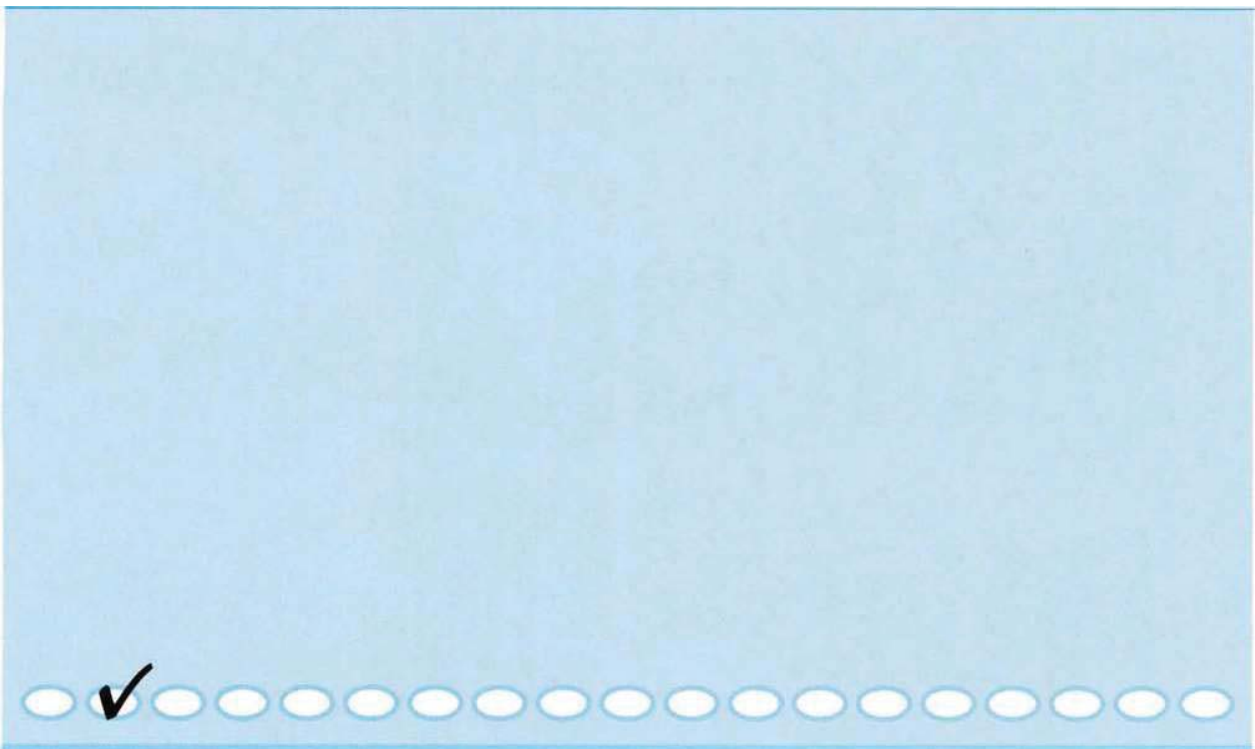


CHAPTER 2

DIAGNOSTIC SAT

1. Reading Test		
65 MINUTES	52 QUESTIONS	17
2. Writing and Language Test		
35 MINUTES	44 QUESTIONS	35
3. Math Test – No Calculator		
25 MINUTES	20 QUESTIONS	48
4. Math Test – Calculator		
55 MINUTES	38 QUESTIONS	54
5. Essay (optional)		
50 MINUTES	1 QUESTION	65



3



3

Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

Turn to Section 3 of your answer sheet to answer the questions in this section.

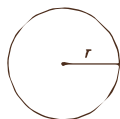
DIRECTIONS

For questions 1–15, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. For questions 16–20, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 16 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

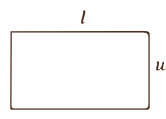
- The use of a calculator is NOT permitted.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the domain of a given function f is the set of all real numbers for which $f(x)$ is a real number.

REFERENCE

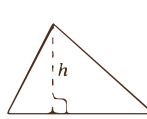


$$A = \pi r^2$$

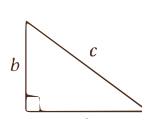
$$C = 2\pi r$$



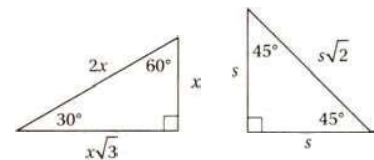
$$A = lw$$



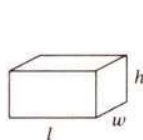
$$A = \frac{1}{2}bh$$



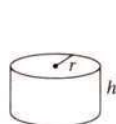
$$c^2 = a^2 + b^2$$



Special Right Triangles



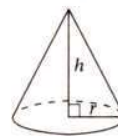
$$V = lwh$$



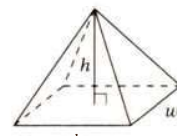
$$V = \pi r^2 h$$



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



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



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

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is 2π .

The sum of the measures in degrees of the angles of a triangle is 180.

CONTINUE

3



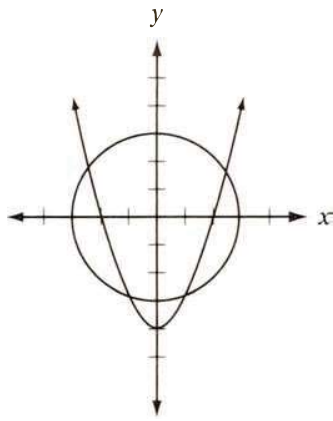
3

1

If $6x + 9 = 30$, what is the value of $2x + 3$?

- A) 5
- B) 10
- C) 15
- D) 20

2



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

$$y = x^2 - 4$$

A system of two equations and their graphs in the xy -plane are shown above. How many solutions does the system have?

- A) One
- B) Two
- C) Three
- D) Four

3

A total of 300 tickets were sold for a performance of a school play. The ticket prices were \$5 for each adult and \$3 for each child, and the total revenue from tickets was \$1,400. Solving which of the following systems of equations would yield the number of adult tickets sold, a , and the number of children's tickets sold, c ?

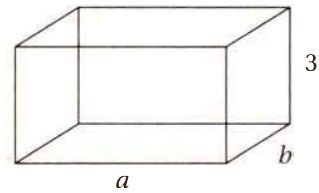
- A) $a + c = 1,400$
 $5a + 3c = 300$
- B) $a + c = 300$
 $5a + 3c = 1,400$
- C) $a + c = 300$
 $3a + 5c = 1,400$
- D) $a + c = 300$
 $3a + 5c = 1,400 \times 2$

4

Which of the following expressions is equivalent to $2(x - 4)^2 - 5x$?

- A) $2x^2 - 21x + 32$
- B) $2x^2 - 21x - 32$
- C) $2x^2 - 13x + 32$
- D) $2x^2 - 16x - 21$

5



Note: Figure not drawn to scale

A rectangular solid above has dimensions 3, a , and b , where a and b are integers. Which of the following CANNOT be the areas of three different faces of this solid?

- A) 15, 18, and 30
- B) 18, 24, and 48
- C) 12, 15, and 24
- D) 15, 24, and 40

CONTINUE

3



3

6

The cost in dollars, C , to manufacture n necklaces is given by the equation $C(n) = an + b$, where a and b are positive constants. In this equation, what does a represent?

- A) the fixed costs, in dollars, independent of any necklaces being manufactured
- B) the total cost, in dollars, to produce n necklaces, not including fixed costs
- C) the total cost, in dollars, to produce one necklace, including fixed costs
- D) the cost, in dollars, to produce one necklace, not including any fixed costs

7

Line l intersects the graph of the function $f(x) = 2x^2 - 4x + 1$ at two points where $x = -1$ and $x = 2$, respectively. What is the slope of line l ?

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

8

Which of the following equations represents a parabola in the xy -plane with a vertex that lies on the x -axis?

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

9

If the function $m(x)$ satisfies the equation $\frac{m(x)}{x+3} - \frac{x+1}{x-1} = 1$ for all values of x greater than 1, then $m(x) =$

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

10

In the mesosphere, the atmospheric layer between 50 km and 80 km in altitude, the average atmospheric temperature varies linearly with altitude. If the average temperature at 50 km altitude is 10°C and the average temperature at 80 km is -80°C , then at what altitude is the average temperature -50°C ?

- A) 60 km
- B) 65 km
- C) 70 km
- D) 75 km

11

The graph of the equation $y = 2x^2 - 16x + 14$ intersects the y -axis at point A and the x -axis at points B and C . What is the area of triangle ABC ?

- A) 42
- B) 48
- C) 54
- D) 56

3



3

12

What is the total number of x - and y -intercepts in the graph of the equation $y = (x + 2)^2(x - 3)^2$?

- A) Two
- B) Three
- C) Four
- D) Five

13

If the complex number A satisfies the equation

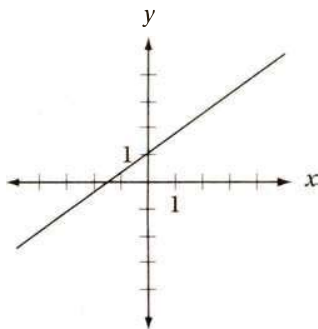
$A(2 - i) = 2 + i$, where $i = \sqrt{-1}$, what is the value of A ?

- A) $5 - i$
- B) $5 + i$
- C) $\frac{3}{5} + \frac{4}{5}i$
- D) $\frac{3}{4} + \frac{5}{4}i$

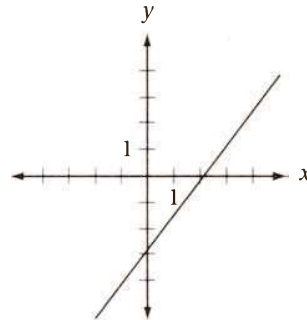
14

If $k > 2$, which of the following could be the graph of $y + x = k(x - 1)$ in the xy -plane?

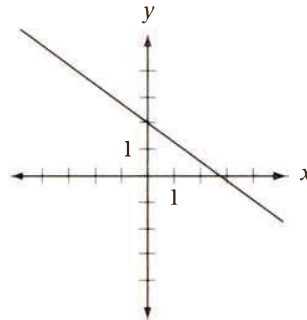
A)



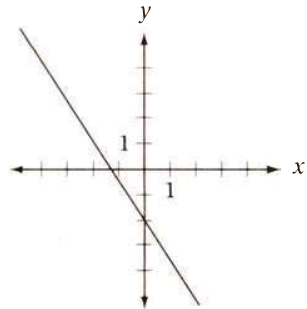
B)



C)



D)



15

The function $g(x) = ax^3 + bx^2 + cx + d$ has zeroes at $x = -2$, $x = 3$, and $x = 6$. If $g(0) < 0$, which of the following must also be negative?

- A) $g(-3)$
- B) $g(-1)$
- C) $g(4)$
- D) $g(5)$

3



3

DIRECTIONS

For questions 16–20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $\frac{7}{2}$.

(If $3\frac{1}{2}$ is entered into the grid as

3	1	/	2
<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

, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$).

- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer in boxes. →

Grid in result. →

Answer: $\frac{7}{12}$

7	/	1	2
<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	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Answer: 2.5

2	.	5
<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	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

Acceptable ways to grid $\frac{2}{3}$ are:

2	/	3
<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

.	6	6	6
<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

.	6	6	7
<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

CONTINUE

3



3

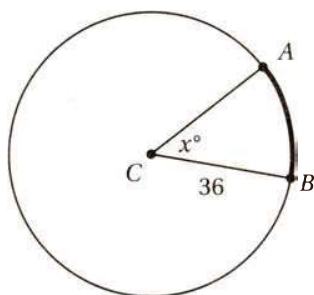
16

If $\frac{2}{3}x + \frac{1}{2}y = 5$, what is the value of $4x + 3y$?

17

If $\frac{5}{x} - \frac{2}{5} = 1$, what is the value of x ?

18



Note: Figure not drawn to scale.

In the circle above, arc AB has a measure of 7π . What is the value of x ?

19

$$\begin{aligned}\frac{1}{2}x &= \frac{1}{3}y + \frac{1}{10} \\ 6x - 4y &= k\end{aligned}$$

For what value of k will the system of equations above have at least one solution?

20

If x represents the radian measure of an angle, where $0 \leq x \leq \frac{\pi}{2}$, and $\sin x = \frac{5}{13}$, then what is the value of $\tan\left(\frac{\pi}{2} - x\right)$?

STOP

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

4



4

Math Test – Calculator

55 MINUTES, 38 QUESTIONS

Turn to Section 4 of your answer sheet to answer the questions in this section.

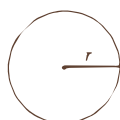
DIRECTIONS

For questions 1–30, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. For questions 31–38, solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 31 on how to enter your answers in the grid. You may use any available space in your test booklet for scratch work.

NOTES

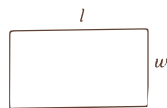
1. The use of a calculator **is permitted**.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers for which $f(x)$ is a real number.

REFERENCE



$$A = \pi r^2$$

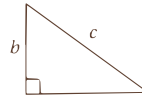
$$C = 2\pi r$$



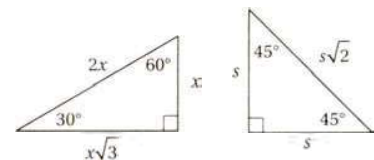
$$A = lw$$



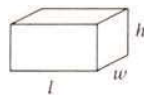
$$A = \frac{1}{2}bh$$



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



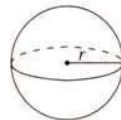
Special Right Triangles



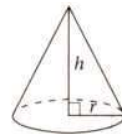
$$V = lwh$$



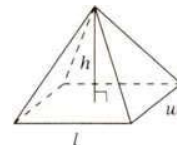
$$V = \pi r^2 h$$



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



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



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

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is 2π .

The sum of the measures in degrees of the angles of a triangle is 180.

CONTINUE

4



4

1

$$a - b = 10$$

$$a - 2b = 8$$

Based on the system of equations above, what is the value of b ?

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

2

The average (arithmetic mean) of three numbers is 50. If two of the numbers have a sum of 85, what is the third number?

- A) 75
- B) 70
- C) 65
- D) 55

3

What number is the same percent of 225 as 9 is of 25?

- A) 27
- B) 54
- C) 64
- D) 81

4

RESULTS OF FAVORABILITY POLL

	Favorable	Unfavorable	No Opinion	Total
Men	26		12	
Women			13	89
Total	59			162

The table above shows the partial results of a favorability poll for a local politician. If the data shown are correct, how many of the women who were polled viewed the politician unfavorably?

- A) 33
- B) 43
- C) 61
- D) It cannot be determined by the information given.

5

If $2^{2n-2} = 32$, what is the value of n ?

- A) 2.0
- B) 2.5
- C) 3.0
- D) 3.5

6

A bag of Nellie's Nut Mix contains x ounces of walnuts, 15 ounces of peanuts, and 20 ounces of pecans. Which of the following expresses the fraction of the mix, by weight, that is walnuts?

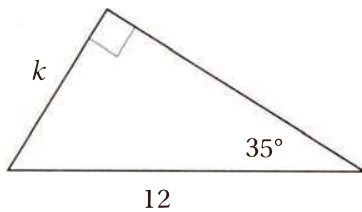
- A) $\frac{x}{35}$
- B) $\frac{x}{35-x}$
- C) $\frac{x}{35+x}$
- D) $\frac{35-x}{35+x}$

4



4

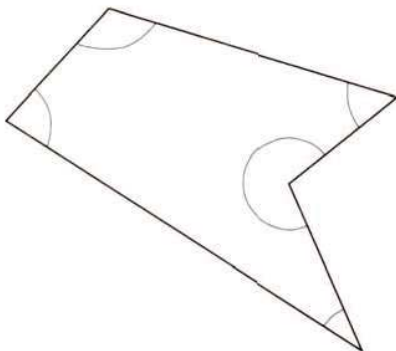
7



In the triangle above, what is the value of k ?
($\sin 35^\circ = 0.574$, $\cos 35^\circ = 0.819$, $\tan 35^\circ = 0.700$)

- A) 6.00
- B) 6.88
- C) 8.40
- D) 9.83

8

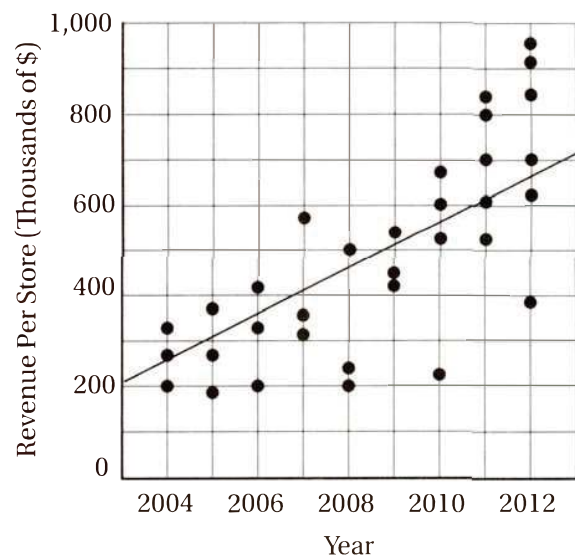


The figure above shows a polygon with five sides. What is the average (arithmetic mean) of the measures, in degrees, of the five angles shown?

- A) 108°
- B) 110°
- C) 112°
- D) 114°

Questions 9 and 10 are based on the graph below.

ANNUAL REVENUE PER STORE



9

The scatterplot above shows the annual revenue for each of the individual retail stores operated by a clothing company for each year from 2004 through 2012. Based on the line of best fit to the data shown, which of the following is closest to the average annual increase in revenue per store?

- A) \$5,000
- B) \$50,000
- C) \$100,000
- D) \$500,000

4



4

10

Which of the following statements is most directly justified by the data shown in the scatterplot above?

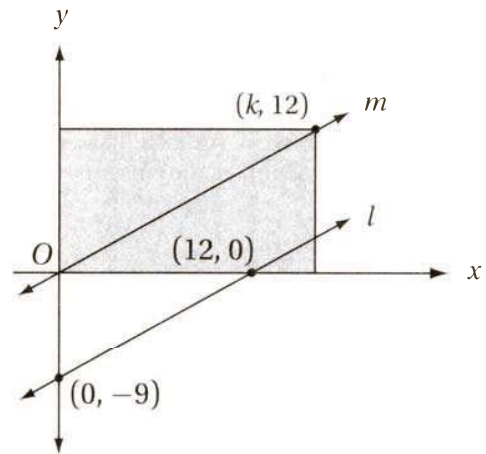
- A) The average revenue per store increased by over 100% from 2005 to 2009.
- B) The total number of retail stores increased by 50% from 2005 to 2012.
- C) The total revenue from all stores in 2012 was more than three times the total revenue from all stores in 2004.
- D) The total revenue from all stores in 2008 was over \$1 million.

11

Which of the following statements expresses the fact that the product of two numbers, a and b , is 6 greater than their sum?

- A) $ab + 6 > a + b$
- B) $ab = a + b + 6$
- C) $ab + 6 = a + b$
- D) $ab > a + b + 6$

12



Note: Figure not drawn to scale.

In the figure above, if $m \parallel l$, what is the area, in square units, of the shaded rectangle?

- A) 156
- B) 168
- C) 180
- D) 192

13

The Glenville Giants have played a total of 120 games and have a win-to-loss ratio of 2 to 3. How many more games have they lost than won?

- A) 24
- B) 30
- C) 40
- D) 48

CONTINUE

4



4

14

A culture of bacteria initially contained p cells, where $p > 100$. After one hour, this population decreased by $\frac{1}{3}$. In the second and third hours, however, the population increased by 40% and 50%, respectively. At the end of those first three hours, what was the population of the culture?

- A) $1.3p$
- B) $1.4p$
- C) $1.5p$
- D) $1.6p$

15

If $(6^{-2})(m^{-2}) = \frac{1}{16}$, what is the value of m^2 ?

- A) $\frac{1}{9}$
- B) $\frac{4}{9}$
- C) $\frac{9}{16}$
- D) $\frac{9}{4}$

16

A jar contains only red, white, and blue marbles. It contains twice as many red marbles as white marbles and three times as many white marbles as blue marbles. If a marble is chosen at random, what is the probability that it is not red?

- A) $\frac{1}{5}$
- B) $\frac{2}{5}$
- C) $\frac{3}{5}$
- D) $\frac{4}{5}$

17

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

In the xy -plane, line l passes through the point $(-1, 3)$ and the vertex of the parabola with equation above. What is the slope of line l ?

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

18

A certain function takes an input value and transforms it into an output value according to the following three-step procedure:

Step 1: Multiply the input value by 6.

Step 2: Add x to this result.

Step 3: Divide this result by 4.

If an input of 7 to this function yields an output of 15, what is the value of x ?

- A) 12
- B) 16
- C) 18
- D) 24

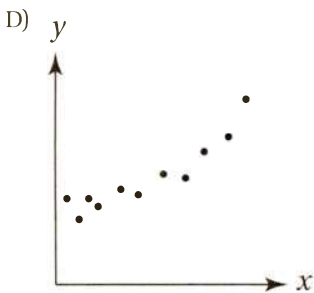
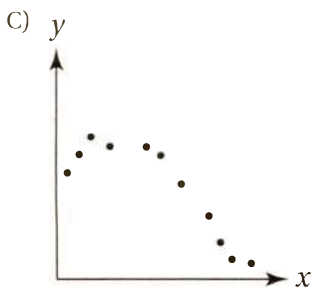
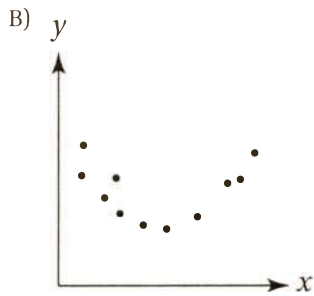
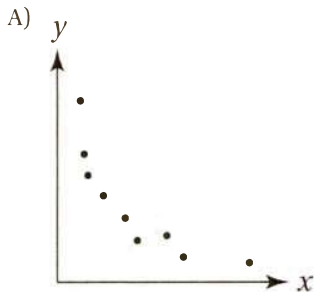
4



4

19

The variables x and y are believed to correlate according to the equation $y = ax^2 + bx + c$, where a , b , and c are constants. Which of the following scatterplots would provide the strongest evidence in support of the hypothesis that $a < 0$?



20

On a number line, the coordinates of points P and R are p and r , respectively, and $p < r$. If the point with coordinate x is closer to p than to r , then which of the following statements must be true?

- A) $x < \frac{p-r}{2}$
- B) $x < \frac{p+r}{2}$
- C) $|x-p| < r$
- D) $|x+p| < r-p$

21

Let function $f(x)$ be defined by the equation

$$f(x) = \frac{1}{2-x}. \text{ If } m \text{ is a positive integer, then } f\left(\frac{1}{m}\right) =$$

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

22

The value of y varies with x according to the equation $y = a(x-2)(x+1)$, where $a < 0$. As the value of x increases from 0 to 5, which of the following best describes the behavior of y ?

- A) It increases and then decreases.
- B) It decreases and then increases.
- C) It increases only.
- D) It decreases only.

CONTINUE

4



4

23

If the expression $\frac{n^2-9}{n^2+3}$ is equivalent to the expression $1 - \frac{k}{n^2+3}$ for all values of n , what is the value of k ?

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

24

An online trading company charges a 3% commission for all stock purchases. If a trader purchases 200 shares of a stock through this company and is charged \$3,399 including commission, what is the cost per share for this stock?

- A) \$16.45
- B) \$16.48
- C) \$16.50
- D) \$16.52

25

For nonzero numbers w and y , if w is 50% greater than y , then what is the ratio of w^{-2} to y^{-2} ?

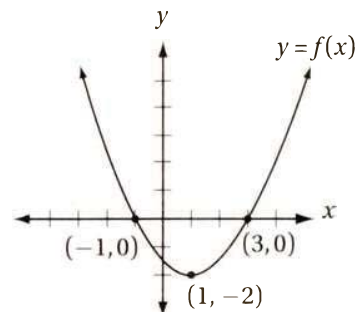
- A) 4 to 9
- B) 2 to 3
- C) 9 to 4
- D) 4 to 1

26

Every athlete in a group of 60 female varsity athletes at Greenwich High School either runs track, plays soccer, or does both. If one-third of the athletes in this group who play on the soccer team also run on the track team, and one-half of the athletes in this group who run on the track team also play on the soccer team, which of the following statements must be true?

- A) This group contains 40 soccer players.
- B) This group contains 20 athletes who play soccer but do not run track.
- C) This group contains 20 athletes who play both track and soccer.
- D) The number of soccer players in this group is 15 greater than the number of track team members in this group.

27



A portion of the graph of the quadratic function $y = f(x)$ is shown in the xy -plane above. The function g is defined by the equation $g(x) = f(x) + b$. If the equation $g(x) = 0$ has exactly one solution, what is the value of b ?

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

4



4

28

If $\cos x = a$, where $\frac{\pi}{2} < x < \pi$, and $\cos y = -a$, then which of the following could be the value of y ?

- A) $x + 2\pi$
- B) $x + \pi$
- C) $x + \frac{\pi}{2}$
- D) $-x + 2\pi$

Questions 29 and 30 refer to the following table.

OPINION POLL ON PROPOSAL 81A

Age of Voter	Approve	Disapprove	No Opinion	Total
18 to 39	918	204	502	1,624
40 to 64	1,040	502	102	1,644
65 and older	604	420	115	1,139
Total	2,562	1,126	719	4,407

29

Of those surveyed who expressed an opinion on Proposal 81a, approximately what percentage are under 40 years of age?

- A) 30%
- B) 38%
- C) 68%
- D) 72%

30

If the data in the table above are assumed to be representative of the general voting population, which of the following statements is most directly justified by these data?

- A) The approval rate for Proposal 81a generally decreases with the age of the voter.
- B) The disapproval rate for Proposal 81a generally increases with the age of the voter.
- C) Those who express an opinion on Proposal 81a are more likely to be over 64 than they are to be under 40.
- D) In all three age categories, voters are more than twice as likely to approve of Proposal 81a than to have no opinion about it.

4



4

Student-Produced Response Questions

DIRECTIONS

For questions 31–38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

- Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $\frac{7}{2}$.
(If $3\frac{1}{2}$ is entered into the grid as

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)
- Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.

Write answer in boxes. →

Grid in result. →

Answer: $\frac{7}{12}$

7	/	1	2
<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	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Answer: 2.5

2	.	5
<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	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

Acceptable ways to grid $\frac{2}{3}$ are:

2	/	3
<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

.	6	6	6
<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

.	6	6	7
<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



CONTINUE

4



4

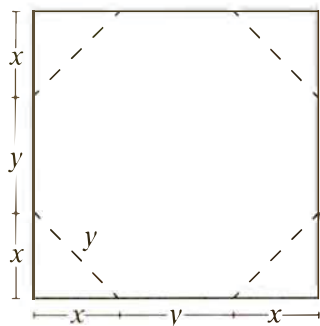
31

If y varies inversely as x , and $y = \frac{1}{2}$ when $x = 10$, then for what value of x does $y = 25$?

32

If $x^2 + 12x = 13$, and $x < 0$, what is the value of x^2 ?

33



Four triangles are to be cut and removed from a square piece of sheet metal to create an octagonal sign with eight equal sides, as shown in the figure above. If the total area of the removed material is 196 square centimeters, what is the perimeter, in centimeters, of the octagon?

34

If m and n are integers such that $m^2 + n^2 = 40$ and $m < 0 < n$, what is the value of $(m + n)^2$?

35

If $(\cos x)(\sin x) = 0.2$, what is the value of $(\cos x + \sin x)^2$?

36

MONTHLY SALES (FEBRUARY)

Item	Price Per Item	Number Sold
Model AT350	\$120	20
Model U32	\$98	80
Model GY53	\$140	62
Model CDP3	\$162	38
Model AP14	\$110	40

The table above shows information about the February sales for five different cell phone models at a local store. What was the median price, to the nearest dollar, of the 240 phones sold in February?

CONTINUE

4



4

Questions 37 and 38 are based on the scenario described below. Enter your responses on the corresponding grids on your answer sheet.

Performance Banner Company creates promotional banners that include company logos. The Zypz Running Shoe Company would like a 4-foot high and 20-foot long banner that includes its logo, which has a height-to-length ratio of 5:8.

37

If the logo were scaled so that its height matched the height of the banner and then were placed in the center of the banner, then what would be the width, in feet, of each margin on either side of the logo?

38

Performance Banner Company charges its customers \$1.20 per square foot for the banner material, \$2.50 per square foot of any printed logo, and \$32 in fixed costs per banner. The Zypz Running Shoe Company is considering two options for the banner: one with a single logo, and another with two logos. If these logos are all to be the same size as described in Part 1, what percent of the banner costs would the company save by choosing the single-logo option instead of the two-logo option? (Ignore the % symbol when entering into the grid. For example, enter 27% as 27.)

STOP

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

DIAGNOSTIC SAT ANSWER KEY

Section 1: Reading	Section 2: Writing and Language	Section 3: Math (No Calculator)	Section 4: Math (Calculator)
1. C	1. B	1. B	1. D
2. A	2. C	2. D	2. C
3. C	3. C	3. B	3. D
4. B	4. A	4. A	4. B
5. D	5. B	5. C	5. D
6. C	6. C	6. D	6. C
7. D	7. A	7. A	7. B
8. A	8. D	8. B	8. A
9. B	9. A	9. D	9. B
10. D	10. D	10. C	10. C
11. B	11. D	11. A	11. B
12. C	12. C	12. B	12. D
13. C	13. B	13. C	13. A
14. D	14. D	14. B	14. B
15. A	15. A	15. B	15. B
16. D	16. B	-----	16. B
17. B	17. C	16. 30	17. C
18. D	18. D	17. $25/7$ or 3.57	18. C
19. C	19. C	18. 35	19. C
20. B	20. D	19. 1.2	20. B
21. B	21. B	20. 2.4	21. A
22. C	22. A		22. A
23. D	23. D		23. D
24. D	24. C		24. C
25. A	25. A		25. A
26. A	26. D		26. D
27. C	27. C		27. D
28. C	28. B		28. B
29. C	29. C		29. A
30. B	30. D		30. B
31. A	31. A		-----
32. B	32. C		31. $1/5$ or 0.2
33. C	33. B		32. 169
34. C	34. B		33. 112
35. A	35. A		34. 16
36. A	36. B		35. 1.4
37. B	37. D		36. 115
38. B	38. C		37. 6.8
39. B	39. C		38. 25
40. B	40. D		
41. A	41. B		
42. D	42. B		
43. C	43. D		
44. B	44. B		
45. D			
46. A			
47. A			
48. D			
49. D			
50. C			
51. B			
52. D			
Total Reading Points (Section 1)	Total Writing and Language Points (Section 2)	Total Math Points (Section 3)	Total Math Points (Section 4)

42. B Data Analysis

According to the graph, the line indicating the Insight condition separates from the line representing the Non-insight condition approximately 0.3 seconds prior to the button being pushed, and remains elevated until about 0.7 seconds after the button is pushed, for a duration of approximately 1 second.

43. D Pronoun-Antecedent Agreement, Subject-Verb Agreement

The verb *is* agrees with the subject *interpreting* (both are singular), but the pronoun *this* disagrees with its antecedent *data* (*this* is singular, but *data* is plural).

44. B Coordinating Clauses

The correct choice should combine the two questions into a single sentence. Choice (A) misstates the second question. Choice (C) inappropriately uses the subjunctive mood. Choice (D) misuses the parallel construction *both A and B*.

Section 3: Math (No Calculator)

1. B Algebra (solving equations) EASY

To solve in one step, just divide both sides by 3: $6x + 9 = 30$
 Most students waste time solving for x , which will work, but takes longer: $2x + 3 = 10$
 Subtract 9: $6x + 9 = 30$
 Divide by 6: $6x = 21$
 Evaluate $2x + 3$ by substituting $x = 3.5$: $x = 3.5$
 $2x + 3 = 2(3.5) + 3 = 7 + 3 = 10$

2. D Advanced Mathematics (nonlinear systems) EASY

The solutions to the system correspond to the points of intersection of the two graphs. The figure shows four such intersection points.

3. B Algebra (algebraic expressions) EASY

Let $a = \#$ of adult tickets sold, and $c = \#$ of child tickets sold. If 300 tickets were sold altogether: $c + a = 300$
 The revenue for a adult tickets sold at \$5 each is $5a$, and the revenue for c child tickets sold at \$3 each is $3c$. Since the total revenue is \$1,400: $5a + 3c = 1,400$

4. A Advanced Mathematics (polynomials) EASY

Factor: $2(x - 4)^2 - 5x$
 FOIL: $2[(x - 4)(x - 4)] - 5x$
 $2[x^2 - 4x - 4x + 16] - 5x$

Simplify: $2[x^2 - 8x + 16] - 5x$
 Distribute: $2x^2 - 16x + 32 - 5x$
 Combine like terms: $2x^2 - 21x + 32$

5. C Special Topics (three-dimensional geometry) MEDIUM

On the drawing, we should first mark the areas of the three faces. The front and back faces both have an area of $3a$. The left and right faces both have an area of $3b$. The top and bottom faces both have an area of ab . We should now try to find integer values for a and b so that these areas match those given in the choices.

- (A) 15, 18, and 30 This is possible if $a = 5$ and $b = 6$.
- (B) 18, 24, and 48 This is possible if $a = 6$ and $b = 8$.
- (C) 12, 15, and 24 This cannot work for any integer values of a and b .
- (D) 15, 24, and 40 This is possible if $a = 5$ and $b = 8$.

6. D Algebra (linear equations) MEDIUM

$C(n) = an + b$
 Since this expression is linear in n (the input variable, which represents the number of necklaces produced), the constant a represents the slope of this line, which in turn represents the "unit rate of increase," in other words, the increase in total cost for each individual necklace produced.

The constant b represents the "y-intercept" of this line, which in this case means the costs when $n = 0$ (that is, the fixed costs before any necklaces are produced).

7. A Algebra (lines) MEDIUM

To find the slope of line l , we can find two points on l and then use the slope formula.

$f(x) = 2x^2 - 4x + 1$
 Plug in -1 for x : $f(-1) = 2(-1)^2 - 4(-1) + 1$
 Simplify: $f(-1) = 2(1) + 4 + 1 = 2 + 4 + 1 = 7$
 Therefore line l intersects the function at $(-1, 7)$.
 Plug in 2 for x : $f(2) = 2(2)^2 - 4(2) + 1$
 Simplify: $f(2) = 2(4) - (8) + 1 = 8 - 8 + 1 = 1$
 Therefore line l intersects the function at $(2, 1)$. Now we find the slope of the line containing these two points.

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - 1}{-1 - 2} = \frac{6}{-3} = -2$$

8. B Advanced Mathematics (parabolas) MEDIUM

The general equation of a parabola in the xy -plane is $y = a(x - h)^2 + k$, in which (h, k) is the vertex. Now let's express each choice in precisely this form.

- (A) $y = (x - 3)^2 + 2$ $y = 1(x - 3)^2 + 2$ $a = 1, h = 3, k = 2$
- (B) $y = 2(x - 3)^2$ $y = 2(x - 3)^2 + 0$ $a = 2, h = 3, k = 0$
- (C) $y = 2x^2 - 3$ $y = 2(x - 0)^2 - 3$ $a = 2, h = 0, k = -3$
- (D) $y = 3x^2 + 2$ $y = 3(x - 0)^2 + 2$ $a = 3, h = 0, k = 2$

If this vertex is on the x -axis, then $k = 0$. The only equation in which $k = 0$ is (B).

9. D Advanced Mathematics (rational equations)

MEDIUM

$$\frac{m(x)}{x+3} - \frac{x+1}{x-1} = 1$$

Add $\frac{x+1}{x-1}$:

$$\frac{m(x)}{x+3} = \frac{x+1}{x-1} + 1$$

Express right side in terms of a common denominator:

$$\frac{m(x)}{x+3} = \frac{x+1}{x-1} + \frac{x-1}{x-1}$$

Combine terms on right into one fraction:

$$\frac{m(x)}{x+3} = \frac{x+1+x-1}{x-1}$$

Combine terms:

$$\frac{m(x)}{x+3} = \frac{2x}{x-1}$$

Multiply by $x+3$:

$$m(x) = \frac{2x(x+3)}{x-1}$$

10. C Algebra (linear relationships) MEDIUM

We are told that the temperature varies linearly with altitude, so if y represents the temperature (in $^{\circ}\text{C}$) and x represents altitude (in km), these variables are related by the equation $y = mx + b$, where m (the slope) and b (the y -intercept) are constants.

We are given two points on this line: $(50 \text{ km}, 10^{\circ})$ and $(80 \text{ km}, -80^{\circ})$. We can use these points to find the slope, m :

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{10 - (-80)}{50 - (80)} = \frac{90}{-30} = -3$$

Recall that the slope of a linear relationship is the "unit rate of change." In other words, the slope of -3 means that the temperature declines by 3° for every 1 km of additional altitude. Since we want the altitude at which the temperature is -50° , we want the value of x such that $(x, -50^{\circ})$ is on this line. To find x , we can simply use the slope formula again, using either of the other two points: Slope formula using $(50, 10)$ and $(x, -50)$:

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{10 - (-50)}{50 - x} = \frac{60}{50 - x} = -3$$

Multiply by $50 - x$:

$$60 = -3(50 - x)$$

Distribute:

$$60 = -150 + 3x$$

Add 150:

$$210 = 3x$$

Divide by 3:

$$70 = x$$

11. A Advanced Mathematics (triangles/quadratics)

MEDIUM-HARD

Any point that intersects the y -axis has an x -value of 0. So, to find point A , plug in 0 for x and solve for y :

$$y = 2x^2 - 16x + 14$$

Plug in 0 for x :

$$y = 2(0)^2 - 16(0) + 14 = 14$$

Any point that intersects the x -axis has a y -value of 0. So, to find points B and C , plug in 0 for y and solve for x :

$$y = 2x^2 - 16x + 14$$

Substitute 0 for y :

$$0 = 2x^2 - 16x + 14$$

Divide by 2:

$$0 = x^2 - 8x + 7$$

Factor:

$$0 = (x - 7)(x - 1)$$

Use the Zero Product Property:

$$x = 7 \text{ and } x = 1$$

If we connect these three points, we get a triangle with a height of 14 (from $y = 0$ to $y = 14$) and a base of 6 (from $x = 1$ to $x = 7$).

Use the triangle area formula $A = \frac{1}{2}bh$:

$$A = \frac{1}{2}bh = \frac{1}{2}(14)(6) = 42$$

12. B Advanced Mathematics (polynomials)

MEDIUM-HARD

Given equation:

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

To find the y -intercept, set $x = 0$:

$$y = (0 + 2)^2(0 - 3)^2$$

Simplify:

$$y = (2)^2(-3)^2 = (4)(9) = 36$$

Therefore the y -intercept is at $(0, 36)$.To find the x -intercepts, set $y = 0$:

$$0 = (x + 2)^2(x - 3)^2$$

By the Zero Product Property, the only solutions to this equation are $x = -2$ and $x = 3$, so there are two x -intercepts and a total of three x - and y -intercepts.

13. C Special Topics (complex numbers) HARD

$$A(2 - i) = 2 + i$$

Divide by $(2 - i)$:

$$A = \frac{2 + i}{2 - i}$$

Multiply numerator and denominator by the conjugate

 $(2 + i)$:

$$A = \frac{(2 + i)(2 + i)}{(2 - i)(2 + i)}$$

FOIL:

$$A = \frac{4 + 2i + 2i + i^2}{4 - i^2}$$

Combine terms:

$$A = \frac{4 + 4i + i^2}{4 - i^2}$$

Substitute $i^2 = -1$:

$$A = \frac{4 + 4i + (-1)}{4 - (-1)}$$

Simplify:

$$A = \frac{4 + 4i - 1}{4 + 1}$$

Combine terms:

$$A = \frac{3 + 4i}{5}$$

Distribute to express in standard $a + bi$ form:

$$A = \frac{3}{5} + \frac{4}{5}i$$

14. B Algebra (graphs of linear equations) HARD

Given equation:

$$y + x = k(x - 1)$$

Subtract x :

$$y = k(x - 1) - x$$

Distribute:

$$y = kx - k - x$$

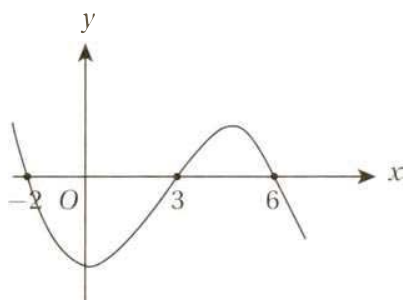
Collect like terms:

$$y = (k - 1)x - k$$

The slope of this line is $k - 1$ and its y -intercept is $-k$. If $k > 2$, then $k - 1 > 1$, and $-k < -2$. In other words, the slope of the line is greater than 1 and the y -intercept is less than -2 . The only graph with these features is the one in choice (B).

15. **B** **Advanced Mathematics (analyzing polynomial functions) HARD**

Because this polynomial has a degree of 3 (which is the highest power of any of its terms), it cannot have more than 3 zeros. These three zeros are given as -2 , 3 , and 6 . We also know that $g(0)$, the y -intercept of the graph, is negative. This gives us enough information to make a rough sketch of the graph.



This shows that the only values of x for which the function is negative are $-2 < x < 3$ and $x > 6$. Therefore the only negative value among the choices is (B) $g(-1)$.

16. **30** **Algebra (linear equations) EASY**

$$\frac{2}{3}x + \frac{1}{2}y = 5$$

Multiply by 6 (the common denominator):

$$6\left(\frac{2}{3}x + \frac{1}{2}y = 5\right)$$

Distribute:

$$\frac{12}{3}x + \frac{6}{2}y = 30$$

Simplify:

$$4x + 3y = 30$$

17. **25/7 or 3.57** **Advanced Mathematics (rational equations) EASY**

$$\frac{5}{x} - \frac{2}{5} = 1$$

Add $\frac{2}{5}$:

$$\frac{5}{x} = 1 + \frac{2}{5}$$

Simplify:

$$\frac{5}{x} = \frac{7}{5}$$

Cross multiply:

$$25 = 7x$$

Divide by 7:

$$\frac{25}{7} = x$$

18. **35** **Special Topics (radians and arcs) MEDIUM-HARD**

Since an arc is simply a portion of a circumference, let's first calculate the circumference of the circle:

$$C = 2\pi r = 2\pi(36) = 72\pi$$

Because arc AB has a measure of 7π , it is $\frac{7\pi}{72\pi} = \frac{7}{72}$ of the entire circumference. Since x° is the measure of the central angle that corresponds to this arc, it must be the same fraction of the whole:

$$\frac{x^\circ}{360^\circ} = \frac{7}{72}$$

Cross multiply:

$$72x = 7(360)$$

Divide by 72:

$$x = 7(5)$$

Simplify:

$$x = 35$$

19. **1.2** **Algebra (linear systems) MEDIUM-HARD**

First, we should simplify the

first equation:

$$\frac{1}{2}x = \frac{1}{3}y + \frac{1}{10}$$

Subtract $\frac{1}{3}y$:

$$\frac{1}{2}x - \frac{1}{3}y = \frac{1}{10}$$

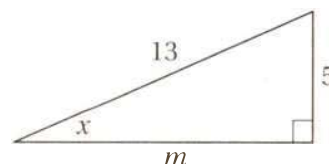
Multiply by 12:

$$6x - 4y = 1.2$$

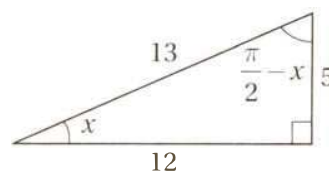
This equation represents a line with slope of $\frac{6}{4} = \frac{3}{2}$. The second equation, $6x - 4y = k$, also represents a line with slope $\frac{6}{4} = \frac{3}{2}$. In order for this system of equations to have at least one solution, these two lines must have an intersection. How can two lines with the same slope intersect? They must be identical lines, and therefore intersect in all of their points. If this is the case, then k must equal 1.2.

20. **2.4** **Special Topics (trigonometry) HARD**

Since x represents the radian measure of an acute angle, and $\sin x = \frac{5}{13}$, we can use the definition of sine $\left(= \frac{O}{H} \right)$ to draw a right triangle:



We might notice that this is a 5-12-13 special right triangle, or simply use the Pythagorean Theorem to show that $m = 12$. We can also show that the other acute angle in the triangle must be complementary to x (that is, together they form a right angle), and so must have a measure of $\frac{\pi}{2} - x$.



To find $\tan\left(\frac{\pi}{2} - x\right)$, we simply have to use the angle with measure $\frac{\pi}{2} - x$ as our new reference angle, and use TOA:

$$\tan\left(\frac{\pi}{2} - x\right) = \frac{12}{5} = 2.4$$

Section 4: Math (Calculator)

1. D Algebra (systems) EASY

When faced with a system of equations, notice whether the two equations can be combined in a simple way—either by subtracting or adding the corresponding sides—to get the expression the question is asking for.

$$a - b = 10$$

$$a - 2b = 8$$

Subtract corresponding sides:

$$b = 2$$

2. C Data Analysis (central tendency) EASY

The average of three numbers is 50: $50 = \frac{a + b + c}{3}$

Multiply by 3: $150 = a + b + c$

Two of the numbers have a sum of 85: $85 = a + b$

Substitute into the previous equation: $150 = 85 + c$

Subtract 85 to find c : $65 = c$

3. D Problem Solving/Data Analysis (proportions) EASY

Set up a proportion: $\frac{9}{25} = \frac{x}{225}$

Cross multiply: $2,025 = 25x$

Divide by 25: $81 = x$

4. B Data Analysis (tables) EASY

Let's fill in the table with the information we're given and work our way to the value the question asks us to find. First, use the information in the FAVORABLE column to determine how many women viewed the politician favorably:

$$26 + w = 59$$

Subtract 26: $w = 33$

Next, go to the WOMEN row: $33 + x + 13 = 89$

Combine terms: $46 + x = 89$

Subtract 46: $x = 43$

5. D Algebra (exponentials) EASY

$$2^{2n-2} = 32$$

When dealing with exponential equations, it helps to see if we can express the two sides of the equation in terms of the same base. Since $32 = 2^5$, we can express both sides in base 2:

$$2^{2n-2} = 2^5$$

If $x^a = x^b$ and $x > 1$, then $a = b$ (if the bases are equal, the exponents are equal): $2n - 2 = 5$

Add 2: $2n = 7$

Divide by 2: $n = \frac{7}{2} = 3.5$

6. C Algebra (representing quantities) EASY

The question asks us to find the "part-to-whole" ratio of walnuts: walnut fraction = $\frac{\text{ounces of walnuts}}{\text{ounces of nuts}}$.

Since the walnuts weigh x ounces, and the total weight of all the nuts is $x + 15 + 20 = x + 35$ ounces,

$$\text{walnut fraction} = \frac{x}{x + 35}$$

7. B Advanced Mathematics (triangle trigonometry) EASY

Remember the definitions of the basic trigonometric functions: SOH CAH TOA. Since the "side of interest" (k) is the OPPOSITE side to the given angle (35°), and since we know the length of the HYPOTENUSE (12), we should use SOH.

$$\sin x = \frac{\text{opp}}{\text{hyp}}$$

Plug in the values:

$$\sin 35^\circ = \frac{k}{12}$$

Substitute $\sin 35^\circ = 0.574$:

$$0.574 = \frac{k}{12}$$

Multiply by 12:

$$(12)(0.574) = 6.88 = k$$

8. A Special Topics (polygons) EASY

The sum of the measures of the interior angles of any polygon is $(n - 2)180^\circ$, where n is the number of sides in the polygon. Since this is a 5-sided polygon, the sum of its interior angles is $(5 - 2)(180^\circ) = 3(180^\circ) = 540^\circ$. Therefore the average of these measures is $540^\circ/5 = 108^\circ$.

9. B Data Analysis (scatterplot) MEDIUM

We want to find the slope of the line of best fit because it represents the average annual increase in revenue per store. Although the question asks about the years 2004 and 2012, we can choose ANY two points on this line to find its slope. We should choose points on the line of best fit that are easy to calculate with, such as (2005, \$300,000) and (2011, \$600,000).

$$\begin{aligned} \text{slope} &= \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{600,000 - 300,000}{2011 - 2005} \\ &= \frac{300,000}{6} = 50,000 \end{aligned}$$

10. C Data Analysis (scatterplot) MEDIUM-HARD

When faced with a question like this, we must analyze each statement individually.

(A) *The average revenue per store increased by over 100% from 2005 to 2009.* True or false? In 2005, according to the line of best fit, the average revenue per store was approximately \$300,000. In 2009, the average revenue per store was approximately \$500,000. This is a percent increase of

$$\frac{500,000 - 300,000}{300,000} \times 100\% = \frac{2}{3} \times 100\% = 67\%$$

FALSE

- (B) *The total number of retail stores increased by 50% from 2005 to 2012. True or false? According to the scatterplot, in 2005 there were 3 stores corresponding to the three dots above 2005. In 2012 there were 6 stores corresponding to the 6 dots above 2012. This is a percent increase of*

$$\frac{6-3}{3} \times 100\% = 100\%$$

FALSE

- (C) *The total revenue for all stores in 2012 is more than three times the total revenue from all stores in 2004. True or false? In 2004, there were 3 stores with an average revenue per store of approximately \$250,000. Therefore the total revenue in 2004 was approximately $3 \times \$250,000 = \$750,000$. In 2012, there were 6 stores with an average revenue per store of approximately \$650,000. Therefore the total revenue in 2012 was approximately $6 \times \$650,000 = \$3,900,000$. Since \$3,900,000 is more than three times \$750,000, this statement is TRUE.*

11. B Algebra (translating quantitative information) MEDIUM

This question tests your ability to translate words into algebraic expressions. Systematically translate the sentence phrase by phrase.

The product of two numbers, a and b is 6 greater than their sum.

Translation: $ab = 6 + a + b$

Use commutative law of equality

on right side: $ab = a + b + 6$

12. D Special Topics (coordinate geometry) MEDIUM

First, find the slope of l using the points $(0, -9)$ and $(12, 0)$:

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - (-9)}{12 - 0} = \frac{9}{12} = \frac{3}{4}$$

Since the two lines are parallel, line m must also have a slope of $\frac{3}{4}$. Now we can solve for k using the slope equation and the two points on line m , $(0, 0)$ and $(k, 12)$:

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{12 - (0)}{k - 0} = \frac{12}{k} = \frac{3}{4}$$

Cross multiply: $4(12) = 3(k)$

Simplify: $48 = 3k$

Divide by 3: $16 = k$

Notice that the coordinates of the point $(16, 12)$ correspond to the *width* and the *length* of the rectangle, respectively. Therefore, the area of the rectangle is $16 \times 12 = 192$ square units.

13. A Problem Solving/Data Analysis (ratios) MEDIUM

If the Giants' win-loss is 2:3, then they won $2n$ games and lost $3n$ games, where n is some unknown integer. (For instance, perhaps they won 2 games and lost 3, in which case $n = 1$, or perhaps they won 20 games and lost 30, in which case $n = 10$, etc.) This means that the total number of games they played is $2n + 3n = 5n$. Since they won 120 games,

$$5n = 120$$

Divide by 5:

$$n = 24$$

Therefore they won $2n = (2)(24) = 48$ games and lost $3n = (3)(24) = 72$ games, and so they lost $72 - 48 = 24$ more games than they won.

14. B Advanced Mathematics (exponential growth) MEDIUM

We might begin by plugging in a number for p . Let's say $p = 120$ cells to start. We are told that after one hour the population decreased by $\frac{1}{3}$. Since $\frac{1}{3}$ of 120 is

40, the population decreased by 40 and the population was then $120 - 40 = 80$ cells. In the second hour, the population *increased* by 40%. Increasing a number by 40% is equivalent to it by 1.40 (because it becomes 140% of what it was), so the population was then $80(1.40) = 112$ cells. In the third hour, the population *increased* by 50%, so it became $112(1.50) = 168$ cells.

Substituting $p = 120$ into each of the answer choices yields (A) $1.3p = 1.3(120) = 156$, (B) $1.4p = 1.4(120) = 168$, (C) $1.5p = 1.5(120) = 180$, and (D) $1.6p = 1.6(120) = 192$. Therefore the answer is (B).

Alternately, you can solve this problem algebraically: $p(2/3)(1.40)(1.50) = 1.40p$.

15. B Advanced Mathematics (exponentials) MEDIUM

For this one, we'll need the Laws of Exponentials from Chapter 9, Lesson 9.

$$(6^{-2})(m^{-2}) = \frac{1}{16}$$

Translate by using Exponential Law #3: $\frac{1}{6^2} \times \frac{1}{m^2} = \frac{1}{16}$

Multiply by m^2 : $\frac{1}{6^2} = \frac{1}{16} m^2$

Multiply by 16: $\frac{16}{6^2} = m^2$

Simplify: $\frac{16}{6^2} = \frac{16}{36} = \frac{4}{9} = m^2$

16. B Data Analysis (probability) MEDIUM

Let R = the number of red marbles, W = the number of white marbles, and B = the number of blue marbles. If

the jar contains twice as many red marbles as white marbles, then $R = 2W$. If the jar contains three times as many white marbles as blue marbles, then $W = 3B$. We can substitute numbers to these equations to solve the problem. Let's say $B = 10$. This means there are $3(10) = 30$ white marbles and $2(30) = 60$ red marbles. The total number of marbles is therefore $10 + 30 + 60 = 100$, and the number of non-red marbles is therefore $10 + 30 = 40$ marbles, so the probability that the marble is *not* red is $\frac{40}{100} = \frac{2}{5}$.

**17. C Advanced Mathematics (parabolas)
MEDIUM**

The vertex of a parabola with the equation $y = A(x - h)^2 + k$ is (h, k) . For this parabola, $h = 2$ and $k = 2$. So, the vertex is $(2, 2)$. The slope of the line that passes through $(1, -3)$ and $(2, 2)$ is

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 2}{-1 - 2} = \frac{1}{-3} = -\frac{1}{3}$$

**18. C Advanced Mathematics (functions)
MEDIUM-HARD**

Let the input number be 7.

Step 1: Multiply the input value by 6: 42

Step 2: Add x to that result: $42 + x$

Step 3: Divide this result by 4: $\frac{42 + x}{4}$

This must yield an output of 15: $15 = \frac{42 + x}{4}$

Multiply by 4: $60 = 42 + x$

Subtract 42: $18 = x$

19. C Data Analysis (graphing data) MEDIUM-HARD

The graph of the quadratic $y = ax^2 + bx + c$ is a parabola. If $a < 0$, the parabola is "open-down" like a frowny-face. The only graph with this feature is (C).

**20. B Algebra (expressing relationships)
MEDIUM-HARD**

Draw a number line, and to show that $p < r$, place p to the left of r on the number line. The points that are closer to p than to r are all the points to the left of their midpoint.

The midpoint is the average of the endpoints: $\frac{p+r}{2}$, so

if the point with coordinate x is closer to p than to r , then

$$x < \frac{p+r}{2}$$

**21. A Algebra (simplifying expressions)
MEDIUM-HARD**

$$f(x) = \frac{1}{2-x}$$

Substitute $\frac{1}{m}$ for x :

$$f\left(\frac{1}{m}\right) = \frac{1}{2 - \left(\frac{1}{m}\right)}$$

Simplify the denominator:

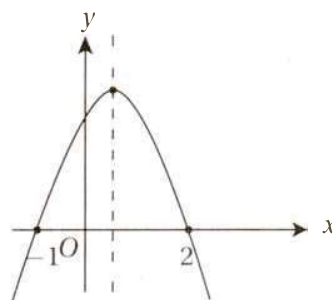
$$f\left(\frac{1}{m}\right) = \frac{1}{2 - \left(\frac{1}{m}\right)} = \frac{1}{\frac{2m}{m} - \frac{1}{m}} = \frac{1}{\frac{2m-1}{m}}$$

Divide by multiplying by the reciprocal:

$$1 \div \frac{2m-1}{m} = 1 \times \frac{m}{2m-1} = \frac{m}{2m-1}$$

**22. A Advanced Mathematics (quadratics)
MEDIUM-HARD**

The graph of $y = a(x - 2)(x + 1)$ is a quadratic with zeros (x -intercepts) at $x = 2$ and $x = -1$. The axis of symmetry of this parabola is halfway between the zeros, at $x = (2 + -1)/2 = 1/2$. Since $a < 0$, the parabola is "open down," and so we have a general picture like this:



If you trace the curve from $x = 0$ to $x = 5$, that is, from the y -intercept and then to the right, you can see that the graph goes up a bit (until $x = 1/2$), and then goes down again.

Alternately, you can pick a negative value for a (like -2) and graph the equation on your calculator.

**23. D Advanced Mathematics (rational equations)
HARD**

Given equation: $\frac{n^2 - 9}{n^2 + 3} = 1 - \frac{k}{n^2 + 3}$

Add $\frac{k}{n^2 + 3}$: $\frac{n^2 - 9}{n^2 + 3} + \frac{k}{n^2 + 3} = 1$

Combine the fractions into one: $\frac{n^2 - 9 + k}{n^2 + 3} = 1$

Multiply by $n^2 + 3$: $n^2 - 9 + k = n^2 + 3$

Subtract n^2 : $-9 + k = 3$

Add 9: $k = 12$

24. C Problem Solving (percentages) MEDIUM-HARD

Let p = the price per share of the stock. The cost of 200 of these shares (before commission) is therefore $200p$. With a 3% commission, the cost becomes $(1.03)(200p)$

$$(1.03)(200p) = \$3,399$$

Divide by 1.03: $200p = \$3,300$
 Divide by 200: $p = \$16.50$ per share

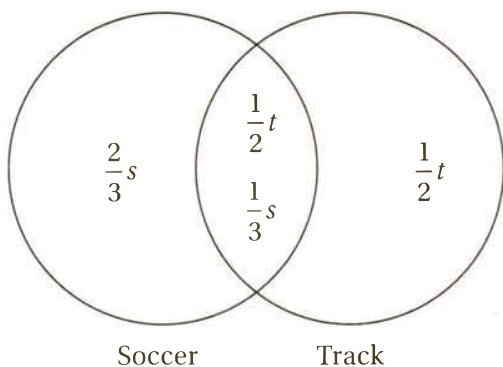
25. A Algebra (expressing quantities) MEDIUM-HARD

It may be easiest to choose number for w and y . Assume $y = 4$. If w is 50% greater than y , then $w = 1.5(4) = 6$. Therefore $w^{-2} = 6^{-2} = 1/36$, and $y^{-2} = 4^{-2} = 1/16$. Therefore the ratio of w^{-2} to y^{-2} is

$$\frac{\frac{1}{36}}{\frac{1}{16}} = \frac{1}{36} \times \frac{16}{1} = \frac{16}{36} = \frac{8}{18} = \frac{4}{9}$$

26. D Data Analysis (set relations) HARD

Let's let s = the total number of athletes in the group who play soccer, and t = the number of athletes in the group who run track. We can set up a Venn diagram to show the relationship between these two overlapping sets.



Since one-third of the soccer players also run track, we must put $\frac{1}{3}s$ in the overlapping region between soccer and track, and therefore the number who play only soccer is $\frac{2}{3}s$. Likewise, since one-half of the athletes who run track also play soccer, we must put $\frac{1}{2}t$ in the overlapping region, and therefore the number of athletes who only run track is $\frac{1}{2}t$.

Since there are 60 athletes in total: $\frac{2}{3}s + \frac{1}{2}t + \frac{1}{2}t = 60$

Simplify: $\frac{2}{3}s + t = 60$

Multiply by 3 to simplify: $2s + 3t = 180$

The number of soccer players who run track must equal the number of track athletes who play soccer: $\frac{1}{3}s = \frac{1}{2}t$

Multiply by 6 (the common denominator): $2s = 3t$

Substitute $2s = 3t$ into the previous equation: $3t + 3t = 180$

Simplify: $6t = 180$

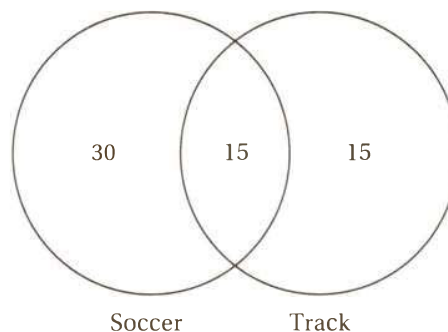
Divide by 6: $t = 30$

Substitute $t = 30$ into the other equation to solve for s : $2s = 3(30)$

Simplify: $2s = 90$

Divide by 2: $s = 45$

Now we can use these values to complete the Venn diagram:



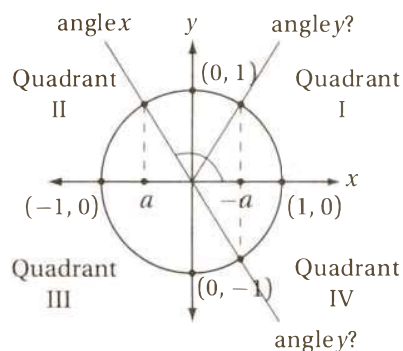
From this diagram, we can see that the only true statement among the choices is (D).

27. D Advanced Mathematics (transformations) HARD

The graph of $y = g(x) = f(x) + b$ is the graph of f vertically shifted up by b units. If $g(x) = 0$ has exactly one solution, the graph of $y = g(x)$ can touch the x -axis at only one point: the vertex. Since the vertex of f has a y -coordinate of -2 , this can only happen if f is shifted up 2 units, so $b = 2$.

28. B Special Topics (trigonometry) HARD

The statement $\frac{\pi}{2} < x < \pi$ indicates that x is an angle in quadrant II, where the cosine is negative. Let's draw this situation on the unit circle so we can visualize it. (We don't want to confuse the *angles* called x and y in the problem with the x -coordinates and y -coordinates in the xy -plane. For this reason, let's label the terminal rays for the angles "angle x " and "angle y ." Recall that the cosine of any angle is the x -coordinate of the point on the unit circle that corresponds to that angle. If $\cos x = a$, then a is the x -coordinate of the point on the unit circle that corresponds to "angle x ," as shown in the diagram.



Now notice that, since a is a negative number, $-a$ (that is, the *opposite* of a), is a *positive* number. More specifically, it is the reflection of the point labeled a over the x -axis, as shown in the diagram. Now, if $\cos y = -a$, then “angle y ” corresponds to a point on the unit circle with an x -coordinate of $-a$. There are two possible locations for this point on the circle, and both are shown in the diagram above. Notice that one of these angles is the reflection of “angle x ” over the y -axis. This is the supplement of “angle x ,” that is, $\pi - x$. The other is the reflection of “angle x ” over the origin, that is $x + \pi$. Therefore, the correct answer is (B).

Alternately, we could use the calculator to solve this problem by process of elimination. We can choose a value of “angle x ” between $\pi/2$ and π . (In radian mode this is an angle between 1.57 and 3.14, and in degree mode it is an angle between 90° and 180° .) Let’s pick “angle x ” to be 2 radians (about 115°). According to the calculator, $\cos(2) = -.416$. Therefore, $\cos y$ must equal $.416$. Now we can substitute $x = 2$ into all of the choices and see which angle has a cosine of $.416$.

- (A) $\cos(2 + 2\pi) = -.416$
 - (B) $\cos(2 + \pi) = .416$
 - (C) $\cos(2 + \pi/2) = -.909$
 - (D) $\cos(-2 + 2\pi) = -.416$
- Therefore the correct answer is (B).

29. A Data Analysis (table) HARD

Since the question asks about those “who expressed an opinion on Proposal 81a,” we must *ignore* those who are listed as having No Opinion.

The number at the bottom right of the table indicated that there were 4,407 total people surveyed. But 719 of those had No Opinion, so $4,407 - 719 = 3,688$ *did* have an opinion. What percentage of *those* are under 40? The answer is in the first row of the table (18 to 39): 917 of these Approve and 204 of these Disapprove. Therefore $917 + 204 = 1,121$ of those showing an opinion are under 40 years of age.

Therefore the percentage of those showing an opinion who are under 40 is $\left(\frac{1,121}{3,688}\right)100 = 30.4\%$

30. B Data Analysis (table) HARD

(A) The approval rate for Proposal 81a generally decreases with the age of the voter.

- Age 18 to 39: 918 out of 1,624 approve (56%)
- Age 40 to 64: 1,040 out of 1,644 approve (64%)
- Age 65 and older: 604 out of 1,139 approve (53%)

The approval rate increases and then decreases with age, so (A) is not correct.

(B) The disapproval rate for Proposal 81a generally increases with the age of the voter:

- Age 18 to 39: 204 out of 1,624 disapprove (13%)
- Age 40 to 64: 502 out of 1,644 disapprove (31%)

Age 65 and older: 420 out of 1,139 disapprove (37%)
 The disapproval rate INCREASES as age increases, therefore (B) is correct.

31. 1/5 or 0.2 Data Analysis (variation) MEDIUM

If y varies inversely as x : $y = \frac{k}{x}$

Substitute $\frac{1}{2} = y$ and $10 = x$: $\frac{1}{2} = \frac{k}{10}$

Cross multiply: $10 = 2k$
 Divide by 2: $5 = k$

Therefore the general equation is: $y = \frac{5}{x}$

Substitute $25 = y$: $25 = \frac{5}{x}$

Multiply by x : $25x = 5$

Divide by 25: $x = \frac{5}{25} = \frac{1}{5}$

32. 169 Advance Mathematics (quadratics) MEDIUM

Subtract 13: $x^2 + 12x - 13 = 0$

Factor: $(x + 13)(x - 1) = 0$

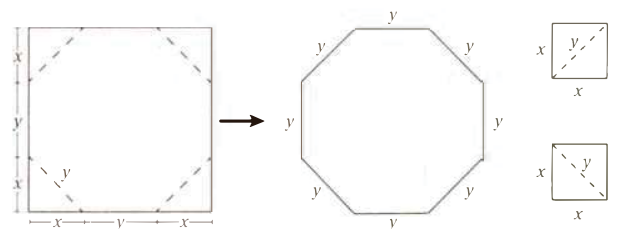
Use the Zero Product Property: $x = -13$ or $x = 1$

If $x < 0$, x must be -13 . Therefore $x^2 = (-13)^2 = 169$.

Alternately, if you have QUADFORM (a quadratic formula program) programmed into your calculator, select PROGRAM, QUADFORM, and input $a = 1$, $b = 12$ and $c = -13$ to find the zeros (-13 and 1).

33. 112 Special Topics (polygons) MEDIUM-HARD

Notice that the “cutouts” can be reassembled to form two squares with side x and diagonal y , leaving an octagon with perimeter $8y$.



Since each of the cutout triangles is a right triangle: $x^2 + x^2 = y^2$

Simplify: $2x^2 = y^2$

If the total area of the “cutouts” is 196 square centimeters: $2x^2 = 196$

Substitute $2x^2 = y^2$: $y^2 = 196$

Take square root: $y = 14$

Therefore the perimeter of the octagon is $8 \times 14 = 112$.

34. 16 Algebra (solving equations) HARD

Because $m^2 + n^2 = 40$, where m and n are both integers, we must look for two perfect squares that have a sum of 40. The perfect squares are 1, 4, 9, 16, 25, 36, 49, 64, 81, 100 . . . and the only two of these with a sum of 40 are 4 and 36. So either $m^2 = 4$ and $n^2 = 36$ or $m^2 = 36$ and $n^2 = 4$.

CASE 1: $m^2 = 4$ and $n^2 = 36$

Take square root: $m = \pm 2$ and $n = \pm 6$

Since $m < 0 < n$: $m = -2$ and $n = 6$

Evaluate $(m + n)^2$: $(m + n)^2 = (-2 + 6)^2 = 4^2 = 16$

CASE 2: $m^2 = 36$ and $n^2 = 4$

Take square root: $m = \pm 6$ and $n = \pm 2$

Since $m < 0 < n$: $m = -6$ and $n = 2$

Evaluate $(m + n)^2$: $(m + n)^2 = (-6 + 2)^2 = (-4)^2 = 16$

35. 1.4 Advanced Mathematics (trigonometry) MEDIUM-HARD

Recall the Pythagorean Trigonometric

Identity, which is true for all x : $\sin^2 x + \cos^2 x = 1$

Expression to be evaluated: $(\sin x + \cos x)^2$

FOIL: $(\sin x + \cos x)(\sin x + \cos x) = \sin^2 x +$

$2(\sin x)(\cos x) + \cos^2 x$

Rearrange with Commutative

and Associative Laws of

Addition: $2(\sin x)(\cos x) + (\sin^2 x + \cos^2 x)$

Substitute $\sin^2 x + \cos^2 x = 1$: $2(\sin x)(\cos x) + 1$

Substitute $(\sin x)(\cos x) = 0.2$: $2(0.2) + 1 = 1.4$

36. 115 Data Analysis (central tendency) MEDIUM

Begin by putting the data in order from least expensive to most expensive:

80 phones sold for \$98

40 phones sold for \$110

20 phones sold for \$120

62 phones sold for \$140

38 phones sold for \$162

We don't have to actually write out the prices of all 240 phones to find the median price. We can divide any set of 240 numbers, in ascending order, into two sets of 120 numbers. The median is in the middle of these, so it is the average of the 120th and 121st numbers. Since the first two categories account for $40 + 80 = 120$ of these numbers, the 120th number in the set is \$110, and the 121st number in the set is in the next higher category, \$120. The median price is therefore $(\$110 + \$120)/2 = \$115$.

37. 6.8 Problem Solving (extended thinking) HARD

If the height of the logo is to match the height of the banner, it must have a height of 4 feet. Let x be the corresponding length of the logo.

Since the logo has a height-to-length

ratio of 5:8:

$$\frac{5}{8} = \frac{4}{x}$$

Cross multiply:

$$5x = 32$$

Divide by 5:

$$x = 6.4$$

Since the banner is 20 feet long, there are $20 - 6.4 = 13.6$ feet in total for the side margins. If the logo is centered, then each margin is half this length, $13.6 \div 2 = 6.8$ feet.

38. 25 Problem Solving (extended thinking) HARD

The banner has dimensions of 20 feet by 4 feet, so its area is $20 \times 4 = 80$ square feet. If the company charges \$1.20 per square foot for the banner material, this cost is $80 \times \$1.20 = \96 . Based on the logo dimensions we determined in the previous problem, the area of the logo is $4 \times 6.4 = 25.6$ square feet. If the company charges \$2.50 per square foot for the logo, the cost per printed logo is $25.6 \times \$2.50 = \64 .

If the company charges a fixed cost of \$32 per banner, then the total cost of a banner with ONE logo would be $\$96 + \$64 + \$32 = \192 . The total cost of a banner with TWO logos would be $\$96 + \$64 + \$64 + \$32 = \$256$.

We can calculate the percent savings with the "percent change" formula, since we are considering a "change" from the more expensive banner to the less expensive banner.

$$\frac{192 - 256}{256} \times 100\% = \frac{-64}{256} \times 100\% = -25\%$$

Therefore the percent savings is 25%.

Section 5: Essay**Sample Response**

Reading Score: 8 out of 8

Analysis Score: 8 out of 8

Writing Score: 8 out of 8

In this essay, Steven Pinker examines the "moral panics" surrounding new forms of media and the supposed cognitive and moral decline they cause. His essay provides a measure of balance to our modern discussions of social media and instantaneous digital information. He supports his thesis, that "such panics often fail reality checks," with examples dating back as far as the 1950s, logical analysis, vibrant illustrative images, and touches of humor. He provides historical and scientific context for his claims and effectively encapsulates the broad misconceptions that cultural critics have about the relationship between modern media and the human brain. Although his argument could have been bolstered with more specific scientific support, his essay as a whole effectively argues for a reprieve from the hysteria about intellectual and moral decline allegedly caused by Twitter and Facebook.

Pinker makes use of "reductio ad absurdum," or indirect proof, to make his case. This technique proceeds by arguing that if the point to be refuted were true, it would lead necessarily to a contradiction, and therefore it

cannot be true. For instance, Pinker hints at this logical technique in the second paragraph: “When comic books were accused of turning juveniles into delinquents in the 1950s, crime was falling to record lows, just as the denunciations of video games in the 1990s coincided with the great American crime decline.” Here, Pinker is suggesting that sociological and psychological evidence refutes claims of social decline.

He uses *reductio ad absurdum* even more explicitly in the third paragraph: “If electronic media were hazardous to intelligence, the quality of science would be plummeting. Yet discoveries are multiplying like fruit flies, and progress is dizzying. Other activities in the life of the mind, like philosophy, history and cultural criticism, are likewise flourishing.” Unfortunately, Pinker does not provide substantial evidence to bolster these claims. He fails to address the common counterclaim that much of the “science” published on the Internet is flimsy, and the “cultural criticism” lazy.

Pinker then goes on to outline a basic lesson in human information processing, in an attempt to ground his argument in science. To Pinker, the claim that “information can change the brain” is facile (“it’s not as if the information is stored in the pancreas”) and misleading (“the existence of neural plasticity does not mean the brain is a blob of clay pounded into shape by experience”). Rather, Pinker suggests, “the effects of experience are highly specific to the experiences themselves. . . . Music doesn’t make you better at math; conjugating Latin doesn’t make you more logical; brain-training games don’t make you smarter.” Unfortunately, Pinker here seems to mistake assertion for argumentation. He is directly contradicting the claims of thousands of music and Latin teachers, as well as dozens of Lumosity commercials. But he is only gainsaying. Here again, we might expect some data to support his points.

Next, Pinker attempts to refute cultural critics by drawing analogies between their reasoning and the faulty reasoning of “primitive peoples” who believe that “eating fierce animals will make them fierce.” He likens this to the thinking of modern observers who believe that “reading bullet points and Twitter postings turns your thoughts into bullet points and Twitter postings.” But of course just because one line of reasoning parallels another does not mean that both are equally incorrect. Here again, Pinker’s argument would benefit from information about the actual cognitive effects of reading Twitter feeds.

Next, Pinker provides a qualification: “Yes, the constant arrival of information packets can be distracting or addictive, especially to people with attention deficit disorder.” But here again, even in conceding a point, Pinker doesn’t quite offer the information a reader might want: How significant is this distraction or addiction, and does it have any harmful long-term effects? We don’t get this information from Pinker, but we do get some practical

advice: “Turn off e-mail or Twitter when you work . . .” We get even more substantial advice in the next paragraph: to cultivate “intellectual depth,” we must avail ourselves of “special institutions, which we call universities” and engage in “analysis, criticism, and debate.” But why, a reader might wonder, should we moderate our use of electronic media if it doesn’t have any real harmful effects?

Finally, Pinker ends with a broader perspective and a note of hope: “the Internet and information technologies are helping us manage, search, and retrieve our collective intellectual output. . . . Far from making us stupid, these technologies are the only things that will keep us smart.” Perhaps Pinker is right, but his argument would be stronger with more substantial quantitative evidence and more direct refutation of our real concerns about how the Internet might be changing our brains.

Scoring

Reading—8 (both readers gave it a score of 4)

This response demonstrates extremely thorough comprehension of Pinker’s essay through skillful use of summary, paraphrase, and direct quotations. The author summarizes Pinker’s central thesis and modes of persuasion (*His thesis, that “such panics often fail reality checks,” is supported with examples dating back as far as the 1950s, careful logical analysis, vibrant illustrative images, and touches of humor*) and shows a clear understanding of Pinker’s supporting ideas and overall tone (*He provides historical and scientific context for his claims and effectively encapsulates the broad misconceptions that cultural critics have about the relationship between modern media and the human brain. . . . Pinker ends with a broader perspective and a note of hope*). Each quotation is accompanied by insightful commentary that demonstrates that this author thoroughly understands Pinker’s central and secondary ideas, and even recognizes when Pinker seems occasionally to fall short of his own purpose.

Analysis—8 (both readers gave it a score of 4)

This response provides a thoughtful and critical analysis of Pinker’s essay and demonstrates a sophisticated understanding of the analytical task. The author has identified Butler’s primary modes of expression (*logical analysis, vibrant illustrative images, and touches of humor*) and has even provided a detailed examination of Pinker’s preferred logical method, *reductio ad absurdum*, with a discussion of several examples. Perhaps even more impressively, the author indicates where Pinker’s evidence falls short, providing critical analysis and suggesting alternatives (*Unfortunately, Pinker does not provide substantial evidence to bolster these claims. He doesn’t address the common counterclaim that much*

of the “science” published on the Internet is flimsy, and the “cultural criticism” lazy. . . . Pinker here seems to mistake assertion for argumentation. . . . Here again, Pinker’s argument would benefit from information about the actual cognitive effects of reading Twitter feeds). Overall, the author’s analysis of Pinker’s essays demonstrates a thorough understanding not only of the rhetorical task that Pinker has set for himself, but also the means by which it is best accomplished.

Writing—8 (both readers gave it a score of 4)

This response shows a masterful use of language, sentence structure to establish a clear and insightful central claim (*Although his argument could have been bolstered with more specific scientific support, his essay as a whole*

effectively argues for a reprieve from the hysteria about intellectual and moral decline allegedly caused by Twitter and Facebook). The response maintains a consistent focus on this central claim and supports it with a well-developed and cohesive analysis of Pinker’s essay. The author demonstrates effective verb choice (*effectively encapsulates the broad misconceptions. . . . He likens this to the thinking of modern observers*), strong grasp of relevant analytical terms, like *reduction ad absurdum*, *facile*, *sociological and psychological evidence*, *counterclaim*, *assertion*, *argumentation*, and *gainsaying*. The response is well-developed, progressing from general claim to specific analysis to considered evaluation. Largely free from grammatical error, this response demonstrates strong command of language and proficiency in writing.