5, 0)$. Using the equation

$y = \frac{12}{5}x + b$ to represent line k and substituting the coordinate point $(5, 0)$ yields $(0) = \frac{12}{5}(5) + b$, or $0 = 12 + b$. Solving for b yields $b = -12$, which makes the

y -intercept $(0, -12)$. Substituting the x -intercept and the y -intercept into the distance

formula $D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ yields

$$D = \sqrt{((0) - (5))^2 + ((-12) - (0))^2} = \sqrt{25 + 144} = \sqrt{169} = 13.$$

Alternatively, one can recognize that the points $(5, 0)$ and $(0, -12)$ form a 5-12-13 special right triangle with the origin, thus making the distance from $(5, 0)$ to $(0, -12)$ equivalent to 13.

QUESTION 36.

The correct answer is 48.8. The equation $B = 3,520(0.8)^m$ dictates that the account balance of 3,520 euros will reduce to 0.8 times or 80% of its current value each month that passes. After 3 months, the 3,520 euros would reduce to $(0.8)^3$, 0.512 times or 51.2% of its original value. This is a reduction of $100\% - 51.2\%$, or 48.8%. The answer is 48.8.

QUESTION 37.

The correct answer is 6552. The manufacturer's current profit, $P_{Current}$, is equivalent to 120% of last year's profit, or $1.2(P_{Last})$. Substituting $1.2(P_{Last})$ for $P_{Current}$ and 5,200 for

A_{Last} in the equation $A_{Current} = 1.05\left(\frac{P_{Current}}{P_{Last}}\right)(A_{Last})$ yields $A_{Current} = 1.05\left(\frac{1.2(P_{Last})}{P_{Last}}\right)(5,200)$.

Simplifying yields $A_{\text{Current}} = 1.05(1.2)(5,200) = 6,552$. Therefore, the company can expect to spend \$6,552 on advertising in the current year. Disregard the comma when gridding your answer. The answer is 6552.

QUESTION 38.

The correct answer is 7500. Substituting 5,187 for A_{Current} , 142,500 for

P_{Current} , and 5,200 for A_{Last} in the equation $A_{\text{Current}} = 1.05\left(\frac{P_{\text{Current}}}{P_{\text{Last}}}\right)(A_{\text{Last}})$ yields

$(5,187) = 1.05\left(\frac{142,500}{P_{\text{Last}}}\right)(5,200)$. Dividing both sides by 1.05 and 5,200 yields

$0.95 = \frac{142,500}{P_{\text{Last}}}$. Multiplying both sides by P_{Last} and dividing both sides by 0.95

yields $P_{\text{Last}} = \frac{142,500}{0.95} = 150,000$. Therefore, last year's net profit of \$150,000 was

\$150,000 – \$142,500, or \$7,500 larger than this year's net profit. Disregard the comma

when gridding your answer. The answer is 7500.

TEST 3



Math Test - No Calculator

25 MINUTES, 20 QUESTIONS

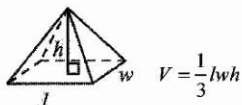
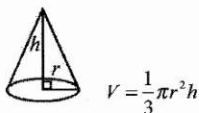
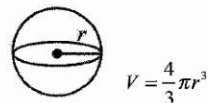
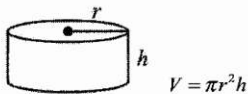
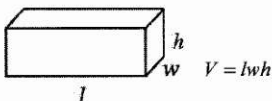
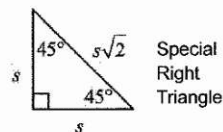
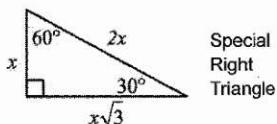
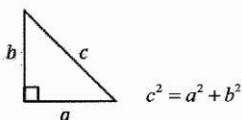
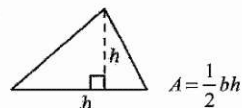
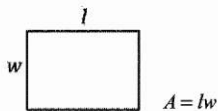
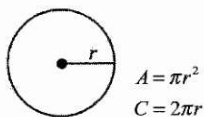
DIRECTIONS

For each question from 1-15, choose the best answer choice provided in the multiple choice bank and fill in the appropriate circle in the provided answer key. Alternatively, for questions 16-20, answer the problem and enter your answer in the grid-in section of the answer key. Refer to the directions given before question 16 as to how to enter your answers for the grid-in questions. You may complete scratch work in any empty space in your test booklet.

NOTES

- Calculator usage is **not allowed** in this section.
- Variables, constants, and coefficients used represent real numbers unless indicated otherwise.
- All figures are created to appropriate scale unless the question states otherwise.
- All figures are two-dimensional unless the question states otherwise.
- The domain of any given function is all real numbers x for which the function, $f(x)$, is a real number unless the question states otherwise.

REFERENCE



There are 360° in a circle.
There are 2π radians in a circle.
There are 180° in a triangle.



1

If $3 + h(x - 4) = 33$ and $h = 5$, what is the value of x ?

- A) $\frac{16}{5}$
- B) $\frac{34}{5}$
- C) 10
- D) 50

2

Manny can ride his bicycle 5 miles in h hours. If Manny rides his bicycle h hours each day for d days, which of the following expressions represents the total number of miles that Manny rode on his bicycle?

- A) $5d$
- B) $5hd$
- C) $\frac{5h}{d}$
- D) $\frac{5d}{h}$

3

$$\frac{5x^2 - 20xy}{3xy - 12y^2}$$

If $x \neq 4y$ and $y \neq 0$, the expression above is equivalent to which of the following?

- A) 1
- B) $x - 4$
- C) $\frac{5x}{3y}$
- D) $\frac{5x(x - 20y)}{3y(x - 12y)}$

4

$$(-1 + i)(-3 + 2i)$$

Which of the following is equivalent to the value of the expression above? (Note: $i = \sqrt{-1}$)

- A) $1 - i$
- B) $1 - 5i$
- C) $-5 - 5i$
- D) $5 - 5i$



5

Hernando owns and operates an ice cream parlor in the city of Highgate. When the ice cream parlor opened, Hernando opened a savings account at a local bank. Not counting any deposits, the balance in Hernando's savings account closely follows the model $B = 5,500(1.01)^t$, where B is the account balance t years after the account was opened. The constant 1.01 indicates which of the following in the context of Hernando's savings account balance?

- A) The account balance will decrease by 1% each year.
- B) The account balance will increase by .01% each year.
- C) The account balance will increase by .1% each year.
- D) The account balance will increase by 1% each year.

6

$$3p - 9c = 120$$

A video gamer's point total, p , and number of competitions entered, c , closely follows the linear relationship above. If the gamer were to use the equation to estimate the point total based on the number of competitions he had entered, the gamer could expect an increase of how many points per competition?

- A) 3
- B) 9
- C) 12
- D) 120

7

If a is not equivalent to 0 and $b = \frac{a}{5}$, what is the value of $\frac{25b}{a}$?

- A) $\frac{1}{5}$
- B) 5
- C) 25
- D) 125

8

Given $f(x) = \frac{b}{2}x^2$ and $f(8) = 96$, what is the value of $f(2)$?

- A) 2
- B) 3
- C) 4
- D) 6



9

$$y = -\frac{1}{2}x + 7$$

Line k is perpendicular to the line defined by the equation above and passes through the point $(4, 0)$. Which of the following points also lies on line k ?

- A) $(0, 8)$
- B) $(2, -4)$
- C) $(2, -2)$
- D) $(2, 8)$

10

$$S = \frac{\left(\frac{320}{h}\right)(h-8)}{64B} - MP_h$$

The final selling price per bottle, S , for B bottles of breath mints can be calculated based on the number of hours, h , that the manufacturing machines have been running, M , the number of men operating the machines, and P , the current hourly wage for the machine workers. Which of the following gives B in terms of S , h , M , and P ?

- A) $B = \frac{\left(\frac{320}{h}\right)(h-8) - MP_h}{64S}$
- B) $B = \frac{\left(\frac{320}{h}\right)(h-8)}{64S + MP_h}$
- C) $B = \frac{\left(\frac{320}{h}\right)(h-8)}{64(S + MP_h)}$
- D) $B = \frac{64S - 64MP_h}{\left(\frac{320}{h}\right)(h-8)}$

11

$$\begin{aligned} 12x - 2y &= 21 \\ -4x + Ay &= -7 \end{aligned}$$

If the system of equations above is true for all values of x and y , what is the value of A ?

- A) $-\frac{1}{3}$
- B) -1
- C) 1
- D) $\frac{2}{3}$

12

One phone service provider charges \$1 for the first two minutes of a long-distance phone call and \$0.03 per minute thereafter. Another phone service provider charges \$0.05 per minute for long-distance calls of any length. What is the price, in dollars, of a long-distance phone call that costs the same from both providers?

- A) 2.35
- B) 2.65
- C) 47
- D) 53



13

$$\frac{16^x \cdot 4^y}{2}$$

If $4x + 2y - 1 = 5$, what is the value of the expression above?

- A) 1
- B) 32
- C) 64
- D) 1024

14

$$m(x^2 - b^2) = (2x - 1)(2x + 1)$$

If the equation above is true for all values of x , m is a constant, and $b < 0$, what is the value of b ?

- A) $-\frac{1}{2}$
- B) $-\frac{1}{16}$
- C) $\frac{1}{16}$
- D) $\frac{1}{2}$

15

Given that $x < 0$, which of the following is equivalent to

the expression $\frac{\frac{1}{x-1} + \frac{1}{x-2}}{4x-6}$?

- A) $\frac{1}{2x^2 - 6x + 4}$
- B) $\frac{2}{x^2 - 3x + 2}$
- C) $\frac{8x^2 - 24x + 18}{x^2 - 3x + 2}$
- D) $\frac{1}{2}$



DIRECTIONS

For each question from 16-20, solve and enter your answer in the grid-in section of your answer sheet as described below.

- A. Write out your answers in the boxes at the top of each column in order to help you fill in the circles accurately. Remember, you will only receive credit for the circles that are filled in correctly, not for the written answer at the top of the columns.
- B. Mark only a single circle in each column.
- C. There are no negative answers.
- D. If the problem has more than one correct answer, grid only one of the correct answers.
- E. When your answer is a **mixed number**, such as $1\frac{1}{2}$, it should be entered as 1.5 or 3/2. You cannot enter a mixed number because there is no room to fill in a circle that represents a space.
- F. If you enter a **decimal answer** with more digits than the grid can handle, the answer may be rounded or truncated, but it absolutely must fill the entire grid.

Answer: $\frac{8}{21}$

Written answer →

Decimal point →

← Fraction line

8	/	2	1
<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	<input checked="" type="radio"/>	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	7	7	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	<input checked="" type="radio"/>	8	8
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	9	9	9
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Answer: 6.4

	6	.	4
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	<input checked="" type="radio"/>	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	7	7	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	8	8	8
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	9	9	9
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Answer: 102 - both positions are correct

REMEMBER:
You can begin writing your answers in any column as long as there is enough space. Leave unused columns blank.

	1	0	2
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	<input checked="" type="radio"/>	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

1	0	2	
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The ways to correctly grid $\frac{7}{9}$ are:

	7	/	9
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	<input checked="" type="radio"/>	7	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	8	8	8
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	9	9	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

.	7	7	7
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	8	8	8
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	9	9	9
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

.	7	7	8
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	1	1	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	2	2	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	3	3	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	4	4	4
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	5	5	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	<input checked="" type="radio"/>	<input checked="" type="radio"/>	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	8	8	<input checked="" type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	9	9	9
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>





16

How many integer values of x satisfy the inequality $2x^2 - 9x + 4 < 0$?

17

$$y = x^2 - 2x + 1$$

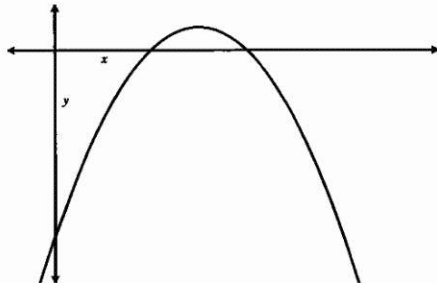
$$y = -2x + \frac{13}{4}$$

If the point (x_1, y_1) is a solution to the system of equations above in which $x_1 > 0$, what is the value of y_1 ?

18

In a right triangle, the smaller acute angle measures x° and the larger acute angle measures y° . If $\sin x^\circ = \frac{5}{13}$, what is $\tan y^\circ$?

19



The equation of the function graphed above in the y -plane can be written in the form $y = -a(x-h)^2 + 1$ where a and h are positive constants. If the function crosses the x -axis at 2 and 4, what is the value of a ?

3**3****20**

A triangle has two sides that measure 6 inches and 26 inches. A similar triangle has sides that measure exactly half of the length of the original triangle. What is the greatest possible area of the smaller triangle?

STOP

**If you finish before time is called, you may check your work on this section only.
Do not turn to any other section.**

207



Math Test - Calculator

55 MINUTES, 38 QUESTIONS

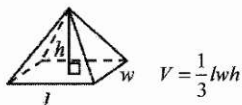
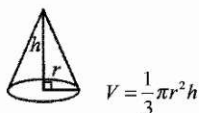
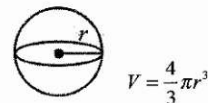
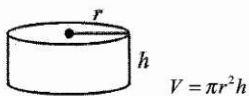
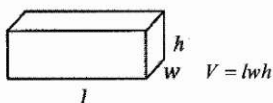
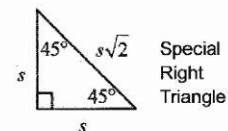
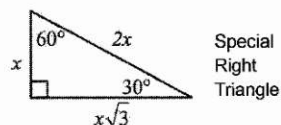
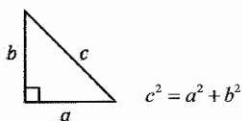
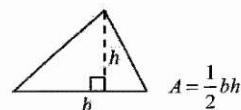
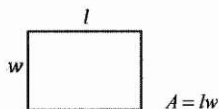
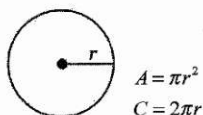
DIRECTIONS

For each question from 1-30, choose the best answer choice provided in the multiple choice bank and fill in the appropriate circle in the provided answer key. Alternatively, for questions 31-38, answer the problem and enter your answer in the grid-in section of the answer key. Refer to the directions given before question 31 as to how to enter your answers for the grid-in questions. You may complete scratch work in any empty space in your test booklet.

NOTES

- Calculator usage **is allowed**.
- Variables, constants, and coefficients used represent real numbers unless indicated otherwise.
- All figures are created to appropriate scale unless the question states otherwise.
- All figures are two-dimensional unless the question states otherwise.
- The domain of any given function is all real numbers x for which the function, $f(x)$, is a real number unless the question states otherwise.

REFERENCE



There are 360° in a circle.
There are 2π radians in a circle.
There are 180° in a triangle.



1

$\frac{y}{x} = k$ where k is a positive constant. If $y = 12$ when $x = 60$, what is the value of y when $x = 35$?

- A) 5
- B) 7
- C) 25
- D) 175

2

Three less than one half of a number is twelve more than the number. What is the number?

- A) -30
- B) -15
- C) $-\frac{15}{2}$
- D) 30

3

There are 128 ounces in a gallon of orange juice. A one pint glass can hold exactly 16 ounces of liquid. Three half-gallon containers of orange juice can fill exactly how many pint glasses with orange juice?

- A) 6
- B) 8
- C) 12
- D) 24

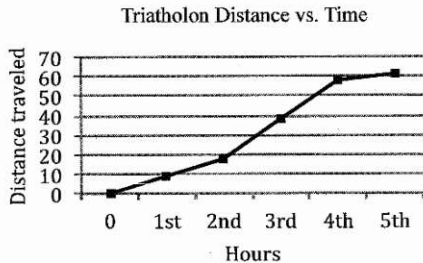
4

For how many integer values of x is $x^2 + 16 \leq 7$?

- A) 0
- B) 1
- C) 2
- D) Infinitely many



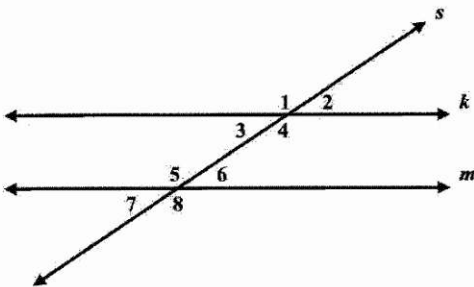
5



Tom recently entered a triathlon where he had to swim, run, and cycle a course that totaled 61 miles. If Tom cycles faster than he runs and runs faster than he swims, during which of the following intervals could Tom have been running?

- A) 0-2 hours
- B) 0-4 hours
- C) 2-4 hours
- D) 4-5 hours

6



If line k is parallel to line m and $\angle 1$ has twice the measure of $\angle 3$, what is the measure of $\angle 5 + \angle 8$ in degrees?

- A) 60
- B) 120
- C) 240
- D) 270

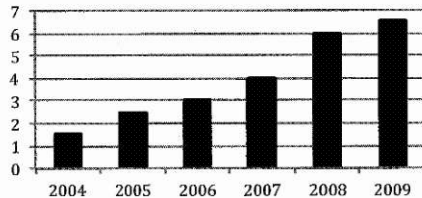
7

A scatterplot created in the xy -plane is populated by a group of 24 points that closely approximates a line with little to no outliers. A best fit line has been calculated for the data and has the equation $y = -0.5x + 6.5$. Which of the following best describes the association between the variables x and y ?

- A) Strong positive linear association
- B) Weak positive linear association
- C) Strong negative linear association
- D) Weak negative linear association

8

SAT Prep Cumulative Revenue from
2004 to 2009



The cumulative revenue for an SAT preparation company for the years 2004 through 2009 is shown in the bar graph above. If \$500,000 was made by the company over the course of the year 2005, which of the following would be an appropriate label for the vertical axis of the graph?

- A) Cumulative revenue as per the first of the year in millions of dollars.
- B) Cumulative revenue as per the first of the year in thousands of dollars.
- C) Cumulative revenue as per the last day of the year in millions of dollars.
- D) Cumulative revenue as per the last day of the year in thousands of dollars.



9

If b is a prime number and the product bc is equivalent to 30 for some positive integer value of c , which of the following could NOT be the value of b ?

- A) 2
- B) 3
- C) 5
- D) 7

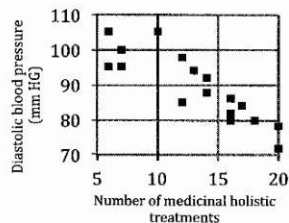
10

The average of 11 consecutive numbers is 9. If the largest number is increased by 55, by how much does the average increase?

- A) 3
- B) 5
- C) 9
- D) 14

Questions 11 and 12 refer to the following information.

Holistic Treatments Effect on Diastolic Blood Pressure



A random sample of 17 adults diagnosed with high blood pressure who have been undergoing medicinal holistic treatments to reduce their diastolic blood pressure were asked the number of treatments they have received and their current diastolic blood pressure. The results are gathered in the scatterplot above.

11

Which of the following linear models could best be used as a line of best fit to predict diastolic blood pressure, D , in mm HG as defined by t , the number of medicinal holistic treatments received?

- A) $D = -2.3t + 110$
- B) $D = -2.3t + 122$
- C) $D = -3.5t + 110$
- D) $D = -3.5t + 122$

12

For the one patient who reported 10 treatments, what is the approximate difference between the patient's observed diastolic blood pressure and the diastolic blood pressure that would have been predicted using the best fit model?

- A) 0
- B) 6
- C) 18
- D) 30



13

Runner	Time
Daniel	4:30
Bill	5:05
Geraldine	5:25
Gregory	4:45
Angela	5:05
Samantha	4:50

The table above includes the times, in minutes and seconds, that it took 6 runners to complete a one-mile run. Geraldine's time was accidentally recorded as a minute longer than she actually ran. If Geraldine's time were adjusted appropriately, which of the following would change?

- A) Range
- B) Median
- C) Mean
- D) They will all change.

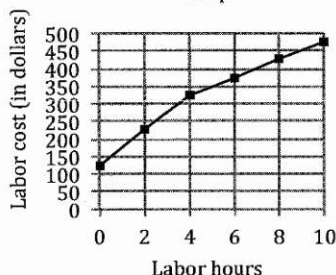
14

If $f(x) = 3x^2 - 6x + 2$, what is the least possible value of $f(x)$?

- A) -1
- B) 1
- C) Infinite
- D) The minimum value cannot be determined.

Questions 15 and 16 refer to the following information.

Labor Costs at an Autobody Shop



The graph above displays the total cost of labor for an autobody repair job that lasts between 0 and 10 hours.

15

What does the point at $(0, 125)$ represent in the graph?

- A) The total number of laborers required.
- B) The initial cost of parts required for the job.
- C) The initial fixed cost of a repair.
- D) The total cost of repair and labor if no additional labor hours are required.

16

What is the difference in the price of additional labor per hour, in dollars, during the period from 0 to 4 hours as compared to the period from 4 to 10 hours?

- A) 25
- B) 35
- C) 50
- D) 100



Questions 17 and 18 refer to the following information.

	Business	Science	TOTAL:
Undergraduate	18	9	27
Graduate	27	9	36
TOTAL:	45	18	63

63 students studying business or science at a local university were asked which degree they were working toward and if they were undergraduates or graduate students. The results were collected in the table above.

17

Which of the following categories accounts for approximately 43% of the students in the sample?

- A) Graduate students studying Business
- B) Graduate students
- C) Undergraduate students studying Business
- D) Undergraduate students studying Science

18

If a student studying business were to be selected at random, what is the probability that the student is an Undergraduate?

- A) $\frac{2}{5}$
- B) $\frac{3}{7}$
- C) $\frac{2}{3}$
- D) $\frac{5}{7}$

19

The drama club at a high school is charging \$5 for tickets sold in advance to the performance of the spring play and \$7 for tickets sold on the day of the performance. If the club sold a total of 200 tickets and raised a total of \$1,150, how many tickets were sold on the day of the performance?

- A) 50
- B) 75
- C) 125
- D) 150

20

$$y = 2x + a$$

$$y = ax + 2$$

If the coordinate point $(1, s)$ is the only solution to the system of linear equations above, which of the following statements is true about a and s ?

- A) $a + s = 2$
- B) $a = s + 2$
- C) $a + 2 = s$
- D) $a = \frac{s}{2}$



21

$$x^2 + y^2 - 2y = 3$$

Which of the following coordinate points is the center of the circle represented by the equation above?

- A) (0, -1)
- B) (0, 2)
- C) (1, 0)
- D) (0, 1)

22

Helina bought a purse that was discounted by 35% and her receipt read that she paid d dollars. If Helina paid 6% sales tax, which of the following is equivalent to the original selling price of the purse?

- A) $0.35(1.06)d$
- B) $0.65(1.06)d$
- C) $\frac{1.06d}{0.65}$
- D) $\frac{d}{0.65(1.06)}$

23

A statistics professor at Knoll University noticed that the enrollment for Introductory Statistics was 30% lower than the enrollment for Intro to Statistics for Business. If there were 210 students enrolled in Introductory Statistics, how many students enrolled in Intro to Statistics for Business?

- A) 63
- B) 147
- C) 300
- D) 840

24

A tennis ball is thrown upward from the ground and its height, h , with respect to time, t , is given by the equation $h = 22t - t^2$. Some kids are sitting on the roof of a building that stands 21 feet tall. If the kids are sitting in such a position that they cannot see the ball until it reaches the height of the roof, for how many seconds of the tennis ball's flight can the kids see the ball?

- A) 18
- B) 20
- C) 21
- D) 22



Questions 25 and 26 refer to the following information.

Net Profit for Multiple Income Streams of a Music Store

	2010	2011	2012	2013	2014
Classes	35	41	45	49	55
Book Sales	12	14	13	12	14
Equipment Sales	4	8	15	31	64
TOTAL:	51	63	73	92	133

The table above displays the net profit in thousands of dollars for the three sales divisions of a music store from the year 2010 through the year 2014.

- 25 The net profits of which of the following divisions of the music store would best be approximated by a linear equation of the form $y = b$ where b is a positive constant?

- A) Classes
- B) Book Sales
- C) Equipment Sales
- D) None of the divisions

- 26 Which of the following best approximates the average change in dollars per year of net profits from the sale of classes?

- A) 4
- B) 5
- C) 4,000
- D) 5,000

27

$$x + y < -1$$

$$x - 2y \geq 2$$

Which of the following is true of all solutions (x, y) in the solution set of the system of linear inequalities above?

- A) $x < y$
- B) $y \leq x$
- C) $x \leq -1$
- D) $y < -1$

28

When the polynomial $f(x)$ is divided by $x - 4$, the remainder is equivalent to $\frac{5}{x - 4}$. Which of the following statements must be true?

- A) $f(4) = 5$
- B) $f(-4) = 5$
- C) $f(5) = 4$
- D) $f(4) = 0$



29

	Number of Gold Awards
Student 1	5
Student 2	8
Student 3	2
Student 4	4
Student 5	1
Student 6	10

6 students were each asked to play 50 simple mind games generated by an educational website and to record the number of Gold Awards they received in those 50 games. The website states that any student who earns over 500 Gold Awards will be entered in a lottery to win a free iPad. A new student would like to know how many Gold Awards he could expect to win if he played all of the games generated by the website. Using the data in the table above, if the website boasts that it has 45,000 games available, how many Gold Awards can the student reasonably expect to receive if he plays all of the games generated by the website?

- A) 450
- B) 500
- C) 4,500
- D) 7,500

30

$$y = -x^2 + 6x - 5$$

The quadratic equation above reaches its maximum at the point (a, b) . A second quadratic equation intercepts the x -axis at the same points as the equation above, except it has an absolute minimum at the point $(a, -b)$. Which of the following is an equivalent form of the second quadratic equation in which a and $-b$ appear as constants in the equation?

- A) $y = (x - 1)(x - 5)$
- B) $y = (x + 1)(x + 5)$
- C) $y = (x - 3)^2 - 4$
- D) $y = -1(x - 3)^2 + 4$

**DIRECTIONS**

For each question from 31-38, solve and enter your answer in the grid-in section of your answer sheet as described below.

- A. Write out your answers in the boxes at the top of each column in order to help you fill in the circles accurately. Remember, you will only receive credit for the circles that are filled in correctly, not for the written answer at the top of the columns.
- B. Mark only a single circle in each column.
- C. There are no negative answers.
- D. If the problem has more than one correct answer, grid only one of the correct answers.
- E. When your answer is a **mixed number**, such as $1\frac{1}{2}$, it should be entered as 1.5 or 3/2. You cannot enter a mixed number because there is no room to fill in a circle that represents a space.
- F. If you enter a **decimal answer** with more digits than the grid can handle, the answer may be rounded or truncated, but it absolutely must fill the entire grid.

Answer: $\frac{8}{21}$

Written answer	8	/	2	1	← Fraction line
Decimal	●	●	●	●	
	0	0	0	0	
	1	1	1	1	
	2	2	●	2	
	3	3	3	3	
	4	4	4	4	
	5	5	5	5	
	6	6	6	6	
	7	7	7	7	
	●	8	8	8	
	9	9	9	9	

Answer: 6.4

	6	.	4
●	7	7	●
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	●
5	5	5	5
6	●	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Answer: 102 - both positions are correct

REMEMBER:
You can begin writing your answers in any column as long as there is enough space. Leave unused columns blank.

	1	0	2
●	7	7	●
0	0	0	0
1	1	1	1
2	2	2	●

	1	0	2
●	7	7	●
0	0	0	0
1	1	1	1
2	2	●	2

The ways to correctly grid $\frac{7}{9}$ are:

	7	/	9
●	7	●	●
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	●	7	7
8	8	8	8
9	9	9	●

.	7	7	7
●	7	7	●
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	●	7	7
8	8	8	8
9	9	9	9

.	7	7	8
●	7	7	●
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	●	7	7
8	8	8	●
9	9	9	9



31

Justine makes homemade candles as a small side business to make extra money. Justine ships her candles in pre-paid shipping boxes that allow her to ship a maximum weight of 28 pounds in each box before she is charged additional postage. Justine knows that the packaging material for each box of candles weighs 3 pounds and she knows that each candle weighs 1.5 pounds. If x is the maximum number of candles that Justine can pack in the shipping box without going over weight, what is the value of x ?

32

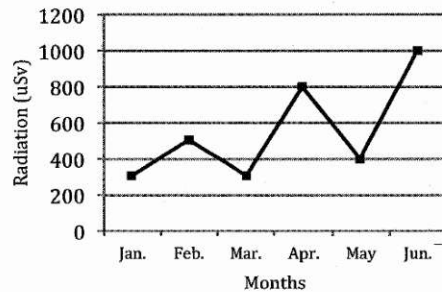
Felipe rents self-storage spaces that measure 320 cubic feet each. Each warehouse that Felipe owns has a total of 17,600 cubic feet of available rental space. If Felipe owns two warehouses, how many total self-storage spaces can he rent?

33

Daniella trains for long distance road races. In her most recent training cycle, her lowest average pace for a single run was 5 miles per hour, whereas her fastest pace was completed on a day where she ran 14 miles in 2 hours. If Daniella were to run for 2 and a half hours, what is one possible distance, in miles, she could have run?

34

Radiation Readings for the Months of January Through June



According to the radiation readings in the line graph above, the radiation reading in June was what percent larger than the radiation reading in April?



35

A square with an area of 16 square centimeters is inscribed in a circle. If the area of the square is $\frac{a}{\pi}\%$ of the area of the circle, what is the value of a ?

36

$$g(x) = \frac{x-2}{x^3 - \frac{5}{2}x^2 + x}$$

For how many values of x is the function above undefined?



Questions 37-38 refer to the following information.

$$\$2,100\left(1 + \frac{r}{100}\right)^{\frac{m}{12}}$$

The account balance of a savings account at a bank can be calculated using the expression above, where r is the annual interest rate of the account and m is the number of months that have passed since the initial deposit of \$2,100 was placed in the account.

- 37 If the account balance after 24 months was \$2,227.89, what is the value of r ?

- 38 If the account balance was \$2,227.89 after 24 months had passed, by exactly what rational number of percentage points must the annual interest rate, r , be increased in order for the account to grow to the same value in half the amount of time?

STOP

If you finish before time is called, you may check your work on this section only.
Do not turn to any other section.

Answer Key: TEST 3

SAT

SECTION 1—READING

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. D | 11. D | 21. D | 32. D | 42. D |
| 2. A | 12. A | 22. A | 33. B | 43. C |
| 3. C | 13. C | 23. B | 34. B | 44. D |
| 4. D | 14. B | 24. D | 35. D | 45. B |
| 5. B | 15. D | 25. B | 36. A | 46. B |
| 6. A | 16. C | 26. A | 37. D | 47. A |
| 7. C | 17. B | 27. D | 38. C | 48. C |
| 8. B | 18. D | 28. C | 39. A | 49. D |
| 9. B | 19. A | 29. B | 40. C | 50. B |
| 10. C | 20. A | 30. A | 41. C | 51. C |
| | | 31. A | | 52. A |

SECTION 2—WRITING

- | | | | |
|-------|-------|-------|-------|
| 1. D | 12. D | 23. C | 34. B |
| 2. A | 13. A | 24. A | 35. A |
| 3. B | 14. C | 25. C | 36. B |
| 4. B | 15. B | 26. D | 37. A |
| 5. D | 16. B | 27. A | 38. D |
| 6. B | 17. C | 28. A | 39. C |
| 7. A | 18. A | 29. C | 40. A |
| 8. A | 19. B | 30. B | 41. B |
| 9. D | 20. A | 31. D | 42. A |
| 10. B | 21. B | 32. C | 43. B |
| 11. B | 22. D | 33. C | 44. D |

SECTION 3—MATH

- | | |
|-------|----------------------------|
| 1. C | 12. A |
| 2. A | 13. B |
| 3. C | 14. A |
| 4. B | 15. A |
| 5. D | |
| 6. A | Fill-Ins: |
| 7. B | 16. 3 |
| 8. D | 17. $\frac{1}{4}$ or .25 |
| 9. B | 18. $\frac{12}{5}$ or 2.4 |
| 10. C | 19. 1 |
| 11. D | 20. $\frac{39}{2}$ or 19.5 |

SECTION 4—MATH

- | | | | |
|-------|-------|-------|-----------------------|
| 1. B | 13. D | 24. B | Fill-Ins: |
| 2. A | 14. A | 25. B | 31. 16 |
| 3. C | 15. C | 26. D | 32. 110 |
| 4. A | 16. A | 27. D | 33. $12.5 < x < 17.5$ |
| 5. A | 17. A | 28. A | 34. 25 |
| 6. C | 18. A | 29. C | 35. 200 |
| 7. C | 19. B | 30. C | 36. 3 |
| 8. A | 20. C | | 37. 3 |
| 9. D | 21. D | | 38. 3.09 |
| 10. B | 22. D | | |
| 11. B | 23. C | | |
| 12. B | | | |

Math Test - No Calculator

30 QUESTIONS

TEST 3

Answer Key: TEST 3

SAT

SECTION 1—READING

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. D | 11. D | 21. D | 32. D | 42. D |
| 2. A | 12. A | 22. A | 33. B | 43. C |
| 3. C | 13. C | 23. B | 34. B | 44. D |
| 4. D | 14. B | 24. D | 35. D | 45. B |
| 5. B | 15. D | 25. B | 36. A | 46. B |
| 6. A | 16. C | 26. A | 37. D | 47. A |
| 7. C | 17. B | 27. D | 38. C | 48. C |
| 8. B | 18. D | 28. C | 39. A | 49. D |
| 9. B | 19. A | 29. B | 40. C | 50. B |
| 10. C | 20. A | 30. A | 41. C | 51. C |
| | | 31. A | | 52. A |

SECTION 2—WRITING

- | | | | |
|-------|-------|-------|-------|
| 1. D | 12. D | 23. C | 34. B |
| 2. A | 13. A | 24. A | 35. A |
| 3. B | 14. C | 25. C | 36. B |
| 4. B | 15. B | 26. D | 37. A |
| 5. D | 16. B | 27. A | 38. D |
| 6. B | 17. C | 28. A | 39. C |
| 7. A | 18. A | 29. C | 40. A |
| 8. A | 19. B | 30. B | 41. B |
| 9. D | 20. A | 31. D | 42. A |
| 10. B | 21. B | 32. C | 43. B |
| 11. B | 22. D | 33. C | 44. D |

SECTION 3—MATH

- | | |
|-------|----------------------------|
| 1. C | 12. A |
| 2. A | 13. B |
| 3. C | 14. A |
| 4. B | 15. A |
| 5. D | |
| 6. A | Fill-Ins: |
| 7. B | 16. 3 |
| 8. D | 17. $\frac{1}{4}$ or .25 |
| 9. B | 18. $\frac{12}{5}$ or 2.4 |
| 10. C | 19. 1 |
| 11. D | 20. $\frac{39}{2}$ or 19.5 |

SECTION 4—MATH

- | | | | |
|-------|-------|-------|-----------------------|
| 1. B | 13. D | 24. B | Fill-Ins: |
| 2. A | 14. A | 25. B | 31. 16 |
| 3. C | 15. C | 26. D | 32. 110 |
| 4. A | 16. A | 27. D | 33. $12.5 < x < 17.5$ |
| 5. A | 17. A | 28. A | 34. 25 |
| 6. C | 18. A | 29. C | 35. 200 |
| 7. C | 19. B | 30. C | 36. 3 |
| 8. A | 20. C | | 37. 3 |
| 9. D | 21. D | | 38. 3.09 |
| 10. B | 22. D | | |
| 11. B | 23. C | | |
| 12. B | | | |

Section 3: Math Test - No Calculator

QUESTION 1.

Choice C is correct. Substituting 5 for h yields $3+5(x-4)=33$. Subtracting 3 from both sides yields $5(x-4)=30$ and dividing by 5 gives $x-4=6$, or $x=10$.

Choice A is incorrect and may result from distributing the 5, combining like terms, and subtracting 17 from both sides rather than adding 17 to both sides. Choice B is incorrect and may result from errors in applying the distributive property appropriately. Choice E is incorrect and may result from solving for $5x$ rather than x .

QUESTION 2.

Choice A is correct. If Manny can ride his bicycle 5 miles in h hours and Manny rides h hours each day, then by substituting 5 miles for h hours, one knows that Manny rides 5 miles each day. So, if Manny rode his bicycle for d days at 5 miles per day, then Manny rode a total of $5d$ miles.

Choice B is incorrect and may result from incorrectly interpreting that Manny travels at a rate of 5 miles per hour and h represents the number of hours that Manny rides per day. Choices C and D are incorrect and may result from errors in calculating Manny's total mileage.

QUESTION 3.

Choice C is correct. Factoring $5x$ out of the expression $5x^2-20xy$ yields $5x(x-4y)$. Factoring $3y$ out of the expression $3xy-12y^2$ yields $3y(x-4y)$. Substituting

$5x(x-4y)$ for $5x^2-20xy$ and $3y(x-4y)$ for $3xy-12y^2$ in the expression $\frac{5x^2-20xy}{3xy-12y^2}$ yields $\frac{5x(x-4y)}{3y(x-4y)}$, or simply $\frac{5x}{3y}$.

Choices A, B, and D are incorrect and may result from errors in properly factoring and simplifying the original expression.

QUESTION 4.

Choice B is correct. Expanding the expression $(-1+i)(-3+2i)$ yields $(-1)(-3)+(-1)(2i)+(i)(-3)+(i)(2i)$ which simplifies to $3-2i-3i+2i^2$, or $3-5i+2i^2$. Substituting $\sqrt{-1}$ for i in the expression $2i^2$ yields $3-5i+2(\sqrt{-1})^2$ which simplifies to $3-5i-2$, or simply $1-5i$.

Choices A, C, and D are incorrect and may result from errors in expanding the expression $(-1+i)(-3+2i)$. For example, Choice A is incorrect because $(-1)(2i)+(i)(-3)$ was accidentally combined as $-1i$.

QUESTION 5.

Choice D is correct. The equation $B = 5,500(1.01)^t$ is an exponential growth model in the form $y = a(1+r)^t$, where a is the initial value and r is the percent growth in decimal form. Rewriting the equation $B = 5,500(1.01)^t$ in the form $B = 5,500(1+.01)^t$ reveals the percent of growth as .01, or 1%. Therefore, the constant 1.01 in the equation $B = 5,500(1.01)^t$ implies that the account balance will grow by 1% per year.

Choice A is incorrect because the account balance will never decrease for $t > 0$. Choices B and C are incorrect and may result from computational errors when converting to a percentage from decimal form.

QUESTION 6.

Choice A is correct. If the gamer were to use the equation to estimate total points, p , from the number of competitions entered, c , the equation should be solved for p in terms of c . Adding $9c$ to both sides of the equation $3p - 9c = 120$ yields $3p = 9c + 120$ and dividing both sides of this equation by 3 yields the equation $p = 3c + 40$. In this form, it is apparent that the increase in the total of number of points per competition is equivalent to the slope, or the coefficient attached to the number of competitions entered, c . Therefore the increase in total points per competition is 3.

Choices A, B, and C are incorrect and may result from errors in converting the equation $3p - 9c = 120$ into an equivalent form where the change in total points per competition, or the slope, is present as a coefficient in the equation.

QUESTION 7.

Choice B is correct. Dividing both sides of $b = \frac{a}{5}$ by a yields $\frac{b}{a} = \frac{1}{5}$. Substituting $\frac{1}{5}$ for $\frac{b}{a}$ in the expression $\frac{25b}{a}$ yields $25\left(\frac{1}{5}\right)$, or 5.

Choices A, C, and D are incorrect and may result from substitution errors when substituting for $\frac{b}{a}$. For example, Choice D is incorrect because 5 was substituted for $\frac{b}{a}$ instead of $\frac{1}{5}$ which yields $25(5) = 125$.

QUESTION 8.

Choice D is correct. Since $f(x) = \frac{b}{2}x^2$, it follows that $f(8) = \frac{b}{2}(8)^2$ being that 8 is in the place of x . Substituting 96 for $f(8)$ as defined by the question yields $96 = \frac{b}{2}(8)^2$.

Multiplying both sides of the equation by 2 and squaring the 8 yields $192 = 64b$, or $b = 3$. This yields the equation $f(x) = \frac{3}{2}x^2$. Substituting 2 for x gives $f(2) = \frac{3}{2}(2)^2 = 6$.

Choices A, B, and C are incorrect and may result from substitution errors and/or calculation errors.

QUESTION 9.

Choice B is correct. If line k is perpendicular to the line with the equation

$y = -\frac{1}{2}x + 7$, it has an equation with an opposite reciprocal slope, or a slope of 2. The equation of line k follows the form $y = 2x + b$. Substituting the point $(4, 0)$ into this form of the equation for line k yields $(0) = 2(4) + b$, or $b = -8$. Therefore, the equation for line k is $y = 2x - 8$. Substituting the point $(2, -4)$ yields $(-4) = 2(2) - 8$, which is a true statement. Therefore the point $(2, -4)$ lies on line k .

Choices A, C, and D are incorrect because none of the coordinate points lie on the line with the equation $y = 2x - 8$.

QUESTION 10.

Choice C is correct. In the equation $S = \frac{(\frac{320}{h})(h-8)}{64B} - MPh$, making $x = (\frac{320}{h})(h-8)$

and $y = MPh$ yields a much more basic equation, $S = \frac{x}{64B} - y$. Adding y to both

sides gives $S + y = \frac{x}{64B}$ and multiplying each side by $64B$ yields $64B(S + y) = x$.

Dividing both sides of $64B(S + y) = x$ by $64(S + y)$ yields $B = \frac{x}{64(S + y)}$.

Substituting $x = (\frac{320}{h})(h-8)$ and $y = MPh$ back into this form of the equation yields

$$B = \frac{(\frac{320}{h})(h-8)}{64(S + MPh)}$$

Choices A, B, and D are incorrect and may result from errors in correctly applying the order of operations when solving for B .

QUESTION 11.

Choice D is correct. If the system of equations $\begin{matrix} 12x - 2y = 21 \\ -4x + Ay = -7 \end{matrix}$ is true for all values

of x and y , the two linear equations are the same and have infinitely many solutions.

Multiplying the second equation by -3 yields $12x - 3Ay = 21$. Looking at the system in

elimination form, $\begin{matrix} 12x - 2y = 21 \\ 12x - 3Ay = 21 \end{matrix}$, it is apparent that -2 must be equivalent to $-3A$ in

order to have infinitely many solutions. Solving $-2 = -3A$ for A yields $A = \frac{2}{3}$.

Choices A, B, and C are incorrect and may result from errors in simplifying the system and calculating the correct value for A . For example, Choice A is incorrect because the

coefficients in the second equation are $-\frac{1}{3}$ times the coefficients in the first equation, but

$-\frac{1}{3}$ is the multiplier, not the value of A . $-\frac{1}{3}(-2) = \frac{2}{3}$, which is the correct value of A .

QUESTION 12.

Choice A is correct. The first phone service provider's long-distance billing can be represented by the equation $C = 1 + .03(m - 2)$, where C is the total cost of a long-distance call in dollars and m is overall call length in minutes. The second service provider's long-distance billing can be represented by the equation $C = .05m$, where C is the total cost of a long-distance call in dollars and m is the overall call length in minutes. Setting the two equations equal to each other yields $1 + .03(m - 2) = .05m$. Distributing $.03$ yields $1 + .03m - .06 = .05m$, or $.94 + .03m = .05m$. Subtracting $.03m$ from either side yields $.94 = .02m$, or simply $m = 47$ minutes. Substituting 47 back into the equation $C = .05m$ yields $C = .05(47) = 2.35$, or a call that costs \$2.35.

Choice B is incorrect and may result from calculating the incorrect call length by adding $.06$ to 1 instead of subtracting $.06$ from 1 when solving for m . Choice C is incorrect because 47 is the length of the phone call in minutes, not the cost of the phone call in dollars. Choice D is incorrect because 53 would be the length of the phone call in minutes if one were to add $.06$ to 1 instead of subtracting $.06$ from 1 when solving for m .

QUESTION 13.

Choice B is correct. Converting every part of the expression $\frac{16^x \cdot 4^y}{2}$ to a base of 2 yields $\frac{2^{4x} \cdot 2^{2y}}{2^1}$. The laws of exponents state that when one multiplies two powers with the same base one can add the exponents. Therefore, $\frac{2^{4x} \cdot 2^{2y}}{2^1}$ can be rewritten as $\frac{2^{4x+2y}}{2^1}$. The laws of exponents also state that when one divides powers with the same base one can subtract the exponents. Therefore, $\frac{2^{4x} \cdot 2^{2y}}{2^1}$ can be rewritten as $2^{4x+2y-1}$.

Given that $4x + 2y - 1 = 5$, substituting 5 for $4x + 2y - 1$ yields 2^5 , or 32.

Choices A, C, and D are incorrect and may result from errors in converting to the correct base. For example, D is incorrect because 1,024 is 4^5 , not 2^5 .

QUESTION 14.

Choice A is correct. In the equation $m(x^2 - b^2) = (2x - 1)(2x + 1)$, distributing m on the left and expanding the right hand side yields $mx^2 - mb^2 = 4x^2 - 1$. Looking at the symmetry of the equation, one can see that $mx^2 = 4x^2$, in which m clearly equals 4. By the same symmetry, $-mb^2 = -1$ and substituting 4 for m yields $-4b^2 = -1$. Dividing both sides of the equation by -4 yields $b^2 = \frac{1}{4}$ and after taking the square root of both sides, $b = \pm \frac{1}{2}$. Since the question states that $b < 0$, $-\frac{1}{2}$ is the correct value for b .

Choice B is incorrect and may result from an error in squaring instead of square rooting when solving the equation $b^2 = \frac{1}{4}$. Choices C and D are incorrect because they are positive solutions and the question states $b < 0$.

QUESTION 15.

Choice A is correct. In order to simplify the expression $\frac{\frac{1}{x-1} + \frac{1}{x-2}}{4x-6}$, one must create a common denominator in order to add the fractions in the numerator. Multiplying $\frac{1}{x-1}$

by $\frac{x-2}{x-2}$ and multiplying $\frac{1}{x-2}$ by $\frac{x-1}{x-1}$ yields $\frac{\frac{1}{x-1} \cdot \frac{x-2}{x-2} + \frac{1}{x-2} \cdot \frac{x-1}{x-1}}{4x-6}$. This

expression simplifies to $\frac{\frac{x-2}{(x-1)(x-2)} + \frac{x-1}{(x-1)(x-2)}}{4x-6}$, and after adding the fractions

in the numerator, the expression becomes $\frac{\frac{2x-3}{(x-1)(x-2)}}{4x-6}$. Since dividing by $4x-6$ is

the same as multiplying by $\frac{1}{4x-6}$, the expression $\frac{2x-3}{(x-1)(x-2) \cdot 4x-6}$ can be rewritten as

$\frac{2x-3}{(x-1)(x-2)} \cdot \frac{1}{4x-6}$. Factoring a 2 out of $4x-6$ yields $\frac{2x-3}{(x-1)(x-2)} \cdot \frac{1}{2(2x-3)}$

which allows one to cancel the expression $2x-3$ from the numerator and the

denominator, which yields $\frac{1}{(x-1)(x-2)} \cdot \frac{1}{2}$. Finally, multiplying and expanding the

denominator yields the correct expression, $\frac{1}{2x^2-6x+4}$.

Choices B, C, and D are incorrect and may result from errors in simplifying a rational expression and/or errors in applying the rules of division to fractions.

QUESTION 16.

The correct answer is 3. Factoring the left hand side of the equation $2x^2 - 9x + 4 < 0$

yields $(2x-1)(x-4) < 0$. The factors $2x-1$ and $x-4$ yield the roots $\frac{1}{2}$ and 4.

Since the quadratic equation $y = 2x^2 - 9x + 4$ is concave up, or opens upward, all

values of x between $\frac{1}{2}$ and 4 will yield a negative result that will make the statement

$2x^2 - 9x + 4 < 0$ true. The values 1, 2, and 3 fall between $\frac{1}{2}$ and 4. Therefore, there are

3 integer values of x that satisfy the inequality $2x^2 - 9x + 4 < 0$.

QUESTION 17.

The correct answer is .25 or $\frac{1}{4}$. Setting the equations equal to each other yields

$x^2 - 2x + 1 = -2x + \frac{13}{4}$ and adding $2x$ to both sides gives $x^2 + 1 = \frac{13}{4}$. Subtracting 1 from

both sides yields $x^2 = \frac{9}{4}$ and taking the square root of both sides gives $x = \pm \frac{3}{2}$.

Since $x_1 > 0$, substituting $\frac{3}{2}$ for x back into the equation $y = -2x + \frac{13}{4}$ yields

$y = -2\left(\frac{3}{2}\right) + \frac{13}{4} = -3 + \frac{13}{4} = \frac{1}{4}$. Therefore, if (x_1, y_1) is the solution to the system of equations where $x_1 > 0$, then $y_1 = \frac{1}{4}$.

QUESTION 18.

The correct answer is 2.4 or $\frac{12}{5}$. If $\sin x^\circ = \frac{5}{13}$, then the right triangle has one leg that measures 5 and a hypotenuse that measures 13. As per the Pythagorean Theorem, it follows that $(5)^2 + b^2 = (13)^2$. Squaring the 5 and the 13 yields $25 + b^2 = 169$. Then, after subtracting 25 from both sides, the equation simplifies to $b^2 = 144$, which after square rooting both sides yields $b = 12$. Given that this side length of 12 sits opposite the other acute angle in the right triangle, the one that measures y° , the tangent of y° , or the side opposite the angle that measures y° divided by the side tangent to the angle that measures y° , would be $\frac{12}{5}$.

Alternatively, one can recognize that a right triangle with one leg that measures 5 and a hypotenuse that measures 13 is a part of the special right triangle with sides of length 5, 12, and 13. Then, the tangent of the angle opposite the side that measures 12, the angle that measures y° , would be $\frac{12}{5}$.

QUESTION 19.

The correct answer is 1. Being that the given equation, $y = -a(x - h)^2 + 1$, follows the vertex form of a quadratic, $y = a(x - h)^2 + k$ where (h, k) is the vertex, we know that the vertex of the function in question occurs at the point $(h, 1)$. Since the function crosses the x -axis at the points 2 and 4, the x -coordinate of the vertex must occur at 3 given the symmetry of the graph of a quadratic function in the xy -plane. This makes h equivalent to 3 and yields the equation $y = -a(x - 3)^2 + 1$. Substituting the coordinates of one of the x -intercepts, in this case $(2, 0)$, yields $0 = -a(2 - 3)^2 + 1$. Simplifying the equation gives $0 = -a + 1$, or $a = 1$.

QUESTION 20.

The correct answer is 19.5 or $\frac{39}{2}$. The similar triangle must have two sides that measure 3 and 13. The area of a triangle is calculated using the formula $A_s = \frac{1}{2}bh$, where b is the length of the base and h is the height of the triangle. If one were to make the base of the triangle 3, the highest height the triangle could have would be 13. This would occur if the side that measured 13 was perpendicular to the side that measured 3. If the two met at any other angle, the absolute height of the triangle would be lower, thus making $\frac{1}{2}bh$ lower. Therefore, the greatest possible area for the smaller triangle is

$$A_s = \frac{1}{2}(3)(13) = \frac{39}{2}$$

Section 4: Math Test - Calculator

QUESTION 1.

Choice B is correct. Substituting 12 for y and 60 for x in the equation $\frac{y}{x} = k$ yields $\frac{12}{60} = k$. Therefore, $k = \frac{1}{5}$. Substituting 35 for x and $\frac{1}{5}$ for k yields $\frac{y}{35} = \frac{1}{5}$.

Multiplying both sides by 35 yields $y = 7$.

Choices A, C, and D are incorrect and may result from errors in substitution and calculation. For example, choice D is incorrect because if one accidentally substituted 3 for y instead of x in the equation $\frac{y}{x} = k$, the equation would become $\frac{35}{x} = \frac{1}{5}$ and when cross-multiplied, x would equal 175.

QUESTION 2.

Choice A is correct. The phrase “Three less than half of a number is twelve more than the number” can be written as $\frac{1}{2}x - 3 = x + 12$. Subtracting $\frac{1}{2}x$ from both sides of the equation yields $-3 = \frac{1}{2}x + 12$, and subtracting 12 from both sides yields $-15 = \frac{1}{2}x$.

Finally, multiplying both sides of the equation by 2 yields the solution, $x = -30$.

Choice B is incorrect and may result from neglecting to completely finish solving for x once the equation has reached $-15 = \frac{1}{2}x$. Choice C is incorrect and may result from multiplying both sides of the equation by $\frac{1}{2}$ in the last step of solving rather than multiplying by 2. Choice D is incorrect and may result from misplacing a negative during the process of solving.

QUESTION 3.

Choice C is correct. If 128 ounces is equivalent to one gallon then 64 ounces is equivalent to one-half gallon. Therefore, three half gallon containers of orange juice would hold $64 \times 3 = 192$ ounces. Dividing 192 ounces by 16 ounces yields $192 \div 16 = 12$. The three containers would fill 12 glasses.

Choice A, B, and D are incorrect and may result from calculation errors or errors in comprehension. For example, Choice D is incorrect and may result from calculating the result for three gallon containers of orange juice, not three half gallon containers.

QUESTION 4.

Choice A is correct. Subtracting 16 from both sides of $x^2 + 16 \leq 7$ yields $x^2 \leq -9$. Since the square of any integer is positive, one can look at the equation $x^2 \leq -9$ and see

that there are no integer values of x that satisfy the inequality. The answer is 0.

Choices B, C, and D are incorrect and may result from calculation errors. For example, choice D is incorrect and may result from calculating the square root of -9 as -3 , which results in the inequality $x \leq -3$, an inequality to which there are infinitely many integer solutions.

QUESTION 5.

Choice A is correct. Looking at the line graph, there are three different line segments that have three distinct slopes. Using the slope formula $m = \frac{y_2 - y_1}{x_2 - x_1}$, the slope from 0-2 hours is approximately equivalent to $\frac{18-0}{2-0}$ or 9, the slope from 2-4 hours is approximately equivalent to $\frac{58-18}{4-2}$ or 20, and the slope from 4-5 hours is approximately equivalent to $\frac{62-58}{5-4}$ or 4. Since Tom cycles faster than he runs and runs faster than he swims, his slope while running will be in the middle. Therefore, Tom could be running from 0-2 hours.

Choices B, C, and D are incorrect and may result from misreading the question and misinterpreting the relationship involving Tom's speed at which he cycles, runs, and swims.

QUESTION 6.

Choice C is correct. Since $\angle 1$ is twice the measure of $\angle 3$ and the two angles are supplementary, setting $\angle 3$ equivalent to x and $\angle 1$ equivalent to $2x$ yields the equation $x + 2x = 180$. Combining like terms and dividing by 3 yields $x = 60^\circ$ and $2x = 120^\circ$. Therefore, $\angle 1$ is equivalent to 120° . Since line k and line m are parallel, $\angle 5$ is equivalent to $\angle 1$ because they are corresponding angles. Additionally, $\angle 5$ is also equivalent to $\angle 8$ because they are vertical angles. Therefore, $\angle 5 + \angle 8$ is equivalent to $120^\circ + 120^\circ$, or 240° .

Choices A and D are incorrect and may result from calculation errors. Choice B is incorrect and may result from a substitution error when comparing $\angle 1$ and $\angle 3$.

QUESTION 7.

Choice C is correct. Since the 24 points in the scatterplot closely resemble a line with few to no outliers, the spread of the points is minimal, which makes the association strong and linear. Since the slope of the line of best fit is negative, the association is negative. Therefore, there is a strong negative linear association between the variables x and y .

Choices A and B are incorrect because they imply a positive association and the negative slope of the line of best fit implies a negative association. Choice D is incorrect because a weak association would be related to points that are more scattered.

QUESTION 8.

Choice A is correct. One can see by looking at the bar graph that the cumulative revenue in 2006 is .5 higher than the cumulative revenue in 2005. Since the company earned a revenue of \$500,000 in 2005, it stands that the vertical scale is given in millions of dollars since \$500,000 is equivalent to .5 million dollars. Further, since this change of \$500,000 is present in the bar graphed for 2006 as compared to the bar graphed for 2005, instead of the bar graphed for 2005 as compared to the bar graphed for 2004, the cumulative revenue must be reported at the beginning of the year.

Choices B and D are incorrect because \$500,000 is half of one million dollars, not half of one thousand dollars. Choice C is incorrect because if the cumulative revenue were reported at the end of the year, the \$500,000 change from 2005 to 2006 would have been earned in 2006, not 2005.

QUESTION 9.

Choice D is correct. If b is equivalent to 7, then $7c$ would have to equal 30. Dividing 30 by 7 yields $\frac{30}{7}$, which is not an integer value.

Choice A is incorrect and may result from a student assuming that 2 is not a prime number. Choices B and C are incorrect because $3 \times 10 = 30$ which makes c equivalent to the integer 10 and $5 \times 6 = 30$ which makes c equivalent to the integer 6.

QUESTION 10.

Choice B is correct. The average of 11 consecutive numbers being equal to 9 can be expressed through the average formula as $\frac{Sum}{11} = 9$. Therefore, the sum of the 11 consecutive numbers is equivalent to $9 \times 11 = 99$. If the largest number were increased by 55, the sum would increase by 55 as well, $Sum = 99 + 55 = 154$. Dividing 154 by 11 yields a new average of $\frac{154}{11} = 14$. Therefore, the average increased by 5.

Alternatively, one can just divide 55 by 11 since 55 is the increase in the sum that will occur and the number of numbers in the average has not changed. Therefore, $\frac{55}{11} = 5$.

Choices A and C are incorrect and may result from calculation errors. Choice D is incorrect because 14 is the new average, not the increase in the average.

QUESTION 11.

Choice B is correct. In order to calculate the most appropriate line of best fit, one must first visually attempt to approximate the slope of the line that best represents the data points. This can be done by sketching a line through the center of the trend in the scatterplot. Looking at the scatterplot from left to right, at the lowest number of treatments, 5, the center of the trend appears to be at a diastolic blood pressure of approximately 110. Further to the right, when the number of treatments reaches 20, the center of the trend appears to be at a diastolic blood pressure of approximately 75.

Calculating the slope as the change in diastolic blood pressure over the change in the number of treatments, one can substitute the points (5,110) and (20,75) into the

slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$. This substitution yields $m = \frac{110 - 75}{5 - 20} = \frac{35}{-15} \approx -2.3$.

Substituting one of the approximated points used to find the slope, (5,110), into the equation $D = -2.3t + b$ yields $110 = -2.3(5) + b$, or $110 = -11.5 + b$. Adding 11.5 to both sides yields $b = 121.5$ which makes the estimated equation for the line of best fit $D = -2.3t + 121.5$. The most similar equation for the line of best fit to this estimation is $D = -2.3t + 122$.

Choice A is incorrect and may result from assuming that the y -intercept was 110 and missing the fact that the scale on the x -axis starts at 5. Choices C and D are incorrect because the slopes of the lines of best fit are too steep to match the trend that is present in the scatterplot.

QUESTION 12.

Choice B is correct. For the patient who reported 10 treatments, the observed diastolic blood pressure was approximately 105 mm Hg. If one were to utilize the model $D = -2.3t + 122$ to estimate the diastolic blood pressure, D , for a person who had 10 treatments, substituting 10 for t would yield $D = -2.3(10) + 122$, or $D = 99$. Therefore, the difference between observed and estimated is $105 - 99 = 6$.

Choice A is incorrect and may result from a calculation error. Choices C and D are incorrect and may result from using the incorrect best fit model to estimate the diastolic blood pressure for a person who has had 10 treatments.

QUESTION 13.

Choice D is correct. In the original table, the longest time is 5:25 and the shortest time is 4:30, making the range 55 seconds. If Geraldine's time were to be changed to 4:25, the longest time would be 5:05 and the shortest time would be 4:25, making the range 40 seconds. Therefore, the range changes. In the original table, if the times are placed in order from fastest to slowest, the list would read: 4:30, 4:45, 4:50, 5:05, 5:05, and 5:25. The median is the average of 4:50 and 5:05, or approximately 4:58. If Geraldine's time were to be changed to 4:25, the new order from fastest to slowest would read: 4:25, 4:30, 4:45, 4:50, 5:05, and 5:05. The new median would be the average of 4:45 and 4:50, or approximately 4:48. Therefore, the median changes as well. Given that the times are given in minutes and seconds, finding the actual mean of the original list of times and the adjusted list of times is a time consuming task because one must first convert all of the times to just minutes or just seconds. Instead, it is easier to see that if Geraldine's time gets reduced, the sum of all of the times gets reduced, thus reducing the mean as well. Therefore, the range, the median, and the mean all change.

Choices A, B, and C are incorrect and may result from incorrect calculations of the range, median, and mean after Geraldine's time has been adjusted.

QUESTION 14.

Choice A is correct. Since $f(x) = 3x^2 - 6x + 2$ is quadratic equation with a positive coefficient attached to the x^2 , the function has a minimum value at its vertex. Using

the expression $-\frac{b}{2a}$ to determine the x -value of the vertex by substituting 3 for a and -6 for b yields $-\frac{(-6)}{2(3)}$, or 1. Substituting 1 for x in the original equation yields $f(1) = 3(1)^2 - 6(1) + 2$, or $f(1) = -1$.

Choices B, C, and D are incorrect and may result from calculation errors or a conceptual misunderstanding of quadratic equations and their graphs.

QUESTION 15.

Choice C is correct. The point $(0,125)$ is the y -intercept of the graph. It is the amount of money that must be paid if 0 hours of labor take place. Since the line graph is showing the cost of labor only, the initial cost of \$125 must account for some form of labor that has taken place before the actual billed labor starts. At an autobody shop this initial charge would be considered the cost for the labor involved in diagnosing the estimated labor hours or repair issues.

Choice A is incorrect because the line graph shows cost versus time. The number of laborers is not a variable. Choice B is incorrect because the line graph is entitled "Labor Costs at an Autobody Shop." The cost for parts is not included in a graph that charts the cost for labor. Choice D is incorrect because it implies total cost involving labor and repairs where the graph only accounts for the cost of labor, and labor cost clearly rises with time.

QUESTION 16.

Choice A is correct. Labor cost per hour is the same as the change in cost divided by the change in time. This would be considered the slope of the two line segments in the graph. From 0 hours to 4 hours, the cost increases from \$125 to \$325. The change in cost divided by the change in time would be $\frac{325 - 125}{4 - 0}$, or \$50 per hour. From 4 hours to 10 hours, the cost changes from \$325 to \$475. This change in cost over change in time would be $\frac{475 - 325}{10 - 4}$, or \$25 per hour. Therefore, the difference in additional cost of labor per hour is $\$50 - \25 , or \$25 per hour.

Choices B, C, and D are incorrect and may result from calculating the incorrect rate of change requested by the problem. For example, choice B is incorrect because \$35 per hour is the rate of change for the cost of labor for the entire 10 hour time period and choice C is incorrect because \$50 per hour is just the rate of change for the cost of labor from the 4th hour to the 10th hour.

QUESTION 17.

Choice A is correct. There are 27 graduate students studying business. Therefore, 27 of the 63 total students sampled are graduate students studying business. $\frac{27}{63}$ is equivalent to $\frac{3}{7}$, or approximately 43%.

Choices B, C, and D are incorrect because none of these categories account for approximately 43% of the sample.

QUESTION 18.

Choice A is correct. When the question states, "If a student studying business were to be selected at random...", a conditional probability is being defined. The total population is not the entire sample anymore. The total population now is the 45 students that are studying business. The probability of randomly selecting a student that is an undergraduate *given* that they are studying business, is $\frac{18}{45}$, which can be reduced to $\frac{2}{5}$.

Choices B, C, and D are incorrect and may result from errors in correctly applying conditions to the population. For example, Choice C is incorrect and may be the result of randomly selecting a student who is studying business *given* that the student is an undergraduate, as opposed to randomly selecting a student who is an undergraduate *given* that the student is studying business.

QUESTION 19.

Choice B is correct. Substituting a for the number of tickets sold in advance and d for the number of tickets sold the day of the performance, one can create a system of equations including one equation for the total number of ticket sales ($a + d = 200$) and one equation for the total amount of money raised ($5a + 7d = 1,150$). Multiplying the equation $a + d = 200$ by 5 yields $5a + 5d = 1,000$. Subtracting $5a + 5d = 1,000$ from $5a + 7d = 1,150$ yields $2d = 150$, or $d = 75$ tickets.

Choices A and D are incorrect and may result from errors in creating or solving the correct system of equations. Choice C is incorrect because 125 tickets in the number of tickets sold in advance, not on the day of the performance.

QUESTION 20.

Choice C is correct. Substituting 1 for x in both equations and s for y in both equations yields the system of linear equations $\begin{matrix} s = 2(1) + a \\ s = a(1) + 2 \end{matrix}$. Both equations simplify to the same equation, $s = a + 2$. Therefore, the statement $a + 2 = s$ is true.

Choices A, B, and D are incorrect because none of the expressions are equivalent to the expression $s = a + 2$.

QUESTION 21.

Choice D is correct. When the equation of a circle is written in the form $(x-a)^2 + (y-b)^2 = r^2$, the center is the point (a,b) . In order to write the equation $x^2 + y^2 - 2y = 3$ in this form, one must complete the square for the expression $y^2 - 2y$. Adding 1 to both sides of the equation $x^2 + y^2 - 2y = 3$ yields $x^2 + y^2 - 2y + 1 = 3 + 1$. Factoring the expression $y^2 - 2y + 1$ yields $(y-1)^2$. Substituting $(y-1)^2$ for $y^2 - 2y + 1$ in $x^2 + y^2 - 2y + 1 = 4$ yields $x^2 + (y-1)^2 = 4$. Substituting $(x-0)^2$ for x^2 and 2^2 for 4 yields $(x-0)^2 + (y-1)^2 = 2^2$. In this form, one can see that the center of the circle is at the point $(0,1)$.

Choices A, B, and C are incorrect and may result from an error in understanding the form of a circle equation.

QUESTION 22.

Choice D is correct. A 35% discount implies that Helina is paying for $1 - .35$, or 65% of the purse. A sales tax of 6% means that after that discount, Helina is paying for $1 + .06$, or 106% of that discounted price. After setting the original selling price of the purse equal to x , if Helina's receipt said that she paid d dollars, then $x(0.65)(1.06) = d$. Solving for x , the original selling price of the purse, by dividing both sides of the

equation by $(0.65)(1.06)$ yields $x = \frac{d}{(0.65)(1.06)}$.

Choice A is incorrect and may result from incorrectly assuming that d is the original selling price of the purse and neglecting to subtract the 35% discount from 100% of the purse's selling price. Choice B is incorrect and may result from assuming that d is the original selling price of the purse rather than the price after discount and tax. Choice C is incorrect and may result from assuming that sales tax had not yet been applied to the price on the bill, d .

QUESTION 23.

Choice C is correct. Using S to represent the enrollment in Introductory Statistics and I to represent the enrollment in Intro to Statistics for Business, if S is 30% than I , then S is equivalent to 70% of I , or $S = .7I$. Substituting 210 for S yields $210 = .7I$ and dividing both sides by $.7$ makes $I = 300$.

Choice A is incorrect because 63 is 30% of 210 instead of 30% more than 210. Choice B is incorrect because 147 is 70% of 210 which is 30% less than 210, not 30% more than 210. Choice D is incorrect because 840 is 300% more than 210, rather than 30%.

QUESTION 24.

Choice B is correct. Setting h equal to 21 and solving for t in the equation $h = 22t - t^2$ will yield the time when the tennis ball first reaches the height of the top of the building and the second time it reaches the top of the building upon its descent. Setting h equal to 21 yields $21 = 22t - t^2$. Subtracting $22t$ and adding t^2 to both sides of the equation

yields $t^2 - 22t + 21 = 0$. Factoring the left hand side of the equation yields $(t-1)(t-21) = 0$. The roots at 1 and 21 mean that the tennis ball reaches a height of 21 feet 1 second after it is released and again at 21 seconds. Therefore, the kids sitting on the roof can see the tennis ball for $21-1 = 20$ seconds.

Choices A, C, and D are incorrect and may result from substitution errors and/or factoring errors.

QUESTION 25.

Choice B is correct. A linear equation of the form $y = b$ where b is a positive constant is a horizontal line with a slope of 0. A horizontal line would best represent an income stream that has little to no change over time; an income stream that seems to hover around the same net profit each year. Therefore, book sales would be the income stream best represented by a line of the form $y = b$.

Choice A is incorrect because classes would best be represented by a line, but one with a positive slope of the form $y = mx + b$ where m and b are positive constants. Choice C is incorrect because equipment sales would best be represented by an exponential function of the form $y = ab^x$ where a and b are positive constants. Choice D is incorrect because book sales can be represented by a line of the form $y = b$.

QUESTION 26.

Choice D is correct. In 2010, the net profit from the sale of classes was \$35,000. In 2014, the net profit from the sale of classes was \$55,000. Calculating the change in net profit from the sale of classes divided by the number of years that have passed yields $\frac{55,000 - 35,000}{2014 - 2010}$, which simplifies to $\frac{20,000}{4}$, or \$5,000 per year.

Choice A is incorrect and may result from overlooking the fact that the table is in thousands of dollars and from dividing by 5 years because there are 5 years listed in the table rather than the change which was only 4 years. Choice B is incorrect and may result from overlooking the fact that the table is in thousands of dollars. Choice C is incorrect and may result from dividing by 5 years because there are 5 years listed in the table rather than the change which was only 4 years.

QUESTION 27.

Choice D is correct. Converting both equations in the system of linear inequalities

$$\begin{array}{l} x + y < -1 \\ x - 2y \geq 2 \end{array} \text{ to } y = mx + b \text{ form yields } \begin{array}{l} y < -x - 1 \\ y \leq \frac{1}{2}x - 1 \end{array} . \text{ Being that the two lines intersect at}$$

the same y -intercept, $(0, -1)$, and that y must be less than or less than or equal to this point, it follows that y must be strictly less than -1 in order to satisfy both inequalities. Therefore, $y < -1$.

Choices A, B, and C are incorrect because there are coordinate points (x, y) that satisfy

all three answers that are, however, not solutions to the system of linear inequalities.

QUESTION 28.

Choice A is correct. If a polynomial $f(x)$ were divided by the binomial $x - 4$ and there were no remainder, 4 would be a root of the polynomial. In other words, if you substituted 4 for x in the polynomial, the output, $f(4)$, would be equivalent to 0, or $f(4) = 0$. However, when the polynomial is divided by $x - 4$, there is a remainder of

$\frac{5}{x-4}$. This implies that if $f(x)$ is divided by $x - 4$, there is 5 left over. Therefore,

$f(4) = 0 + 5$, or more simply $f(4) = 5$.

Choices B, C, and D are incorrect because none of the pairs of inputs and outputs are necessarily solutions to the polynomial $f(x)$. For example, choice D is incorrect because if $f(4) = 0$, there would be no remainder.

QUESTION 29.

Choice C is correct. If 6 students each played 50 mind games, the total number of games played by the 6 students is $6 \times 50 = 300$ games. Summing up all of the Gold Awards won by the 6 students yields $5 + 8 + 2 + 4 + 1 + 10 = 30$ gold awards. So, for every 300 games played, a student can reasonably expect 30 gold awards. So, if the website boasts

that it has 45,000 games available, then one could solve the proportion $\frac{30}{300} = \frac{x}{45,000}$

for x , the number of gold awards to be expected if all 45,000 games are played. Cross-

multiplying yields $30(45,000) = 300x$, or $x = \frac{30(45,000)}{300} = 4,500$.

Choices A, B, and D are incorrect and may result from calculation errors or errors in calculating a proportional estimate.

QUESTION 30.

Choice C is correct. A second quadratic equation with the same x - and y -intercepts and a vertex with an opposite y -value as the equation $y = -x^2 + 6x - 5$ would be the inversion of the equation, $y = x^2 - 6x + 5$. The vertex form of the equation $y = x^2 - 6x + 5$ would have the coordinates of the vertex, $(a, -b)$, as coefficients in the equation. In order to convert $y = x^2 - 6x + 5$ to vertex form, a form in which $y = a(x - h)^2 + k$ where the coordinate point (h, k) is the vertex of the equation, one must complete the square of the expression $x^2 - 6x$. By dividing -6 by 2 and squaring the outcome, the resulting outcome is 9. With this value, one can re-express $y = x^2 - 6x + 5$ as the equivalent equation $y = (x^2 - 6x + 9) + 5 - 9$ and, after factoring the expression $x^2 - 6x + 9$, the equivalent vertex form of the equation remains: $y = (x - 3)^2 - 4$. In this form, the coordinates of the vertex, $(3, -4)$, appear as coefficients in the equation.

Choices A and B are incorrect because they are not in vertex form, the form in which the coordinates of the vertex appear as constants in the equation. Choice D is incorrect and may result from converting the original, non-inverted equation to vertex form.

QUESTION 31.

The correct answer is 16. Subtracting 3 from the 28 allowable pounds yields 25 available pounds to be accounted for by the candles. Since each candle weighs 1.5 pounds, dividing 25 by 1.5 yields $\frac{25}{1.5} = 16.333\dots$ Therefore, 16 candles is the maximum number of candles that can be shipped before Justine is charged for additional shipping.

QUESTION 32.

The correct answer is 110. If Filipe owns two warehouses that each contain 17,600 cubic feet of rental space, Filipe has a total of $17,600 \times 2 = 35,200$ cubic feet of rental space available. If each self-storage space that Filipe rents is 320 cubic feet, dividing 35,200 by 320 yields $\frac{35,200}{320} = 110$ available self-storage rental spaces.

QUESTION 33.

The correct answer is $12.5 < x < 17.5$. If Daniella ran a total of 14 miles in 2 hours on the day of her fastest pace run, dividing 14 by 2 yields $\frac{14}{2} = 7$ miles per hour. If Daniella ran at her slowest pace of 5 mph for 2 and a half hours, multiplying yields $5 \times 2.5 = 12.5$ miles. If Daniella ran at her slowest pace of 7 mph for 2 and a half hours, multiplying yields $7 \times 2.5 = 17.5$ miles. Daniella could have run anywhere from 12.5 to 17.5 miles.

QUESTION 34.

The correct answer is 25. According to the line graph, the radiation reading in June was 1,000 uSV and the radiation reading in April was 800 uSV. If June has a higher radiation reading than April, multiplying the radiation reading in April by a growth factor of $(1+r)$, where r is the growth rate in decimal form, will yield the radiation reading in June. So, $800(1+r) = 1,000$. Dividing both sides of the equation by 800 yields

$$1+r = \frac{1,000}{800}, \text{ or } 1+r = 1.25. \text{ Subtracting 1 from both sides of the equation yields}$$

$$r = 0.25, \text{ or } 25\%.$$

QUESTION 35.

The correct answer is 200. Taking the square root of the area of the square yields 4, the side length of the square. Using the side length relationship of an isosceles right triangle, x , x , and $x\sqrt{2}$, yields the length of the diagonal of the square, $4\sqrt{2}$. This diagonal happens to be the diameter of the circle which, when divided by 2, makes the circle's radius $2\sqrt{2}$. Using the formula for the area of a circle, $A = \pi r^2$, yields $A = \pi(2\sqrt{2})^2$,

or $A = 8\pi$. The area of the square divided by the area of the circle is $\frac{16}{8\pi}$. Multiplying

$\frac{16}{8\pi}$ by 100 yields $\frac{1600}{8\pi}\%$, or $\frac{200}{\pi}\%$. If the area of the square is $\frac{a}{\pi}\%$ of the area of the

circle and the area of the square is $\frac{200}{\pi}\%$, $a = 200$.

QUESTION 36.

The correct answer is 3. The function $g(x)$ is undefined for any value of x that creates a zero in the denominator. Factoring an x out of the denominator of the function

$$g(x) = \frac{x-2}{x^3 - \frac{5}{2}x^2 + x} \text{ yields } g(x) = \frac{x-2}{x(x^2 - \frac{5}{2}x + 1)}. \text{ Factoring the expression } x^2 - \frac{5}{2}x + 1$$

yields $(x-2)(x - \frac{1}{2})$, revealing roots at 2 and $\frac{1}{2}$. Therefore, since an x was factored out of the denominator, which implies that the function is undefined at 0, and because 2 and $\frac{1}{2}$ are also roots of the function $y = x^3 - \frac{5}{2}x^2 + x$, there are three total values of x where $g(x)$ is undefined.

QUESTION 37.

The correct answer is 3. Substituting 24 for m in the expression

$$\$2,100(1 + \frac{r}{100})^{\frac{m}{12}} \text{ and setting the expression equal to } \$2,227.89 \text{ yields the equation}$$

$$\$2,100(1 + \frac{r}{100})^{\frac{24}{12}} = \$2,227.89. \text{ Dividing both sides of the equation by } \$2,100 \text{ yields}$$

$$(1 + \frac{r}{100})^2 = 1.0609 \text{ and then taking the square root of both sides yields } 1 + \frac{r}{100} = 1.03.$$

After subtracting 1 from both sides $\frac{r}{100} = .03$ and multiplying by 100 leaves r equivalent to 3.

QUESTION 38.

The correct answer is 3.09. Substituting half of the amount of time, 12, for m in the

$$\text{expression } \$2,100(1 + \frac{r}{100})^{\frac{m}{12}} \text{ and setting the expression equal to } \$2,227.89 \text{ yields the}$$

$$\text{equation } \$2,100(1 + \frac{r}{100})^{\frac{12}{12}} = \$2,227.89. \text{ Dividing both sides of the equation by } \$2,100$$

$$\text{yields } 1 + \frac{r}{100} = 1.0609. \text{ After subtracting 1 from both sides } \frac{r}{100} = .0609 \text{ and multiplying}$$

by 100 leaves r equivalent to 6.09. Given the answer explanation to question 37, in order for the account value to rise to \$2,227.89 after 24 months have passed, r must be equivalent to 3. In order for the account value to rise to \$2,227.89 in half of the amount of time, 12 months, r must be equivalent to 6.09. Therefore, r must be increased by 3.09.

TEST 4



Math Test - No Calculator

25 MINUTES, 20 QUESTIONS

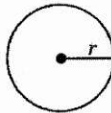
DIRECTIONS

For each question from 1-15, choose the best answer choice provided in the multiple choice bank and fill in the appropriate circle in the provided answer key. Alternatively, for questions 16-20, answer the problem and enter your answer in the grid-in section of the answer key. Refer to the directions given before question 16 as to how to enter your answers for the grid-in questions. You may complete scratch work in any empty space in your test booklet.

NOTES

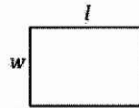
- A. Calculator usage is **not allowed** in this section.
- B. Variables, constants, and coefficients used represent real numbers unless indicated otherwise.
- C. All figures are created to appropriate scale unless the question states otherwise.
- D. All figures are two-dimensional unless the question states otherwise.
- E. The domain of any given function is all real numbers x for which the function, $f(x)$, is a real number unless the question states otherwise.

REFERENCE

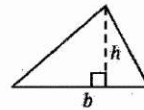


$$A = \pi r^2$$

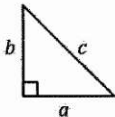
$$C = 2\pi r$$



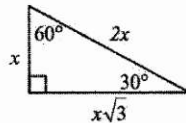
$$A = lw$$



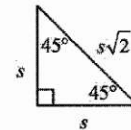
$$A = \frac{1}{2}bh$$



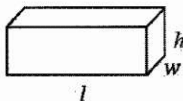
$$c^2 = a^2 + b^2$$



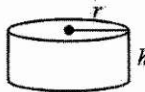
Special
Right
Triangle



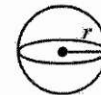
Special
Right
Triangle



$$V = lwh$$



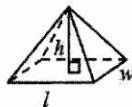
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

There are 360° in a circle.
There are 2π radians in a circle.
There are 180° in a triangle.



1

Resha and Kiley wrote a total of 842 text messages in the last month. If Resha wrote 4 less than twice the number of text messages that Kiley wrote, which of the following equations could be solved to find x , the number of text messages written by Kiley?

- A) $2x - 4 = 842$
- B) $3x - 4 = 842$
- C) $4 - 2x = 842$
- D) $4 - x = 842$

2

$$b\sqrt{b}$$

The expression above is *not* equivalent to which of the following expressions?

- A) $\sqrt{b^3}$
- B) $b^{\frac{3}{2}}$
- C) $\frac{b^3}{b^2}$
- D) $\sqrt{\frac{b^5}{b^2}}$

3

If $4x^2 - 17 = 11$, what is the value of $16x^2$?

- A) -24
- B) 7
- C) 56
- D) 112

4

$$4x + 9y = 12$$

$$5x + 3y = 12$$

What is the value of $3x + 4y$ given that the coordinate pair (x, y) is a solution to the system of equations above?

- A) 6
- B) 8
- C) 12
- D) 24



5

$$\frac{a-2}{2} = \frac{3a}{a+8}$$

If the equation above is true, what is the value of a^2 ?

- A) -4
- B) 4
- C) 16
- D) 256

6

A professional steam cleaning service charges its clients by using the expression $CLh + f$, where C is the number of cleaning machines, L is the number of laborers, h is the number of hours, and f is the square footage of the area to be cleaned. If the carpets at a certain location are stained much deeper than expected, which of the following values would be affected the most?

- A) C
- B) L
- C) f
- D) CLh

7

Line m is perpendicular to a line with the equation $y = -Kx + t$. If line m goes through the point $(4, 3)$ and has a y -intercept at the point $(0, b)$, which of the following is equivalent to b ?

- A) $b = 4 - \frac{3}{K}$
- B) $b = 3 - \frac{4}{K}$
- C) $b = 4 + 3K$
- D) $b = 3 + 4K$

8

$$\begin{aligned} 2x + y &= 15 \\ kx - 4y &= 100 \end{aligned}$$

If the system of equations above has one solution at the point $(1, y)$, what is the value of k ?

- A) 13
- B) 48
- C) 152
- D) 168



9

The quadratic function $y = -(x-2)^2 + 4$ intercepts the origin. If the absolute maximum of the function occurs at point A , what is the distance between point A and the origin?

- A) $2\sqrt{3}$
- B) $2\sqrt{5}$
- C) 5
- D) $4\sqrt{3}$

11

The quadratic function $y = x^2 - 12x + 20$ intercepts another quadratic function $y = -x^2 + 12x - 34$ at the points A and B . What is the length of \overline{AB} ?

- A) 3
- B) 4
- C) 6
- D) 9

10

In the polynomial $g(x)$, if $g(2) = 1$, which of the following must be true?

- A) $x-2$ is a factor of $g(x)$.
- B) $x-1$ is a factor of $g(x)$.
- C) $x+2$ is a factor of $g(x)$.
- D) The remainder when $g(x)$ is divided by $x-2$ is 1.

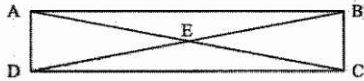
12

If the expression $2x^2 - 7x + M$ is divided by the binomial $2x + 5$, the remainder is $\frac{4M}{2x+5}$. What is the value of M ?

- A) 6
- B) 10
- C) 36
- D) 100



13



In the figure above, quadrilateral $ABCD$ is a rectangle. If the measure of $\angle DAE$ is four times the measure of $\angle BAE$, what is the measure of $\angle AED + \angle BEC$ in degrees?

- A) 18
- B) 36
- C) 72
- D) 144

14

For integers a and b , if $|a - b| = 2a$ and $a + b = 0$, which of the following must be true?

- I. $a^2 = b^2$
- II. $a - b < 0$
- III. $ab < 0$

- A) I only
- B) I and III only
- C) II and III only
- D) I, II, and III

15

The coordinate pairs $(\frac{-1 + \sqrt{13}}{3}, 0)$ and $(\frac{-1 - \sqrt{13}}{3}, 0)$ are solutions to which of the following equations?

- A) $y = 3x^2 + 2x - 4$
- B) $y = \frac{3}{2}x^2 + 2x - 8$
- C) $y = x^2 - 16x + 39$
- D) $y = 3x^2 - 40x + 13$

**DIRECTIONS**

For each question from 16-20, solve and enter your answer in the grid-in section of your answer sheet as described below.

- A. Write out your answers in the boxes at the top of each column in order to help you fill in the circles accurately. Remember, you will only receive credit for the circles that are filled in correctly, not for the written answer at the top of the columns.
- B. Mark only a single circle in each column.
- C. There are no negative answers.
- D. If the problem has more than one correct answer, grid only one of the correct answers.
- E. When your answer is a **mixed number**, such as $1\frac{1}{2}$, it should be entered as 1.5 or $3/2$. You cannot enter a mixed number because there is no room to fill in a circle that represents a space.
- F. If you enter a **decimal answer** with more digits than the grid can handle, the answer may be rounded or truncated, but it absolutely must fill the entire grid.

Answer: $\frac{8}{21}$

Written answer →

Decimal point →

← Fraction line

8	/	2	1
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	<input checked="" type="radio"/>	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
<input checked="" type="radio"/>	8	8	8
9	9	9	9

Answer: 6.4

6	.	4
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	<input checked="" type="radio"/>
5	5	5
6	<input checked="" type="radio"/>	6
7	7	7
8	8	8
9	9	9

Answer: 102 - both positions are correct

REMEMBER:
You can begin writing your answers in any column as long as there is enough space. Leave unused columns blank.

1	0	2
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	<input checked="" type="radio"/>	0
1	<input checked="" type="radio"/>	1
2	2	<input checked="" type="radio"/>

1	0	2
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<input checked="" type="radio"/>	0	0
1	<input checked="" type="radio"/>	1
2	2	<input checked="" type="radio"/>

The ways to correctly grid $\frac{7}{9}$ are:

7	/	9
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	<input checked="" type="radio"/>	7
8	8	8
9	9	<input checked="" type="radio"/>

.	7	7	7
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
8	8	8	8
9	9	9	9

.	7	7	8
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
8	8	8	<input checked="" type="radio"/>
9	9	9	9



16

$$2 + \frac{3}{7}\left(x - \frac{1}{3}\right) = \frac{5}{2}$$

What value of x makes the equation above true?

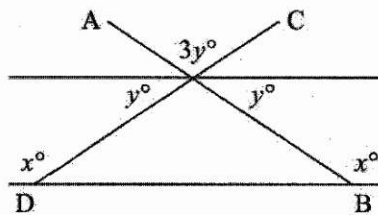
17

For what value of x , where $x > 0$, is the equation $255 = (x^2 + 1)(x^2 - 1)$ true?

18

In a recent gymnastics competition, Team A scored 30 points less than four times the number of points that Team B scored. Team C scored 61 points more than half of the number of points that Team B scored. If Team A and Team C shared in the victory, having earned the same number of points, how many more points did each team have than Team B ?

19



If \overline{AB} intersects \overline{CD} as shown in the figure above, what is the value of x ?

3**3****20**

A 26 foot bridge crosses a stream at an incline. If one bank of the river is 2 feet above the height of the water and the other bank is 12 feet above water level, what is the tangent of the angle that the bridge makes with the surface of the water?

STOP

If you finish before time is called, you may check your work on this section only.
Do not turn to any other section.

289



Math Test - Calculator

55 MINUTES, 38 QUESTIONS

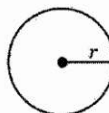
DIRECTIONS

For each question from 1-30, choose the best answer choice provided in the multiple choice bank and fill in the appropriate circle in the provided answer key. Alternatively, for questions 31-38, answer the problem and enter your answer in the grid-in section of the answer key. Refer to the directions given before question 31 as to how to enter your answers for the grid-in questions. You may complete scratch work in any empty space in your test booklet.

NOTES

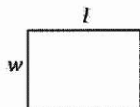
- A. Calculator usage is allowed.
- B. Variables, constants, and coefficients used represent real numbers unless indicated otherwise.
- C. All figures are created to appropriate scale unless the question states otherwise.
- D. All figures are two-dimensional unless the question states otherwise.
- E. The domain of any given function is all real numbers x for which the function, $f(x)$, is a real number unless the question states otherwise.

REFERENCE

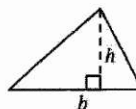


$$A = \pi r^2$$

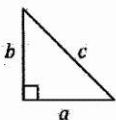
$$C = 2\pi r$$



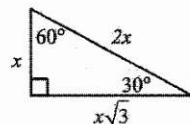
$$A = lw$$



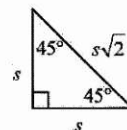
$$A = \frac{1}{2}bh$$



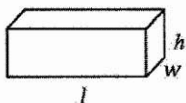
$$c^2 = a^2 + b^2$$



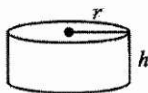
Special
Right
Triangle



Special
Right
Triangle



$$V = lwh$$



$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

There are 360° in a circle.
There are 2π radians in a circle.
There are 180° in a triangle.



1

$$(12x^2 + 5x + 1) - (10x^2 - 5x - 1)$$

The difference of the polynomials shown above is equivalent to which of the following expressions?

- A) $2x^2 + 10x + 2$
- B) $2x^2 + 10x$
- C) $2x^2 + 2$
- D) $2x^2$

2

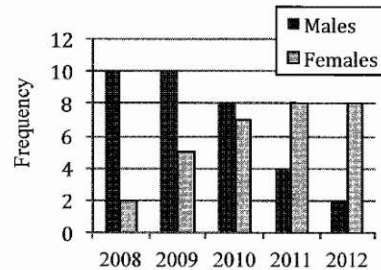
x	y
-3	5
0	7
6	11
9	13

Which of the following linear equations is displayed in the xy -table above?

- A) $y = \frac{2}{3}x + 7$
- B) $y = \frac{2}{3}x + 5$
- C) $y = 2x + 7$
- D) $y = 3x + 5$

3

Distribution of Actuarial Students



If one actuarial student were to be selected at random from all of the actuarial students from 2008 to 2012, what is the probability that the student is a female from either 2011 or 2012?

- A) $\frac{3}{32}$
- B) $\frac{1}{8}$
- C) $\frac{1}{4}$
- D) $\frac{11}{32}$

4

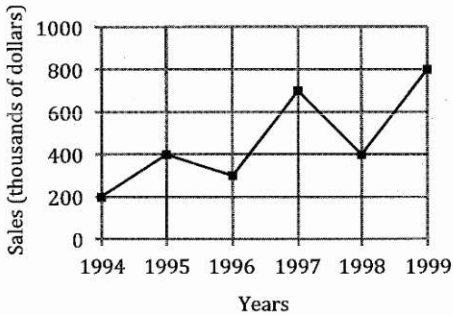
Approximately 22% of the students at Lakesedge High School are sophomores and 40% of the sophomores took the class Contemporary American Issues. If there are 1670 students in Lakesedge High School, approximately how many sophomores took Contemporary American Issues?

- A) 135
- B) 150
- C) 370
- D) 670



5

Sales for a Computer Wholesale Company
from 1994 to 1999



The graph above shows the total sales in thousands of dollars each year from 1994 to 1999 for a computer wholesale company. Which of the following best describes the trend in sales from 1994 to 1999?

- A) The sales steadily increased each year.
- B) The sales increased and then decreased.
- C) The sales increased on average by approximately \$100 each year.
- D) The sales increased on average by approximately \$100,000 each year.

6

If $\frac{7}{2}a = \frac{5}{b}$ and $a = 5$, what is the value of b ?

- A) $\frac{2}{7}$
- B) $\frac{7}{2}$
- C) $\frac{50}{7}$
- D) 14

7

Madeline can drink 13 bottles of water in 5 minutes. Approximately how many seconds would it take Madeline to drink 3 bottles of water?

- A) 1.2
- B) 15
- C) 23
- D) 69

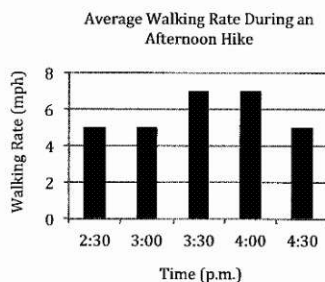
8

The enrollment for a training seminar for construction foremen on how to employ tablets as a means of updating progress at construction sites has increased by 18 people since the seminar's inception six years ago. If the current enrollment is 42 construction foremen, which of the following linear equations could be used to estimate the enrollment, y , based on the number of years, x , that have passed since the first year the seminar was held?

- A) $y = 18x + 42$
- B) $y = 18x + 24$
- C) $y = 3x + 42$
- D) $y = 3x + 24$



9



Hernando was hiking one afternoon and he would record his walking rate in miles per hour every half an hour until his hike was over. At one point during his hike, Hernando switched from walking uphill to walking downhill. If Hernando walks at a constant rate uphill and a constant rate downhill, Hernando most likely transitioned from walking uphill to walking downhill during which of the following time frames?

- A) 2:30 to 3:00
- B) 3:00 to 3:30
- C) 3:30 to 4:00
- D) 4:00 to 4:30

10

$$y = a(x - h)^2 + k$$

The quadratic equation above is the vertex form of a quadratic function where a , h , and k are constants and (h, k) is the vertex of the function's graph. Which of the following equations gives the x -coordinate of the vertex in terms of y , a , x , and k , where $x > 0$?

- A) $h = \frac{y - k}{a} - x$
- B) $h = x - \frac{y - k}{a}$
- C) $h = \sqrt{\frac{y - k}{a}} - x$
- D) $h = x - \sqrt{\frac{y - k}{a}}$

Questions 11 and 12 refer to the following information.

Name of Tree	Growth Rate (Feet per year)	Years to Maturity
Empress	15	3.33
Lombardy Poplar	10	6
Eucalyptus	8	5
Quaking Aspen	5	10
Cleveland Pear	4	7.5

The chart above shows the names, growth rates, and years to maturity of 5 of the fastest growing trees in the world. A tree's maturity is defined as the point at which a tree's future growth is negligible and the tree has reached its highest height.

11

Which of the following pairs of trees will be of the same approximate height when they have reached maturity?

- A) Empress and Lombardy Poplar
- B) Eucalyptus and Cleveland Pear
- C) Empress and Quaking Aspen
- D) Lombardy Poplar and Quaking Aspen

12

The tree with the greatest height at maturity is what percent taller than the tree with the lowest height at maturity?

- A) 50
- B) 66
- C) 100
- D) 200



13

At an arcade, a machine dispenses 4 tokens for every dollar placed in the machine. If a boy uses his tokens at a steady rate and puts a ten dollar bill in the machine every 20 minutes, which of the following equations represents t , the total number of tokens dispensed by the machine in m total minutes of time?

- A) $t = 20(4)m$
- B) $t = 20(10)(4)m$
- C) $t = \frac{4m}{20}$
- D) $t = \frac{10(4)m}{20}$

14

Name	Time (seconds)
Andrew	12
Brenda	9
Larissa	14
Mandeep	8
Roger	13
Shobitha	6
Willamina	12
Xavier	8

As a fun project to get her students interacting with each other, a kindergarten teacher decided to have every student tie both of his or her shoes and she recorded the time that it took each student to complete the task. She recorded the data in the table above. What is the median time it takes one of the students to tie his or her shoes?

- A) 9
- B) 10.5
- C) 11.5
- D) 12

15

A student conducting an experiment would like to test the theory that temperature affects the elasticity before breaking of a rubber band. The student takes a random sample of 20 rubber bands from Company A and places them in the freezer for 15 minutes. The student also takes a random sample of 20 of the same sized rubber bands from Company B and places them on a warming tray for 15 minutes. After the 15 minutes have passed, the student tests all 40 rubber bands. All of the rubber bands from the freezer snapped at under 10 inches of stretch length and all of the rubber bands from the warming tray broke at over 10 inches of stretch length. Which of the following conclusions can be drawn by the student?

- A) Frozen rubber bands have less elasticity before breaking than rubber bands that have not been frozen.
- B) Frozen rubber bands have less elasticity before breaking than rubber bands that have been warmed.
- C) Frozen rubber bands from Company A have less elasticity before breaking than frozen rubber bands from Company B.
- D) The student cannot draw a conclusion because he does not know whether the frozen rubber bands have less elasticity before breaking because they were frozen or because they were made by a different company.

16

Osmium is the densest of all metals. A single liter of osmium weighs 50 pounds. If there are 3.88 liters in every gallon, how many gallons of osmium would weigh 582 pounds?

- A) 2
- B) 2.65
- C) 3
- D) 11.64



Questions 17 and 18 refer to the following information.

$$y = 10 + 62x$$

$$y = 10(2)^x$$

Two stock market analysts have generated models for the growth of a stock that recently became publicly traded. The models predict the trading price of the stock, y , based on x , the number of years that have passed from the stock's opening trading date. Both analysts believe that the stock is going to be extremely successful over its first few years. However, one analyst believes that the stock will follow a linear growth model and the other analyst believes that the stock will see exponential growth.

17

By how much more does the analyst who generated the exponential model feel that the stock is going to increase from its 3rd to 4th year, than the analyst who predicts linear growth?

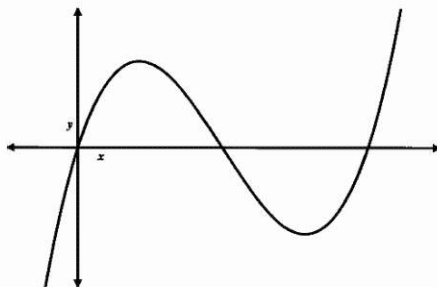
- A) 18
- B) 22
- C) 40
- D) 80

18

The linear growth model places the stock at its greatest advantage over the exponential model after approximately how many years have passed?

- A) 2
- B) 3
- C) 4
- D) 5

19



The function $g(x)$ is graphed in the xy -plane above. Which of the following could be the equation for $g(x)$?

- A) $y = -x^2 + 2x$
- B) $y = (x-3)^3$
- C) $y = x^3 - 6x^2 + 8x$
- D) $y = x^3 + 6x^2 + 8x$

20

The sum of four numbers is 84. If one of the numbers is equivalent to the sum of the other three numbers, what is the average of the other 3 numbers?

- A) 7
- B) 14
- C) 21
- D) 42

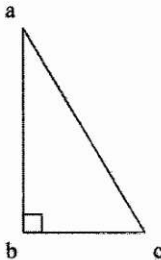


21

On halloween, Mrs. Darcy had enough candy to give each person who came by her house 2 pieces of candy, and she then had 24 pieces of candy left over. If Mrs. Darcy had given each trick-or-treater 5 pieces of candy, she would have needed twice as much candy to give an equal amount to everyone that came by her house. How many trick-or-treaters came by Mrs. Darcy's house?

- A) 48
- B) 60
- C) 96
- D) 120

22



If the measure of $\angle acb$ is equivalent to $7x + 4$ degrees and the measure of $\angle cab$ is equivalent to $4x - 2$ degrees, what is the tangent of $\angle acb$?

- A) $\frac{1}{2}$
- B) $\frac{1}{\sqrt{3}}$
- C) $\sqrt{3}$
- D) 2

23

A cylindrical container of salt stands 6 inches tall and has a diameter of 3 inches. If all of the salt in the container is poured into another cylindrical container that has 3 times the diameter of the first container, how tall must the second container be, in inches, in order to hold the same amount of salt?

- A) $\frac{1}{3}$
- B) $\frac{2}{3}$
- C) $\frac{4}{3}$
- D) 2

24

$$H(x) = 2.1x + 48$$

The equation above is a best fit line that is used to predict the height of a person in inches, $H(x)$, given the person's shoe size, x , for shoe sizes where $6 < x < 13$. In a scatterplot, the residual of a data point is defined as the difference between an observed data point and a predicted data point, or *observed - predicted*. If the residual for a particular person who had a size 10 shoe was -3 , what was the observed height in inches of the person?

- A) 66
- B) 69
- C) 72
- D) 75



25

By what percent must each side of a cube with a volume of 8 cubic inches be increased in order to attain a volume of 27 cubic inches?

- A) 25%
- B) 50%
- C) 67%
- D) 150%

26

Which of the following *does not* detail an account balance that grows exponentially?

- A) At the end of each month, an account grows by 5% of the total value of the account.
- B) At the end of each month, an account increases by one tenth of its current value.
- C) At the end of each month, an account increases by 10% more than \$100.
- D) At the end of each month, an account increases by 99% less than its current value.

27

Two different lines with two different slopes are both satisfied by the coordinate pairs $(5, 24)$ and $(15, h^2)$, where h happens to be the value of each of their respective slopes. What is the sum of the two slopes?

- A) -10
- B) -2
- C) 10
- D) 14

28

$$a = 2b + 3$$

$$4c = 5d + 6$$

In the system of linear relationships above, if a is equivalent to $3c$, which of the following expressions is equivalent in value to d ?

- A) $\frac{8b-6}{15}$
- B) $\frac{8b+6}{5}$
- C) $\frac{8b-3}{15}$
- D) $\frac{2b-3}{5}$



29

A radioactive isotope has decayed to a size of 202 kilograms over the last 20 years. If the isotope has a half-life of 40 years, which of the following is equivalent to I , the initial mass of the isotope 20 years prior?

- A) $I = 202\left(\frac{1}{2}\right)^2$
- B) $I = 101\left(\frac{1}{2}\right)^2$
- C) $I = 101\sqrt{2}$
- D) $I = 202\sqrt{2}$

30

In a group of 250 men and women, some are doctors and some are lawyers. There are 50 more women than men and there are 100 fewer doctors than lawyers. If there are 30 male doctors and a woman is to be selected at random, what is the probability that the woman is a lawyer?

- A) $\frac{3}{10}$
- B) $\frac{2}{5}$
- C) $\frac{3}{5}$
- D) $\frac{7}{10}$



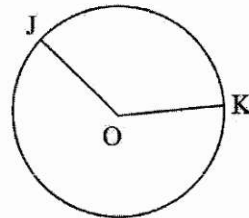
31

If the function $g(x)$ is created by adding the expression $-x^2 + 22$ to the expression $2x^2 + 7x - 52$, what is the absolute value of the sum of the roots of $g(x)$?

32

Jefferson has at least one ten-dollar bill, one five-dollar bill, and one one-dollar bill in his wallet. If Jefferson has \$30 in his wallet, what is one possible number of one-dollar bills he can have in his wallet?

33



If the measure of arc \widehat{JK} is 7 and the area of circle O is 16π , what is the measure of $\angle JOK$ in radians?

34

If $x > -2$ and $y \geq \frac{13}{2}x + 20$, what is the least integer value of y that satisfies the system of linear inequalities?

4**4****35**

The sum of 8 different positive integers is 124. If at least 3 of the integers are greater than 10, what is the greatest possible value that one of the integers can have?

36

$$f(x) = x^2 + abx + bc$$

In the function above, a , b , and c are positive integer constants. If $f(x)$ has only one root at the point $(-4, 0)$ and $b < a < c$, what is one possible value for the product abc ?



Questions 37-38 refer to the following information.

$$w = mg$$

The weight of an object, measured in Newtons, N , is the force of gravity acting on the object. It can be calculated by multiplying the mass of an object, in kilograms, or kg , by gravitational acceleration in meters per second squared, or m/s^2 . The gravitational acceleration on Earth is $9.8 m/s^2$ and the gravitational acceleration on Mars $3.75 m/s^2$.

37

If one Newton of force is equivalent to approximately 0.225 pounds of force and a 200-pound man were to stand on a standard scale on the surface of Mars, what would the scale read in pounds? (Round the answer to the nearest tenth of a pound.)

38

If the same man were to stand on the scale on a mysterious planet and the scale read 1,000 pounds, the planet would have to have a gravitational acceleration that was how many times as large as the gravitational acceleration on Mars? (Round the answer to the nearest whole number.)

STOP

If you finish before time is called, you may check your work on this section only.
Do not turn to any other section.

Answer Key: TEST 4

SAT

SECTION 1—READING

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. A | 11. C | 22. A | 33. D | 43. A |
| 2. C | 12. D | 23. C | 34. A | 44. D |
| 3. D | 13. A | 24. C | 35. B | 45. C |
| 4. B | 14. C | 25. A | 36. D | 46. B |
| 5. B | 15. B | 26. D | 37. C | 47. A |
| 6. D | 16. B | 27. B | 38. B | 48. D |
| 7. B | 17. D | 28. B | 39. B | 49. B |
| 8. A | 18. D | 29. C | 40. B | 50. C |
| 9. C | 19. A | 30. A | 41. B | 51. A |
| 10. A | 20. D | 31. C | 42. C | 52. A |
| | 21. C | 32. C | | |

SECTION 2—WRITING

- | | | | |
|-------|-------|-------|-------|
| 1. A | 12. B | 23. D | 34. A |
| 2. C | 13. C | 24. C | 35. D |
| 3. B | 14. A | 25. B | 36. A |
| 4. D | 15. C | 26. C | 37. C |
| 5. D | 16. B | 27. A | 38. B |
| 6. C | 17. D | 28. C | 39. C |
| 7. A | 18. A | 29. A | 40. A |
| 8. D | 19. D | 30. A | 41. C |
| 9. C | 20. B | 31. B | 42. C |
| 10. C | 21. C | 32. D | 43. B |
| 11. D | 22. A | 33. C | 44. B |

SECTION 3—MATH

- | | |
|-------|------------------------------------|
| 1. B | 12. B |
| 2. C | 13. C |
| 3. D | 14. A |
| 4. B | 15. A |
| 5. C | |
| 6. D | Fill-Ins: |
| 7. B | 16. $\frac{3}{2}$ or 1.5 |
| 8. C | 17. 4 |
| 9. B | 18. 48 |
| 10. D | 19. 144 |
| 11. C | 20. $\frac{5}{12}$, .416, or .417 |

SECTION 4—MATH

- | | | | |
|-------|-------|-------|---------------------------|
| 1. A | 13. D | 24. A | Fill-Ins: |
| 2. A | 14. B | 25. B | 31. 7 |
| 3. C | 15. D | 26. C | 32. 5, 10, or 15 |
| 4. B | 16. C | 27. C | 33. $\frac{7}{4}$ or 1.75 |
| 5. D | 17. A | 28. A | 34. 8 |
| 6. A | 18. B | 29. D | 35. 86 |
| 7. D | 19. C | 30. D | 36. 64 or 128 |
| 8. D | 20. B | | 37. 76.5 |
| 9. B | 21. A | | 38. 13 |
| 10. D | 22. C | | |
| 11. C | 23. B | | |
| 12. C | | | |

TEST 4

Answer Key: TEST 4

SAT

SECTION 1—READING

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. A | 11. C | 22. A | 33. D | 43. A |
| 2. C | 12. D | 23. C | 34. A | 44. D |
| 3. D | 13. A | 24. C | 35. B | 45. C |
| 4. B | 14. C | 25. A | 36. D | 46. B |
| 5. B | 15. B | 26. D | 37. C | 47. A |
| 6. D | 16. B | 27. B | 38. B | 48. D |
| 7. B | 17. D | 28. B | 39. B | 49. B |
| 8. A | 18. D | 29. C | 40. B | 50. C |
| 9. C | 19. A | 30. A | 41. B | 51. A |
| 10. A | 20. D | 31. C | 42. C | 52. A |
| | 21. C | 32. C | | |

SECTION 2—WRITING

- | | | | |
|-------|-------|-------|-------|
| 1. A | 12. B | 23. D | 34. A |
| 2. C | 13. C | 24. C | 35. D |
| 3. B | 14. A | 25. B | 36. A |
| 4. D | 15. C | 26. C | 37. C |
| 5. D | 16. B | 27. A | 38. B |
| 6. C | 17. D | 28. C | 39. C |
| 7. A | 18. A | 29. A | 40. A |
| 8. D | 19. D | 30. A | 41. C |
| 9. C | 20. B | 31. B | 42. C |
| 10. C | 21. C | 32. D | 43. B |
| 11. D | 22. A | 33. C | 44. B |

SECTION 3—MATH

- | | |
|-------|------------------------------------|
| 1. B | 12. B |
| 2. C | 13. C |
| 3. D | 14. A |
| 4. B | 15. A |
| 5. C | |
| 6. D | Fill-Ins: |
| 7. B | 16. $\frac{3}{2}$ or 1.5 |
| 8. C | 17. 4 |
| 9. B | 18. 48 |
| 10. D | 19. 144 |
| 11. C | 20. $\frac{5}{12}$, .416, or .417 |

SECTION 4—MATH

- | | | | |
|-------|-------|-------|---------------------------|
| 1. A | 13. D | 24. A | Fill-Ins: |
| 2. A | 14. B | 25. B | 31. 7 |
| 3. C | 15. D | 26. C | 32. 5, 10, or 15 |
| 4. B | 16. C | 27. C | 33. $\frac{7}{4}$ or 1.75 |
| 5. D | 17. A | 28. A | 34. 8 |
| 6. A | 18. B | 29. D | 35. 86 |
| 7. D | 19. C | 30. D | 36. 64 or 128 |
| 8. D | 20. B | | 37. 76.5 |
| 9. B | 21. A | | 38. 13 |
| 10. D | 22. C | | |
| 11. C | 23. B | | |
| 12. C | | | |

Section 3: Math Test - No Calculator

QUESTION 1.

Choice B is correct. If x is the total number of text messages that Kiley wrote, then since Resha sent 4 less than twice the number of text messages Kiley sent, Resha sent $2x - 4$ text messages. Since Resha and Kiley sent a total of 842 text messages together, then $x + 2x - 4$ must be equivalent to 842, or $3x - 4 = 842$.

Choice A is incorrect and may result from neglecting Kiley's text messages as a part of the total. Choices C and D are incorrect and may result from errors in translating the context to mathematical equations.

QUESTION 2.

Choice C is correct. The expression $b\sqrt{b}$ can be rewritten as $b^1 \cdot b^{\frac{1}{2}}$. Exponent rules state that when one is multiplying powers, the exponents are added together. Therefore, $b^1 \cdot b^{\frac{1}{2}} = b^{\frac{3}{2}}$. The division rule for exponents states that when dividing powers, one subtracts the exponents. Therefore, the expression $\frac{b^3}{b^2}$ can be rewritten as b^1 and since $b^{\frac{3}{2}}$ is not equivalent to b^1 , choice C is the correct answer.

Choice A is incorrect because $\sqrt{b^3}$ can be rewritten as $b^{\frac{3}{2}}$, which is equivalent to $b\sqrt{b}$.

Choice B is incorrect because $b^{\frac{3}{2}}$ is equivalent to $b\sqrt{b}$. Choice D is incorrect because $\sqrt{\frac{b^5}{b^2}}$ can be rewritten as $\sqrt{b^3}$, which can be rewritten as $b^{\frac{3}{2}}$, which is equivalent to $b\sqrt{b}$.

QUESTION 3.

Choice D is correct. Adding 17 to both sides of $4x^2 - 17 = 11$ yields $4x^2 = 28$. Multiplying both sides by 4 yields $16x^2 = 112$.

Choice A is incorrect and may result from subtracting 17 from 11, yielding $4x^2 = -6$, which after multiplying by 4 on both sides becomes $16x^2 = -24$. Choice B is incorrect and may result from solving for x^2 rather than $16x^2$. Choice C is incorrect and may result from calculation errors.

QUESTION 4.

Choice B is correct. Taking the sum of $4x + 9y = 12$ and $5x + 3y = 12$ yields $9x + 12y = 24$. Dividing both sides of the equation by 3 yields $3x + 4y = 8$.

Choices A, C, and D are incorrect and may result from calculation errors while adding or subtracting the equations, or from calculation errors while attempting to solve for x and y individually.

QUESTION 5.

Choice C is correct. In the equation $\frac{a-2}{2} = \frac{3a}{a+8}$, cross-multiplying yields $(a-2)(a+8) = 6a$. Expanding the left-hand side of the equation yields $a^2 + 6a - 16 = 6a$ and after subtracting $6a$ from either side one can see that $a^2 - 16 = 0$, or $a^2 = 16$.

Choices A and B are incorrect and may result from solving for a instead of a^2 . Choice D is incorrect and may result from calculation errors.

QUESTION 6.

Choice D is correct. If the carpets were stained much deeper than expected, it would take a longer time to get the stains out with the same number of machines and laborers. Therefore, h , the number of hours, would be the variable that would change the most with deeply stained carpets. The only expression that includes h is CLh .

Choices A, B, and C are incorrect because they do not include h , which is the only variable that gets affected by extended time.

QUESTION 7.

Choice B is correct. A line that is perpendicular to a line with the equation $y = -Kx + t$ will have an opposite reciprocal slope. Therefore, the equation of this line in slope-intercept form would be $y = \frac{1}{K}x + b$. If the line goes through the point $(4, 3)$, substituting 4 for x and 3 for y yields $3 = \frac{1}{K}4 + b$. Subtracting $\frac{4}{K}$ from both sides reveals that $b = 3 - \frac{4}{K}$.

Choice A is incorrect and may result from incorrectly substituting 3 for x and 4 for y . Choice C is incorrect and may result from giving the line a parallel, or the same, slope and substituting 3 for x and 4 for y . Choice D is incorrect and may result from giving the line a parallel, or the same, slope.

QUESTION 8.

Choice C is correct. Since the point $(1, y)$ is the only solution to the system of linear equations, one can substitute 1 for x in the equation $2x + y = 15$, which yields $2(1) + y = 15$, or simply $y = 13$. Substituting 1 for x and 13 for y in the other equation, $kx - 4y = 100$, yields $k(1) - 4(13) = 100$ or $k - 52 = 100$, which simplifies to $k = 152$.

Alternately, one can multiply the first equation, $2x + y = 15$, by 4 on both sides, which yields $8x + 4y = 60$. Adding this new equation to $kx - 4y = 100$ yields $(k+8)x = 160$. Substituting 1 for x yields $k+8 = 160$, or simply $k = 152$.

Choices A, B, and D are incorrect and may result from basic substitution and/or calculation errors. For example, choice D is incorrect and results from adding 8 to 160, rather than subtracting 8.

QUESTION 9.

Choice B is correct. Since the quadratic function $y = -(x-2)^2 + 4$ is in vertex form, the form given by $y = a(x-h)^2 + k$ where (h,k) is the coordinate of the vertex, one can see that the vertex of the quadratic function in question is $(2,4)$. Substituting the points $(2,4)$ and $(0,0)$ into the distance formula, $D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ yields $D = \sqrt{(2-0)^2 + (4-0)^2}$, which simplifies to $D = \sqrt{4+16} = \sqrt{20}$. Therefore, after simplifying the radical, $D = 2\sqrt{5}$.

Choices A, C, and D are incorrect and may result from a misunderstanding of the vertex form of a quadratic function or an incorrect application of the distance formula.

QUESTION 10.

Choice D is correct. If $g(2)$ were equivalent to 0, $(2,0)$ would be an x -intercept of the function $g(x)$ and $x-2$ would be a factor of $g(x)$. However, $g(2)$ does not equal 0, but instead, $g(2) = 1$. Looking at it another way, one can see that $g(2) = 0 + 1$. Therefore, if the function $g(x)$ were divided by the factor $x-2$, there would be a remainder of 1.

Choices A, B, and C are incorrect because the question does not state that $g(2) = 0$, $g(1) = 0$, or $g(-2) = 0$, the conditions that would make $x-2$, $x-1$, and $x+2$ factors of the function $g(x)$, respectively.

QUESTION 11.

Choice C is correct. Setting the equation $y = x^2 - 12x + 20$ equivalent to $y = -x^2 + 12x - 34$ yields $x^2 - 12x + 20 = -x^2 + 12x - 34$. Moving all terms in the equation to the left hand side by adding $x^2 - 12x + 34$ to both sides yields $2x^2 - 24x + 54 = 0$. Factoring out a 2 yields $2(x^2 - 12x + 27) = 0$, and factoring the expression $x^2 - 12x + 27$ yields $2(x-9)(x-3) = 0$. This makes the two solutions to the equation, 9 and 3. Substituting 3 for x in the equation $y = x^2 - 12x + 20$ yields $y = (3)^2 - 12(3) + 20$, or $y = -7$. Substituting 9 for x in the same equation yields $y = (9)^2 - 12(9) + 20$, or $y = -7$. Since the y -values of each point are the same, one can calculate the straight line distance between 9 and 3. The straight line distance between 9 and 3 is $9 - 3 = 6$.

Choices A and D are incorrect and may result from calculating the x -value of the points of intersection not the distance between them. Choice B is incorrect and may result from a calculation error.

QUESTION 12.

Choice B is correct. Dividing the expression $2x^2 - 7x + M$ by the binomial $2x + 5$ yields the following:

$$\begin{array}{r} x-6 \\ 2x+5 \overline{) 2x^2 - 7x + M} \\ \underline{-(2x^2 + 5x)} \\ -12x + M \\ \underline{-(-12x - 30)} \\ M + 30 \end{array}$$

Therefore, the remainder is $\frac{M+30}{2x+5}$. If the remainder is given in the form $\frac{4M}{2x+5}$, it follows that $M+30 = 4M$. Subtracting M from both sides yields $30 = 3M$, or $M = 10$.

Choices A, C, and D are incorrect and may result from calculation errors in performing polynomial long division or synthetic division.

QUESTION 13.

Choice C is correct. $\angle DAE$ and $\angle BAE$ are complementary angles whose sum is 90° . If $\angle BAE$ was equivalent to x , it follows that $\angle DAE$ is equivalent to $4x$. Then, solving the equation $x + 4x = 90$ yields $x = 18$. Therefore, $\angle DAE$ is equivalent to $4(18) = 72^\circ$. Due to the symmetry of a rectangle, $\angle ADE$ is equivalent to $\angle DAE$ making $\triangle AED$ isosceles. Subtracting $2(72)$ from 180 yields the measure of $\angle AED$ which is 36° . Since $\angle DAE$ and $\angle BEC$ are vertical angles, $\angle BEC$ also measures 36° . Therefore, $\angle AED + \angle BEC$ is equivalent to $36^\circ + 36^\circ$, or 72° .

Choices A, B, and D are incorrect and may result from errors in understanding complementary angles and/or neglecting to account for the sum of two angles.

QUESTION 14.

Choice A is correct. If $|a - b| = 2a$ then a must be non-negative since absolute values can only produce non-negative outcomes. Since $a + b = 0$, then b must be equivalent to $-a$ in order to make both statements true. If $b = -a$, then the equation $a^2 = b^2$ would be equivalent to $a^2 = (-a)^2$, which is true. In the equation $a - b < 0$, if $b = -a$ then $a - (-a) < 0$, which is *not* true. Finally, in the equation $ab < 0$, if $b = -a$ then $a(-a) < 0$, which is true. However, if $a = 0$ the equation would not be true and the question never states that a cannot be the same as b , nor that a cannot be equal to 0.

Choice B is incorrect because if a is equivalent to 0, ab is *not* less than 0. Choices C and D are incorrect because if $b = -a$ then $a - (-a)$ is *not* less than 0 and if a is equivalent to 0, ab is *not* less than 0.

QUESTION 15.

Choice A is correct. If one were to apply the quadratic formula, $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$,

to the equation $0 = 3x^2 + 2x - 4$, where $a = 3$, $b = 2$, and $c = -4$, the result would

be $\frac{-(2) \pm \sqrt{(2)^2 - 4(3)(-4)}}{2(3)}$. Simplifying yields $\frac{-2 \pm \sqrt{52}}{6}$ which can be rewritten as $\frac{-2 \pm 2\sqrt{13}}{6}$, or $\frac{-1 \pm \sqrt{13}}{3}$.

Choices B, C, and D are incorrect because they do not have roots with x -values equivalent to $\frac{-1 + \sqrt{13}}{3}$ and $\frac{-1 - \sqrt{13}}{3}$.

QUESTION 16.

The correct answer is 1.5 or $\frac{3}{2}$. Subtracting 2 from both sides of the equation

$2 + \frac{3}{7}(x - \frac{1}{3}) = \frac{5}{2}$ yields $\frac{3}{7}(x - \frac{1}{3}) = \frac{1}{2}$. Multiplying each side by $\frac{7}{3}$ yields $x - \frac{1}{3} = \frac{7}{6}$,

and adding $\frac{1}{3}$ to both sides gives $x = \frac{9}{6}$. After simplifying, $x = \frac{3}{2}$.

QUESTION 17.

The correct answer is 4. Multiplying the binomial $x^2 + 1$ by the binomial $x^2 - 1$ in the equation $255 = (x^2 + 1)(x^2 - 1)$ yields $255 = x^4 - 1$. Adding 1 to both sides of the equation gives $256 = x^4$ and the 4th root of 256 is equivalent to ± 4 . Since x must be greater than 0, the answer is 4.

QUESTION 18.

The correct answer is 48. If Team A scored 30 points less than four times the number of points that Team B scored, using a for Team A 's score and b for Team B 's score yields $a = 4b - 30$. If Team C scored 61 points more than half of the number of points that Team B scored, using c for Team C 's score and b for Team B 's score yields $c = \frac{1}{2}b + 61$.

If Team A and Team C shared in the victory then $a = c$. Therefore, $4b - 30 = \frac{1}{2}b + 61$.

Subtracting $\frac{1}{2}b$ and adding 30 to both sides of the equation yields $\frac{7}{2}b = 91$. Multiplying

both sides by $\frac{2}{7}$ yields $b = \frac{182}{7}$, or $b = 26$. Substituting 26 for b in either equation,

$a = 4b - 30$ for example, yields $a = 4(26) - 30 = 74$. Therefore, Team A and Team C scored $74 - 26 = 48$ more points than Team B.

QUESTION 19.

The correct answer is 144. Given that \overline{AB} intersects \overline{CD} , the angle below the angle that measures $3y^\circ$ also measures $3y^\circ$ because they are vertical angles. Therefore, $y^\circ + 3y^\circ + y^\circ = 180^\circ$ because the angles form a straight line. Combining like terms yields $5y^\circ = 180^\circ$ and dividing by 5 gives $y^\circ = 36^\circ$. Since on both sides of the triangle the exterior angles on the top measure y° and the exterior angles on the bottom measure x° , we know that the two horizontal lines in the diagram are parallel. Therefore, using the rule that the interior angles on the same side of a transversal are supplementary, it follows that $x^\circ + y^\circ = 180^\circ$. Substituting 36 for y yields $x^\circ + 36^\circ = 180^\circ$ and after subtracting 36° from both sides, $x^\circ = 144^\circ$.

QUESTION 20.

The correct answer is .416, .417, or $\frac{5}{12}$. If the height of the bridge is 2 feet above the

level of the water on one side and 12 feet above the level of the water on the other side, the actual height increase is 10 feet from one side of the river to the next. Looking at the distance straight across the river as one leg of a right triangle measuring x feet, the increase in the height of the river bank from one side to the other as the other leg which measures 10 feet, and the bridge's length of 26 feet as the hypotenuse, the Pythagorean Theorem, $a^2 + b^2 = c^2$, states that $x^2 + (10)^2 = (26)^2$. Simplifying yields the equation $x^2 + (10)^2 = (26)^2$ which is equivalent to $x^2 + 100 = 676$. Subtracting 100 from both sides yields $x^2 = 576$, or $x = 24$ feet. Alternatively, one could recognize the special right triangle side length relationship 5-12-13 which, when doubled, would yield 10-24-26. The tangent of the angle that the bridge makes with the surface of the water would be opposite over adjacent, which is the height change of the bank over the distance straight across the river, or $\frac{10}{24} = \frac{5}{12}$.

Section 4: Math Test - Calculator

QUESTION 1.

Choice A is correct. Distributing the negative sign to the second half of the expression $(12x^2 + 5x + 1) - (10x^2 - 5x - 1)$ yields $12x^2 + 5x + 1 - 10x^2 + 5x + 1$. Combining like terms yields $2x^2 + 10x + 2$.

Choice B is incorrect and may result from neglecting to distribute the negative sign to the -1 at the end of the expression. Choice C is incorrect and may result from neglecting to distribute the negative sign to the $-5x$ near the end of the expression. Choice D is incorrect and may result from neglecting to distribute the negative sign to both the $-5x$ and the -1 at the end of the expression.

QUESTION 2.

Choice A is correct. In order to calculate the slope of the line that represents the points

in the table, one can use the points $(-3,5)$ and $(0,7)$, as well as the formula for finding

slope, $m = \frac{y_2 - y_1}{x_2 - x_1}$. Substituting 7 for y_2 , 5 for y_1 , 0 for x_2 , and -3 for x_1 yields

$m = \frac{(7)-(5)}{(0)-(-3)} = \frac{2}{3}$. Being that $m = \frac{2}{3}$ and the y -intercept, b , is 7, as given by the point

$(0,7)$, the equation of the line that represents the data in the table in the form $y = mx + b$

is $y = \frac{2}{3}x + 7$.

Choices B and D are incorrect because their y -intercepts would indicate that the point $(0,5)$ should be in the table, which it is not. Choice C is incorrect because the slope of the line, 2, does not match the change in y in relation to the change in x that is present in the table.

QUESTION 3.

Choice C is correct. In order to calculate the total number of actuarial students from 2008 through 2012, one must count every male and female from 2008 through 2012. This yields the sum $(10+2)+(10+5)+(8+7)+(4+8)+(2+8)$, which is equivalent to 64. The number of female students in 2011 was 8 and the number of female students in 2012 was also 8, which makes the total number of female students from 2011 and 2012 equivalent to 16. Therefore, the probability of randomly selecting a female actuarial student from 2011 or 2012 from all of the actuarial students from 2008 to 2012 is $\frac{16}{64}$, or $\frac{1}{4}$.

Choice A is incorrect and may result from calculating the probability of selecting a male from 2011 and 2012 instead of a female. Choice B is incorrect and may result from calculating the probability of selecting a female from only 2011 or from only 2012, but not from either/or. Choice D is incorrect and may result from calculating the probability of selecting any actuarial student from 2011 or 2012, not females only.

QUESTION 4.

Choice B is correct. If there are 1670 students in Lakesedge High School and approximately 22% of the students are sophomores, there are approximately $1670(.22) \approx 367$ sophomores. If approximately 40% of the sophomores take Contemporary American Issues, then approximately $367(.40) \approx 147$ students take the course. Therefore, approximately 150 sophomores take Contemporary American Issues.

Choices A, C, and D are incorrect and may result from percentage calculation errors.

QUESTION 5.

Choice D is correct. In 1994 the computer wholesale company had \$200,000 in sales. Over the next 5 years, the annual sales increased and decreased but generally rose to \$800,000 in sales in 1999. The increase in sales over the change in years is equivalent to

$$\frac{\$800,000 - \$200,000}{1999 - 1994} = \$120,000 \text{ per year. This approximately represents a } \$100,000 \text{ per}$$

year increase in sales, on average, from 1994 to 1999.

Choice A is incorrect because the sales do not steadily increase. The sales increase and decrease year after year. Choice B is incorrect because the sales did not increase then decrease from 1994 to 1999. The sales increased and decreased year after year. Choice C is incorrect and may result from misinterpreting the scale of the y -axis of the graph.

QUESTION 6.

Choice A is correct. Substituting 5 for a in the equation $\frac{7}{2}a = \frac{5}{b}$ yields $\frac{7}{2}(5) = \frac{5}{b}$, or $\frac{35}{2} = \frac{5}{b}$. Cross-multiplying yields $35b = 10$ and after dividing both sides of the equation by 35, the equation yields $b = \frac{10}{35} = \frac{2}{7}$.

Choices B, C, and D are incorrect and may result from calculation errors while solving for b .

QUESTION 7.

Choice D is correct. If Madeline can drink 13 bottles of water in 5 minutes, she can drink 13 bottles of water in $5(60) = 300$ seconds. If Madeline can drink 13 bottles of water in 300 seconds, then she can drink 3 bottles of water in x seconds. One can solve the proportion $\frac{13}{300} = \frac{3}{x}$ in order to find x , the number of seconds it takes Madeline to drink 3 bottles of water. Cross-multiplying yields $13x = 900$ and dividing both sides by 13 yields $x \approx 69$ seconds.

Choice A is incorrect and may result from calculating the approximate number of minutes it takes Madeline to drink 3 bottles of water instead of the approximate number of seconds. Choice B is incorrect and may result from a calculation error. Choice C is incorrect and may result from solving for approximately how long it takes Madeline to drink 1 bottle of water instead of 3 bottles of water.

QUESTION 8.

Choice D is correct. If the current enrollment for the training seminar for construction foremen is 42 and 6 years have passed since the seminar's inception, the point $(6, 42)$ would be a solution to the linear model that represents the enrollment in the seminar. Further, if enrollment has increased by 18 over 6 years, the slope of the linear model that represents the current enrollment would be $\frac{18}{6} = 3$ foremen per year. Substituting 3 for

m in the linear form $y = mx + b$ and substituting the point $(6, 42)$ for x and y yields $(42) = (3)(6) + b$, or $42 = 18 + b$. Subtracting 18 from both sides of the equation gives $b = 24$, which leads to the linear model $y = 3x + 24$.

Choices A and B are incorrect because a slope of 18 implies that the seminar's enrollment grew by 18 foremen per year, when in fact it grew by 18 foremen over the course of 6 years. Choice C is incorrect because the y -intercept of 42 is actually the current enrollment, not the initial enrollment that the y -intercept should represent.

QUESTION 9.

Choice B is correct. If Hernando were walking downhill his walking rate in miles per hour would be faster than his walking rate while walking uphill. At 3:00, Hernando recorded that he was walking at a rate of 5 miles per hour. At 3:30, Hernando reported that he was walking at a rate of 7 miles per hour. At some point in time between 3:00 and 3:30, Hernando switched from moving at a rate of 5 miles per hour to a rate of 7 miles per hour. Therefore, this implies that between 3:00 and 3:30, Hernando switched from walking uphill to walking downhill.

Choices A and C are incorrect because the walking rate does not change from 2:30 to 3:00, nor does it change from 3:30 to 4:00, which implies that during these times Hernando was walking uphill or downhill, but did not switch from one to the other. Choice D is incorrect because from 4:00 to 4:30 Hernando's walking rate drops, which would imply switching from walking downhill to walking uphill, not the opposite.

QUESTION 10.

Choice D is correct. Isolating the x -coordinate of the vertex, h , in the vertex form of a quadratic equation, $y = a(x - h)^2 + k$, first involves subtracting k from either side of the equation which yields $y - k = a(x - h)^2$. Dividing both sides of the equation by a yields $\frac{y - k}{a} = (x - h)^2$ and taking the square root of both sides of the equation yields

$\sqrt{\frac{y - k}{a}} = x - h$. Adding h to both sides and subtracting $\sqrt{\frac{y - k}{a}}$ from both sides gives h in terms of y , a , x , and k , $h = x - \sqrt{\frac{y - k}{a}}$.

Choices A, B, and C are incorrect and may result from errors in correctly applying the order of operations in order to isolate the variable h .

QUESTION 11.

Choice C is correct. An Empress tree grows at a rate of 15 feet per year and reaches maturity after 3.33 years. Therefore, the height of a mature Empress tree is $15(3.33) \approx 50$ feet. The Quaking Aspen tree grows at a rate of 5 feet per year and reaches maturity after 10 years. Therefore, the height of a mature Quaking Aspen is $5(10) = 50$ feet. At maturity, the Empress tree and the Quaking Aspen are approximately the same height.

Choices A, B, and D are incorrect because none of these pairs of trees are the same height when they have reached maturity.

QUESTION 12.

Choice C is correct. The Lombardy Poplar tree grows at a rate of 10 feet per year and reaches maturity after 6 years. Its height at maturity is $10(6) = 60$ feet, representing the tallest tree at maturity in the table. The Cleveland Pear tree grows at a rate of 4 feet per year and reaches maturity after 7.5 years, making its height at maturity $4(7.5) = 30$ feet, representing the shortest tree at maturity in the table. Multiplying the height of the shortest tree at maturity by the growth factor $(1+r)$ and setting the expression equal to the height of the tallest tree at maturity will allow one to solve for r , the percentage increase in the height of the shortest tree compared to the height of the tallest tree. Therefore, $30(1+r) = 60$. Dividing both sides of the equation by 30 yields $1+r = 2$ and subtracting 1 from both sides makes $r = 1$, or 100%. Therefore, the height of the tallest tree at maturity in the table, the Lombardy Poplar tree, is 100% taller than the height of the shortest tree in the table, the Cleveland Pear tree.

Choice A is incorrect because 50% is how much shorter the shortest tree is at maturity than the highest tree at maturity. Choice B is incorrect and may result from a calculation error. Choice D is incorrect and may result from calculating what percent the tallest tree at maturity is compared to the height of the shortest tree at maturity rather than what percent *larger* the tallest tree at maturity is than the shortest tree at maturity.

QUESTION 13.

Choice D is correct. If the boy approaches the token dispensing machine once every 20 minutes for a total of m minutes, taking m and dividing it by 20 yields $\frac{m}{20}$, the total number of times the boy uses the token dispensing machine. If every time the boy uses the machine he uses a ten-dollar bill and the machine dispenses 4 tokens for every dollar it receives, then multiplying 10 by 4 yields $10(4)$, the number of tokens the boy receives every time he uses the token machine. If the boy visits the machine $\frac{m}{20}$ times and receives $10(4)$ tokens every time he uses the machine, then multiplying the two expressions together yields t , the total number of tokens the machine dispenses to the boy in m minutes. Therefore, $t = \frac{10(4)m}{20}$.

Choices A, B, and C are incorrect because they do not equal the correct number of total tokens, t , dispensed by the machine over the course of m minutes.

QUESTION 14.

Choice B is correct. By definition, the median is the middle number in a list of ordered numbers. If there is an even number of numbers in the list, the median is the average of the middle two numbers. In this case, placing the students' times in order from least to greatest yields: 6, 8, 8, 9, 12, 12, 13, and 14. The two middle times are 9 seconds and 12

seconds. The average of 9 and 12 is $\frac{9+12}{2} = 10.5$ seconds.

Choices A and D are incorrect and may result from selecting one of the 2 middle numbers when all of times are in order, rather than taking the average of the two middle numbers. Choice C is incorrect and may result from a calculation error.

QUESTION 15.

Choice D is correct. The student's experiment is an example of poor experimental design. The student places rubber bands of one type in a colder environment and rubber bands of another type in a warmer environment. In the end the results are clear that the rubber bands from Company A that were placed in the freezer for 15 minutes are less elastic before breaking than the rubber bands from Company B that were placed on the warming tray for 15 minutes. The issue is that the initial experiment as to whether or not temperature affects the elasticity before breaking of rubber bands is not clearly answered. The rubber bands from Company A that were in the freezer for 15 minutes definitely snapped at a shorter stretch distance. However, the student does not know whether or not the rubber bands snapped at a shorter stretch distance because they were colder in temperature, or because they were made by a different company. The fact of the matter is that according to this student's experimental design, it is possible that temperature has no effect on elasticity before breaking. Company A may just make a less elastic rubber band. Therefore, temperature is confounded with rubber band manufacturer and the student cannot make a legitimate inference about temperature and elasticity of rubber bands.

Choices A, B, and C are incorrect because none of the statements can be proven because of a poor experimental design due to confounding variables.

QUESTION 16.

Choice C is correct. If a single liter of Osmium is equivalent to 50 pounds, then 582 pounds of Osmium would be equivalent to $\frac{582}{50} = 11.64$ liters of Osmium. If there are 3.88 liters in a gallon, then 11.64 liters of Osmium would be equivalent to $\frac{11.64}{3.88} = 3$ gallons of Osmium.

Choices A, B, and D are incorrect and may result from calculation errors and/or errors in correctly applying unit conversions.

QUESTION 17.

Choice A is correct. Using the exponential model for the stock's growth, $y = 10(2)^x$, yields a price of $y = 10(2)^3 = \$80$ after 3 years have passed and a price of $y = 10(2)^4 = \$160$ after 4 years have passed. Therefore, the analyst who predicts exponential growth for the stock predicts that the stock will rise by $\$160 - \$80 = \$80$ from the third year to the fourth year. Looking at the linear model for the stock's growth, $y = 10 + 62x$, one can see that the slope, or change in price per year, is 62. Therefore,

the analyst who predicts linear growth for the stock predicts that the stock will rise by \$62 from the third year to the fourth year. Therefore, since $\$80 - \$62 = \$18$, the analyst who predicts exponential growth believes that the stock will grow by \$18 more from the third to fourth year than the analyst who predicts linear growth.

Choices B, C, and D are incorrect and may result from substitution and calculation errors while using the linear and exponential growth models.

QUESTION 18.

Choice B is correct. Building a table for the value of the stock, y , predicted by both the linear model and the exponential model at x , the times of 0, 1, 2, 3, 4, and 5 years after the stock's opening trading date yields the following:

$x =$	0	1	2	3	4	5
$y = 10 + 62x$	10	72	134	196	258	320
$y = 10(2)^x$	10	20	40	80	160	320

Three years after the stock's opening date, the linear model predicts the stock's price to be \$196 whereas the exponential model predicts the stock's price to be \$80. This is a difference of $\$196 - \$80 = \$116$, which is the largest advantage the linear model ever has over the exponential model.

Choices A, C, and D are incorrect because the difference between the linear model's prediction for the stock's price and the exponential model's prediction for the stock's price is not as high as year 3 in any of these years.

QUESTION 19.

Choice C is correct. Looking at the graph of $G(x)$ in the xy -plane, one can see that the function has 3 x -intercepts, or roots, one of which is at 0 and the other two of which have positive x -values. Therefore, one of the factors of the function $G(x)$ will be x and the other two factors will be in the form $(x - a)$ and $(x - b)$, where a and b represent the positive values of the two x -intercepts. Factoring the x out of the right-hand side of the function $y = x^3 - 6x^2 + 8x$ yields $y = x(x^2 - 6x + 8)$ and further factoring the expression $x^2 - 6x + 8$ yields $y = x(x - 2)(x - 4)$. Therefore, the function $y = x^3 - 6x^2 + 8x$ has two positive roots and one root at zero, the characteristics present in the graph of $G(x)$.

Choice A is incorrect because it is a polynomial of degree two and only has two roots, whereas the graph of $G(x)$ has three distinct roots. Choice B is incorrect because even though it is a cubic function, it only has one root at $x = 3$. Choice D is incorrect because in its factored form, $y = x(x + 2)(x + 4)$, it is clear there is a root at 0, but there are also two negative roots which are not present in the graph of $G(x)$.

QUESTION 20.

Choice B is correct. Suppose that the four numbers are a , b , c , and d . Then, $a + b + c + d = 84$. Further, if a is equivalent to $b + c + d$, then via substitution $(b + c + d) + b + c + d = 84$. Combining like terms yields $2b + 2c + 2d = 84$ and dividing both sides of the equation by 2 yields $b + c + d = 42$. Since the average of the other

three numbers, b , c , and d , is equivalent to $\frac{b + c + d}{3}$, dividing both sides of the equation

$b + c + d = 42$ by 3 yields $\frac{b + c + d}{3} = \frac{42}{3} = 14$.

Choices A, C, and D are incorrect and may be the result of not correctly applying the average formula or misinterpreting the target of the question. For example, choice D is incorrect because 42 is the sum of the other three numbers, not the average of the other three numbers.

QUESTION 21.

Choice A is correct. Making c the total number of candies that Mrs. Darcy had and t the number of trick-or-treaters that came to the house, if Mrs. Darcy had enough pieces of candy to give each trick-or-treater 2 pieces with 24 pieces left over, then $c = 2t + 24$. Further, if Mrs. Darcy only had enough money to give half of the trick-or-treaters 5

pieces of candy, then $c = 5\left(\frac{1}{2}t\right)$. Setting the two equations equal to each other yields $2t + 24 = 5\left(\frac{1}{2}t\right)$. Subtracting $2t$ from both sides of the equation yields $24 = \frac{1}{2}t$ and after multiplying both sides by 2, t is equivalent to 48 trick-or-treaters.

Choices B, C, and D are incorrect and may result from calculation errors when solving for the number of trick-or-treaters or errors in creating the appropriate equations to represent Mrs. Darcy's total candy count.

QUESTION 22.

Choice C is correct. Since $\angle acb$ and $\angle cab$ are complementary angles, the sum of $7x + 4$ and $4x - 2$ must be equivalent to 90. Combining like terms in the equation $7x + 4 + 4x - 2 = 90$ yields $11x + 2 = 90$. Subtracting 2 from both sides of the equation yields $11x = 88$ and then dividing by 11 yields $x = 8$. Substituting 8 for x in the expression $7x + 4$ yields $7(8) + 4 = 60$ and substituting 8 for x in the expression $4x - 2$ yields $4(8) - 2 = 30$. Being that $\triangle abc$ is a 30-60-90 right triangle, the ratio of \overline{ab} to \overline{bc} is equivalent to $\sqrt{3}$ to 1. Therefore, the tangent of $\angle acb$ is equivalent to $\frac{\sqrt{3}}{1}$, or just $\sqrt{3}$.

Choice A is incorrect because $\frac{1}{2}$ is the cosine of $\angle acb$. Choice B is incorrect because $\frac{1}{\sqrt{3}}$ is the tangent of $\angle cab$, not $\angle acb$. Choice D is incorrect because 2 is the cosecant of angle $\angle acb$.

QUESTION 23.

Choice B is correct. A cylindrical container with a height of 6 inches and a diameter of 3 inches has a radius of 1.5 inches. Substituting 6 for h and 1.5 for r into the formula for the volume of a cylinder, $V = \pi r^2 h$, yields $V = \pi(1.5)^2(6) = 13.5\pi$ cubic inches. The other cylindrical container with a diameter that is three times the diameter of the first cylindrical container will have a radius that is three times the original radius which would be $3 \times 1.5 = 4.5$ inches. A cylindrical equation with a radius of 4.5 inches would have a volume of $V = \pi(4.5)^2 h$ cubic inches. Setting $\pi(4.5)^2 h$ equal to 13.5π yields $\pi(4.5)^2 h = 13.5\pi$. Dividing both sides by π yields $(4.5)^2 h = 13.5$ and squaring 4.5 yields $20.25h = 13.5$. Then, dividing both sides by 20.25 gives $h = 0.66\dots$ or $\frac{2}{3}$.

Choice A is incorrect because a container with a diameter of 9 and a height of $\frac{1}{3}$ would not have enough volume to hold all of the salt. Choices C and D are incorrect because containers with diameters of 9 and heights of $\frac{4}{3}$ inches and 2 inches, respectively, would hold more salt than 13.5π cubic inches.

QUESTION 24.

Choice A is correct. Substituting 10 for x in the equation $H(x) = 2.1x + 48$ yields $H(10) = 2.1(10) + 48$, which makes $H(10)$ equivalent to 69 inches. If a residual is defined as an observed data point minus a predicted data point, a residual of -3 would be equivalent to $Observed - 69$. If $Observed - 69 = -3$, adding 69 to both sides of the equation yields $Observed = 66$ inches. Therefore, the actual height of the person, or the observed height, is equivalent to 66 inches.

Choice B is incorrect because if the person's actual height were 69 inches, there would be a residual of 0. Choice C is incorrect and may result from accidentally flipping observed and expected in the defined equation for a residual. Choice D is incorrect and may result from a calculation error.

QUESTION 25.

Choice B is correct. A cube with a volume of 8 cubic inches has sides of length 2 because $\sqrt[3]{8} = 2$. A cube with a volume of 27 cubic inches has sides of length 3 because $\sqrt[3]{27} = 3$. If each side length is increased from 2 to 3, multiplying 2 by $(1+r)$ and setting the expression equal to 3 will reveal r , the percent increase in decimal form. Dividing both sides of $2(1+r) = 3$ by 2 yields $1+r = 1.5$ and after subtracting 1 from both sides $r = .5$, or 50%.

Choices A and C are incorrect and may result from calculation errors while solving for the percent increase in side length. Choice D is incorrect because 150% represents the percent that the side length of the cube with a volume of 27 is of the side length of the cube with a volume of 8, not how much *larger* the side length is comparatively.

QUESTION 26.

Choice C is correct. If at the end of each month an account increased by 10% more than \$100, then the account would increase by $\$100(1.10) = \110 each month. Increasing by \$110 each month represents linear growth, not exponential growth.

Choices A, B, and D are incorrect because all three answers describe an account that increases by a fixed percent each month, thus representing exponential growth.

QUESTION 27.

Choice C is correct. The slope of each line, h , is equivalent to m in the equation

$m = \frac{y_2 - y_1}{x_2 - x_1}$. Substituting h for m and the points $(5, 24)$ and $(15, h^2)$ into the equation

$m = \frac{y_2 - y_1}{x_2 - x_1}$ yields $h = \frac{(h^2) - (24)}{(15) - (5)}$. Simplifying gives $h = \frac{h^2 - 24}{10}$ and multiplying

both sides by 10 yields $10h = h^2 - 24$. Subtracting $10h$ from both sides yields $0 = h^2 - 10h - 24$ and factoring the right-hand side gives $0 = (h - 12)(h + 2)$, which reveals the roots of 12 and -2 . Therefore, the sum of the roots is $12 + (-2) = 10$.

Choices A, B, and D are incorrect and may result from miscalculating the signs of one or both of the roots.

QUESTION 28.

Choice A is correct. Substituting $3c$ for a in the equation $a = 2b + 3$ yields $3c = 2b + 3$

and dividing each side of the equation by 3 yields $c = \frac{2}{3}b + 1$. Then, substituting $\frac{2}{3}b + 1$

for c in the equation $4c = 5d + 6$ yields $4(\frac{2}{3}b + 1) = 5d + 6$. Distributing the 4 on the left-

hand side yields $\frac{8}{3}b + 4 = 5d + 6$ and subtracting 6 from both sides gives

$\frac{8}{3}b - 2 = 5d$. Dividing both sides of the equation by 5 reveals that $d = \frac{8}{15}b - \frac{2}{5}$, or

$d = \frac{8b - 6}{15}$.

Choices B, C, and D are incorrect and may result from substitution and/or calculation errors while attempting to solve for d .

QUESTION 29.

Choice D is correct. The decay of a radioactive isotope can be represented by an

exponential decay model of the form $y = I(r)^{\frac{t}{a}}$, where y represents the mass of an isotope after t years have passed, with an initial mass of I , a decay factor of r , and a time of a years that it takes the isotope to complete one cycle of the decay factor. Substituting

202 for y , 20 for t , $\frac{1}{2}$ for r , and 40 for a yields $202 = I(\frac{1}{2})^{\frac{20}{40}}$. Raising $\frac{1}{2}$

to the power of $\frac{1}{2}$, or taking the square root of $\frac{1}{2}$, on the left hand side of the equation yields $202 = I\sqrt{\frac{1}{2}}$. Since $\sqrt{\frac{1}{2}}$ can be rewritten as $\frac{\sqrt{2}}{2}$, the equation $202 = I\sqrt{\frac{1}{2}}$ can be rewritten as $202 = \frac{\sqrt{2}I}{2}$. Multiplying both sides of the equation by $\sqrt{2}$ yields $I = 202\sqrt{2}$.

Choices A, B, and C are incorrect and may result from an error in setting up the appropriate exponential decay equation involving I . For example, choice A is incorrect because I and 202 were incorrectly swapped when their substitution took place.

QUESTION 30.

Choice D is correct. In a group of 250 men and women, if there are 50 more women than men, one can use x for men and $x + 50$ for women to develop the equation $x + x + 50 = 250$ which simplifies to $2x + 50 = 250$. Subtracting 50 from both sides of the equation yields $2x = 200$ and dividing by 2 makes $x = 100$. Therefore, there are 100 men and 150 women. Similarly, if there are 100 fewer doctors than lawyers, one can use x for lawyers and $x - 100$ for doctors to develop the equation $x + x - 100 = 250$ which simplifies to $2x - 100 = 250$. Adding 100 to both sides of the equation yields $2x = 350$ and dividing by 2 makes $x = 175$. Therefore, there are 175 lawyers and 75 doctors. If there are 30 male doctors, the remaining 45 doctors must be female. If there are a total of 150 women and 45 of them are doctors, the remaining 105 women are lawyers. If a woman is to be selected at random, the probability of selecting a lawyer is $\frac{105}{150}$, or $\frac{7}{10}$.

Choice A is incorrect because $\frac{3}{10}$ is the probability of selecting a doctor if a woman is to be selected at random. Choice B is incorrect because $\frac{2}{5}$ is the probability of selecting a man if a lawyer is selected at random. Choice C is incorrect because $\frac{3}{5}$ is the probability of selecting a woman if a lawyer is selected at random.

QUESTION 31.

The correct answer is 7. Adding $-x^2 + 22$ to $2x^2 + 7x - 52$ makes $g(x)$ equivalent to $x^2 + 7x - 30$. Factoring the right-hand side of the function $g(x) = x^2 + 7x - 30$ yields $g(x) = (x + 10)(x - 3)$. This form shows that the roots of the function $g(x)$ are -10 and 3 . Therefore, the absolute value of the sum the roots is equivalent to $|-10 + 3| = 7$.

QUESTION 32.

The correct answer is 5, 10, or 15. Jefferson could have the following sets of bills in his wallet to sum to a total of \$30:

1-\$10 bill,	1-\$5 bill,	and 15-\$1 bills.
1-\$10 bill,	2-\$5 bills,	and 10-\$1 bills.
1-\$10 bill,	3-\$5 bills,	and 5-\$1 bills.
2-\$10 bills,	1-\$5 bill,	and 5-\$1 bills.

Any other configuration of \$10, \$5, and \$1 bills that summed to \$30 would not have at least one of each bill. Therefore, the only possible number of \$1 bills Jefferson could have in his wallet would be 5, 10, or 15 one-dollar bills.

QUESTION 33.

The correct answer is 1.75 or $\frac{7}{4}$. If the area of circle O is 16π , setting 16π equal to πr^2 yields $\pi r^2 = 16\pi$. Dividing both sides by π yields $r^2 = 16$ and taking the square root of both sides of the equation reveals that the radius is 4. Given that the length of an arc is equivalent to the radius of the circle multiplied by the measure of the arc's central angle in radians, one can say that $7 = 4(\theta)$, where θ is the measure of the central angle that defines the arc in radians. Dividing both sides of the equation by 4 yields $\theta = \frac{7}{4}$, or 1.75 radians.

QUESTION 34.

The correct answer is 8. Solving the inequality $y \geq \frac{13}{2}x + 20$ as an equality,

$y = \frac{13}{2}x + 20$, for x , yields $y - 20 = \frac{13}{2}x$ and after multiplying both sides of the equation

by $\frac{2}{13}$ the equation reveals x as $x = \frac{2}{13}(y - 20)$. Distributing $\frac{2}{13}$ and combining like

terms yields $x = \frac{2y - 40}{13}$. Substituting $\frac{2y - 40}{13}$ for x in the inequality $x > -2$ yields

$\frac{2y - 40}{13} > -2$. Multiplying both sides of the inequality by 13 yields $2y - 40 > -26$ and

adding 40 to both sides gives $2y > 14$. Finally, dividing both sides by 2 yields $y > 7$. Therefore, the least integer value of y that satisfies the system of inequalities is 8.

QUESTION 35.

The correct answer is 86. If the sum of 8 different integers is 124 and at least three of them are greater than 10, the greatest possible value for one of the integers can be found by minimizing the other 7 integers. Since 5 of the integers are at most 10, the least possible values for these 5 integers would be 1, 2, 3, 4, and 5. Further, since the other two integers must be greater than 10, the least possible values for these two integers would be 11 and 12. Using x to represent the value of the largest possible integer in the set of 8 numbers yields the equation $1 + 2 + 3 + 4 + 5 + 11 + 12 + x = 124$. Simplifying yields $38 + x = 124$, or $x = 86$.

QUESTION 36.

The correct answers are 64 or 128. If the function has only one root at the point $(-4, 0)$, the only factor of the function is $x + 4$. In order to create the function, the only factor $x + 4$ must be squared to create $(x + 4)^2 = x^2 + 8x + 16$. Therefore, if $x^2 + 8x + 16$ is equivalent to the function $x^2 + abx + bc$, one can see that ab is equivalent to 8 and bc is equivalent to 16. The following set of values for a , b , and c satisfy both conditions:

- | | | | |
|----|---------|---------|----------|
| 1. | $a = 1$ | $b = 8$ | $c = 2$ |
| 2. | $a = 2$ | $b = 4$ | $c = 4$ |
| 3. | $a = 4$ | $b = 2$ | $c = 8$ |
| 4. | $a = 8$ | $b = 1$ | $c = 16$ |

Since the question states that $b < a < c$, then cases 3 and 4 are the only two combinations of a , b , and c that work. Therefore, $(4)(2)(8) = 64$ or $(8)(1)(16) = 128$.

QUESTION 37.

The correct answer is 76.5. If one newton of force is equivalent to approximately 0.225 pounds of force, then dividing 200 pounds by 0.225 pounds would yield the man's weight as approximately equivalent to 888.89 newtons. Substituting 888.89 for w and 9.8 (the gravitational acceleration on Earth) for g in the equation $w = mg$ yields $(888.89) = m(9.8)$. Dividing both sides of the equation by 9.8 reveals the man's mass, $m \approx 90.7$ kilograms. Substituting 90.7 for m and 3.75 (the gravitational acceleration on Mars) for g in the equation $w = mg$ yields $w = (90.7)(3.75)$, or $w = 340.125$ newtons. Multiplying 340.125 by 0.225 reveals the man's weight on Mars, $340.125 \times 0.225 \approx 76.5$ pounds.

Alternatively, since the man's mass of approximately 90.7 kilograms never changes, then the man's weight in pounds is directly proportional to the gravitational acceleration of the planet on which his weight is being calculated. So, weight in pounds on Earth divided

by $9.8 \frac{m}{s^2}$ is equivalent to weight in pounds on Mars divided by $3.75 \frac{m}{s^2}$. Cross-multiplying in the proportion $\frac{200}{9.8} = \frac{x}{3.75}$ yields $200(3.75) = 9.8x$. Dividing both sides by 9.8 yields $x = \frac{200(3.75)}{9.8} \approx 76.5$ pounds.

QUESTION 38.

The correct answer is 13. Since the scale on the mysterious planet reads 1,000 pounds, or 5 times his current weight on Earth of 200 pounds, then the gravitational acceleration on the planet would have to be 5 times the gravitational acceleration on Earth due to the fact that the man's mass, $m \approx 90.7$ kilograms as calculated in the answer explanation for Question 37, never changes. Therefore, the gravitational acceleration on the mysterious planet would be $5 \times 9.8 = 49 \frac{m}{s^2}$. Dividing 49 by 3.75 yields approximately 13.067. Therefore, the gravitational acceleration on the mysterious planet is approximately 13 times the gravitational acceleration of $3.75 \frac{m}{s^2}$ on Mars.

TEST 5



Math Test - No Calculator

25 MINUTES, 20 QUESTIONS

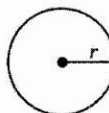
DIRECTIONS

For each question from 1-15, choose the best answer choice provided in the multiple choice bank and fill in the appropriate circle in the provided answer key. Alternatively, for questions 16-20, answer the problem and enter your answer in the grid-in section of the answer key. Refer to the directions given before question 16 as to how to enter your answers for the grid-in questions. You may complete scratch work in any empty space in your test booklet.

NOTES

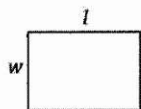
- A. Calculator usage is **not allowed** in this section.
- B. Variables, constants, and coefficients used represent real numbers unless indicated otherwise.
- C. All figures are created to appropriate scale unless the question states otherwise.
- D. All figures are two-dimensional unless the question states otherwise.
- E. The domain of any given function is all real numbers x for which the function, $f(x)$, is a real number unless the question states otherwise.

REFERENCE

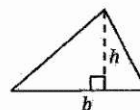


$$A = \pi r^2$$

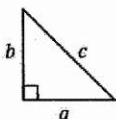
$$C = 2\pi r$$



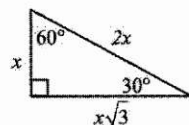
$$A = lw$$



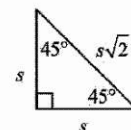
$$A = \frac{1}{2}bh$$



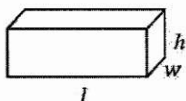
$$c^2 = a^2 + b^2$$



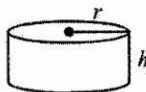
Special
Right
Triangle



Special
Right
Triangle



$$V = lwh$$



$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

There are 360° in a circle.
There are 2π radians in a circle.
There are 180° in a triangle.



1

$$103 = 8x + 9$$

Given the equation above, what is the value of $4x + 4$?

- A) 12
- B) 51
- C) 52
- D) 102

2

The coordinate point $(1, -1)$ is a solution to which of the following systems of linear inequalities?

- A) $x + y \geq 0$
 $x - y \leq 0$
- B) $x - y \geq 0$
 $x + y \leq 0$
- C) $2x + 3y < 0$
 $3x + 4y > 0$
- D) $-x - 2y < 0$
 $-x + 4y > 0$

3

Line r is perpendicular to line s in the xy -plane. If line r goes through the points $(-10, 0)$ and $(0, 5)$ and line s goes through the origin, at what value of x do the two lines intersect?

- A) -2
- B) -1
- C) 2
- D) 4

4

$$\sqrt{g + 3} = x$$

If $g = 3x + 1$ and x must be greater than 1, what is the value of x ?

- A) 1
- B) 3
- C) 8
- D) 9



5

A kindergarten teacher's supply of crayons during the school year follows the linear model $N = 450 - 3c$, where N is the remaining supply of crayons and c is the number of classes that have passed. What does the value -3 most likely represent in this equation?

- A) The number of crayons that the teacher distributes for use during class each day
- B) The number of crayons that the teacher distributes for use to each student each day
- C) The number of crayons that are used up or lost by each student each day of class
- D) The number of crayons that are used up or lost by the entire class each day

6

Which of the following expressions is equivalent to the expression $4x^2 - 35$?

- A) $(2x + 6)(2x - 6) + 1$
- B) $(2x + 6)(2x - 6) - 1$
- C) $(2x + 3)(2x - 3) + 26$
- D) $(2x + 3)(2x - 3) - 16$

7

The measure of the length of an arc in degrees can be calculated using the expression $\frac{\theta\pi d}{360}$, where θ is the measure of the central angle that defines the arc in degrees and d is the diameter of the circle. What is the smallest integer diameter that a circle can have if the measure of the arc is π inches and $\theta < 120^\circ$?

- A) 2
- B) 3
- C) 4
- D) 6

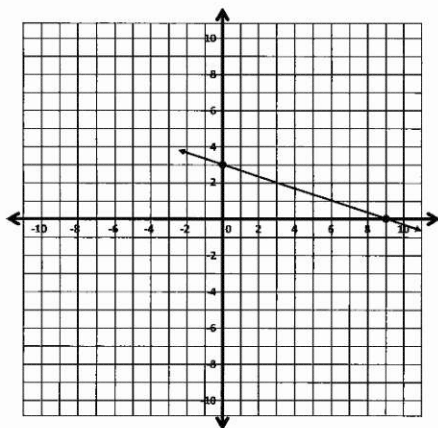
8

If $a^{x^2} \cdot a^{4x} \cdot a^4 = a^9$, $a > 0$, and $x > 0$, what is the value of x ?

- A) -5
- B) 1
- C) 3
- D) 7



9



Line h is parallel to the line graphed in the xy -plane above.

If line h goes through the point $(0, -\frac{4}{3})$, what is the x -value of the x -intercept of line h ?

- A) -4
- B) -3
- C) $-\frac{9}{4}$
- D) $\frac{3}{4}$

10

Which of the following equations has a graph in the xy -plane where y is always less than or equal to 6?

- A) $y = x^2 + 6$
- B) $y = -x^2 + 36$
- C) $y = |x - 6|$
- D) $y = -|x| + 6$

11

A fallen tree branch in the woods has an initial mass of 125 kilograms and decays by 15% of its mass every year. Which of the following equations gives the current mass, M , of the fallen tree branch after x years have passed?

- A) $M = .85(125)^x$
- B) $M = .15(125)^x$
- C) $M = 125(.85)^x$
- D) $M = 125(.15)^x$

12

The function $f(t) = t^2 - 8t + 4$ crosses the x -axis twice at the coordinate points $(x_1, 0)$ and $(x_2, 0)$. What is the absolute distance between x_1 and x_2 ?

- A) $8 + 4\sqrt{3}$
- B) $8\sqrt{3}$
- C) 8
- D) $4\sqrt{3}$



13

$$\frac{5-2i}{5+3i}$$

If the expression above is written in the form $a+bi$ where $i=\sqrt{-1}$, which of the following is the value of a ?

- A) $-\frac{25}{34}$
 B) $-\frac{2}{3}$
 C) $\frac{19}{34}$
 D) 1

14

The equation $y = -\frac{x}{m} + b_2$ is the equation of a line that is perpendicular to the line with an equation of the form $y = mx + b_1$. Which of the following equations gives m in terms of y , x , and b_2 ?

- A) $m = \frac{x}{b_2 - y}$
 B) $m = \frac{x}{y - b_2}$
 C) $m = \frac{b_2 - y}{x}$
 D) $m = \frac{y - b_2}{x}$

15

If x does not equal $-\frac{1}{2}$, what is the average of the

expressions $\frac{8x+1}{2x+1}$ and $4 + \frac{3}{2x+1}$?

- A) 4
 B) $4 + \frac{1}{2x+1}$
 C) $4 + \frac{3}{2x+1}$
 D) 8


DIRECTIONS

For each question from 16-20, solve and enter your answer in the grid-in section of your answer sheet as described below.

- A. Write out your answers in the boxes at the top of each column in order to help you fill in the circles accurately. Remember, you will only receive credit for the circles that are filled in correctly, not for the written answer at the top of the columns.
- B. Mark only a single circle in each column.
- C. There are no negative answers.
- D. If the problem has more than one correct answer, grid only one of the correct answers.
- E. When your answer is a **mixed number**, such as $1\frac{1}{2}$, it should be entered as 1.5 or $3/2$. You cannot enter a mixed number because there is no room to fill in a circle that represents a space.
- F. If you enter a **decimal answer** with more digits than the grid can handle, the answer may be rounded or truncated, but it absolutely must fill the entire grid.

Answer: 102 - both positions are correct

REMEMBER:
You can begin writing your answers in any column as long as there is enough space. Leave unused columns blank.

	1	0	2	
	7	7		
	0	0	0	
1	1	1	1	
2	2	2	2	
3	3	3	3	

	1	0	2	
	7	7		
	0	0	0	
1	1	1	1	
2	2	2	2	
3	3	3	3	

Answer: $\frac{8}{21}$

Written answer →

8	/	2	1
7		7	
0		0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Decimal point →

← Fraction line

Answer: 6.4

	6	.	4
	7	7	
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

The ways to correctly grid $\frac{7}{9}$ are:

	7	/	9
	7		
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

.	7	7	7
	7		
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

.	7	7	8
	7		
	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9



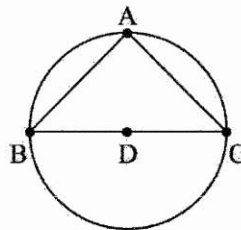
16

An isosceles right triangle has a hypotenuse that measures $50\sqrt{2}$. If a similar triangle has a longest side length of $5\sqrt{8}$, what is the sum of its shorter two sides?

17

Mr. Waterman has \$5, \$10, and \$25 gift certificates to a local ice cream parlor. He would like to give each of his nephews and nieces \$55 worth of gift certificates to the ice cream parlor. If he wants to make sure that each nephew and niece receives at least one of each type of gift certificate, what is the difference between the maximum number of \$5 gift certificates and minimum number of \$5 gift certificates that each child could receive?

18



In the circle above, the measure of \overline{AB} is equivalent to $5\sqrt{2}$ and the measure of \overline{BC} is equivalent to 10. If the measure of $\angle ACB$ in radians is given by the expression $H\pi$, what is the value of H ?

19

$$A^2x + 10y = 75$$

$$Ax + 2y = 15$$

For what positive value of A does the system of equations above have infinitely many solutions?

3**3****20**

$$(2a + B)^2 = Ma^2 + 8a + Q$$

If the equation above is true for all values of a and if B , M , and Q are all positive constants, what is the value of the product BMQ ?

STOP

If you finish before time is called, you may check your work on this section only.

Do not turn to any other section.

371



Math Test - Calculator

55 MINUTES, 38 QUESTIONS

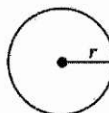
DIRECTIONS

For each question from 1-30, choose the best answer choice provided in the multiple choice bank and fill in the appropriate circle in the provided answer key. Alternatively, for questions 31-38, answer the problem and enter your answer in the grid-in section of the answer key. Refer to the directions given before question 31 as to how to enter your answers for the grid-in questions. You may complete scratch work in any empty space in your test booklet.

NOTES

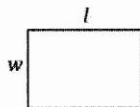
- A. Calculator usage is allowed.
- B. Variables, constants, and coefficients used represent real numbers unless indicated otherwise.
- C. All figures are created to appropriate scale unless the question states otherwise.
- D. All figures are two-dimensional unless the question states otherwise.
- E. The domain of any given function is all real numbers x for which the function, $f(x)$, is a real number unless the question states otherwise.

REFERENCE

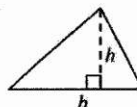


$$A = \pi r^2$$

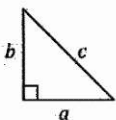
$$C = 2\pi r$$



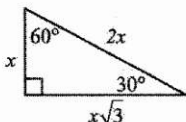
$$A = lw$$



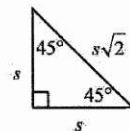
$$A = \frac{1}{2}bh$$



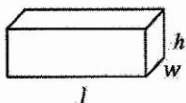
$$c^2 = a^2 + b^2$$



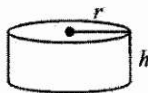
Special
Right
Triangle



Special
Right
Triangle



$$V = lwh$$



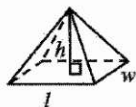
$$V = \pi r^2 h$$



$$V = \frac{4}{3}\pi r^3$$



$$V = \frac{1}{3}\pi r^2 h$$



$$V = \frac{1}{3}lwh$$

There are 360° in a circle.
There are 2π radians in a circle.
There are 180° in a triangle.

4



4

1

A cell phone vendor at a trade show makes \$15 for every accessory that he sells and has to pay \$35 per hour to rent the table at the trade show. If the vendor sells a accessories and rents the table for h hours, which of the following expressions is equivalent to the vendor's profit in dollars?

- A) $15a - 35h$
- B) $15a + 35h$
- C) $35a - 15h$
- D) $35a + 15h$

2

Janelle always gives away 24% of her jelly beans to friends at her lunch table. If Janelle has a bag with 75 jelly beans, how many will she eat?

- A) 18
- B) 24
- C) 51
- D) 57

3

Which of the following quadratic equations has the same x -intercepts as the equation $y = 2(x + 2)(x - 3)$?

- A) $y = x^2 + x - 6$
- B) $y = -x^2 + x + 6$
- C) $y = 2x^2 - 10x - 12$
- D) $y = 4x^2 + 20x + 24$

4

12 times a number is equivalent to 30 more than 6 times the number. What is the value of 30 less than 6 times the number?

- A) 0
- B) 15
- C) 30
- D) 45



Questions 5 and 6 refer to the following information.

The percentage of the night's profits that a restaurant owner pays out to his employees on any given night is inversely proportional to the number of patrons that visit the restaurant on that night. On a night when 50 people ate dinner at the restaurant, the owner paid out 80% of the profits to the employees. On a night when 125 people ate dinner at the restaurant, the owner paid out 32% of the profits to his employees.

5

What percentage of the night's profit would the restaurant owner pay out to his employees on a night when 250 patrons visited the restaurant?

- A) 4
- B) 8
- C) 10
- D) 16

6

One night the restaurant is charging every customer a \$10 door charge to enter for an all you can eat buffet. If 160 customers eat at the buffet and the owner has 5 employees working that night, how much money, in dollars, will each employee take home?

- A) 80
- B) 320
- C) 400
- D) 1600

7

The amount of remaining gas, G , in a car's gas tank can be calculated using the equation $G = 13 - \frac{1}{21}m$, where m represents the number of miles driven since the last time the gas tank was filled. If the gas tank has 11 gallons of gas remaining, how many miles has the car driven since its most recent fill-up?

- A) 2
- B) 11
- C) 21
- D) 42

8

Arielle has been collecting figurines since she was a child. Every year she receives one figurine from her parents and one from her grandmother on both her birthday and again during the holiday season. If Arielle currently has 56 figurines and had f figurines collected before she started receiving them as presents from her parents and grandmother 6 years ago, what is the value of f ?

- A) 32
- B) 44
- C) 50
- D) 52



9

Nadia is selling hardcover books for \$2 each and paperback books for \$1 each at a garage sale. Nadia would like to sell at least 40 books to make at least \$60. Using h for the number of hardcover books and p for the number of paperback books, which of the following systems of linear inequalities accurately represents the number of book sales and the amount of money that Nadia would like to make?

- A) $h + p \geq 60$
 $2h + p \geq 40$
- B) $h + p \geq 40$
 $2h + p \geq 60$
- C) $h + p \geq 60$
 $h + 2p \geq 40$
- D) $h + p \geq 40$
 $h + 2p \geq 60$

10

A random sample of 85 adults leaving a local Mexican restaurant were asked to answer a quick one-question survey without giving their names. The survey revealed that 82% of the participants preferred to eat out on a regular basis as opposed to eating at home. The results of this survey are unreliable for gauging the dining preferences of adults in the population mainly due to which of the following?

- A) Insufficient sample size
- B) Inappropriate sample collection methods
- C) Biased sampling location
- D) All of the above

11

A ball is tossed upward from the ground and its height, $h(x)$, after x seconds have passed is given by the equation $h(x) = -4x^2 + 24x$. Which of the following inequalities represents all of the times, x , when the height of the ball, $h(x)$, is above 20 feet?

- A) $20 \geq -4x^2 + 24x$
- B) $20 \leq -4x^2 + 24x$
- C) $0 > -4x^2 + 24x - 20$
- D) $0 < -4x^2 + 24x - 20$

12

If $t(8) = 9$, $s(7) = 2t(8)$, and $r(x) = \sqrt{2x}$, what is the positive value of $r(s(7))$?

- A) 3
- B) 6
- C) 81
- D) 1,296



13

	Miles Driven	Hours Driven
Monday	248	4
Tuesday	120	2
Wednesday	240	6
Thursday	256	4
Friday	136	4

The table above shows the number of miles driven and the number of hours that Mike spent on the road in the first week of his job. Which of the following is Mike's average speed, in miles per hour, for the week?

- A) 40
- B) 48
- C) 50
- D) 56

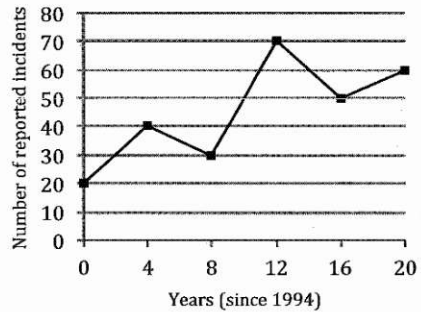
14

On average, Mrs. Teetertotter can grade 8 tests in an hour. If Mrs. Teetertotter gives 24 tests a year and has approximately 16 students in each of her 4 classes, how many full 24-hour days does Mrs. Teetertotter spend grading tests?

- A) 4
- B) 8
- C) 192
- D) 1,536

15

Number of Reported Incidents of Bullying



During which 4-year period did the greatest change in reported incidents of bullying take place?

- A) 1994-1998
- B) 2002-2006
- C) 2006-2010
- D) 2010-2014

16

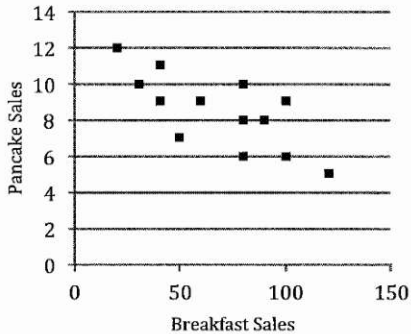
Jessica's pottery class is 25% larger than Michelle's pottery class. Lauren's pottery class is 50% smaller than Michelle's pottery class. Jessica's pottery class is what percent larger than Lauren's pottery class?

- A) 75
- B) 150
- C) 250
- D) 300



17

Breakfast Sales and Pancake Sales



A local diner kept track of the total number of breakfast meals sold and the number of those meals that were pancake breakfasts on 13 separate days. If one of the days that the restaurant had 50 or more breakfast sales is chosen at random, what is the probability that there were more than 6 pancake meals sold?

- A) $\frac{6}{13}$
 B) $\frac{8}{13}$
 C) $\frac{2}{3}$
 D) $\frac{8}{9}$

18

A cereal manufacturer wants to keep the weight of its cereal boxes to 9.5 ounces at a minimum and 12.5 ounces at a maximum. Which of the following equations defines x , the weight of an acceptable cereal box?

- A) $|x-11| \leq 1.5$
 B) $|x-1.5| \leq 11$
 C) $|x-12.5| \leq 3$
 D) $|x+9.5| \leq 3$

Questions 19 and 20 refer to the following information.

	A	B	C	D	F
Freshman	8	8	3	1	0
Sophomore	10	6	3	1	0
Junior	13	2	4	1	0
Senior	6	12	1	0	1

In a recent survey, a group of 50 students from each grade level in a local high school were asked how many A's, B's, C's, D's, and F's they received among the 20 marking period grades they received for the year. The average responses for each grade level were recorded in the table above.

19

Which of the following is the average number of B's that could be expected in a single school year for all of the students in the high school?

- A) 1
 B) 3
 C) 7
 D) 9

20

If there are a total of 428 freshman in the high school, which of the following is the best estimate for the total number of grades lower than B to be expected from the entire freshman class?

- A) 30
 B) 110
 C) 1,700
 D) 6,400



21

Data collected from the guidance counseling department of Jefferson High School stated that the most popular number of colleges applied to by graduating seniors was 4, the median number of colleges applied to was 4.5, and the mean number of colleges applied to was 2.5. Which of the following could explain the difference between the median and the mean number of colleges applied to?

- A) Half of the students applied to 4 colleges or fewer.
- B) A large majority of the students applied to 2 or 3 colleges.
- C) A few students applied to more than 4 colleges.
- D) A few students applied to no colleges at all.

22

$$x^2 + 8x + y^2 = 20$$

What is the area of the circle, in units squared, defined by the equation above?

- A) 4π
- B) 16π
- C) 20π
- D) 36π

Questions 23 and 24 refer to the following information.

$$F = k \frac{Q_1 Q_2}{r^2}$$

Coulomb's Law states that the force, in newtons, between two charges Q_1 and Q_2 , measured in Coulombs, at a separation distance of r meters can be calculated using the equation above where k is a constant.

23

Which of the following represents the distance between the charges, r , in terms of the force between the two charges, the charges themselves, and the constant k ?

- A) $r = \sqrt{\frac{kQ_1 Q_2}{F}}$
- B) $r = \sqrt{\frac{FQ_1 Q_2}{k}}$
- C) $r = \sqrt{\frac{F}{kQ_1 Q_2}}$
- D) $r = k\left(\frac{Q_1 Q_2}{F}\right)^2$

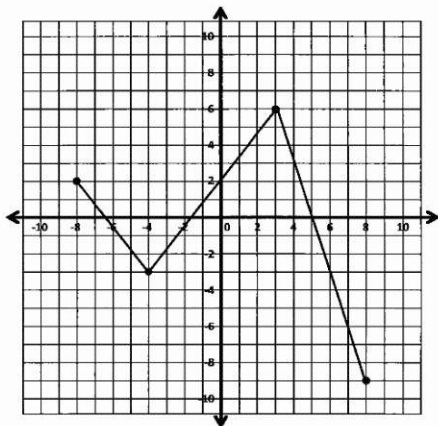
24

If the distance between the two charges is doubled, the force between the two charges will decrease by what percent?

- A) 25
- B) 50
- C) 75
- D) 100



25



The entire function $g(x)$ is shown in the graph above. For how many values of x is $g(x)$ equivalent to $g(-8)$?

- A) 0
- B) 1
- C) 2
- D) 3

26

The line with the equation $y = 2x + 2$ and the line with the equation $y = 6$ intersect at the point A . The line defined by the equation $y = -x - 1$ intersects the line $y = \frac{1}{2}x - 4$ at the point B . Which of the following best defines the slope of the line that intersects point A and point B ?

- A) It equals 0.
- B) It is undefined.
- C) It is positive.
- D) It is negative.

27

$$y = 2b + 1$$

$$y = x^3 + 8b$$

The system of equations above has one negative integer value for x that satisfies the system when b is equivalent to which of the following?

- A) 1
- B) $\frac{9}{2}$
- C) $\frac{14}{3}$
- D) 5

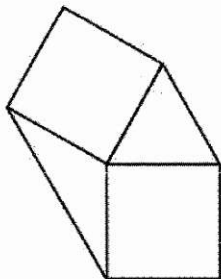
28

Two hundred forty kilograms of organic matter decay following the exponential decay model $R = 240(0.5)^x$, where R is the mass of the remaining organic matter in kilograms and x is the number of years that have passed. One hundred fifty-five kilograms of inorganic matter decay in a linear fashion following the model $R = -35x + 155$, where R is the mass of the remaining inorganic matter in kilograms and x is the number of years that have passed. For how many years is the mass of the organic matter lower than the mass of the inorganic matter?

- A) 2
- B) 3
- C) 4
- D) 5



29



The figure above contains two squares of equal size, an equilateral triangle, and an isosceles triangle. If the area of the equilateral triangle is $13\sqrt{3}$ and the area of the isosceles triangle is $A\sqrt{3}$, what is the value of A ?

- A) $\frac{13}{2}$
- B) 13
- C) 26
- D) 52

30

The equation of a line that goes through two non-adjacent vertices of a square is $y = -3x + 2$. Line r passes through the point $(3, 5)$ and is parallel to the line that goes through the other non-adjacent vertices of the square. If the y -intercept of line r is $(0, b)$, what is the value of b ?

- A) 4
- B) 8
- C) 10
- D) 14



31

A beekeeper estimates that a population of bees will double every year for the foreseeable future. If the initial population of bees is 31,250 bees, how many years will pass before the population reaches one million bees?

32

A ladder measures exactly 12 feet 6 inches in length. If 1 inch is equivalent to 2.54 centimeters, what is the length of the ladder in centimeters?

33

$$C(x) = 125 + 50mh$$

A painting company uses the linear model above to calculate $C(x)$, the total estimated price of a job that requires m men to paint for h hours. If a job were to last 8 hours, what would be the client's estimated cost per additional man in dollars?

34

Angel and Sebastian logged a total of 136 hours combined at a woodworking residency in New Hampshire. If Sebastian logged 204 hours less than four times the number of hours that Angel logged, how many additional hours had Angel logged over Sebastian?



35

$$y = ax^2 + 2ax + c$$

If the quadratic equation above contains the point $(-3, a)$

and $c = -\frac{1}{4}$, what is the value of a ?

36

The points R and S lie on circle O . If the length of RS is 4π and the area of circle O is 64π , what is the area of $\triangle RSO$?



Questions 37-38 refer to the following information.

3, 9, 21, 33, ...

The sequence given above is defined by the equation $A_n = d(1 + n(n-1))$, where A_n is the value of the n th term of the sequence, d is a positive constant, and n is the number of the term in the sequence.

37

What value of the constant d makes the equation produce the given sequence?

38

The k th term of the sequence has a value of 1659. What is the value of k ?

STOP

If you finish before time is called, you may check your work on this section only.
Do not turn to any other section.

Answer Key: TEST 5

SAT

SECTION 1—READING

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. D | 11. C | 22. C | 32. C | 42. A |
| 2. B | 12. C | 23. B | 33. A | 43. C |
| 3. B | 13. A | 24. A | 34. C | 44. B |
| 4. C | 14. D | 25. D | 35. B | 45. C |
| 5. A | 15. D | 26. C | 36. A | 46. A |
| 6. A | 16. B | 27. B | 37. D | 47. D |
| 7. C | 17. B | 28. D | 38. B | 48. D |
| 8. C | 18. A | 29. D | 39. A | 49. B |
| 9. B | 19. D | 30. C | 40. D | 50. A |
| 10. C | 20. A | 31. B | 41. A | 51. A |
| | 21. B | | | 52. C |

SECTION 2—WRITING

- | | | | |
|-------|-------|-------|-------|
| 1. B | 12. C | 23. C | 34. C |
| 2. A | 13. B | 24. B | 35. D |
| 3. D | 14. A | 25. B | 36. B |
| 4. A | 15. B | 26. A | 37. B |
| 5. A | 16. D | 27. C | 38. A |
| 6. B | 17. A | 28. D | 39. C |
| 7. D | 18. D | 29. D | 40. A |
| 8. C | 19. C | 30. A | 41. C |
| 9. D | 20. B | 31. D | 42. A |
| 10. A | 21. D | 32. A | 43. D |
| 11. D | 22. B | 33. B | 44. A |

SECTION 3—MATH

- | | |
|-------|--------------------------|
| 1. B | 12. D |
| 2. B | 13. C |
| 3. A | 14. A |
| 4. C | 15. A |
| 5. D | |
| 6. A | Fill-Ins: |
| 7. C | 16. 20 |
| 8. B | 17. 2 |
| 9. A | 18. $\frac{1}{4}$ or .25 |
| 10. D | 19. 5 |
| 11. C | 20. 32 |

SECTION 4—MATH

- | | | | |
|-------|-------|-------|---------------------------|
| 1. A | 13. C | 24. C | Fill-Ins: |
| 2. D | 14. B | 25. D | 31. 5 |
| 3. B | 15. B | 26. B | 32. 381 |
| 4. A | 16. B | 27. C | 33. 400 |
| 5. D | 17. C | 28. B | 34. 0 |
| 6. A | 18. A | 29. B | 35. $\frac{1}{8}$ or .125 |
| 7. D | 19. C | 30. A | 36. 32 |
| 8. A | 20. C | | 37. 3 |
| 9. B | 21. D | | 38. 24 |
| 10. C | 22. D | | |
| 11. D | 23. A | | |
| 12. B | | | |

Faint, illegible text at the top of the page, likely bleed-through from the reverse side.

TEST 5

Faint, illegible text in the middle section of the page, likely bleed-through from the reverse side.

Faint, illegible text in the lower middle section of the page, likely bleed-through from the reverse side.

Faint, illegible text in the lower section of the page, likely bleed-through from the reverse side.

Answer Key: TEST 5

SAT

SECTION 1—READING

- | | | | | |
|-------|-------|-------|-------|-------|
| 1. D | 11. C | 22. C | 32. C | 42. A |
| 2. B | 12. C | 23. B | 33. A | 43. C |
| 3. B | 13. A | 24. A | 34. C | 44. B |
| 4. C | 14. D | 25. D | 35. B | 45. C |
| 5. A | 15. D | 26. C | 36. A | 46. A |
| 6. A | 16. B | 27. B | 37. D | 47. D |
| 7. C | 17. B | 28. D | 38. B | 48. D |
| 8. C | 18. A | 29. D | 39. A | 49. B |
| 9. B | 19. D | 30. C | 40. D | 50. A |
| 10. C | 20. A | 31. B | 41. A | 51. A |
| | 21. B | | | 52. C |

SECTION 2—WRITING

- | | | | |
|-------|-------|-------|-------|
| 1. B | 12. C | 23. C | 34. C |
| 2. A | 13. B | 24. B | 35. D |
| 3. D | 14. A | 25. B | 36. B |
| 4. A | 15. B | 26. A | 37. B |
| 5. A | 16. D | 27. C | 38. A |
| 6. B | 17. A | 28. D | 39. C |
| 7. D | 18. D | 29. D | 40. A |
| 8. C | 19. C | 30. A | 41. C |
| 9. D | 20. B | 31. D | 42. A |
| 10. A | 21. D | 32. A | 43. D |
| 11. D | 22. B | 33. B | 44. A |

SECTION 3—MATH

- | | |
|-------|--------------------------|
| 1. B | 12. D |
| 2. B | 13. C |
| 3. A | 14. A |
| 4. C | 15. A |
| 5. D | |
| 6. A | Fill-Ins: |
| 7. C | 16. 20 |
| 8. B | 17. 2 |
| 9. A | 18. $\frac{1}{4}$ or .25 |
| 10. D | 19. 5 |
| 11. C | 20. 32 |

SECTION 4—MATH

- | | | | |
|-------|-------|-------|---------------------------|
| 1. A | 13. C | 24. C | Fill-Ins: |
| 2. D | 14. B | 25. D | 31. 5 |
| 3. B | 15. B | 26. B | 32. 381 |
| 4. A | 16. B | 27. C | 33. 400 |
| 5. D | 17. C | 28. B | 34. 0 |
| 6. A | 18. A | 29. B | 35. $\frac{1}{8}$ or .125 |
| 7. D | 19. C | 30. A | 36. 32 |
| 8. A | 20. C | | 37. 3 |
| 9. B | 21. D | | 38. 24 |
| 10. C | 22. D | | |
| 11. D | 23. A | | |
| 12. B | | | |

Section 3: Math Test - No Calculator

QUESTION 1.

Choice B is correct. Subtracting 1 from both sides of the equation $103 = 8x + 9$ yields $102 = 8x + 8$. Dividing both sides by 2 yields $51 = 4x + 4$. Therefore, the expression $4x + 4$ is equivalent to 51.

Choice A is incorrect because 12 is the value of x , not $4x + 4$. Choices C and D are incorrect and may result from calculation errors from not completely solving for the target, $4x + 4$.

QUESTION 2.

Choice B is correct. Substituting the point $(1, -1)$ into the inequality $x - y \geq 0$ yields $(1) - (-1) \geq 0$, which simplifies to $2 \geq 0$, which is a true statement. Substituting $(1, -1)$ into the inequality $x + y \leq 0$ yields $(1) + (-1) \leq 0$, which simplifies to $0 \leq 0$, which is also a true statement. Therefore, the coordinate point $(1, -1)$ is a solution to the system of

linear inequalities
$$\begin{array}{l} x - y \geq 0 \\ x + y \leq 0 \end{array}$$

Choices A, C, and D are incorrect because the coordinate point $(1, -1)$ is a solution to either one or none of the inequalities each system, but not both.

QUESTION 3.

Choice A is correct. If line r goes through the points $(-10, 0)$ and $(0, 5)$, substituting into the slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$, yields $m = \frac{(5) - (0)}{(0) - (-10)} = \frac{5}{10} = \frac{1}{2}$. Therefore, if the slope of line r is $\frac{1}{2}$ and the y -intercept is 5, as defined by the point $(0, 5)$, then the equation of line r is $y = \frac{1}{2}x + 5$. Now, if line s is perpendicular to line r , then line s has an opposite reciprocal slope of -2 , and since line s intercepts the origin, the y -intercept is 0, making the equation of line s equivalent to $y = -2x$. Setting the equations of line r and line s equal to each other yields $\frac{1}{2}x + 5 = -2x$. Multiplying both sides by 2 yields $x + 10 = -4x$ and further subtracting x from each side yields $10 = -5x$. Therefore, after dividing both sides by -5 , $x = -2$.

Choices B and C are incorrect and may result from errors in calculating the appropriate equations for line r and line s , and/or substitution errors made once the equations have been identified. Choice D is incorrect because 4 is the y -value at the point where the two lines intersect, not the x -value.

QUESTION 4.

Choice C is correct. Substituting $3x+1$ for g in the equation $\sqrt{g}+3=x$ yields $\sqrt{3x+1}+3=x$. Subtracting 3 from both sides of the equation yields $\sqrt{3x+1}=x-3$. Squaring both sides yields $(\sqrt{3x+1})^2=(x-3)^2$, or $3x+1=x^2-6x+9$. Subtracting the expression $3x+1$ from both sides of the equation yields $0=x^2-9x+8$. Factoring the right-hand side of the equation gives $0=(x-8)(x-1)$ which reveals the roots at 8 and 1. Since x must be greater than 1, $x=8$.

Choice A is incorrect and may result from correctly solving the equation after $3x+1$ was substituted for g , but neglecting the fact that x must be greater than 1. Choices B and D are incorrect and may result from calculation and/or substitution errors.

QUESTION 5.

Choice D is correct. The equation $N=450-3c$ is a linear function of the form $y=b+mx$, where b is the y -intercept of the linear equation and m is the slope. Therefore, -3 is the slope, or rate of change of the remaining supply of crayons. Since -3 is being multiplied with c , which was defined in the question as the number of classes that have passed in a school year, a slope of -3 must imply that the overall stock of crayons is reduced by 3 for every class that passes. In other words, the entire class uses up or loses 3 crayons per class in total.

Choice A is incorrect because it is not clearly defined that the crayons distributed for use during class will not be returned at the end of each class. Choices B and C are incorrect because the answers imply that c is the number of students in class, where c is actually the number of classes that have passed.

QUESTION 6.

Choice A is correct. The expression $4x^2-35$ is equivalent to the expression $(4x^2-36)+1$. Factoring the difference of perfect squares $4x^2-36$ yields $(2x+6)(2x-6)$ and substituting back into the expression $(4x^2-36)+1$ yields $(2x+6)(2x-6)+1$.

Choice B is incorrect and may result from errors in manipulating the form of the initial expression $4x^2-35$. Choices C and D are incorrect and may result from errors in appropriately factoring the binomial in the expression after it has been modified.

QUESTION 7.

Choice C is correct. Setting the expression $\frac{\theta\pi d}{360}$ equivalent to a , the length of the arc, yields the equation $\frac{\theta\pi d}{360}=a$. Multiplying both sides by $\frac{360}{\theta\pi}$ yields $d=\frac{360a}{\theta\pi}$. Substituting π for a and 120 for θ yields $d=\frac{360\pi}{120\pi}=3$. However, since $\theta < 120^\circ$ and

since θ is in the denominator of the expression $\frac{360a}{\theta\pi}$, d must be greater than 3. The

smallest integer value that is greater than 3 is 4.

Choices A and B are incorrect because 2 and 3 are not greater than 3 and d must be strictly greater than 3. Choice D is incorrect because 4 and 5 are both smaller than 6, but strictly greater than 3.

QUESTION 8.

Choice B is correct. Exponent rules state that when multiplying powers, one must add the exponents. Therefore, the expression $a^x \cdot a^{4x} \cdot a^4$ simplifies to a^{x+4x+4} and substituting in the equation $a^x \cdot a^{4x} \cdot a^4 = a^9$ yields $a^{x+4x+4} = a^9$. Since the bases are the same, the exponents are equivalent, yielding the equation $x^2 + 4x + 4 = 9$. Subtracting 9 from both sides of the equation yields $x^2 + 4x - 5 = 0$. Factoring the left-hand side yields $(x+5)(x-1) = 0$. Therefore, the two values of x that are solutions to the equation are -5 and 1 . Since x must be greater than 0, the answer is 1.

Choice A is incorrect because the question states that x must be greater than 0 and -5 is not greater than 0. Choices C and D are incorrect because neither answer is a solution that makes the equation $a^x \cdot a^{4x} \cdot a^4 = a^9$ true.

QUESTION 9.

Choice A is correct. The line graphed in the xy -plane intercepts the points $(0, 3)$

and $(9, 0)$. Substituting these points into the slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$, yields

$m = \frac{(0) - (3)}{(9) - (0)} = -\frac{3}{9} = -\frac{1}{3}$. Therefore, the slope of line h is also $-\frac{1}{3}$ since line h is

parallel to the line graphed in the xy -plane. Given that the y -intercept of line h is $-\frac{4}{3}$,

as defined by the point $(0, -\frac{4}{3})$, the equation of line h in the form $y = mx + b$, is

$y = -\frac{1}{3}x - \frac{4}{3}$. In order to find the x -intercept of line h , one must substitute 0 for y which

yields $0 = -\frac{1}{3}x - \frac{4}{3}$. Adding $\frac{4}{3}$ to both sides of the equation yields $\frac{4}{3} = -\frac{1}{3}x$ and

multiplying both sides by -3 reveals the x -intercept, $x = -4$.

Choices B and C are incorrect and may result from calculation errors while developing the equation for line h . Choice D is incorrect because $\frac{3}{4}$ would be the x -intercept of line h if it were perpendicular to the line graphed in the xy -plane, not parallel to the line graphed in the xy -plane.

QUESTION 10.

Choice D is correct. An absolute value will always have a value of 0 or greater. Because of this, the expression $-|x|$ will always have a value of 0 or less. Therefore, the equation $y = -|x| + 6$ will have its maximum value of 6 when x is equal to 0 and the equation will be less than 6 for all other values of x .

Choices A, B, and C are incorrect because for all three equations there is a value of x that yields a y -value of greater than 6.

QUESTION 11.

Choice C is correct. Exponential growth and decay models are built off of the formula $y = a(1 \pm r)^x$, where a is the initial value and r is the growth or decay percentage in decimal form. Therefore, an initial mass of 125 kilograms would replace a in the formula and decaying by 15% would make r equivalent to $-.15$, making the equation $y = 125(1 - .15)^x$. Substituting M for y and simplifying yields $M = 125(.85)^x$.

Choice A is incorrect and may result from confusing the positions of the initial value and the decay factor in the formula of an exponential decay equation. Choice B is incorrect and may result from neglecting to subtract the decay rate from 1 and from confusing the positions of the initial value and the decay factor in the formula of an exponential decay equation. Choice D is incorrect and may result from neglecting to subtract the decay rate from 1.

QUESTION 12.

Choice D is correct. The quadratic equation $f(t) = t^2 - 8t + 4$ is written in standard

form where $a = 1$, $b = -8$, and $c = 4$. Substituting these values into the quadratic

formula, $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ yields $\frac{-(-8) \pm \sqrt{(-8)^2 - 4(1)(4)}}{2(1)}$, which simplifies to $\frac{8 \pm \sqrt{48}}{2}$.

Further simplifying of the radical yields $\frac{8 \pm 4\sqrt{3}}{2}$ and dividing by 2 yields $4 \pm 2\sqrt{3}$. The

absolute distance between $4 + 2\sqrt{3}$ and $4 - 2\sqrt{3}$ is equivalent to $|(4 + 2\sqrt{3}) - (4 - 2\sqrt{3})|$

which simplifies to $4\sqrt{3}$.

Choices A, B, and C are incorrect and may result from errors in applying the quadratic formula or errors in calculating the absolute distance between two radical points.

QUESTION 13.

Choice C is correct. Multiplying the expression $\frac{5-2i}{5+3i}$ by $\frac{5-3i}{5-3i}$ yields $\frac{5-2i}{5+3i} \cdot \frac{5-3i}{5-3i}$.

Multiplying the numerators together yields $(5-2i)(5-3i) = 25 - 25i + 6i^2$. Substituting -1 for i yields $25 - 25i + 6(-1) = 19 - 25i$. Multiplying the denominators together yields $(5+3i)(5-3i) = 25 - 9i^2$. Substituting -1 for i yields $25 - 9(-1) = 34$. The expression $\frac{5-2i}{5+3i} \cdot \frac{5-3i}{5-3i}$ can be rewritten as $\frac{19-25i}{34}$, or $\frac{19}{34} - \frac{25}{34}i$. Therefore, in the form $a+bi$, a is equivalent to $\frac{19}{34}$.

Choice A is incorrect because $-\frac{25}{34}$ is the value of b in the form $a+bi$, not a . Choices B and D are incorrect and may result from calculation errors while rationalizing the original expression $\frac{5-2i}{5+3i}$.

QUESTION 14.

Choice A is correct. Subtracting b_2 from both sides of the equation $y = -\frac{x}{m} + b_2$ yields $y - b_2 = -\frac{x}{m}$. Multiplying both sides of the equation by -1 yields $-y + b_2 = \frac{x}{m}$, or $b_2 - y = \frac{x}{m}$. Further, multiplying both sides of the equation by m yields $m(b_2 - y) = x$ and dividing both sides by the expression $b_2 - y$ yields $m = \frac{x}{b_2 - y}$.

Choices B, C, and D are incorrect because none of the equations are equivalent to the equation $y = -\frac{x}{m} + b_2$.

QUESTION 15.

Choice A is correct. Dividing $8x+1$ by $2x+1$ yields the following:

$$\begin{array}{r} 4 \\ 2x+1 \overline{)8x+1} \\ \underline{-(8x+4)} \\ -3 \end{array}$$

So, $\frac{8x+1}{2x+1}$ is equivalent to the expression $4 - \frac{3}{2x+1}$. The average of $4 - \frac{3}{2x+1}$ and

$$4 + \frac{3}{2x+1} \text{ is equivalent to } \frac{(4 - \frac{3}{2x+1}) + (4 + \frac{3}{2x+1})}{2} = \frac{8}{2} = 4.$$

Choices B, C, and D are incorrect and may result from errors in long division and/or applying the average formula to expressions.

QUESTION 16.

The correct answer is 20. The hypotenuse of the smaller isosceles right triangle that measures $5\sqrt{8}$ is equivalent to $10\sqrt{2}$, which is exactly $\frac{1}{5}$ of the size of the larger isosceles right triangle that has a hypotenuse with a measure of $50\sqrt{2}$. An isosceles right triangle is a 45-45-90 right triangle in which the hypotenuse is equivalent to the side length times $\sqrt{2}$. Therefore, the side length of the isosceles right triangle with a hypotenuse that measures $50\sqrt{2}$ is 50 and the sum of its shorter legs is $50 + 50 = 100$. If the smaller triangle has side lengths that are $\frac{1}{5}$ the length of the larger triangle, the sum of the shorter two legs of the smaller triangle is equivalent to $\frac{1}{5}(100) = 20$.

QUESTION 17.

The correct answer is 2. If Mr. Waterman would like to give his nieces and nephews \$55 worth of gift certificates to an ice cream parlor and each must receive at least one \$5, one \$10, and one \$25 gift certificate, the possible combinations of gift certificates that he can give are as follows:

- 1 - \$25, 1 - \$10, and 4 - \$5 which is equivalent to \$55.
- 1 - \$25, 2 - \$10, and 2 - \$5 which is equivalent to \$55.

There are no other ways that Mr. Waterman can give each niece and nephew \$55 worth of gift certificates and at least one of each type besides the two combinations above. Therefore, the difference between the greatest number of \$5 gift certificates and the least number of \$5 gift certificates he can give each niece and nephew is $4 - 2 = 2$.

QUESTION 18.

The correct answer is .25 or $\frac{1}{4}$. Since $\angle BAC$ intercepts an arc that measures 180° and point A lies on the circle, the measure of $\angle BAC$ is equivalent to $\frac{1}{2}(180^\circ) = 90^\circ$. Since $\triangle BAC$ is a right triangle and the measure of one of its shorter legs, $5\sqrt{2}$, times $\sqrt{2}$ yields $5\sqrt{2} \cdot \sqrt{2} = 10$, which happens to be the length of the triangle's hypotenuse, the triangle is an isosceles right triangle with angles that measure 45° , 45° , and 90° . The measure of $\angle ACB$ in radians is equivalent to $45 \cdot \frac{\pi}{180} = \frac{1}{4}\pi$. Therefore, if the measure of the angle in radians is given by the expression $H\pi$, H is equivalent to $\frac{1}{4}$.

QUESTION 19.

The correct answer is 5. In order for the system of equations $\begin{matrix} A^2x + 10y = 75 \\ Ax + 2y = 15 \end{matrix}$ to have infinitely many solutions the two equations must be exactly the same. Multiplying the second equation by 5 yields $\begin{matrix} A^2x + 10y = 75 \\ 5Ax + 10y = 75 \end{matrix}$. Subtracting the second equation from the

the first equation yields $(A^2 - 5A)x = 0$. Therefore, $A^2 - 5A$ must be equivalent to 0. Setting $A^2 - 5A$ equal to 0 yields $A^2 - 5A = 0$ and after factoring the left-hand side, the equation is $A(A - 5) = 0$. The values of 0 and 5 make the equation true, and since A must be positive, the answer is 5.

QUESTION 20.

The correct answer is 32. Expanding the left-hand side of the equation $(2a + B)^2 = Ma^2 + 8a + Q$ yields $4a^2 + 4aB + B^2 = Ma^2 + 8a + Q$. Looking at the symmetry of the left and right sides of the equation, one can see that M is equivalent to 4, 8 is equivalent to $4B$, and Q is equivalent to B^2 . Setting 8 equal to $4B$ yields $8 = 4B$ and dividing both sides by 4 yields $B = 2$. Substituting 2 for B in the equation $Q = B^2$ yields $Q = (2)^2 = 4$. Since $B = 2$, $M = 4$, and $Q = 4$, the product BMQ is equivalent to $(2)(4)(4) = 32$.

Section 4: Math Test - Calculator

QUESTION 1.

Choice A is correct. If a cell phone vendor sells a accessories and makes \$15 for each accessory that he sells, the vendor makes $15a$ dollars. If the vendor rents a table for h hours and has to pay \$35 per hour for the table, the vendor has to pay $35h$ dollars for the table at the trade show. If the vendor makes $15a$ dollars and has to pay $35h$ dollars, his net profit is $15a - 35h$ dollars.

Choice B is incorrect because the vendor would not make money from renting the table. So, the $35h$ should be $-35h$. Choices C and D are incorrect because each coefficient is attached to the incorrect variable.

QUESTION 2.

Choice D is correct. If Janelle gives away 24% of her jelly beans at lunch, then she will consume $100 - 24 = 76\%$ of them. 76% of 75 is $75(.76) = 57$ jelly beans.

Choice A is incorrect because 18 jelly beans is 24% of 75, or the number of jelly beans Janelle is giving away, not consuming. Choices B and C are incorrect and may result from solving for the incorrect total and/or calculation errors.

QUESTION 3.

Choice B is correct. Factoring a -1 out of the equation $y = -x^2 + x + 6$ yields $y = -1(x^2 - x - 6)$ and factoring the expression $x^2 - x - 6$ yields $(x - 3)(x + 2)$ which makes the factor form of the original equation $y = -(x - 3)(x + 2)$. The x -intercepts of this equation are 3 and -2 , which are the same x -intercepts as those of the equation $y = 2(x + 2)(x - 3)$.

Choice A is incorrect because the signs of the x -intercepts are reversed, being -3 and 2. Choice C is incorrect because the x -intercepts occur at 6 and -1 . Choice D is incorrect because the x -intercepts occur at -3 and -2 .

QUESTION 4.

Choice A is correct. If 12 times a number is equivalent to 30 more than 6 times the number, then $12x = 6x + 30$. Subtracting $6x$ from both sides of the equation yields $6x = 30$. Further, subtracting 30 from both sides of the equation reveals the fact that $6x - 30 = 0$.

Choices B, C, and D are incorrect and may result from errors in developing the equation that match the context of the problem and/or calculation errors.

QUESTION 5.

Choice D is correct. If the restaurant owner pays out 80% of his profits on a night that 50 patrons visit the restaurant, then $80 \times 50 = 4,000$. Similarly, if the restaurant owner pays out 32% of his profits on a night that 125 patrons visit the restaurant, $32 \times 125 = 4,000$. Therefore, if 250 patrons visit the restaurant, $x\% \times 250 = 4,000$. Dividing both sides of the equation yields $x\% = 16\%$.

Choices A, B, and C are all incorrect because all three percentages would require a much larger number of patrons to match the inversely proportional relationship between number of patrons and the percent of profits paid to employees who are working.

QUESTION 6.

Choice A is correct. If the restaurant sees 160 patrons during the all you can eat buffet night, the owner will pay out $x\% \times 160 = 4,000$, or $x\% = 25\%$ of the night's profits to the employees working that night. If there are 160 patrons and each pays \$10, the total profits are $160 \times \$10 = \$1,600$. 25% of the \$1,600 in profits would be $\$1,600(0.25) = \400 . If 5 employees were working that night, each employee would receive $\frac{\$400}{5} = \80 .

Choice B is incorrect and may result from a calculation error while calculating the percentage of the profits that the owner would pay out to his employees. Choice C is incorrect because \$400 is the total amount of money that the owner will pay out to the employees who worked that evening. Choice D is incorrect because \$1,600 is the total amount of profits that the restaurant made from the buffet.

QUESTION 7.

Choice D is correct. Substituting 11 for G in the equation $G = 13 - \frac{1}{21}m$ yields $11 = 13 - \frac{1}{21}m$. Subtracting 13 from both sides of the equation yields $-2 = -\frac{1}{21}m$, and multiplying both sides by -21 reveals that $m = 42$ miles.

Choice A is incorrect because 2 represents the number of gallons of gas that have been used since the last fill-up. Choice B is incorrect because 11 is the number of gallons of gas that remain in the tank. Choice C is incorrect and may result from a calculation error.

QUESTION 8.

Choice A is correct. If Arielle has f figurines before her parents and grandmother started buying them for her 6 years ago, f represents Arielle's initial number of figurines. If Arielle's parents buy her a figurine and her grandmother buys her a figurine for her birthday and for the holiday season, Arielle receives 4 figurines per year. Therefore, if Arielle currently has 56 figurines, the equation $f + 4y = 56$ must hold true, where f is the initial number of figurines that Arielle had and y is the number of years that have passed. Substituting 6 for y yields $f + 4(6) = 56$, or $f + 24 = 56$. Subtracting 24 from both sides of the equation yields $f = 32$ figurines.

Choice B is incorrect and may result from calculating that Arielle only receives two figurines per year, rather than 4. Choice C is incorrect and may result from assuming that Arielle receives 1 figurine per year, rather than 4. Choice D is incorrect and may result from neglecting to account for the fact that Arielle received 4 figurines per year for 6 years, not just 1 year.

QUESTION 9.

Choice B is correct. Using h to represent the number of hardcover books and p to represent the number of paperback books, if Nadia wants to sell at least 40 books, then $h + p \geq 40$. If each hardcover book sells for \$2, then the expression $2h$ represents the total amount of money earned from selling h hardcover books. If each paperback book sells for \$1, then p not only represents the number of paperback books, but also the total amount of money earned from selling p paperback books. If Nadia would like to raise at least \$60 from the books, then $2h + p \geq 60$. Therefore, the system of equations

$h + p \geq 40$
 $2h + p \geq 60$

accurately represents the number of book sales and the amount of money that Nadia would like to make.

Choice A is incorrect and may result from confusing total book sales with total money earned. Choices C and D are incorrect because both systems of linear inequalities account for \$2 for each paperback book and \$1 for each hardcover book, which is reversed.

QUESTION 10.

Choice C is correct. Since the people being surveyed are leaving a Mexican restaurant, the population from which the people are being randomly selected is people who are already out at a restaurant. People who are already eating out at a restaurant would be more inclined to say that they prefer to dine out rather than dining at home. Therefore, the location of the survey creates an undesired bias.

Choice A is incorrect because a random sample of 85 people is sufficient in size. Choice B is incorrect because the people surveyed were randomly selected and the privacy of not having to give their names helps elicit a truthful response. Choice D is incorrect because Choices A and B were conducted appropriately.

QUESTION 11.

Choice D is correct. If $h(x) = -4x^2 + 24x$ represents the height of the ball, $h(x)$, after x seconds have passed. All of the times when the ball has a height greater than 20 feet would be all of the times where the expression $-4x^2 + 24x$ is greater than 20, or $-4x^2 + 24x > 20$. Subtracting 20 from both sides yields $-4x^2 + 24x - 20 > 0$, or $0 < -4x^2 + 24x - 20$.

Choices A and B are incorrect because both equations include the value of 20 as a solution whereas the question asked for values of x where the ball was at a height strictly greater than 20 feet. Choice C is incorrect because $0 > -4x^2 + 24x - 20$ represents all of the values of x where the height of the ball is *less than* 20 feet, not *greater than* 20 feet.

QUESTION 12.

Choice B is correct. If $t(8) = 9$, then $s(7) = 2(9) = 18$. If $s(7) = 18$ and $r(x) = \sqrt{2x}$, then $r(s(7)) = r(18) = \sqrt{2(18)}$. Since $\sqrt{2(18)} = \sqrt{36} = \pm 6$ and $r(s(7))$ must be positive, then $r(s(7)) = 6$.

Choices A, C, and D are incorrect and may result from substitution errors and/or calculation errors while solving. For example, Choice D is incorrect because 1,296 is $(36)^2$, not $\sqrt{36}$.

QUESTION 13.

Choice C is correct. Mike's average speed for the week would be his total miles traveled divided by his total driving time. Adding $248 + 120 + 240 + 256 + 136$ yields 1,000 total miles driven. Adding $4 + 2 + 6 + 4 + 4$ yields 20 total hours. Dividing 1,000 by 20 yields an average speed of 50 miles per hour.

Choices A, B, and D are incorrect and may result from a calculation error or a conceptual error involving the average formula.

QUESTION 14.

Choice B is correct. If Mrs. Tettertotter has approximately 16 students in each of her 4 classes, Mrs. Tettertotter has a total of $16(4) = 64$ students. If Mrs. Tettertotter gives 24 tests per year to each of these 64 students, Mrs. Tettertotter has to grade a total of $24(64) = 1,536$ tests. If she can grade 8 tests per hour, dividing 1,536 by 8 yields

$$\frac{1,536}{8} = 192 \text{ hours of grading, or } \frac{192}{24} = 8 \text{ days.}$$

Choices A, C, and D are incorrect and may result from incorrectly calculating for the inappropriate value. For example, choice C is incorrect because 192 is the total number of hours it would take Mrs. Tettertotter to grade the tests, not the total number of days.

QUESTION 15.

Choice B is correct. The greatest change in the number of reported instances of

bullying occurred from 8 years passed 1994 to 12 years passed 1994. This would be the years 2002 through 2006.

Choices A, C, and D are incorrect because none of these 4 year periods have a larger change than the years 2002 through 2006. The years 2006 through 2010 had the largest *decrease* in the number of reported incidents of bullying, but the question asked for the largest *change*, increase or decrease.

QUESTION 16.

Choice B is correct. If Jessica's pottery class is 25% larger than Michelle's pottery class, then, using J for Jessica and M for Michelle, $J = 1.25M$. If Lauren's pottery class is 50% smaller than Michelle's pottery class, then using L for Lauren and M for Michelle, $L = 0.50M$. Dividing both sides of $L = 0.50M$ by 0.50 yields $\frac{L}{0.50} = M$. Substituting $\frac{L}{0.50}$ for M in the equation $J = 1.25M$ yields $J = 1.25\left(\frac{L}{0.50}\right)$, or $J = 2.50L$. If J were equivalent to $1L$, then J and L would be the same size. So, if $J = 2.50L$, or equivalently $J = (1+1.50)L$, then Jessica's pottery class is 150% larger than Lauren's class.

Choices A and D are incorrect and may result from calculation errors. Choice C is incorrect because 250% is what percent Jessica's pottery class *is of* Lauren's pottery class, not how much *larger*.

QUESTION 17.

Choice C is correct. Looking at the scatterplot from left to right, visualizing a vertical line at 50 breakfast sales, one can count the number of points on or to the right of that line, which is 9. There are 9 days on which the diner sold 50 or more breakfasts. Disregarding any other points besides these 9 points, one can visualize a horizontal line at 6 pancake meals and count the number of meals above this line, which is 6. Therefore, if a day is to be chosen at random from the days that the diner sold 50 or more breakfast meals, the probability that more than 6 pancake meals were sold on that day is 6 out of 9, or $\frac{2}{3}$.

Choice A is incorrect because $\frac{6}{13}$ is the probability that the diner sold 50 or more breakfast meals and more than 6 pancake meals given that a day is randomly selected from all of the days marked in the scatterplot. Choice B is incorrect because $\frac{8}{13}$ is the probability that the diner sold 50 or more breakfast meals and *at least* 6 pancake meals given that a day is randomly selected from all of the days marked in the scatterplot.

Choice D is incorrect because $\frac{8}{9}$ is the probability of randomly selecting a day where *at least* 6 pancake meals were sold given that a day was randomly chosen from those days where 50 or more breakfast meals were sold.

QUESTION 18.

Choice A is correct. An absolute value measures the distance between two points regardless of direction. For example, $|4 - 7| = 3$. This tells us that the distance between 4 and 7 is 3. Therefore, if the cereal manufacturer wants to keep the weight of each cereal box between 9.5 and 12.5, the manufacturer wants to keep the weight of each box within 1.5 ounces of 11 ounces because $11 - 1.5 = 9.5$ and $11 + 1.5 = 12.5$. Therefore, since the distance between the weight of the box, x , and 11 ounces must be equal to 1.5 ounces, $|x - 11| \leq 1.5$.

Choices B, C, and D are incorrect because all three absolute value equations have values of x that satisfy the equation that are not between 9.5 and 12.5.

QUESTION 19.

Choice C is correct. The formula of an average states that an average can be calculated by adding up the sum of all of the numbers in a set and dividing by how many numbers there are. In this case, adding up the average number of B's for the freshman, sophomore, junior, and senior respondents to the survey yields $8 + 6 + 2 + 12 = 28$. Dividing 28 by 4 yields $\frac{28}{4} = 7$. The average number of B's for the whole school is 7.

Choice A is incorrect because 1 is the approximate average number of D's to be expected from the whole school. Choice B is incorrect because 3 is the approximate average number of C's to be expected from the whole school. Choice D is incorrect because 9 is the approximate average number of A's to be expected from the whole school.

QUESTION 20.

Choice C is correct. Among the freshman respondents, the average number of C's is 3, the average number of D's is 1, and the average number of F's is 0. This is a total of $3 + 1 + 0 = 4$ total grades that are less than a B. If there are a total of 428 freshmen, the best estimate for the total number of grades lower than a B for the freshman class would be $428(4) = 1,712$, or approximately 1,700 grades below a B.

Choices A, B, and D are incorrect and may result from calculation errors.

QUESTION 21.

Choice D is correct. In a set of numbers, the mean is more strongly affected by outliers than the median. For example, in the set of numbers 2, 3, 4, 5, and 6, the median, or middle number, is 4. In addition, the mean, $\frac{2+3+4+5+6}{5}$, is also equivalent to 4. However, in the set of numbers 2, 3, 4, 5, and 16, the median stays the same, but the mean increases to $\frac{2+3+4+5+16}{5} = 6$. Therefore, if the mean is noticeably lower than the median, there must be a few numbers that are significantly lower than the rest of the numbers. So, most likely, there are a few students in the school who applied to 0 colleges.

Choices A, B, and C are incorrect. There is a chance that they could be true, yet they do not identify outliers that can explain why the mean is lower than the median.

QUESTION 22.

Choice D is correct. In order to find the area of the circle from the equation of the circle, one must first complete the square in the equation $x^2 + 8x + y^2 = 20$. Dividing the 8 by 2 and squaring the result yields 16, which must be added to the left-hand side of the equation and also subtracted from the left-hand side of the equation in order to have the equation remain the same. Therefore, adding 16 and subtracting 16 from the left-hand side of the equation yields $(x^2 + 8x + 16) + y^2 - 16 = 20$. Factoring the expression $x^2 + 8x + 16$ yields $(x + 4)^2 + y^2 - 16 = 20$ and adding 16 to both sides yields $(x + 4)^2 + y^2 = 36$. The formula for the equation of a circle is $(x - h)^2 + (y - k)^2 = r^2$, where (h, k) is the center of the circle and r is the radius of the circle. The equation $(x + 4)^2 + y^2 = 36$ can be written in the form $(x + 4)^2 + (y - 0)^2 = 36$, where the 36 is equivalent to r^2 . Therefore, being that the area of a circle is equivalent to πr^2 , the area of the circle defined by the equation $x^2 + 8x + y^2 = 20$ is 36π .

Choices A, C, and D are incorrect and may result from errors in correctly completing the square and/or errors in calculating the radius of the circle. For example, Choice A is incorrect because if one were to incorrectly complete the square as $x^2 + 8x - 16$, one would then subtract 16 from both sides of the equation, thus yielding an area of 4π , not 36π .

QUESTION 23.

Choice A is correct. Multiplying both sides of the equation $F = k \frac{Q_1 Q_2}{r^2}$ by r^2 yields

$Fr^2 = kQ_1 Q_2$. Dividing both sides by F yields $r^2 = \frac{kQ_1 Q_2}{F}$. Finally, taking the square

root of both sides reveals the answer, $r = \sqrt{\frac{kQ_1 Q_2}{F}}$.

Choices B, C, and D are incorrect because when solved for F , none of the answers are equivalent to $F = k \frac{Q_1 Q_2}{r^2}$.

QUESTION 24.

Choice C is correct. If the distance between the two charges is doubled, then the radius is doubled to $2r$. Substituting $2r$ for r in the equation $F = k \frac{Q_1 Q_2}{r^2}$ yields

$F = k \frac{Q_1 Q_2}{(2r)^2} = k \frac{Q_1 Q_2}{4r^2}$, or $F = \frac{1}{4} k \frac{Q_1 Q_2}{r^2}$. Therefore, doubling the charges' distance apart reduces the force to $\frac{1}{4}$ of its strength. Multiplying 1 by $(1 - r)$, where r is the percent of

decay in decimal form, should yield the new value of $\frac{1}{4}$. Solving the equation $1(1-r) = \frac{1}{4}$ for r yields 0.75, or 75%. Therefore, if the distance between two charges is doubled, the force between the two charges is reduced by 75%.

Choice A is incorrect because 25%, or 0.25 in decimal form, is the decay factor by which the force between two charges is multiplied if the distance between the charges is doubled. Choices B and D are incorrect and may result from calculation errors when solving for the decay percentage.

QUESTION 25.

Choice D is correct. Looking at the graph of $g(x)$, tracing up from -8 to a y -value of 2 reveals that the value of $g(-8)$ is 2. The number of values of x where $g(x)$ is equivalent to $g(-8)$ is equivalent to the number of times that the graph of the function $g(x)$ intersects the horizontal line $y = 2$. After visualizing or sketching the line $y = 2$, one can see that the function $g(x)$ intersects this line at 3 distinct points.

Choices A, B, and C are incorrect and may result from a misunderstanding of finding x - and y -values in function notation.

QUESTION 26.

Choice B is correct. Setting $2x + 2$ equal to 6 yields $2x + 2 = 6$. Subtracting 2 from both sides of the equation yields $2x = 4$ and dividing both sides by 2 yields $x = 2$.

Setting $-x - 1$ equal to $\frac{1}{2}x - 4$ yields $-x - 1 = \frac{1}{2}x - 4$. Adding x to both sides of the equation yields $-1 = \frac{3}{2}x - 4$ and adding 4 to both sides yields $3 = \frac{3}{2}x$. Multiplying both sides of the equation by $\frac{2}{3}$ reveals that $x = 2$. Any line that goes through two different points with the same x -value is a vertical line and all vertical lines have an infinite slope.

Therefore, the slope is undefined.

Choice A is incorrect because if the line that goes through the two points has a slope of zero, the two points would have a common y -value, not a common x -value. Choices C and D are incorrect because the two points have a common x -value and if there is no change in the x -value, there is no chance for a positive or negative slope.

QUESTION 27.

Choice C is correct. Setting $2b + 1$ equal to $x^3 + 8b$ yields $2b + 1 = x^3 + 8b$. Subtracting $8b$ from both sides yields $-6b + 1 = x^3$. Therefore, $-6b + 1$ must be equivalent to a perfect cube. Substituting $\frac{14}{3}$ for b in the expression $-6b + 1$ yields $-6(\frac{14}{3}) + 1$. Simplifying yields $-2(14) + 1 = -27$. Since -27 is a perfect cube, if b is equivalent to

$\frac{14}{3}$, then the system of equations has one solution.

Choices A, B, and D are incorrect because substituting any of these values for b in the system of equations yields a non-integer value of x .

QUESTION 28.

Choice B is correct. Substituting 1 for x in the equation $R = 240(0.5)^x$ yields $R = 240(0.5) = 120$ and substituting 1 for x in the equation $R = -35x + 155$ yields $R = -35 + 155 = 120$ as well. Substituting 4 for x in the equation $R = 240(0.5)^x$ yields $R = 240(0.5)^4 = 240(0.0625) = 15$ and substituting 4 for x in the equation $R = -35x + 155$ yields $R = -35(4) + 155 = -140 + 155 = 15$ as well. Therefore, the exponential decay model and the linear model have the same outcome after 1 year has passed and 4 years have passed. Substituting 2 for x in both equations yields $R = 240(0.5)^2 = 60$ for the exponential decay model and $R = -35(2) + 155 = 85$ for the linear decay model. Therefore, the exponential decay model, or model that the organic matter follows, is less than the linear model, or model the inorganic matter follows, between 1 and 4. Therefore, the mass of the organic matter is less than the mass of the inorganic matter for $4 - 1 = 3$ years.

Choices A, C, and D are incorrect and may result from calculation errors while substituting into both the exponential decay model and the linear decay model.

QUESTION 29.

Choice B is correct. If the measure of the largest angle in the isosceles triangle is x , then given the facts that all of the angles in an equilateral triangle measure 60 degrees and that all of the angles in a square measure 90 degrees, $x + 90 + 60 + 90 = 360$. Simplifying yields an x -value of 120 degrees. Cutting this isosceles triangle in half through the 120° angle yields two 30-60-90 triangles that have hypotenuses that have the same length as the side of the square. Repositioning the longest legs of these two 30-60-90 triangles adjacent to each other yields a single triangle with 3 sides that measure the same length as the side length of the squares. Since the original equilateral triangle has an area of $13\sqrt{3}$ and has sides that measure the same length as the sides of the squares, then the isosceles triangle must also have an area that measures $13\sqrt{3}$. Therefore, A is equivalent to 13.

Choices A, C, and D are incorrect and may result from errors in incorrectly assuming similarity or not fully understand the rules of special right triangles, mainly the 30-60-90 right triangle side length relationship. For example, Choice C is incorrect and may result from assuming that the area of the isosceles triangle is double that of the equilateral triangle since the equilateral triangle has angles that measure 60 degrees and the isosceles triangle has an angle that measures 120 degrees.

QUESTION 30.

Choice A is correct. If the line that goes through two non-adjacent vertices of a square

has the equation $y = -3x + 2$, the line that goes through the other two non-adjacent vertices has a slope that is the negative reciprocal of -3 , or $\frac{1}{3}$. Therefore, the slope of line r is $\frac{1}{3}$ and line r has the form $y = \frac{1}{3}x + b$. Substituting 3 for x and 5 for y yields $5 = \frac{1}{3}(3) + b$. Simplifying yields $5 = 1 + b$, or $b = 4$. Therefore, the y -intercept of Line is 4.

Choice B, C, and D are incorrect and may result from a calculation error and/or a misunderstanding of the relationship between parallel and perpendicular lines as well as the relationship between the diagonals of a square.

QUESTION 31.

The correct answer is 5. One can use the exponential growth formula to create the inequality $31,250(2)^t = 1,000,000$. However, this equation requires logarithmic rules to solve. Since the number 31,250 is quite large to begin with, it may be easier for one to simply double the value of 31,250 as many times as it takes to reach 1,000,000:

- 1 - $31,250(2) = 62,500$
- 2 - $62,500(2) = 125,000$
- 3 - $125,000(2) = 250,000$
- 4 - $250,000(2) = 500,000$
- 5 - $500,000(2) = 1,000,000$

Therefore, five years will pass before the population of bees reaches 1,000,000.

QUESTION 32.

The correct answer is 381. If a ladder measures 12 feet 6 inches in length, multiplying 12 by 12 and adding 6 yields the ladder's length in inches, $12(12) + 6 = 150$ inches. If one inch is equivalent to 2.54 centimeters, then multiplying 150 by 2.54 yields the length of the ladder in centimeters, $150(2.54) = 381$ centimeters.

QUESTION 33.

The correct answer is 400. Substituting 8 for h in the equation $C(x) = 125 + 50mh$ yields $C(x) = 125 + 50m(8)$, or $C(x) = 125 + 400m$. The linear equation $C(x) = 125 + 400m$ has a slope of 400, which represents a positive change of \$400 for every additional man who works the job. Therefore, the client's estimated price per additional man is \$400.

QUESTION 34.

The correct answer is 0. Make x the number of hours that Angel logged at the

woodworking residency. If Sebastian logged 204 hours less than four times the number of hours that Angel logged, then Sebastian logged $4x - 204$ hours at the woodworking residency. If the two men logged a total of 136 hours at the woodworking residency then $x + 4x - 204 = 136$. Combining like terms yields $5x - 204 = 136$ and adding 204 to both sides of the equation yields $5x = 340$. Dividing by 5 reveals the number of hours that Angel logged at the woodworking residency, $x = 68$ hours. Substituting 68 into the equation $4x - 204$ reveals Sebastian's hours logged as $4(68) - 204 = 68$ hours. Therefore, the number of additional hours that Angel logged over Sebastian was $68 - 68 = 0$ hours.

QUESTION 35.

The correct answer is $.125$ or $\frac{1}{8}$. Substituting -3 for x , a for y , and $-\frac{1}{4}$ for c in the equation $y = ax^2 + 2ax + c$ yields $a = a(-3)^2 + 2a(-3) + (-\frac{1}{4})$. Simplifying yields $a = 9a - 6a - \frac{1}{4}$. Combining like terms yields $a = 3a - \frac{1}{4}$ and subtracting $3a$ from both sides yields $-2a = -\frac{1}{4}$. Finally, dividing both sides of the equation by -2 yields $a = \frac{1}{8}$.

QUESTION 36.

The correct answer is 32. Area is equivalent to πr^2 and if the area of circle O is 64π , then $r^2 = 64$, or $r = 8$. If the radius of circle O is 8, then the circumference, using the formula $2\pi r$, is equivalent to $2\pi(8) = 16\pi$. If the length of \widehat{RS} is 4π and the circumference of circle O is 16π , then $\angle ROS$ is $\frac{1}{4}$ of 360° , or $\frac{1}{4}(360^\circ) = 90^\circ$. Therefore, $\triangle RSO$ is an isosceles right triangle with two sides of the same length as the radius, 8. Using the formula for the area of a triangle, $\frac{1}{2}bh$, where the base and the height of the isosceles right triangle are both 8, yields $\frac{1}{2}(8)(8) = 32$.

QUESTION 37.

The correct answer is 3. If the first term of the sequence is equivalent to 3, substituting 1 for n and 3 for A_n in the equation $A_n = d(1 + n(n-1))$ yields $3 = d(1 + 1(1-1))$ which is equivalent to $3 = d(1 + 1(0))$, or $d = 3$.

QUESTION 38.

The correct answer is 24. Substituting k for n , 3 for d , and 1659 for A_n in the equation $A_n = d(1 + n(n-1))$ yields $1659 = 3(1 + k(k-1))$ and dividing both sides of the equation by 3 yields $553 = 1 + k(k-1)$. Subtracting 1 from both sides of the equation yields $552 = k(k-1)$ and expanding the expression $k(k-1)$ yields $552 = k^2 - k$. Subtracting 552 from both sides gives $0 = k^2 - k - 552$ and factoring the expression $k^2 - k + 552$ yields $0 = (k-24)(k+23)$ which reveals the roots, 24 and -23 . Since k is the number of terms, k must be positive. Therefore, k is 24.