



Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

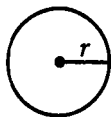
DIRECTIONS

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

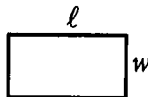
1. The use of a calculator is not permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated,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

REFERENCE

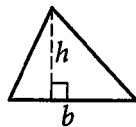


$$A = \pi r^2$$

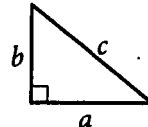
$$C = 2\pi r$$



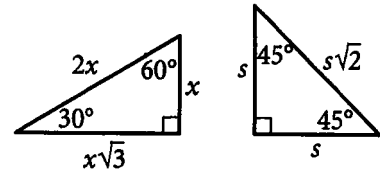
$$A = \ell w$$



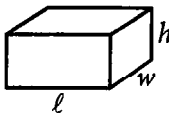
$$A = \frac{1}{2}bh$$



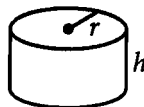
$$c^2 = a^2 + b^2$$



Special Right Triangles



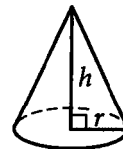
$$V = \ell wh$$



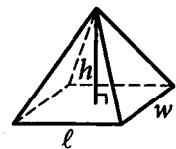
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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.



1

Lardarius spent a total of \$200 to lease snowboard equipment at Winter Mountain during his vacation. Each day of his vacation, he purchased a lift ticket for \$44. If Lardarius purchased t lift tickets, how much money, in dollars, did Lardarius spend during his vacation at Winter Mountain on snowboard equipment and lift tickets?

- A) $44t$
- B) $200 + 11t$
- C) $200 + 44t$
- D) $200 + 176t$

2

Which of the following expressions is equivalent to $3q^2 + r^3 + 5r - 8q + 2(q^2 + r)$?

- A) $7r^3 - 3q^4$
- B) $r^3 + 5q^2 - qr$
- C) $r^3 + 5q^2 - 8q + 6r$
- D) $r^3 + 5q^2 - 8q + 7r$

3

Which of the following equations represents the line in the xy -plane that passes through $(0, 3)$ and has a slope of -3 ?

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

4

$$2(x + b) = ax + c$$

In the equation above, a , b , and c are constants. If the equation has infinitely many solutions, which of the following must be equal to c ?

- A) a
- B) b
- C) $2a$
- D) $2b$



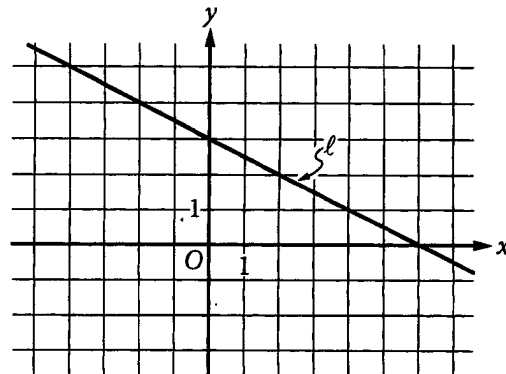
5

Which of the following is equivalent to

$$(2x + 4)^2 - 4x^2 ?$$

- A) $16(x + 1)$
- B) $8(x + 2)$
- C) $4(4x + 1)$
- D) $2(8x + 1)$

6



Line l is shown in the xy -plane above. Which of the following is an equation of line l ?

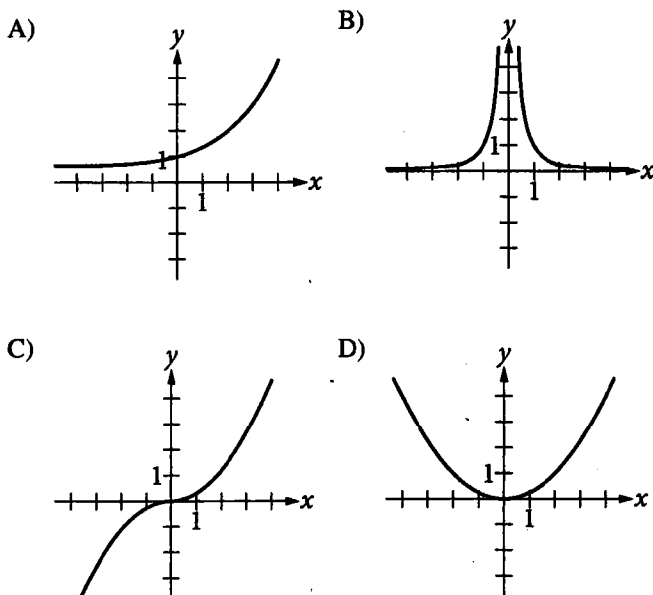
- A) $x + 2y = 6$
- B) $2x - y = 6$
- C) $6x + 3y = 0$
- D) $6x - 3y = 0$



7

x	$f(x)$
1	a
2	b
3	c

For the function f , the table above shows some values of x and their corresponding values of $f(x)$ in terms of the constants a , b , and c . If $a < b < c$, which of the following could NOT be the graph of $y = f(x)$ in the xy -plane?



8

If $3x - 6y = 9z$, which of the following expressions is equivalent to $x^2 - 4xy + 4y^2$?

- A) $9z$
- B) $3z^2$
- C) $9z^2$
- D) $81z^2$

9

$$x^2 - 4x + 2 = 0$$

Which of the following is a solution to the equation above?

- A) $x = -2 + \sqrt{2}$
- B) $x = -2 + \sqrt{6}$
- C) $x = 2 + \sqrt{2}$
- D) $x = 2 + \sqrt{6}$



10

$$f(n) = 5.77(0.98^n)$$

The function above can be used to estimate the number of farms, $f(n)$, in millions, in the United States for $0 \leq n \leq 72$, where n is the number of years after 1940. Which of the following is the best interpretation of the number 5.77 in this context?

- A) The estimated number of farms, in millions, in 1940
- B) The estimated number of farms, in millions, n years after 1940
- C) The estimated decrease in the number of farms, in millions, each year after 1940
- D) The estimated percent by which the number of farms decreased from each year to the next after 1940

11

$$y = x^2$$

$$y = 2x + 3$$

The system of equations above is graphed in the xy -plane. The graphs of the equations intersect at a point (x, y) where $x > 0$ and $y > 0$. What is the y -coordinate of this point of intersection?

- A) 1
- B) 3
- C) 5
- D) 9

12

Which of the following is a solution to the equation $4x^2 + 4x - 3 = 0$?

- A) -1.5
- B) -0.5
- C) 1
- D) 3

13

The equation $p = 14.7 + 0.439d$ approximates the pressure p , in pounds per square inch, exerted on a diver at a depth of d feet (ft) below the surface of the water. What is the increase in depth that is necessary to increase the pressure by 1 pound per square inch?

- A) $\frac{1}{0.439}$ ft
- B) $\frac{1}{14.7}$ ft
- C) 0.439 ft
- D) 14.7 ft



14

If $\frac{4x + 4x + 4x + 4x}{4} = 4$, what is the value of $4x$?

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

15

In the xy -plane, the points $(2, 4)$ and $(-2, -4)$ are the endpoints of a diameter of a circle. Which of the following is an equation of the circle?

- A) $(x - 2)^2 + (y + 4)^2 = 80$
- B) $(x - 2)^2 + (y + 4)^2 = 20$
- C) $x^2 + y^2 = 80$
- D) $x^2 + y^2 = 20$



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 $7/2$. (If $\begin{array}{|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \end{array}$ is entered into the grid, 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. →

← Fraction line

← Decimal point

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

7	/	1	2
●	●	●	●
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
8	8	8	8
9	9	9	9

Answer: 2.5

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

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

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

.	6	6	6
●	●	●	●
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	●	●	●
7	7	7	7

.	6	6	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
7	7	7	●

Answer: 201 – either position is correct

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

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

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



16

In the xy -plane, line k passes through the point $(3, 1)$ and is parallel to the line with equation $y = \frac{5}{2}x - \frac{7}{2}$.

What is the slope of line k ?

17

$$\begin{aligned} 2x + 3y &= 4 \\ y &= 2x \end{aligned}$$

If the ordered pair (x, y) satisfies the system of equations above, what is the value of x ?

18

$$\frac{1}{x-8} = -\frac{1}{x-9}$$

What value of x satisfies the equation above?

19

The two acute angles of a right triangle have degree measures of x and y . If $\sin x = \frac{5}{13}$, what is the value of $\cos y$?

20

$$(15 - 4i)(6 - 3i) = a + bi$$

In the equation above, a and b are real numbers and $i = \sqrt{-1}$. What is the value of a ?

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

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

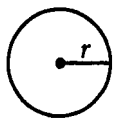
DIRECTIONS

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

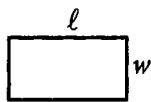
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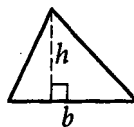


$$A = \pi r^2$$

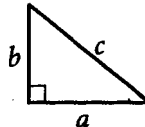
$$C = 2\pi r$$



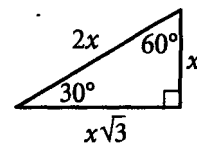
$$A = \ell w$$



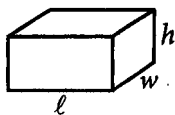
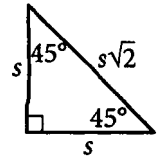
$$A = \frac{1}{2}bh$$



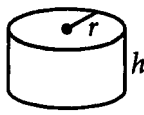
$$c^2 = a^2 + b^2$$



Special Right Triangles



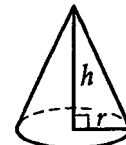
$$V = \ell wh$$



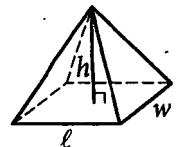
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}\ell wh$$

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

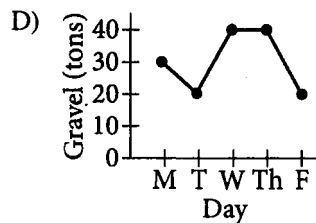
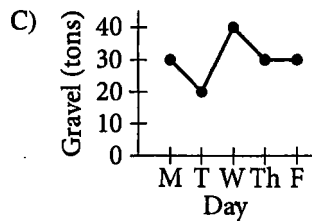
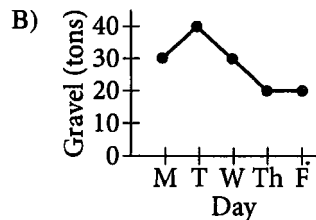
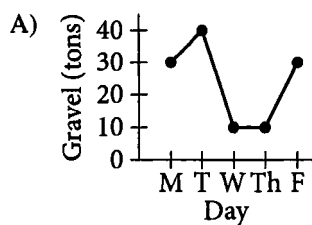
The number of radians of arc in a circle is 2π .

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



1

A gravel company had 30 tons of gravel in stock at the end of the day on Monday. On Tuesday the company shipped 10 tons of gravel and received no deliveries. On Wednesday the company made no shipments and received a delivery of 20 tons of gravel. On Thursday the company made no shipments and received no deliveries. On Friday the company shipped 20 tons of gravel and received no deliveries. Which of the following represents the number of tons of gravel the company had in stock at the end of each day?



2

If $\sqrt{2x} = 8$, what is the value of x ?

- A) 4
- B) 8
- C) 32
- D) 64

3

If $10 = 2x + 14$, which of the following must be true?

- A) $4x = 8$
- B) $10x = 16$
- C) $8x = -16$
- D) $12x = -144$



4

The hardcover books produced by a publisher have pages that are 0.1 millimeter thick and a front cover and a back cover that each are 2 millimeters thick. Which of the following gives the total thickness $f(n)$, in millimeters, of a closed book that has n pages?

- A) $f(n) = 4 + 0.1n$
- B) $f(n) = 2 + 0.1n$
- C) $f(n) = 0.4 + 0.1n$
- D) $f(n) = 0.2 + 0.1n$

5

A teacher has signed up for a program that automatically delivers books for the classroom library. The classroom library currently consists of 48 books. If the program delivers 12 books a month, how many books will the classroom library consist of after 5 months?

- A) 240
- B) 108
- C) 65
- D) 60

6

The area enclosed by a circle is 25π square inches. What is the length, in inches, of the radius of the circle?

- A) 2.5
- B) 5
- C) 10
- D) 12.5

7

An analysis of a random sample of a type of laptop computer battery estimated that the mean working time was 4.7 hours with a margin of error of 0.7 hours. Which of the following is the most appropriate conclusion based on this analysis?

- A) This type of laptop computer battery has a mean working time of at least 4.7 hours.
- B) This type of laptop computer battery has a mean working time of at least 5.7 hours.
- C) This type of laptop computer battery has a mean working time of between 4.0 and 5.4 hours.
- D) This type of laptop computer battery has a mean working time of between 0.0 and 0.7 hours.



8

$$y = 2x + 7$$

An equation of line ℓ in the xy -plane is shown above. Another line, k , has a slope equal to double the slope of ℓ and a y -intercept equal to double the y -intercept of ℓ . At which point (x, y) do lines ℓ and k intersect?

- A) $\left(-\frac{7}{2}, 0\right)$
- B) $\left(-\frac{2}{7}, 0\right)$
- C) $\left(0, \frac{2}{7}\right)$
- D) $\left(0, \frac{7}{2}\right)$

9

In normal weather conditions, a particular type of jet burns an average of 2.4 gallons of fuel per nautical mile flown. The distance from New York to Los Angeles is about 2,100 nautical miles. Approximately how many gallons of fuel will the jet burn for a trip from New York to Los Angeles in normal weather conditions?

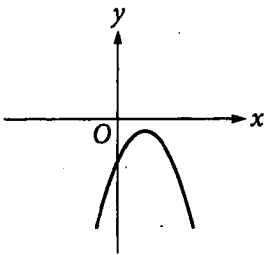
- A) 900
- B) 1,200
- C) 5,000
- D) 7,000



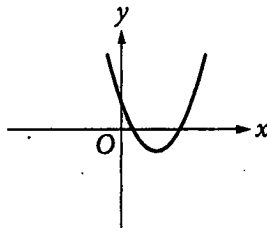
10

The quadratic function f is defined by $f(x) = 2(x + 2)^2 - 1$. In the xy -plane, which of the following could be the graph of $y = f(x)$ shifted 3 units to the right?

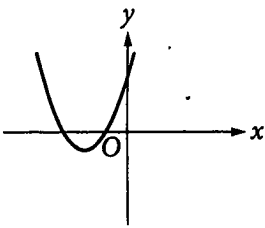
A)



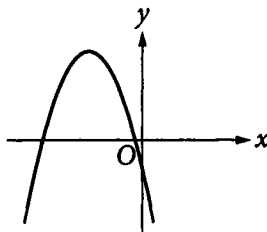
B)



C)



D)



11

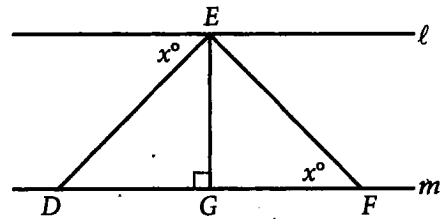
$$5x + 2y = 22$$

$$4x + y = 17$$

In the system of equations above, what is the value of $x + y$?

- A) 5
- B) 4
- C) 3
- D) 2

12



Note: Figure not drawn to scale.

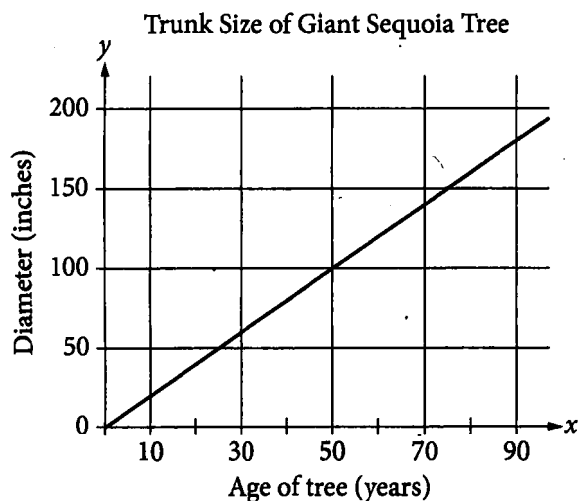
In the figure above, line ℓ is parallel to line m . If $x = 40$, what is the measure of $\angle DEF$?

- A) 140°
- B) 100°
- C) 80°
- D) 50°



Questions 13-15 refer to the following information.

Under the right conditions, giant sequoia trees are the fastest-growing conifer on Earth. In good growing conditions, a giant sequoia tree will form a 1-inch growth ring each year, increasing the size of its trunk diameter by 2 inches per year. This relationship is represented in the graph below. A giant sequoia tree can also grow 4 feet vertically every three years.



13

Which of the following equations represents the relationship between the diameter, in inches, of a giant sequoia tree's trunk and that tree's age, in years?

- A) $y = x - 2$
- B) $y = x + 2$
- C) $y = \frac{1}{2}x$
- D) $y = 2x$

14

Assuming good growing conditions, how many years old is a giant sequoia tree with a trunk diameter of 19 feet? (1 foot = 12 inches)

- A) 9.5
- B) 38
- C) 114
- D) 494

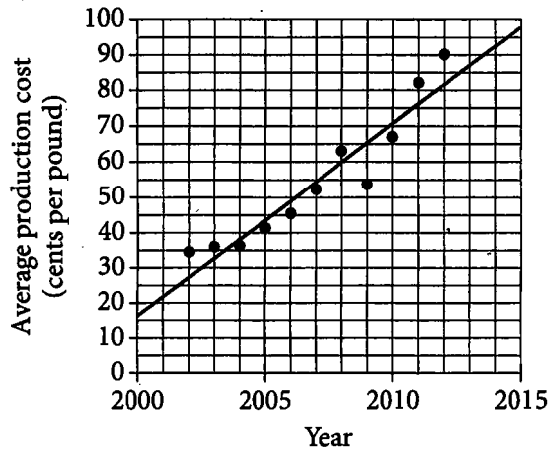
15

The linear model $z = \frac{4}{3}w$ can be used to find the height, in feet, of a giant sequoia tree. What does w represent?

- A) The age of the tree, in years
- B) The height of the tree, in feet
- C) The amount, in feet, the tree grows in one year
- D) The amount, in feet, the tree grows in three years



16



The scatterplot above shows the average production cost, in cents per pound, of coffee in Ecuador for the years from 2002 to 2012. A line of best fit is also drawn. Which of the following is closest to the difference, in cents per pound, between the actual average production cost in 2012 and the average production cost in 2012 predicted by the given line of best fit?

- A) 4
- B) 8
- C) 16
- D) 50

17

Emma mows grass at a constant rate of 1.5 acres per hour. She mowed 2 acres before lunch and plans to spend t hours mowing after lunch. If Emma wants to mow at least 8 acres of grass today, which of the following inequalities best represents this situation?

- A) $1.5t \geq 8$
- B) $1.5t - 2 \geq 8$
- C) $1.5t + 2 \geq 8$
- D) $2t + 1.5 \geq 8$

18

$$kx + y = 1$$

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

In the system of equations above, k is a constant. When the equations are graphed in the xy -plane, the graphs intersect at exactly two points. Which of the following CANNOT be the value of k ?

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

19

Of 100 people who played a certain video game, 85 scored more than 0 but less than 10,000 points, 14 scored between 10,000 and 100,000 points, and the remaining player scored 5,350,000 points. Which of the following statements about the mean and median of the 100 scores is true?

- A) The mean is greater than the median.
- B) The median is greater than the mean.
- C) The mean and the median are equal.
- D) There is not enough information to determine whether the mean or the median is greater.



Questions 20-22 refer to the following information.

In spring 2015, three separate studies on the fitness level of tenth graders were conducted in the city of Mistwick. In each study, every student in a group of tenth graders took the same fitness test and received a score on it. The possible scores on the fitness test are the whole numbers from 50 to 100, inclusive. The distribution of the scores for each of the studies is shown in the table below.

Score range	Study I	Study II	Study III
50–59	24	50	88
60–69	36	67	67
70–79	22	52	65
80–89	11	14	41
90–100	7	17	39
Mean score	68.6	68.7	70.4
Total number of participants	100	200	300

The participants for the studies were selected as follows.

- For Study I, 100 tenth graders were selected at random from all tenth graders in Mistwick.
- For Study II, 200 tenth graders were selected at random from all tenth graders in Mistwick.
- For Study III, 300 tenth graders from Mistwick volunteered to participate.

No tenth grader participated in more than one of the three studies.

20

What percent of all the scores reported in the three studies were in the 50–59 range?

- A) 24%
- B) 25%
- C) 26%
- D) 27%

21

Which of the following could be the median score in Study III?

- A) 59
- B) 68
- C) 70
- D) 82

22

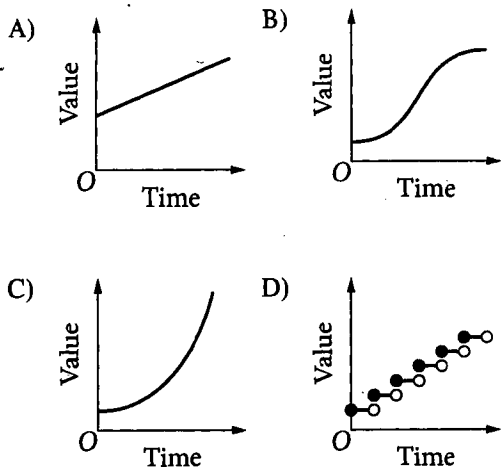
The results of which of the studies can appropriately be generalized to all tenth graders in Mistwick in spring 2015?

- A) Study III only
- B) Studies I and II only
- C) Studies II and III only
- D) Studies I, II, and III



23

In 1789, Benjamin Franklin gave an amount of money to Boston, Massachusetts. The money was to be invested for 100 years in a trust fund. If the value of the trust fund doubled every n years, which of the following graphs best models the value of the trust fund over time for the 100 years?



24

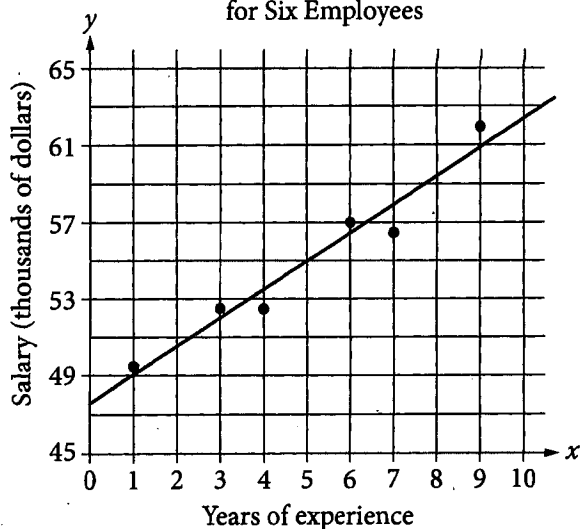
$$x(x+1) + 2(x+1) = ax^2 + bx + c$$

In the equation above, a , b , and c are constants. If the equation is true for all values of x , what is the value of $a + b + c$?

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

25

Salary and Years of Experience
for Six Employees



The scatterplot above represents the salary y , in thousands of dollars, and the number of years of experience, x , for each of six employees at a company. A line of best fit for the data is also shown. Which of the following could be an equation of the line of best fit?

- A) $y = \frac{3}{2}x$
B) $y = \frac{3}{2}x + \frac{95}{2}$
C) $y = \frac{2}{3}x + \frac{95}{2}$
D) $y = \frac{2}{3}x + 55$



26

$$y = (x - h)^2(x + h)(x + k)$$

The equation above is graphed in the xy -plane. If h and k are positive constants and $h \neq k$, how many distinct x -intercepts does the graph have?

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

27

A signal from a spacecraft orbiting Mercury travels to Earth at a speed of 3×10^8 meters per second. If the distance between Earth and the spacecraft is 2.0221×10^8 kilometers, which of the following is closest to the number of minutes it will take for a signal from the spacecraft to reach Earth?

(1 kilometer = 1,000 meters)

- A) 1
- B) 5
- C) 11
- D) 67

28

$$a(-3x - 1) + x = 7x - 2$$

The equation above has no solutions, and a is a constant. What is the value of a ?

- A) $-\frac{7}{3}$
- B) -2
- C) 0
- D) 2



29

The table below shows the number of lakes in the United Kingdom classified by alkalinity and depth.

Depth class	Alkalinity class			
	Low	Medium	High	Total
Shallow	87	61	209	357
Moderate	227	86	110	423
Deep	130	35	21	186
Total	444	182	340	966

If a lake has high alkalinity, which of the following is closest to the probability that the lake also has a shallow depth?

- A) 0.22
- B) 0.37
- C) 0.59
- D) 0.61

30

Radioactive substances decay over time. The mass M , in grams, of a particular radioactive substance d days after the beginning of an experiment is shown in the table below.


Number of days, d	Mass, M (grams)
0	120.00
30	103.21
60	88.78
90	76.36

If this relationship is modeled by the function $M(d) = a \cdot 10^{bd}$, which of the following could be the values of a and b ?

- A) $a = 12$ and $b = 0.0145$
- B) $a = 12$ and $b = -0.0145$
- C) $a = 120$ and $b = 0.0022$
- D) $a = 120$ and $b = -0.0022$


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 7/2. (If  is entered into the grid, 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.

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

Write answer in boxes. →

← Fraction line

Grid in result.

Answer: 2.5

← Decimal point

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

Answer: 201 – either position is correct

NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



31

A scale drawing of a room uses the scale 2 centimeters = 1 foot. In the drawing, one wall has a length of 22 centimeters. What is the actual length, in feet, of this wall?

32

The function f has the property that, for all x , $3f(x) = f(3x)$. If $f(6) = 12$, what is the value of $f(2)$?

33

$$p = 9n - (2n + k)$$

The profit p , in dollars, from producing and selling n units of a certain product is given by the equation above, where k is a constant. If 200 units are produced and sold for a profit of \$1275, what is the value of k ?

34

The numbers of people, in millions, who visited Amusement Park A and Amusement Park B in 2009 through 2013 are listed in the table below. What is the positive difference between the mean number of people, in millions, who visited Amusement Park B and the mean number of people, in millions, who visited Amusement Park A during those years? (Round your answer to the nearest tenth.)

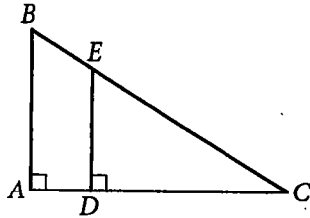
Location	2009	2010	2011	2012	2013
Amusement Park A	15.7	15.2	14.4	14.1	12.3
Amusement Park B	15.9	16.0	16.1	16.0	16.2

35

Lines t and w are parallel in the xy -plane. The equation of line t is $4x + 7y = 14$, and line w passes through $(-3, 8)$. What is the value of the y -intercept of line w ?



36



Note: Figure not drawn to scale.

In the figure above, ABC and DEC are right triangles. If $CD = 20$ and the tangent of angle ABC is 2.5, what is the length of segment ED ?

Questions 37 and 38 refer to the following information.

Recommended Daily Intake of Potassium

Age	Potassium (mg)
0–6 months	400
7–11 months	700
1–3 years	3,000
4–8 years	3,800
9–13 years	4,500
14–17 years	4,700
18 years and up	4,700

The table above shows the recommended amount of potassium, in milligrams (mg) per day, for people of all ages according to the National Academy of Medicine.

37

Andrea's recommended daily intake of potassium is 50% greater than that of her two-year-old brother. What is the least possible age, in years, of Andrea?

38

The recommended daily intake of potassium for an eight-month-old child is what fraction of that recommended for a two-year-old child?

STOP

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