MATH HARD BOOK

Version 2

All SAT Hard Math
Questions Collection

+130 questions added

You will never walk alone...!

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Introduction

Welcome to the Math Hard Book by @satashkent.

Many SAT Math questions available online focus on building basic skills. However, the questions that truly separate **700+** scorers from **750–800** scorers are fewer, more demanding, and require a deeper level of reasoning. These high-difficulty questions are often scattered across different sources and mixed with easier material, making focused advanced practice difficult.

To address this, the SATashkent R&D team created the **Math Hard Book**—a carefully curated collection of the hardest real SAT Math questions from past exams, selected to reflect upper-bound exam difficulty. Every question in this book is chosen to test precision, logical depth, and exam readiness rather than routine procedures.

Instead of dividing questions by individual topics, the Hard Book is organized into four SAT Math-specific chapters, reflecting how difficulty appears on the actual Digital SAT:

- Algebra
- Advanced Math
- Geometry and Trigonometry
- Problem Solving and Data Analysis

This structure trains students to work with mixed concepts, adapt quickly, and maintain accuracy under pressure.

Each chapter contains **real exam–level hard questions** along with an answer sheet to help you evaluate performance, analyze mistakes, and identify recurring advanced patterns. Consistent practice with these sets will strengthen problem-solving skills, reduce careless errors, and build confidence for the most challenging parts of the exam.

Our goal is to support students who are serious about pushing their SAT Math scores to the next level.

How to use this book?

Step 1: Open the book. Don't be scared if it looks tough — you're here to learn.

Step 2: Pick 10 random questions from all 4 chapters as a mini-diagnostic test and spot your weak points.

Step 3: Go to your weakest chapter and work through it step-by-step, then check your answers.

Step 4: Don't just check — learn the pattern. If needed, ask ChatGPT, your support teachers, or your head teacher.

Step 5: Memorize! Mark the questions that got you and revisit them — because on exam day you want the moment:

"Wait, wait... I have seen this one before." (Leonardo DiCaprio pointing)

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Algebra

Algebra

1.
In the xy-plane, line k and the line l are perpendicular and intersect at the point $(2,8)$. If line k is defined by the equation $y = mx + b$, where m and b are constants and $m > 1$, which of the following points lies on line l?

A $(3, 8 - \frac{1}{m})$

B $(3, 8 + \frac{1}{m})$

C $(3, 8 - m)$

D $(3, 8 + m)$

2.
Kyle invented a new temperature scale he called the Tutorllini scale. The function $T(x)$ gives the temperature, in degrees Torte, that corresponds to a temperature of x degrees Celsius.

$$T(x) = \frac{3}{4}\left(\frac{26x}{7} - 800\right) + 15.50$$

If a temperature increased by 3.3 degrees Torte, by how much did the temperature increase, in degrees Celsius?

3.
In the given system of equations, p is a constant. If the system has no solution, what is the value of p?

$$\frac{3}{2}y - \frac{1}{4}x = \frac{2}{3} - \frac{3}{2}y$$
$$\frac{1}{6}x + \frac{3}{6} = py + \frac{9}{5}$$

4.
In the given system of equations, t is a constant. If the system has no solution, what is the value of t?

$$4x - 6y = 10y + 2$$
$$ty = \frac{1}{2} + 2x$$

5.

$$\frac{20}{p} = \frac{20}{q} - \frac{20}{r} - \frac{20}{s}$$

The given equation relates the positive variables p, q, r, and s. Which of the following is equivalent to q?

A $p + r + s$

B $20(p + r + s)$

C $\frac{prs}{pr + rs + ps}$

D $\frac{prs}{20p + 20r + 20s}$

6.

Energy per Gram of Typical Macronutrients		
Macronutrient	Food calories	Kilojoules
Protein	4.0	16.7
Fat	9.0	37.7
Carbohydrate	4.0	16.7

The table above gives the typical amounts of energy per gram, expressed in both food calories and kilojoules, of the three macronutrients in food. If the 180 food calories in a granola bar come entirely from p grams of protein, f grams of fat, and c grams of carbohydrate, which of the following expresses f in terms of p and c?

A $f = 20 + \frac{4}{9}(p + c)$

B $f = 20 - \frac{4}{9}(p + c)$

C $f = 20 - \frac{4}{9}(p - c)$

D $f = 20 + \frac{9}{4}(p + c)$

7.

$$f(x) = 3 + |-2x - x^2|$$
$$g(w) = \left|-\frac{w}{w-1}\right| - w + 5$$

The functions f and g are defined by the given equations. If $f(-4) = c$, where c is a constant, what is the value of $g(c)$?

8.

The equation $9x + 5 = a(x + b)$, where a and b are constants, has no solutions. Which of the following must be true?

I. $a = 9$

II. $b = 5$

III. $b \neq \frac{5}{9}$

A I only

B III only

C I and III only

D None of the above

9.

In the given pair of equations, a and b are constants. The graph of this pair of equations in the xy-plane is a pair of perpendicular lines. Which of the following pairs of equations also represents a pair of perpendicular lines?

$$\begin{cases} 5x + 7y = 1 \\ ax + by = 1 \end{cases}$$

A $\begin{cases} 10x + 7y = 1 \\ ax - 2by = 1 \end{cases}$

B $\begin{cases} 10x + 7y = 1 \\ ax + 2by = 1 \end{cases}$

C $\begin{cases} 10x + 7y = 1 \\ 2ax + by = 1 \end{cases}$

D $\begin{cases} 5x - 7y = 1 \\ ax + by = 1 \end{cases}$

10.

For each real number r, which of the following points (x, y) lies on the graph of both equations in the xy-plane for the given system?

$$3x + 2y = 6$$
$$6x + 4y = 12$$

A $(r, 3 - \frac{3}{2}r)$

B $(r, 3 - \frac{r}{2})$

C $(3 - r, 3 - \frac{3}{2}r)$

D $(3, 2 - \frac{3}{2}r)$

11.

In a set of four consecutive odd integers, where the integers are ordered from the least to the highest, the first integer is represented by z. The product of 24 and the third odd integer in the set is at most the value of 86 less than the sum of the first and fourth odd integers in the set. What is the highest possible value of z?

12.

In the system of equations below, a and c are constants.

$$ax + y = c$$
$$\frac{1}{2}x + \frac{1}{3}y = \frac{1}{6}$$

If the system of equations has an infinite number of solutions (x, y), what is the value of a?

13.

Lines k and l are perpendicular. If the point $(4, m)$ and $(9, m + 3)$ lies on line k and line k and l intersect at $(9, m + 3)$, which of the following can lie on line l?

A $(m - 6, -4)$

B $(m + 9, 24)$

C $(21, m - 17)$

D $(24, m + 12)$

14.

$$22x - 21y = 43$$
$$5x + 14y = 59$$

The solution to the given system of equations is $(x, y) = (\frac{p}{826}, \frac{w}{59})$, where p and q are integers. What is the value of $p + w$?

15.

3 consecutive even integers are ordered from smallest to largest. 5 times the first integer is at least 9 more than the sum of the second and third integers. What is the minimum possible value for the second integer?

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16.

x	y
$-2s$	17
$-s$	14
s	8

The table shows three values of x and their corresponding values of y. There is a linear relationship between x and y. Which of the following equations represents this relationship?

A $sx + 3y = 11s$

B $3x + sy = 11s$

C $3x + sy = 11$

D $sx + 3y = 11$

17.

A cooking school is offering a promotion where the first class is free, the second class is half off the regular price, and the remaining classes are regularly priced. If the regular price of a class is \$22.80, which function f gives the total cost, in dollars, of x classes taken using this promotion, where $x > 2$?

A $f(x) = 22.80(x - 1) + 11.40$

B $f(x) = 22.80(x - 2) + 11.40$

C $f(x) = 22.80(x - 1) + 11.40(x - 2)$

D $f(x) = 22.80(x - 2) + 11.40(x - 1)$

18.

$$-32x + 18y + 150 = 15y + 4x$$
$$52 + \frac{w}{3}x + 18y = -32$$

In the given system of equations, w is a constant. The system has only one solution. Find the value that w is not equal to?

19.

$$5x + 8y = 9$$
$$15x + 24y = 27$$

For each real number r, which of the following points is on the graph of each equation in the xy-plane for the given system?

A $(r, -\frac{5r}{8} + \frac{9}{8})$

B $(-\frac{5r}{8} + \frac{9}{8}, r)$

C $(-\frac{5r}{8} + 9, \frac{5r}{8} + 27)$

D $(\frac{r}{3} + 9, -\frac{r}{3} + 27)$

20.

A beekeeper's initial observation of the population of a certain bee colony was 1,100 bees. The beekeeper set a goal to increase the population to 2,600 bees. The beekeeper uses a model that predicts the population of this bee colony begins at 1,100 and increases by 120 bees per week in the first two weeks after the initial observation, and then increases by 180 bees per week until the beekeeper's goal is reached. According to this model, at the end of week w after the initial observation, where $w > 2$, which of the following functions gives the predicted number of bees still needed to reach the beekeeper's goal?

A $p(w) = 2,600 - 180w$

B $p(w) = 2,480 + 180w$

C $p(w) = 1,620 - 180w$

D $p(w) = -120 + 180w$

21.

During a specific 2-hour period of the day, the mean photosynthetic rate, $P(x)$, of a plant species increases at a constant rate in terms of the photochemical energy available, x. During this period, $P(300) = 9.8$, and the mean photosynthetic rate increases by 0.13 micromoles per meter squared per second ($\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$) when the photochemical energy available increases by 5 $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$. Which equation gives the mean photosynthetic rate, in $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$, in terms of the photochemical energy available, in $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$, during this period?

A $P(x) = 0.026x + 9.8$

B $P(x) = 0.026x + 2$

C $P(x) = 9.8x + 0.026$

D $P(x) = 9.8x - 2,930.2$

22.

x	$g(x)$
-27	3
-9	0
21	5

The table shows three values of x and their corresponding values of $g(x)$, where $g(x) = \frac{f(x)}{x+3}$ and f is a linear function. What is the y-intercept of the graph of $y = f(x)$ in the xy-plane?

A $(0, 36)$

B $(0, 12)$

C $(0, 4)$

D $(0, -9)$

23.

x	y
-7	$d + 3$
-4	$4k + 6d$
$1 - 3d$	8

The table shows three values of x and their corresponding values of y for the linear relationship between x and y. The x-intercept of the line occurs when $x = -4$. The number d is a negative constant. The number k is a constant. What is the value of dk?

24.

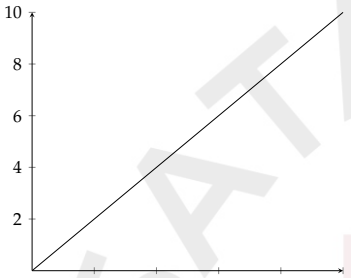
Line s is defined by $x - 4y = 24$. Line t is perpendicular to line s in the xy-plane and passes through the points $(k, 0)$ and $(60, -k)$. What is the value of k?

25.

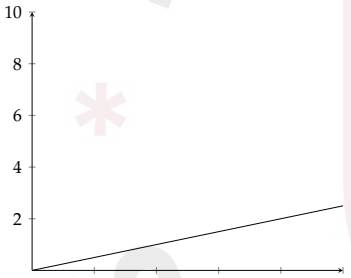
$$t = \frac{1}{2}v$$

For the equation above, which of the following is the graph of v as a function of t?

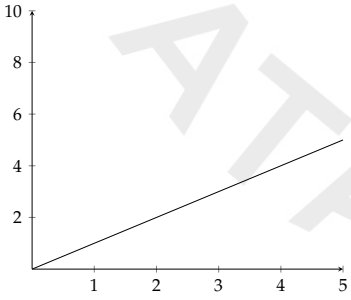
A



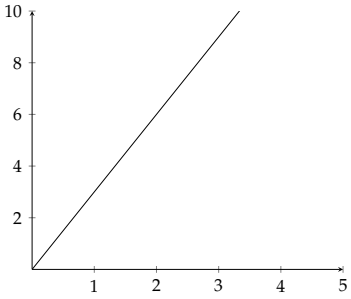
B



C



D



26.

x	y
0	n
4	$n+21$
8	$n+42$

There is a linear relationship between x and y. The table shows three values of x and their corresponding values of y in terms of a constant n. What is the slope of the line in the xy-plane that represents this relationship?

A 21

B 2

C $\frac{21}{4}$

D $\frac{4}{21}$

27.

In the xy-plane, line r passes through the points $(3, 12)$ and $(7, 13)$. Line s passes through the point $(1, 2)$ and is perpendicular to line r. An equation of line s is $ax + 7y = c$, where a and c are constants. What is the value of c?

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28.

Number of cars	Max passengers/crew
2	102
6	294
10	486

The table shows the linear relationship between the number of cars, c, on a commuter train and the maximum number of passengers and crew, p, that the train can carry. Which equation represents the linear relationship between c and p?

A $48p - c = -6$

B $48c - p = 6$

C $48p - c = 6$

D $48c - p = -6$

29.

$$7x + 8y = 3$$

The given equation is one equation in a system of two linear equations. If the system of equations has at least one solution, which of the following equations could be the other equation in the system?

I $14x + 16y = 12$

II $14x + 16y = 6$

A I only

B II only

C I and II

D Neither I nor II

30.

$$a(4 - x) = 28 - 7x$$

In the given equation, a is a constant. The equation has exactly one solution. Which of the following CANNOT be the value of a?

A 1

B 4

C 7

D 28

31.

$$\frac{x}{7} + \frac{y}{5} = \frac{41}{35}$$

An engineer connects resistors in series, where the resistors in the series have a total resistance of $\frac{41}{35}$ ohms. In this series, there are x resistors of type A, which each have a resistance of a ohms, and y resistors of type B, which each have a resistance of b ohms. The given equation represents this situation. According to this equation, what is the positive difference between the value of a and the value of b?

A $\frac{1}{35}$

B $\frac{2}{35}$

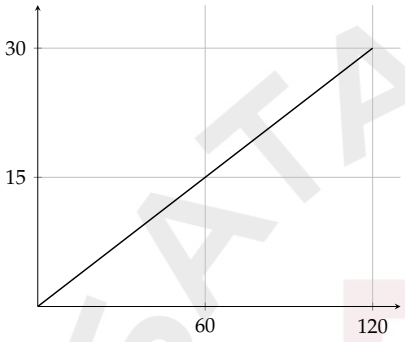
C $\frac{3}{35}$

D $\frac{12}{35}$

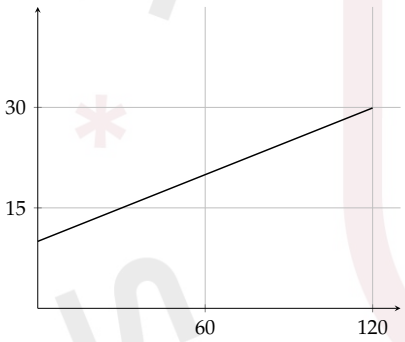
32.

A company is considering placing an advertisement on Website R. Website R charges no initial fee, but charges the same amount per click as Website P. Website P charges $15.00 for every 60 clicks. Which of the following graphs represents the cost y, in dollars, of placing an advertisement that receives x clicks on Website R?

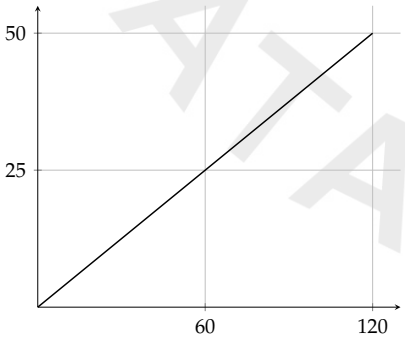
A



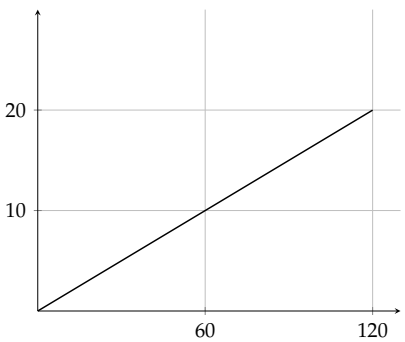
B



C



D

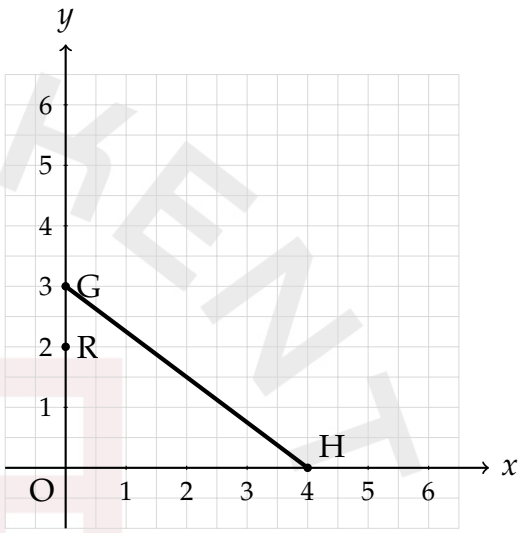


33.

$$j(x-k)=\frac{3}{4}x+15$$

In the equation above, j and k are constants. If the equation has infinitely many solutions for x, what is the value of k?

34.



Line segment GH and point R are shown in the xy-plane. If line ℓ (not shown) contains point R and is perpendicular to line segment GH, which of the following is an equation of line ℓ?

A $-4x+3y=6$

B $-3x+4y=8$

C $3x+4y=8$

D $4x+3y=6$

35.

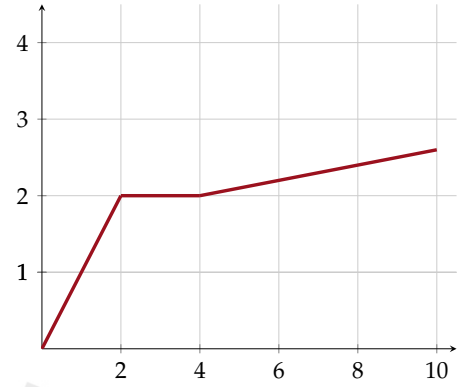
During the first 5.00 seconds after a car started moving, its speed increased to 12.0 meters per second. From 5.00 seconds to 13.0 seconds after the car started moving, its speed increased from 12.0 meters per second to 25.0 meters per second. To the nearest hundredth, what is the positive difference between the average rate of change of the speed of the car, in meters per second per second, during the first 5.00 seconds after the car started moving and the average rate of change of the speed of the car, in meters per second per second, from 5.00 seconds to 13.0 seconds after the car started moving?

36.

$$13kx + 17my = 122$$
$$11kx + 5my = -22$$

In the given system of equations, k and m are constants. The system has a solution of $(2, y)$. What is the value of k?

37.



The graph shows the total amount of rainfall y, in centimeters, from the start of a 10-hour period, where x is the number of hours after the start of the period. Which of the following statements about the rainfall during this time period is true?

A The rate of rainfall was 2 centimeters per hour between $x = 2$ and $x = 4$.

B The rate of rainfall was the greatest between $x = 4$ and $x = 10$.

C The rate of rainfall increased between $x = 0$ and $x = 2$.

D The rate of rainfall was 0 centimeters per hour between $x = 2$ and $x = 4$.

38.

For groups of 25 or more people, a museum charges \$21 per person for the first 25 people and \$14 for each additional person. Which function f gives the total charge, in dollars, for a tour group with n people, where $n \geq 25$?

A $f(n) = 14n + 175$

B $f(n) = 14n + 525$

C $f(n) = 35n - 350$

D $f(n) = 14n + 21$

39.

A landscaping company mixes oil with gasoline to power its tools. A chainsaw requires 8 ounces of oil per gallon of gasoline. A lawnmower requires 4 ounces of oil per gallon of gasoline. The company uses a total of 21 ounces of oil in its mixes for the chainsaw and lawnmower. Which of the following equations represents this situation, where x represents the amount of gasoline, in gallons, in the mix for the chainsaw and y represents the amount of gasoline, in gallons, in the mix for the lawnmower?

A $2(x + 2y) = 21$

B $2(2x + y) = 21$

C $4(x + 2y) = 21$

D $4(2x + y) = 21$

40.

The table shows three values of x and their corresponding values of y, where s is a constant. There is a linear relationship between x and y. Which of the following equations represents this relationship?

x	y
$-2s$	17
$-s$	14
s	8

A $sx + 3y = 11s$

B $3x + sy = 11s$

C $3x + sy = 11$

D $sx + 3y = 11$

41.

$$5x + 4y = 3$$
$$15x + 12y = 9$$

For each real number r, which of the following points lies on the graph of each equation in the xy-plane for the given system?

A $\left(r, -\frac{4r}{5} + \frac{3}{5}\right)$

B $\left(r, \frac{5r}{4} + \frac{3}{4}\right)$

C $\left(-\frac{4r}{5} + \frac{3}{5}, r\right)$

D $\left(\frac{r}{3} + 3, -\frac{r}{3} + 9\right)$

42.

A machine makes 8-inch, 5-inch, and 7-inch parts. During a certain day, the number of 8-inch parts that the machine makes is 3 times the number n of 5-inch parts, and the number of 7-inch parts is 12. During this day, the machine makes 100 parts total. Which equation represents this situation?

A $8(3n) + 5n + 7(12) = 100$

B $8n + 5n + 7n = 100$

C $3n + 12 = 100$

D $4n + 12 = 100$

43.

A square map has a side length of 30 inches, and 1 inch on the map represents an actual distance of 17 miles. A smaller version of the same map is printed as a square with the side length 65% shorter than the side length of the previous map. On the smaller map, which of the following is closest to the actual distance, in miles, represented by 1 inch?

A 5.95

B 10.30

C 19.50

D 48.57

44.

In a set of four consecutive odd integers, where the integers are ordered from least to greatest, the first integer is represented by x. The product of 18 and the fourth odd integer is at most 22 less than the sum of the first and third odd integers. Which inequality represents this situation?

A $18(x + 6) \leq x + (x + 4) - 22$

B $18(x + 6) \geq 22 - (x + (x + 4))$

C $18(x + 4) \leq x + (x + 3) - 22$

D $18(x + 4) \geq 22 - (x + (x + 3))$

45.

A chemist mixed x liters of a 2% saline solution with y liters of a 5% saline solution to produce a 3% saline solution. Which equation best represents this situation? (Assume the volumes of the solutions are additive.)

A $0.02x + 0.05y = 3(x + y)$

B $0.02x + 0.05y = 0.03(x + y)$

C $0.2x + 0.5y = 3(x + y)$

D $0.2x + 0.5y = 0.3(x + y)$

46.

In the xy-plane, line k and line l are perpendicular and intersect at the point $(2,8)$. If line k is defined by the equation $y = mx + b$, where m and b are constants and $m > 1$, which of the following points lies on line l?

A $\left(3,\ 8 - \frac{1}{m}\right)$

B $\left(3,\ 8 + \frac{1}{m}\right)$

C $(3,\ 8 - m)$

D $(3,\ 8 + m)$

47.

In a set of four consecutive odd integers, where the integers are ordered from least to greatest, the first integer is represented by z. The product of 24 and the third odd integer in the set is at most 86 less than the sum of the first and fourth odd integers. What is the greatest possible value of z?

48.

x	$g(x)$
-27	3
-9	0
21	5

The table shows three values of x and their corresponding values of $g(x)$, where $g(x) = \frac{f(x)}{x+3}$ and f is a linear function. What is the y-intercept of the graph of $y = f(x)$ in the xy-plane?

A $(0,\ 36)$

B $(0,\ 12)$

C $(0,\ 4)$

D $(0,\ -9)$

49.

A beekeeper's initial observation of the population of a certain bee colony was 1,100 bees. The beekeeper set a goal to increase the population to 2,600 bees. The beekeeper uses a model that predicts the population begins at 1,100 and increases by 120 bees per week in the first two weeks, then increases by 180 bees per week until the goal is reached. According to this model, at the end of week w after the initial observation, where $w > 2$, which of the following functions gives the predicted number of bees still needed to reach the beekeeper's goal?

A $p(w) = 2{,}600 - 180w$

B $p(w) = 2{,}480 + 180w$

C $p(w) = 1{,}620 - 180w$

D $p(w) = -120 + 180w$

50.

Which equation correctly gives x in terms of a, b, c and 10?

$$\frac{1}{x} = \frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{10}$$

A $x = \frac{10abc}{a+b+c+10}$

B $x = \frac{abc+10}{a+b+c+10}$

C $x = \frac{10abc}{10ab+10ac+10bc+abc}$

D $x = a+b+c+10$

51.

A linear model estimates the population of a city from 1992 to 2016. The model estimates the population was 53 thousand in 1992, 224 thousand in 2012, and x thousand in 2016. To the nearest whole number, what is the value of x?

52.

The shaded region shown represents the solutions to $rx + ty \geq -48$, where r and t are constants. The boundary line passes through $(-8, -10)$ and $(0, -12)$. What is the value of $r + t$?

A 8

B 5

C -5

D 7

53.

A small business owner budgets \$2,200 to purchase candles. The owner must purchase a minimum of 200 candles to maintain the discounted pricing. If the owner pays \$4.90 per candle to purchase small candles and \$11.60 per candle to purchase large candles, what is the maximum number of large candles the owner can purchase to stay within the budget and maintain the discounted pricing?

54.

A landscaping company mixes oil with gasoline to power its tools. A chainsaw requires 8 ounces of oil per gallon of gasoline. A lawnmower requires 4 ounces of oil per gallon of gasoline. The company uses a total of 21 ounces of oil in its mixes for the chainsaw and lawnmower. Which of the following equations represents this situation, where x represents the amount of gasoline, in gallons, in the mix for the chainsaw and y represents the amount of gasoline, in gallons, in the mix for the lawnmower?

A $2(x + 2y) = 21$

B $2(2x + y) = 21$

C $4(x + 2y) = 21$

D $4(2x + y) = 21$

55.

The table shows three values of x and their corresponding values of y, where s is a constant. There is a linear relationship between x and y. Which of the following equations represents this relationship?

x	y
$-2s$	17
$-s$	14
s	y

A $sx + 3y = 11s$

B $3x + sy = 11s$

C $3x + sy = 11$

D $sx + 3y = 11$

56.

$$5x + 4y = 3$$

$$15x + 12y = 9$$

For each real number r, which of the following points lies on the graph of each equation in the xy-plane for the given system?

A $\left(r, -\frac{4r}{5} + \frac{3}{5}\right)$

B $\left(r, \frac{5r}{4} + \frac{3}{4}\right)$

C $\left(-\frac{4r}{5} + \frac{3}{5}, r\right)$

D $\left(\frac{r}{3} + 3, -\frac{r}{3} + 9\right)$

57.

A machine makes 8-inch, 5-inch, and 7-inch parts. During a certain day, the number of 8-inch parts that the machine makes is 3 times the number n of 5-inch parts, and the number of 7-inch parts is 12. During this day, the machine makes 100 parts total. Which equation represents this situation?

A $8(3n) + 5n + 7(12) = 100$

B $8n + 5n + 7n = 100$

C $3n + 12 = 100$

D $4n + 12 = 100$

58.

Which equation correctly gives x in terms of a, b, c and 10?

$$\frac{1}{x} = \frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{10}$$

A $x = \frac{10abc}{a + b + c + 10}$

B $x = \frac{(abc + 10)}{a + b + c + 10}$

C $x = \frac{10abc}{10ab + 10ac + 10bc + abc}$

D $x = a + b + c + 10$

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Algebra Answers

Number	Answer	Number	Answer
1	A	**26**	C
2	1.18	**27**	42
3	2	**28**	D
4	8	**29**	B
5	C	**30**	C
6	B	**31**	B
7	-4.9	**32**	A
8	C	**33**	-20
9	B	**34**	A
10	A	**35**	0.78
11	-9	**36**	$\frac{-246}{61}$
12	1.5	**37**	D
13	C	**38**	A
14	3837	**39**	D
15	8	**40**	B
16	B	**41**	A
17	B	**42**	D
18	-648	**43**	D
19	A	**44**	A
20	C	**45**	B
21	B	**46**	A
22	A	**47**	-9
23	-169/6	**48**	A
24	48	**49**	C
25	A	**50**	C

Number	Answer	Number	Answer
51	258	**55**	B
52	B	**56**	C
53	182	**57**	D
54	D	**58**	C

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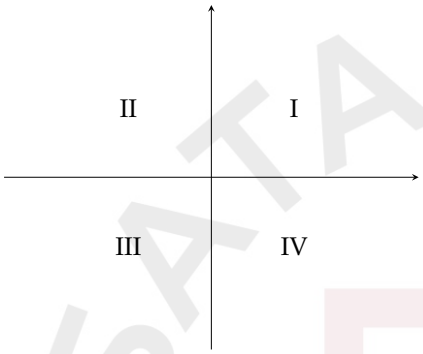
Advanced Math

Advanced Math

1.
In the xy-plane, the quadrants are labeled as shown. The graph of the equation

$$y = 3(x + a)^2 + b$$

where a and b are positive constants, has a vertex in which quadrant?



A Quadrant I

B Quadrant II

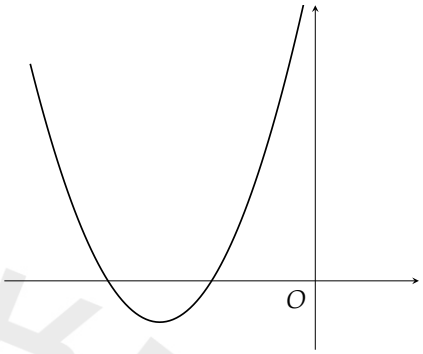
C Quadrant III

D Quadrant IV

2.
The solutions to $x^2 + 12x + 35 = 0$ are r and s, where $r < s$. The solutions to $x^2 + 12x + 27 = 0$ are t and u, where $t < u$. The solutions to $x^2 + 24x + c = 0$, where c is a constant, are $r + u$ and $s + t$. What is the value of c?

3.
If $x = \sqrt[2n]{2x^n + 35}$, where n is a positive integer constant, what is the value of x^n?

4.



The graph of $y = f(x)$ is shown in the xy-plane. If a, b, and c are positive constants, which of the following equations could define the function f?

A $f(x) = -a(x + b)(x + c)$

B $f(x) = -a(x - b)(x - c)$

C $f(x) = a(x + b)(x + c)$

D $f(x) = a(x - b)(x - c)$

5.
The function f is defined by $f(x) = \frac{|x|}{a}$, where $a < 0$. What is the product of $f(17a)$ and $f(8a)$?

6.
If $x^2 - x - 30 = 0$, what is the positive value of x?

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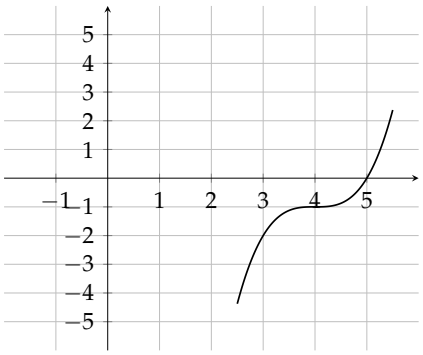
7.



The graph of $y = g(x)$ is shown, where the function g is defined by

$$g(x) = f(x + a) + b$$

and a and b are constants. If the function f is defined by $f(x) = x^3$, what is the value of $a + b$?

A -5

B -1

C 1

D 5

8.

$$(3x + p)(5x^2 - 45)(2x^2 - 16x + 6p) = 0$$

In the given equation, p is a positive constant. The sum of the solutions to the equation is $\frac{20}{3}$. What is the value of p?

9.

$$f(x) = (x - a)()x - b$$

The function f is defined by the given equation, where a and b are integers. If $f(12) > 0$, $f(17) < 0$ and $f(62) > 0$, what is a possible value of $a + b$?

A 31

B 29

C 28

D 80

10.

$$f(x) = ax^2 + 6x + c$$

In the given quadratic function, a and c are constants. The graph of $y = f(x)$ in the xy-plane is a parabola that opens upward and has a vertex at the point (h, k), where h and k are constants. If $k > 0$ and $f(-7) = f(5)$, which of the following must be true?

I. $c > 3$

II. $a > 3$

A I only

B II only

C I and II

D Neither I nor II

11.

Function f is a quadratic function. The graph of $y = f(x)$ in the xy-plane has a vertex at $(9, -7)$, contains the point $(8, -9)$, and has a y-intercept at $(0, a)$. The graph of $y = 6 \cdot f(x)$ has a y-intercept at $(0, b)$. What is the positive difference between a and b?

12.

$$y = 2x^2 - 19x + 40$$

$$y = x + a$$

In the given system of equations, a is a constant. The graph of the equations in the given system intersect at exactly one point (x, y) in the xy-plane. What is the value of x?

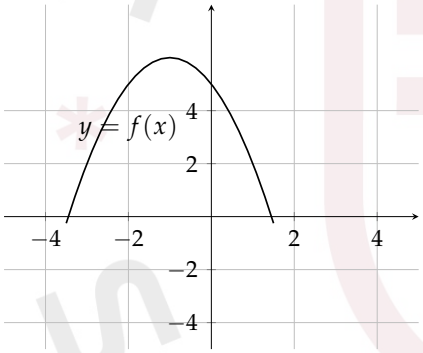
A -10

B -5

C 5

D 10

13.



The graph of $y = f(x)$ is shown in the xy-plane. If the function g is defined by

$$g(x) = (x + 3)(x - 1)$$

for which of the following values of x is $f(x) > g(x)$?

A -3

B -2

C 1

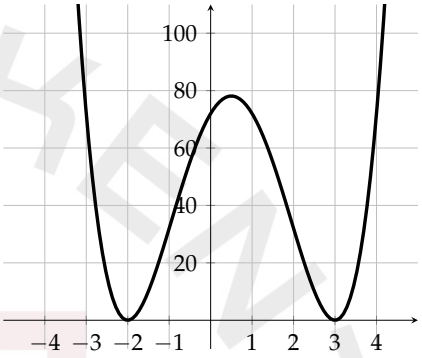
D 2

14.

$$34z^{14} + bz^7 + 70$$

In the given expression, b is a positive integer. If $qz^7 + r$ is a factor of expression, where q and r are positive integers, what is the highest possible value of b?

15.



Which of the following could be the equation of the graph shown?

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

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

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

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

16.

In the $xy - plane$ a parabola has a vertex (7,12) and intersects the $x - axis$ at two points. If the equation of the parabola is written in the form $y = ax^2 + bx + c$ where a, b, and c are constants, which of the following could be the value of $a + b + c$?

A 10

B -14

C -18

D 36

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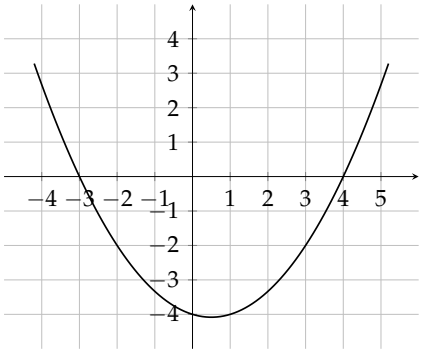
17.



An equation for the graph shown is

$$y = a(x+3)(x+b)$$

where a and b are constants. What is the value of ab?

A -2

B $-\frac{4}{3}$

C $\frac{1}{2}$

D 8

18.

The polynomial $p(x) = x^3 - 6x^2 + 11x - 6$ has roots r, s, and t, where $r < s < t$. What is the value of $r^2 + s^2 + t^2$?

19.

The expression

$$bx^2 - 13x + 22$$

can be rewritten as $(hx - k)(x + j)$ where b is a constant and h, j, and k are integer constants. Which of the following must be an integer?

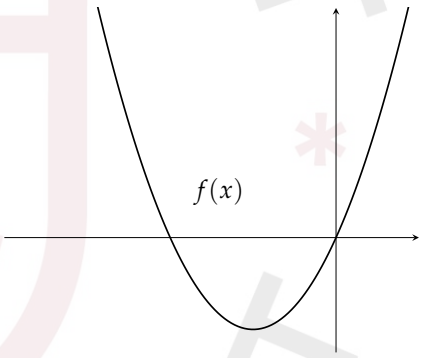
A $\frac{k-13}{h}$

B $\frac{13}{b}$

C $-\frac{j}{22}$

D $\frac{k}{22}$

20.



The graph of $f(x)$ is the result of shifting the graph of $g(x)$ 3 units to the right and 3 units up. If the equation of $f(x)$ is

$$f(x) = x^2 + 4x$$

what is the equation of $g(x)$?

A $(x-5)^2 + 1$

B $(x-5)^2 - 7$

C $(x+5)^2 - 7$

D $(x+5)^2 - 4$

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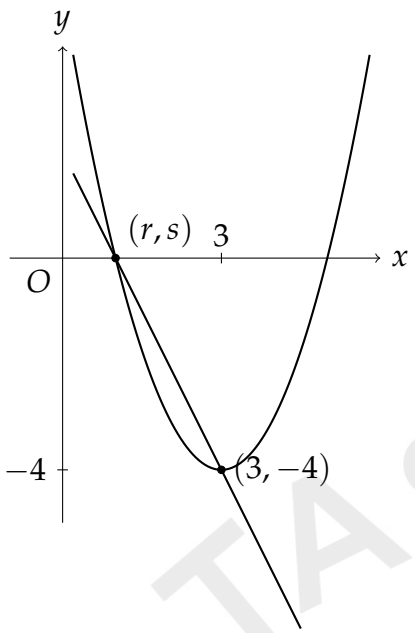
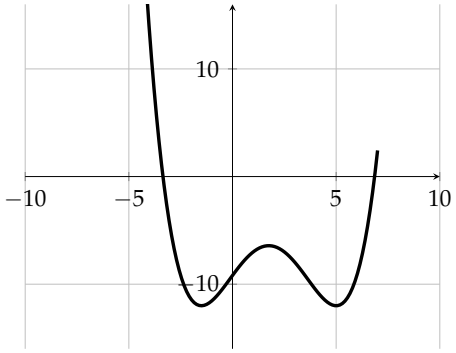


21.

The xy-plane above shows two points of intersection of the graphs of a linear function and a quadratic function. The vertex of the graph of the quadratic function is at $(3, -4)$ and (r, s) is one of the points of intersection of the graphs. What is the value of r?

22.



The graph of

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

is shown in the xy-plane. If k, a, and b are positive constants, which equation could define f?

A $f(x) = (x - a)^2(x + b)$

B $f(x) = (x + a)^2(x - b)$

C $f(x) = (x - a)^2(x + b)^2$

D $f(x) = (x + a)^2(x - b)^2$

23.

$$f(x) = m\sqrt{-x - n}$$

where m and n are constants. If $f(8) = 0$ and $f(4) < -16$, which of the following must be true?

A $m > -8$

B $n + m = 0$

C $n + m > 0$

D $n - m > 0$

24.

For the function f, for every increase in $\frac{1}{2}$ in the value of x, the value of $f(x)$ increases by a factor of c, where c is a constant. Which of the following equivalent forms of the function f displays the value of c as the base or the coefficient?

A $f(x) = 38(2)^{6x}$

B $f(x) = 38(8)^{2x}$

C $f(x) = 38(64)^{x}$

D $f(x) = 38(4,096)^{\frac{x}{2}}$

25.

$$8rx^2 - 80sx + 8r = 0$$

For the given equation, r and s are constants such that $r > 0, s < 0$ and $\frac{r}{s} > k$. What is the least value of k that ensures that the equation has two distinct real solutions?

26.

For the function f, for each increase in the value of x by c, where c is a positive constant, the value of $f(x)$ increases by a factor of 16. Which of the following equivalent forms of the function f displays $\frac{1}{c}$ as a coefficient of x?

A $f(x) = 139(16^{\frac{1}{3}})^{\frac{1}{2}x}$

B $f(x) = 139(8)^{2x}$

C $f(x) = 139(8^2)^{\frac{1}{2}x}$

D $f(x) = 139(64^{\frac{2}{3}})^{\frac{1}{8}x}$

27.

$$f(x) = 250(5)^x$$

The function f is defined by the given equation. If $g(x) = f(x-2)$, which of the following equations defines the function g?

A $g(x) = 10(5)^x$

B $g(x) = 125(5)^x$

C $g(x) = 250(25)^x$

D $g(x) = 250(10)^x$

28.

The functions f and g are defined by the given equations, where $x \geq 0$. Which of the following equations displays, as a constant or coefficient, the maximum value of the function it defines, where $x \geq 0$?

I. $f(x) = 16(1.24)^x + 43$

II. $g(x) = 8(0.72)^x$

A I only

B II only

C I and II

D Neither I nor II

29.

$$z(w) = (0.829)^{2w}$$

The function z is defined by the equation shown. The value of $z(w)$ decreases by $p\%$ for each increase by 1 in the value of w. Which of the following is closest to the value of p?

30.

$$(x-k)^2 = (k-5a)(x-k)$$

In the given equation, a and k are constants, where $k > 5a$. The sum of the solutions to the equation is $3k + 32$. What is the value of a?

31.

The expression $6x^4 + 17x^2 + 7$ can be rewritten as $(3x^2 + a)(2x^2 + b)$, where a and b are positive integers, or as $(3x^2 + c)(2x^2 + d)$, where c and d are positive nonintegers. What is the value of $a + c$?

32.

The function f is defined by $f(x) = \frac{x^2+ax+b}{2x+c}$, where a, b, and c are constants. The graph of the function f in the xy-plane, where $y = f(x)$, does not intersect the line $x = 4$. If $f(5) = f(6) = 0$, what is the value of $a + b + c$?

33.

The function h is defined by

$$h(x) = -\sqrt{x^2 + bx + c}$$

The graph of $y = h(x)$ passes through $(2, 0)$ and $(0, -\sqrt{358})$. If $h(m) = 0$, what is the greatest possible value of m?

34.

$$\sqrt[7]{p^4} = t^{\frac{5}{7}}$$

In the given equation, $p > 1$ and $t > 1$. If $t = p^{2n-1}$, where n is a constant. What is the value of n?

35.

In the xy-plane, a parabola has vertex $(9, -14)$ and intersects the x-axis at two points. If the equation of the parabola is written in the form $y = ax^2 + bx + c$ where a, b, and c are constants, which of the following could be the value of $a + b + c$?

A -23

B -19

C -14

D -12

36.

$$y = ax^2 + bx + c$$

The function f is defined above, where a, b, and c are constants. The graph of $y = f(x)$ in the xy-plane passes through the points $(-16, 0)$ and $(9, 0)$. If a is an integer greater than 3, what is the smallest possible value of $3b - 2a$?

37.

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

The function f is defined above, where a, b, and c are constants and $4 < b < 7$. The graph of $y = f(x)$ is such that $f(1) = f(5)$. If b is an integer, what could be the value of ab?

38.

The function p is defined by $p(x) = a((x + 6)^2 - b)((x + 6)^2 - c)$, where a, b, and c are constants. In the xy-plane, the graph of $y = p(x)$ passes through the points $(-7, 24)$ and $(0, 899)$. What is the value of $p(-12) + p(-5)$?

39.

$$f(x) = \sqrt[3]{x^3 + ax^2 + bx + c}$$

The function f is defined by the given equation, where a, b, c are integers. The graph of $y = f(x)$ passes through the point $(9, 0)$, and $f(0) = 27$. What is the value of $9a + b$?

40.

$$34z^{14} + bz^7 + 70$$

In the given expression, b is a positive integer. If $qz^7 + r$ is a factor of expression, where q and r are positive integers, what is the highest possible value of b?

41.

$$y = ax^2 + bx + c$$

The equation of a parabola is given, where a, b, and c are constants. In the xy-plane, the parabola has vertex $(3, 11)$ and $c < 0$. Which of the following could be the value of b?

A 5

B 6

C 7

D 8

42.

A quadratic function models the height, in feet, of an object above the ground in terms of the time, in seconds, after the object was launched. According to the model, the object was launched from a height of 0 feet and reached its maximum height of 1,600 feet 10 seconds after it was launched. Based on the model, what was the height, in feet, of the object 7 seconds after it was launched?

43.

The function f is defined by $f(x) = 2x^2 - 8x + 3$. What is the minimum value of $f(x)$?

44.

Which of the following expressions has a factor of $x + 2b$, where b is a positive integer constant?

A $3x^2 + 7x + 14b$

B $3x^2 + 16x + 14b$

C $3x^2 + 18x + 14b$

D $3x^2 + 25x + 14b$

45.

A chemical reaction in a closed container produces a gas, and the volume V of gas produced over time t (in minutes) can be modeled by a quadratic function. At $t = 5.0$ minutes, the volume of gas produced is 40.0 liters, and at $t = 15.0$ minutes, the volume of gas produced is 160.0 liters. If the reaction starts at $t = 0$ without gas produced, what will be the volume of gas produced at $t = 25.0$ minutes?

A 375.2 liters

B 483.6 liters

C 423.3 liters

D 333.5 liters

46.

If $p(x) = x^2 + kx + 4$ has no real zeros, what is the range of possible values for k?

A $k < -4$

B $-4 < k < 4$

C $k > 4$

D No range, k can be any real number.

47.

$$f(x) = -3x^2 + bx + c$$

In the given quadratic function b and c are constants. The graph of $y = f(x)$ in the xy-plane is a parabola that has a vertex at the point (h, k), where h and k are constants. If $f(-4) = f(8)$, and the quadratic function has x-intercepts at $(r, 0)$ and $(s, 0)$, which of the following must be true?

I. $r + s = 4$

II. $b < 0$

III. $c < k$

A I and II only

B II and III only

C I and III only

D I, II, and III

48.

The functions f and g are defined by the given equations, where $2 \leq x \leq 8$. Which of the following equations displays, as a constant or coefficient, the minimum value of the function it defines, where $2 \leq x \leq 8$?

I. $f(x) = 0.0625(0.5)(2)^{x+2}$

II. $g(x) = 1500(0.2)^{x-3}$

A I only

B II only

C I and II

D Neither I nor II

49.

The given expression is

$$-16(5x - 3)^2 + 4(5x - 2)^2$$

The given expression can be rewritten as $\frac{ax^2}{4} + \frac{bx}{4} + \frac{c}{4}$, where a, b, and c are constants. What is the value of $a + b + c$?

50.

Given the expression

$$\sqrt[4]{40n} \times (\sqrt[5]{40n})^3$$

find the value of y for which the expression is equivalent to $(40n)^{30y}$, where $n > 1$.

A $\frac{17}{600}$

B $\frac{10}{600}$

C $\frac{7}{600}$

D $\frac{14}{600}$

51.

$$f(x) = 5(0.92)^{3x}$$

The function f is defined by the given equation. The equation can be rewritten as $f(x) = 5(1 - \frac{p}{100})^x$, where p is a constant. Which of the following is closest to the value of p?

A 8

B 12

C 22

D 24

52.

Which of the following expressions has $6x - 5b$ as a factor, where b is a positive integer constant?

A $24x^2 - 22x - 15b$

B $24x^2 + 18x - 15b$

C $24x^2 + 36x - 15b$

D $24x^2 - 484x - 15b$

53.

$$\frac{1}{cx} = \frac{x}{128} + \frac{1}{c}$$

In the given equation, c is a constant. If the equation has exactly one solution, what is the value of c?

54.

The expression

$$bx^2 - 13x + 22$$

can be rewritten as $(hx - k)(x + j)$ where b is a constant and h, j, and k are integer constants. Which of the following must be an integer?

A $\frac{k - 13}{h}$

B $\frac{13}{b}$

C $-\frac{j}{22}$

D $\frac{1}{h}$

55.

$$f(x) = 4^{-(2+x)}$$

Which of the following equivalent forms of the given function displays the y-coordinate of the y-intercept of its graph in the xy-plane as a constant?

A $f(x) = \frac{1}{16}(\frac{1}{4})^x$

B $f(x) = (\frac{1}{4})^{(2+x)}$

C $f(x) = 2^{-2(2+x)}$

D $f(x) = 4^{-(2-x)}$

56.

The equation of a parabola is given, where a, b, and c are constants. In the xy-plane, the parabola has vertex $(5, -9)$ and has zero x-intercepts. Which of the following could be the value of $a - b - c$?

A -47

B -5

C 9

D 23

57.

The function f is defined by the given equation, where a and b are integer constants. If $f(32) > 0, f(35) < 0$, and $f(38) > 0$, which of the following could be the value of $a + b$?

A 35

B 37

C 67

D 69

58.

$$f(x) = 3^{-2(x+1)}$$

Which of the following equivalent forms of the given function f displays, as the base or the coefficient, the y-coordinate of the y-intercept of the graph of $y = f(x)$ in the xy-plane?

A $f(x) = (\frac{1}{3})^{(2x+2)}$

B $f(x) = \frac{1}{9}(\frac{1}{3})^{2x}$

C $f(x) = 81(-\frac{1}{2}x - \frac{1}{2})$

D $f(x) = 3^{(-2x-2)}$

59.

In the given equation, k is a constant. The equation

$$\sqrt{k - x} = 43 - x$$

has exactly one real solution. What is the minimum possible value of $4k$?

60.

The function p is defined by

$$p(x) = a((x+5)^2 - b)((x+5)^2 - c)$$

where a, b, and c are constants. In the xy-plane, the graph of $y = p(x)$ passes through the points $(-4, 34)$ and $(0, 150)$. What is the value of $p(-10) + p(-4)$?

61.

The functions f and g are defined by the given equations, where $2 \leq x \leq 5$. Which of the following equations displays, as a constant or coefficient, the maximum value of the function it defines, where $2 \leq x \leq 5$?

I. $f(x) = -(x-4)^2 + 7$

II. $g(x) = -(x+4)^2 + 7$

A I only

B II only

C I and II

D Neither I nor II

62.

In the given equations, a and b are constants, $a > 1$ and $b > 1$. What is the value of x?

$$\sqrt[7]{a^5} = \sqrt{b^5}$$
$$a^{3x-3} = b^3$$

A 27/21

B 21/27

C 32/21

D 38/21

63.

$$P(t) = 260(1.03)^{t/8}$$

The function P models the population, in thousands, of a certain city t years after 2009. According to the model, the population is predicted to increase by n% every 8 months. What is the value of n?

A 0.22

B 1.03

C 2

D 3

64.

Quadratic function h is defined by

$$h(x) = ax^2 - 2x + c$$

where a and c are constants. The graph of $y = h(x)$ in the xy-plane is a parabola that opens downward and has a vertex of (h, k), where $k > 0$. If $h(1) = h(-13)$, which of the following must be true?

I. $-1 < a < 0$

II. $c > 0$

A I only

B II only

C I and II

D Neither I nor II

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65.

$$f(x) = -2x^2 + bx + c$$

In the given quadratic function, a and c are constants. The graph of $y = f(x)$ is a parabola that has a vertex at the point (h, k), where h and k are constants. If $k < 0$ and $f(-5) = f(7)$ which of the following must be true?

I. $c < -1$

II. $b \geq 3$

A I only

B II only

C I and II

D Neither I nor II

66.

The function f is defined by

$$f(x) = 9x^2 + kx - 21$$

where k is a constant. In the xy-plane, the graph of $y = f(x)$ passes through the points $(r, 23)$ and $(2r, 139)$, where r is a constant. Which of the following could be the value of k?

A 4

B 12

C 116

D 162

67.

The function f is defined by

$$f(x) = a\sqrt{-x + b}$$

where a and b are constants. In the xy-plane, the graph of $y = f(x)$ passes through the point $(5, 0)$, and $f(-12) > f(-7)$. Which of the following must be true?

A $a < f(b)$

B $a > b$

C $f(3) < f(-2b)$

D $a < b$

68.

The function q is defined by

$$q(x) = a|x - 9|^2 - 87|x - 9| + b$$

where a and b are constants and $a > b > 87$. If $q(639) = h$ and $q(-621) = k$, where h and k are constants, what is the value of $9(-639)^{h-k} + 621(9)^{k-h}$?

69.

$$34z^{18} + bz^9 + 30$$

In the given expression, b is a positive integer. If $qz^9 + r$ is a factor of the expression, where q and r are positive integers, what is the greatest possible value of b?

70.

The function

$$v(x) = \frac{x^2 + bx + c}{(x - 7)(x - 17)}$$

where b, c are constants goes through the points $(0, \frac{99}{119})$ and $(11, 0)$. There is another point where $v(q) = 0$. What is the value of q?

71.

The function

$$f(x) = 6(x-a)(x-b)(x-c)$$

is defined by the given equation, where a, b, and c are distinct constants. When $a < x < b$, the value of $f(x)$ is positive. The graph of $y = f(x)$ in the xy-plane contains the point (r, s), where r and s are constants. If $s = 9$, which of the following could be true?

I. $r < a$

II. $b < r < c$

III. $r > c$

A I only

B III only

C I and III only

D II and III only

72.

$$f(x) = 15(b)^x$$

In the given function, b is a positive constant. For every increase in the value of x by 1, the value of $f(x)$ increases by $c\%$, where $0 < c < 100$. Which expression gives the value of c in terms of b?

A $1 + \frac{b}{100}$

B $b + 100$

C $100(b+1)$

D $100(b-1)$

73.

$$g(x) = 12(x-a)(x-b)(x-c)$$

where a, b, and c are distinct constants. When $a < x < b$, $g(x)$ will be positive. If (p, q) is on the graph of $g(x)$, where p and q are constants, and $q = 45$, which of the following could be true?

I. $p < a$

II. $b < p < c$

III. $p > c$

A Only I

B Only III

C I and III only

D II and III only

74.

The function f is defined by

$$f(x) = ab^x$$

where a, b, and n are constants, and b and n are integers. If $f(4) = 5$ and $f(7) = 135$, what is the value of $f(9)$?

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75.

$$r(t) = 55t - 2t^2$$

The function r is defined by the given equation. The function s is defined by $s(t) = r(t) + 1$. Which expression represents the maximum value of $s(t)$?

A $1 + (\frac{55}{2})^2$

B $1 + 2(\frac{55}{4})^2$

C $1 - 2(\frac{55}{4})^2$

D $1 - (\frac{55}{2})^2$

76.

The polynomial

$$8x^4 + 50x^2 + 63$$

can be factored, and one of the factors is of the form $(ax^2 + b)$. What is one possible value of the product $a \cdot b$?

77.

$$-16(5x - 3)^2 + 4(5x - 2)^2$$

The given expression can be rewritten as $\frac{(a+b+c)(a-b+c)}{100}$? (Note: Transcription ambiguous, using calculated value based on standard rewriting interpretation). Where a, b, c are constants. What is the value of the expression?

78.

The function f is defined by $f(x) = a^x - b$ where a and b are constants. In the xy-plane, the graph of $y = f(x)$ passes through the points $(c, 7)$ and $(2c, 117)$, where c is a constant. Which of the following could be the value of b?

A 4

B 17

C 110

D 124

79.

The graph of functions f and g are parabolas, such that $g(x) = 6f(x)$. The vertex of $f(x)$ is at $(2, 10)$. The y-intercept of $f(x)$ and $g(x)$ is at $(0, b)$ and $(0, c)$, respectively. If the point $(3, 78)$ is on the graph of $g(x)$, what is the value of $b - c$?

A -60

B -110

C -130

D -200

80.

The functions f and g are defined by the given equations, where $x \leq 0$. Which of the following equations displays, as a constant or coefficient, the maximum value of the function it defines, where $x \leq 0$?

I. $f(x) = -(x+4)^2 + 7$

II. $g(x) = -(x-4)^2 + 7$

A I only

B II only

C I and II

D Neither I nor II

81.

The function f is defined by

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

where a, b and c are constants. The graph of $y = f(x)$ in the xy-plane passes through the points $(13, 0)$ and $(-6, 0)$. Which of the following is the value of $a + b$ in terms of a?

A $7a$

B $6a$

C $-6a$

D $-7a$

82.

$$f(x) = \frac{3}{8}(x-3)^3 + \frac{ax^2}{4} + \frac{bx}{4} + \frac{c}{4} + \frac{99}{2}$$

If the x-coordinates of the x-intercepts of the given function, f, are at $x = 4, x = 12$ and $x = -2$, what is the value of $16(a + b + c)$?

A -322

B -457

C -603

D -789

83.

The function f is defined by

$$f(x) = 3x^2 - 5x + 10$$

If the function $f(x-2)$ is written in the form $ax^2 + bx + c$, what is the value of $a + b + c$?

84.

In the given equation, p is a positive constant. The product of the solutions to the equation

$$(3x - 7p)(5x^2 + 8x - 4p)(x^3 + 3x^2 - 16x - 48) = 0$$

is $-\frac{560}{9}$. What is the value of p?

A $-\frac{5}{6}$

B $\frac{5}{6}$

C $\frac{25}{36}$

D $\frac{5}{12}$

85.

$$(6a + 10b)x^2 + (9a^2 - 25b^2)x - 15ab = 0$$

The equation above has two real solutions, where a and b are positive constants. The sum of the solutions to the given equation is $k(21a - 35b)$, where k is a constant. What is the value of k?

A $-\frac{1}{14}$

B $\frac{1}{14}$

C $-\frac{1}{7}$

D -14

86.

An acceptable noise criterion rating for the background noise in a school classroom is 30. For a noise criterion rating of 30, the equation

$$y = 19(0.978)^{x-50} + 37$$

gives the estimated sound pressure level, y in decibels, as a function of the octave band center frequency, x, in hertz, where $x \geq 50$. Which of the following is the best interpretation of 37 in this context?

A 37 is 19 less than the estimated sound pressure level, in decibels, at an octave band frequency of 50

B 37 is 19 less than the estimated sound pressure level, in decibels, at an octave band frequency of 0

C 37 is the estimated sound pressure level, in decibels, at an octave band frequency of 50

D 37 is the estimated sound pressure level, in decibels, at an octave band frequency of 0

87.

The functions f, g and h are defined by the given equations, where $x \geq 0$. Which of the following equations displays, as a constant or coefficient, the maximum or minimum value of the function it defines, where $x \geq 0$?

I. $f(x) = (x - 3)^2 + 6$

II. $g(x) = (x + 3)^2 + 6$

III. $h(x) = (x - 5)^2 + 8$

A I only

B I and III only

C Both I and II

D None of these

88.

$$f(x) = -2(x - a)(x - b)(x - c)$$

The function f is defined by the given equation, where a, b and c are distinct constants. When $b < x < c$, the value of $f(x)$ is positive. The graph of $y = f(x)$ in the xy-plane contains the point (m, n), where m and n are constants. If n is equal to -5, which of the following could be true?

I. $m < a$

II. $a < m < b$

III. $m > c$

A I only

B II only

C II and III

D I and III

89.

Which of the following below has a factor of $4x + 7b$, where b is a non-positive integer?

I. $16x^2 - 49$

II. $16x^2 + 56x + 49$

III. $64x^3 + 343$

A I only

B II and III only

C I and III only

D All of them

90.

The quadratic function can be used to model the height, in meters, of an object above the ground in terms of time, in seconds, after the object was launched into the air. The object reached a height of 148 meters 2 seconds and a maximum height of 340 meters 10 seconds after it was launched. Based on the model, what was the longest time period when the object reached a height of 97 meters?

91.

The exponential function f is defined by

$$f(x) = ab^x$$

where a and b are positive. If $f(n-1) = f(n) + \frac{61}{100}f(n-1)$, where n is a constant, what is the value of b?

A 0.39

B 0.61

C 1.61

D 2.56

92.

The equation $N(m) = 63(Q)^{\frac{m}{6}}$ gives the predicted population $N(m)$, in thousands, of a certain bacteria colony m minutes after the initial measurement, where Q is a constant greater than 1. The predicted population increases by $p\%$ every 180 seconds. What is the value of p in terms of Q?

A $100(Q^{30} - 1)$

B $100(Q^{\frac{1}{2}} - 1)$

C $100(Q^{30} + 1)$

D $100(Q^{\frac{1}{2}} + 1)$

93.

For the polynomial function v, $v(2) = 3$ and $v(0) = -13$. The graph of $y = v(x)$ in the xy-plane passes through the points $(-2, 7)$ and $(6, 0)$. Which of the following must be true?

A When $v(x)$ is divided by $(x + 13)$, the remainder is 0.

B When $v(x)$ is divided by $(x + 7)$, the remainder is -2.

C When $v(x)$ is divided by $(x + 2)$, the remainder is 7.

D When $v(x)$ is divided by $(x - 6)$, the remainder is -13.

94.

When the polynomial $P(x) = 2x^3 - 5x^2 + ax + b$ is divided by $x - 2$, the remainder is 10. When $P(x)$ is divided by $x + 1$, the remainder is 1. What is the value of $a + b$?

95.

$$\frac{x^2}{\sqrt{x^2-c^2}} = \frac{c^2}{\sqrt{x^2-c^2+39}}$$

In the given equation, c is a positive constant. Which of the following is one of the solutions to the given equation?

A $-c$

B $-c^2-39^2$

C $-\sqrt{39^2-c^2}$

D $-\sqrt{c^2+39^2}$

96.

The expression

$$12x^2+41x+35$$

can be rewritten as $(4x+r)(3x+s)$, where r and s are integers, or as $(4x+t)(3x+v)$, where t and v are not integers. What is the value of $s+v$?

A $\frac{41}{3}$

B $\frac{41}{4}$

C 12

D 35

97.

For the function f, for each increase in the value of x by 4, the value of $f(x)$ increases by a factor of m. Which of the following equivalent forms displays m as a constant or coefficient?

A $f(x)=13(100)^{2x}$

B $f(x)=13(1000)^{\frac{x}{3}}$

C $f(x)=13(10^{\frac{6}{5}})^{6x}$

D $f(x)=13(100000^{\frac{6}{5}})^{\frac{1}{4}x}$

98.

The function f is defined by

$$f(x)=ab^x$$

where a, b, and x are constants, and a, b, and x are integers. If $f(2)=6$ and $f(5)=162$, what is the value of $f(7)$?

99.

$$x(9x-2a)+b(9x-2a)-(x+b)=0$$

In the given equation, a and b are positive constants. A solution to the equation is $x=42$. What is the value of a?

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100.

For a polynomial function f, the graph of $y = f(x)$ in the xy-plane contains the points $(-6, 0)$, $(7, 0)$, $(0, 0)$, and $(4, 0)$. Which of the following must be a factor of $f(x)$?

A $x^2 - 2x - 24$

B $x^2 - x + 42$

C $x^2 - 11x - 28$

D $x^2 - 7x$

101.

The function f is defined by $f(x) = a(x - h)^2 + k$, where a, h, and k are constants. The vertex of the parabola is at $(3, -5)$ and the parabola passes through the point $(5, 3)$. What is the value of a?

A $\frac{1}{2}$

B 1

C $\frac{3}{2}$

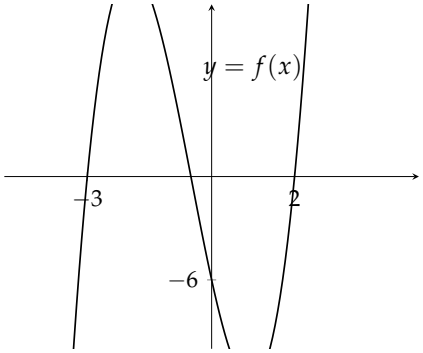
D 2

102.

$$(2x - 3)(x^2 + 5x - 14) = 0$$

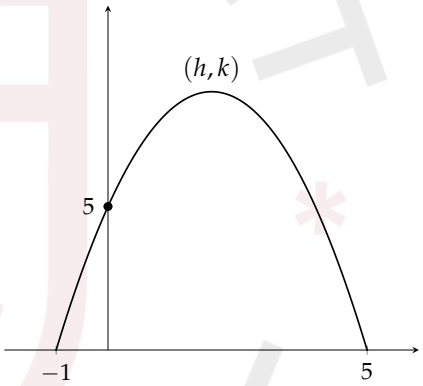
What is the greatest solution to the given equation?

103.



In the xy-plane above, the function f is defined by $f(x) = 2x^3 + 3x^2 + ax + b$, where a and b are constants. If the graph of f intersects the x-axis at three points, what is the value of a?

104.



The graph of $y = a(x + 1)(x - 5)$ is shown in the xy-plane above, where a is a constant. If the graph with vertex (h, k) intersects the y-axis at point $(0, 5)$, which of the following is equal to k?

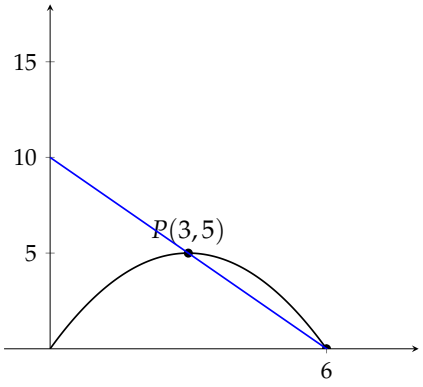
A 7

B 8

C 9

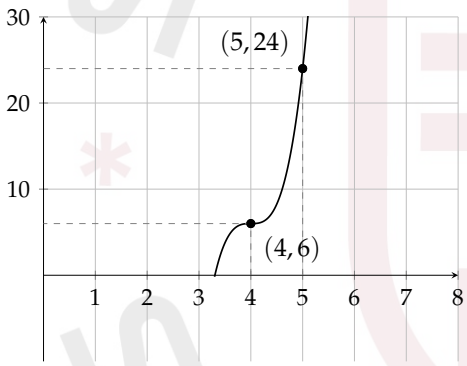
D 10

105.



In the xy-plane above, the graph of a quadratic function $y = f(x)$ intersects the x-axis at points O and Q, and has a vertex at point P. If line ℓ passes through points P and Q, what is the y-intercept of line ℓ?

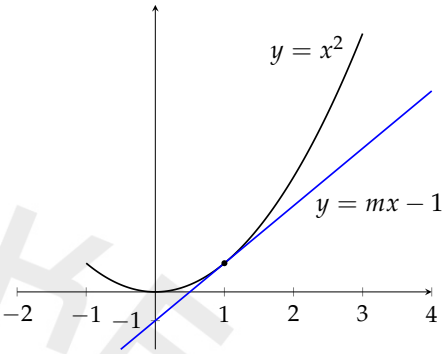
106.



The function f is defined by $f(x) = x^3$. The function g is defined by $g(x) = a \cdot f(x+b) + c$, where a, b, and c are constants. The graph of $y = g(x)$ is shown in the xy-plane. Find the value of ab?

107.

The graphs of $y = x^2$ and $y = mx - 1$ are shown in the xy-plane below, where m is the slope of the line. If the graph of $y = mx - 1$ is tangent to the graph of $y = x^2$, what is the value of m?



108.

A certain investment account offers a special interest rate for the first 4 months the account is open followed by a lower interest rate for the remainder of the time the account is open. Akeyla opened one of these accounts with an original account balance of \$700.00 and did not make any other deposits or withdrawals. 4 months after Akeyla opened the account, the balance had increased by 0.6% of the original balance. 6 months after Akeyla opened the account, the balance had increased by an additional 0.1% of the balance at the end of the first 4 months. Every 2 months after the first 6 months, the balance had increased by an additional 0.1% of the balance 2 months before. Which of the following equations could represent the account balance $B(x)$ in dollars, x months after the account was opened, where $x \geq 4$?

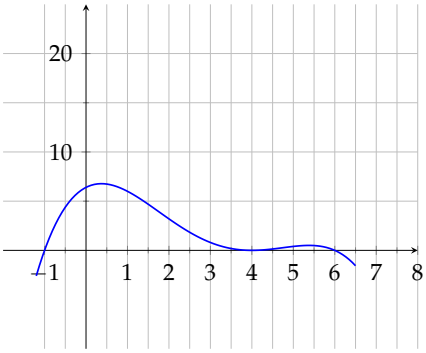
A $B(x) = 704.20(1.001)^{\frac{x-4}{2}}$

B $B(x) = 700.00(1.001)^{\frac{x-4}{2}}$

C $B(x) = 704.20(1.001)^{2(x-4)}$

D $B(x) = 700.00(1.001)^{2(x-4)}$

109.



Which of the following could be the equation of the graph shown in the xy-plane?

A $y = -\frac{1}{15}(x-6)(x-4)^2(x+1)$

B $y = -\frac{1}{15}(x-6)^2(x-4)(x+1)^2$

C $y = -\frac{1}{15}(x+6)(x+4)^2(x+1)$

D $y = -\frac{1}{15}(x+6)^2(x+4)(x-1)^2$

110.

For a certain circuit, its power P, in watts; current C, in amperes; voltage V, in volts; and resistance R, in ohms, are related as

$$\frac{CV^2}{P} = \sqrt{PR}$$

where P, C, V and R are positive. When $R = 18$, which equation correctly expresses P in terms of C and V?

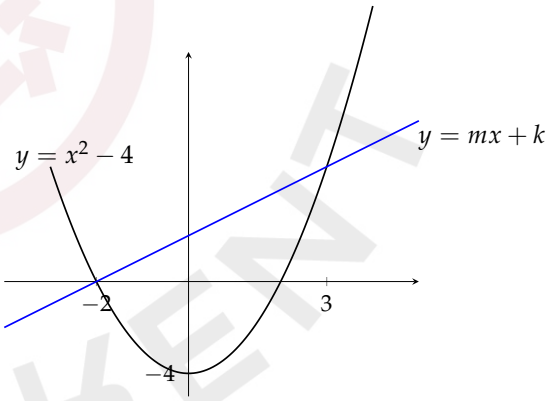
A $P = \frac{CV^2}{\sqrt{18P}}$

B $P = \frac{CV^2}{\sqrt{18}}$

C $P = \sqrt[3]{\frac{C^2V^4}{18}}$

D $P = \sqrt[3]{\frac{18}{C^2V^4}}$

111.



In the xy-plane above, the graphs of $y = x^2 - 4$ and $y = mx + k$ intersect at $x = -2$ and $x = 3$. What is the value of k?

A 1

B 2

C 3

D 4

112.

An exponential function f is defined by $f(x) = c^x$, where c is a constant greater than 1. If $f(6) = 25 \cdot f(4)$, what is the value of c?

113.

$$\frac{1}{R} = \frac{1}{p} + \frac{1}{q} + \frac{1}{s} + \frac{1}{13}$$

A parallel electric circuit contains four resistors with resistances of p ohms, q ohms, s ohms, and 13 ohms. The given equation relates the resistance R, in ohms, of the circuit, to the resistances of the four individual resistors it contains. Which equation correctly expresses R in terms of p, q, and s?

A $R = \dfrac{13pqs}{p+q+s+13}$

B $R = \dfrac{13pqs}{13qs+13ps+13pq+pqs}$

C $R = \dfrac{13qs+13ps+13pq+pqs}{13pqs}$

D $R = p+q+s+13$

114.

In the given equation,

$$\frac{1}{5xy} + xyz = \frac{1}{4yz}$$

Which expression is equivalent to y?

A $\dfrac{5x-4z}{20xz^2}$

B $\sqrt{\dfrac{5x-4z}{20xz^2}}$

C $\sqrt{\dfrac{1}{4xz^2-5xz}}$

D $\sqrt{\dfrac{1}{4xz^2-5xz^2}}$

115.

Which of the following expressions has $6x - 5b$ as a factor, where b is a positive integer constant?

A $24x^2 - 2xb - 15b^2$

B $24x^2 + 18xb - 15b^2$

C $24x^2 + 36xb - 15b^2$

D $24x^2 - 484xb - 15b^2$

116.

The function v is defined by the equation

$$v(x) = \frac{x^2+bx+c}{(x+5)(x-15)}$$

where b and c are constants. In the xy-plane, the graph of $y = v(x)$ passes through the points $(0, \frac{22}{25})$ and $(11, 0)$. If $v(q) = 0$, which of the following could be the value of q?

A -6

B -5

C 5

D 6

117.

$$y = 3\left(\frac{a}{6}\right)^{x+c} - b$$

How many times does the graph of the given equation in the xy-plane cross the x-axis, where a, b, and c are positive constants such that $a > 6$ and $b > c$?

A Zero

B One

C Two

D Three

118.

$$2x^2 - 8x - 21 = 0$$

One solution to the given equation can be written as $x = h - \frac{1}{2}\sqrt{k}$, where h and k are integer constants. What is the value of $h + k$?

A -24

B 10

C 29

D 60

119.

At different times on a certain day, a manager at a theme park recorded the number of visitors. An exponential model gives the estimated number of visitors, V, at the theme park t hours after the theme park opened, where $t \leq 3$. Based on the model, 85 visitors were estimated to be at the theme park when it opened, and every 30 minutes the estimated number of visitors increased by 140% of the estimated number of visitors 30 minutes earlier. Which of the following equations best represents this model?

A $V = 85(1.40)^{\frac{t}{2}}$

B $V = 85(1.40)^{2t}$

C $V = 85(2.40)^{\frac{t}{2}}$

D $V = 85(2.40)^{2t}$

120.

$$r(x) = 9(x - 3)$$

$$s(x) = x^3 + nx^2 + 3nx + 27$$

For the given functions r and s, n is a constant. If $r(x) \cdot s(x) = 9(x^4 - 81)$, what is the value of n?

121.

A certain investment account offers a special interest rate for the first 6 months the account is open followed by a lower interest rate for the remainder of the time the account is open. Bennett opened one of these accounts with an original account balance of \$600 and did not make any other deposits or withdrawals. 6 months after Bennett opened the account, the balance had increased by 0.4% of the original balance. 8 months after Bennett opened the account, the balance had increased by an additional 0.3% of the balance at the end of the first 6 months. Every 2 months after the first 8 months, the balance had increased by an additional 0.3% of the balance 2 months before. Which of the following equations could represent the account balance $B(x)$, in dollars, x months after the account was opened, where $x \geq 6$?

A $B(x) = 602.40(1.003)^{\frac{x}{2}-6}$

B $B(x) = 602.40(1.003)^{\frac{x-6}{2}}$

C $B(x) = 602.40(1.003)^{2x-12}$

D $B(x) = 602.40(1.003)^{2x-6}$

122.

The function j is defined by $j(x) = \frac{10x+5}{3p}$, and the function k is defined by $k(x) = \frac{j(x)\cdot p}{x+1}$, where p is a positive constant. What is the value of $k(9)$?

A $\frac{19}{6}$

B $\frac{10}{3}$

C $\frac{95}{13}$

D $\frac{85}{3}$

123.

$$h(x) = 4^{3-x}$$

Which of the following equivalent forms of the given function h displays the y-coordinate of the y-intercept of the graph of $y = h(x)$ in the xy-plane as a constant or coefficient?

A $h(x) = 4^3 \cdot \left(\frac{1}{4}\right)^x$

B $h(x) = 64\left(\frac{1}{4}\right)^x$

C $h(x) = 4^{-(x-3)}$

D $h(x) = \left(\frac{1}{4}\right)^{x-3}$

124.

The function v is defined by the equation $v(x) = \frac{x^2+bx+c}{(x+5)(x-19)}$, where b and c are constants. In the xy-plane, the graph of $y = v(x)$ passes through the points $(0, \frac{66}{95})$ and $(11, 0)$. If $v(q) = 0$, which of the following could be the value of q?

A -6

B -5

C 5

D 6

125.

The function p is defined by $p(x) = a(x-1)^2 + b$, where a and b are constants. If $p(0) = 10$ and $p(3) = 19$, what is the value of $p(-1) + p(5)$?

126.

$$z(w) = (0.954)^{2w}$$

The function z is defined by the equation shown. The value of $z(w)$ decreases by $q\%$ for each increase by 1 in the value of w. Which of the following is closest to the value of q?

127.

The exponential function f is defined by $f(x) = a \cdot b^x$, where a and b are positive constants. If $f(2) = 12$ and $f(5) = 324$, what is the value of b?

128.

The function f is defined by $f(x) = \frac{x^2 + ax + b}{3x + c}$, where a, b, and c are constants. The graph of $y = f(x)$ in the xy-plane does not intersect the line $x = 2$. If $f(3) = f(5) = 0$, what is the value of $a + b + c$?

129.

$$(x-k)^2 = (k-3a)(x-k)$$

In the given equation, a and k are constants, where $k > 3a$. The sum of the solutions to the equation is $3k + 12$. What is the value of a?

130.

$$(10b + 6a)x^2 + (9a^2 - 25b^2)x - 12ab = 0$$

The equation above has two real solutions, where a and b are positive constants. The sum of the solutions to the given equation is $k(21a - 35)$, where k is a constant. What is the value of k?

131.

$$f(x) = 5(0.92)^{3x}$$

The function f is defined by the given equation. The equation can be rewritten as $f(x) = 5(1 - \frac{p}{100})^x$, where p is a constant. Which of the following is closest to the value of p?

A 8

B 12

C 22

D 24

132.

$$-4 < 3x + 5 \leq 17$$

Which of the following represents all the values of x that satisfy the inequality above?

A $-3 \leq x < 4$

B $-3 < x \leq 4$

C $-9 < x \leq 12$

D $-9 \leq x < 12$

133.

The function

$$v(x) = \frac{x^2 + bx + c}{(x-7)(x-17)}$$

where b, c are constants goes through the points $(0, \frac{99}{119})$ and $(11, 0)$. There is another point where $v(q) = 0$. What is the value of q?

134.

$$f(x) = 15(b)^x$$

In the given function, b is a positive constant. For every increase in the value of x by 1, the value of $f(x)$ increases by c%, where $0 < c < 100$. Which expression gives the value of c in terms of b?

A $1 + \frac{b}{100}$

B $b + 100$

C $100(b + 1)$

D $100(b - 1)$

135.

Which of the following expressions has a factor of $x + 2b$, where b is a positive integer constant?

A $3x^2 + 7x + 14b$

B $3x^2 + 16x + 14b$

C $3x^2 + 18x + 14b$

D $3x^2 + 25x + 14b$

136.

$$r(t) = 55t - 2t^2$$

The function r is defined by the given equation. The function s is defined by $s(t) = r(t) + 1$. Which expression represents the maximum value of $s(t)$?

A $1 + \left(\frac{55}{2}\right)^2$

B $1 + 2\left(\frac{55}{4}\right)^2$

C $1 - 2\left(\frac{55}{4}\right)^2$

D $1 - \left(\frac{55}{2}\right)^2$

137.

Given the expression

$$\sqrt[4]{40n} \times (\sqrt[5]{40n})^3$$

find the value of y for which the expression is equivalent to $(40n)^{30y}$, where $n > 1$.

A $\frac{17}{600}$

B $\frac{10}{600}$

C $\frac{7}{600}$

D $\frac{14}{600}$

138.

If $p(x) = x^2 + kx + 4$ has no real zeros, what is the range of possible values for k?

A $k < -4$

B $-4 < k < 4$

C $k > 4$

D No range, k can be any real number.

139.

The function f is defined by $f(x) = a^x - b$ where a and b are constants. In the xy-plane, the graph of $y = f(x)$ passes through the points $(c, 7)$ and $(2c, 117)$, where c is a constant. Which of the following could be the value of b?

A 4

B 17

C 110

D 124

140.

$$f(x) = -3x^2 + bx + c$$

In the given quadratic function b and c are constants. The graph of $y = f(x)$ in the xy-plane is a parabola that has a vertex at the point (h,k). If $f(-4) = f(8)$, and the quadratic function has x-intercepts at $(r,0)$ and $(s,0)$, which of the following must be true?

I. $r + s = 4$

II. $b < 0$

III. $c < k$

A I and II only

B II and III only

C I and III only

D I, II, and III

141.

$$f(x) = 4^{-(2+x)}$$

Which of the following equivalent forms of the given function displays the y-coordinate of the y-intercept of its graph in the xy-plane as a constant?

A $f(x) = \frac{1}{16}\left(\frac{1}{4}\right)^x$

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

C $f(x) = 2^{-2(2+x)}$

D $f(x) = 4^{-(2-x)}$

142.

$$f(x) = (x-a)(x-b)$$

The function f is defined by the given equation, where a and b are integers. If $f(12) > 0$, $f(17) < 0$, and $f(62) > 0$, what is a possible value of $a + b$?

A 31

B 29

C 28

D 80

143.

$$\sqrt{k-x} = 51 - x$$

The given equation has exactly one real solution. What is the value of $4k$?

144.

The functions f and g are defined by the equations shown, where a and b are integer constants, $a < b$ and $b < 0$. Which of the following equations displays, as a constant or coefficient, the y-coordinate of the y-intercept of the graph of the corresponding function?

I. $f(x) = a(4.2)^{x+b}$

II. $g(x) = a(4.2)^x + b$

A I only

B II only

C I and II

D Neither I nor II

145.
Which of the following expressions has a factor of $2x + 3b$, where b is a positive integer constant?

A $4x^2 + 10x + 9b$

B $4x^2 + 21x + 18b$

C $4x^2 + 24x + 18b$

D $4x^2 + 33x + 18b$

146.

$$f(x) = (r - s)x^2 - (s - r)x + rs$$

In the function f defined above, r and s are positive constants. When the graph of $y = f(x)$ is plotted in the xy-plane, it intersects the x-axis at $(a, 0)$ and $(b, 0)$. What is the value of $a + b$?

147.

$f(x) = ax^2 + bx + c$ and $k(x) = px^2 - 57x + q$

The functions f and k are both quadratic. The parabola of $y = f(x)$ has a vertex y-coordinate of $3m$ and the parabola of $y = k(x)$ has a vertex y-coordinate of m, where $m > 0$. If $f(10) = f(14)$ and $k(-3) = k(27)$, for how many values of x does $f(x) = k(x)$?

A Exactly one

B Exactly two

C Infinitely many

D Zero

148.
The vertex of the function $f(x)$ is $(9, -13)$, and the point $(3, -4)$ lies on the parabola. If $h(x) = 4 \cdot f(x - 2)$, what is the value of $h(0) - 2f(0)$?

149.
Which of the following functions has (have) a minimum value at -3?

I. $f(x) = -6(3)^x - 3$

II. $g(x) = -3(6)^x$

A I only

B II only

C I and II

D Neither I nor II

150.
A quadratic function gives the estimated length of daylight $d(t)$, in hours, in a certain city t months after March 1, where $0 \leq t \leq 7$. According to the function, the estimated length of daylight is 12.66 hours 6 months after March 1 and the maximum estimated length of daylight is 13.91 hours 3.5 months after March 1. Based on this function, what is the estimated length of daylight, in hours, on March 1?

151.
The function f is defined by $f(x) = ax^2 + bx + c$, where a, b, and c are constants. The graph of $y = f(x)$ is a parabola where $f(-11) = f(-1)$. If b is an integer less than -3, what is the greatest possible value of $a + b$?

152.

$$nx^2 - 16x = 26x^2 - 8$$

In the given equation, n is an integer constant. If the equation has two distinct real solutions, what is the greatest possible value of n?

153.

$$f(x) = k^3(k^x) + b$$

The function f is defined by the equation above for $x \geq 0$, where k and b are positive constants and $k < 1$. Which of the following must be true?

I. The maximum value of the function is displayed as a constant or coefficient.

II. $f(1) = f(0) \cdot k$

III. $f(a) < b$ for some $a > 0$

A I only

B II and III only

C I and III only

D Neither I, II, nor III

154.

A quadratic function models the height, in feet, of an object above the ground in terms of time in seconds after the object was launched. The model estimates that the object was launched from a height of 0 feet and reached a maximum height of 207.36 feet at 3.6 seconds. The model also estimates that the object was at a height of 184.32 feet x seconds after it was launched. What is the greatest possible value of x?

155.

$$80x^2 + 80x = -10$$

One solution to the given equation can be written as $x = \dfrac{-8 - k\sqrt{2}}{16}$, where k is a constant. What is the value of k?

156.

$$g(x) = x^3 + ax^2 + bx + c$$

The function g is defined by the given equation, where a, b, and c are integer constants. The zeros of the function are -2, -7, and 3. What is the value of a?

A -42

B -6

C 6

D 42

157.

$$57x^{18} + bx^9 + 34$$

The given expression, where b is a constant, is equivalent to $(3x^9 + q)(rx^9 + 2)$, where q and r are constants. What is the value of b?

158.

$$(x - k)^2 = (k - 5a)(x - k)$$

In the given equation, a and k are constants with $k > 5a$. The sum of solutions is $3k + 21$. What is the value of a?

159.

$$f(x) = -(x+a)^2(x-b)(x-c)$$

For the polynomial function above, a, b, and c are positive constants. Let $b < k < c$ for some constant k. Which of the following must be true?

I. $k > 0$

II. $f(k) > 0$

III. $f(0) > 0$

A I and II only

B II and III only

C I and III only

D I, II, and III

160.

The function w is defined by $w(r) = \dfrac{1}{r-8} - \dfrac{r-5}{-r+4.25}$. What is the greatest possible value of r such that $w(r) = 0$?

161.

The function f is defined by $f(x) = 11x^3$. The graph of $y = f(-x) + c$ in the xy-plane, where c is a positive integer constant, has an x-intercept at $(r, 0)$ and a y-intercept at $(0, t)$. Which of the following must be true about r and t?

A $r < 0$ and $t < 0$

B $r < 0$ and $t > 0$

C $r > 0$ and $t > 0$

D $r > 0$ and $t < 0$

162.

$$f(x) = b\sqrt{a-x} + 7\sqrt{a-x}$$

For the function f, a and b are constants and $f(16) = 0$. If $f(9) > 0$, which of the following could be the value of $a + b$?

A -3

B 7

C 9

D 15

163.

The function j is defined by $j(x) = \dfrac{8x+4}{7p}$, and the function k is defined by $k(x) = \dfrac{j(x) \cdot p}{x+1}$, where p is a positive constant. What is the value of $k(5)$?

A $\dfrac{38}{7}$

B $\dfrac{44}{13}$

C $\dfrac{8}{7}$

D $\dfrac{22}{21}$

164.

Which expression is a factor of $y^2(x-9) - 36(x-9)^3$?

A $y(x-9)$

B $(x-9)(x-6)$

C $y + x - 9$

D $y + 6x - 54$

165.

$$x^2 + y^2 = 36, \quad y = mx + \frac{b}{4}$$

In the given system, m and b are negative constants. The graphs intersect at $(-5, y_1)$ where $y_1 < 0$. Which expression represents the value of b?

A $-\frac{5m}{4} + \frac{\sqrt{11}}{4}$

B $\frac{5m}{4} - \frac{\sqrt{11}}{4}$

C $-20m + 4\sqrt{11}$

D $20m - 4\sqrt{11}$

166.

The functions f and g are defined by the given equations, where $x \geq 0$, a and b are integer constants, $a < b$, and $a > 1$. Which of the following equations displays, as a constant or coefficient, the minimum value of the function it defines, for $x \geq 0$?

I. $f(x) = a(0.63)^{-bx}$

II. $g(x) = a(1.37)^{x+2} + b$

A I only

B II only

C I and II

D Neither I nor II

167.

The function h is defined by $h(x) = a^x + b$ where a and b are positive constants. The graph of $y = h(x)$ passes through $(0, 4)$ and $(2, 12)$. What is the value of ab?

A 8

B 9

C 12

D 15

168.

$$\sqrt{k - x} = 32 - x$$

In the given equation, k is a constant. The equation has exactly one real solution. What is the minimum possible value of $4k$?

169.

For the equation $x(14x + 15) + c = 9$, one possible solution is $x = \frac{-15 + \sqrt{113}}{28}$. What is the value of c?

A 2

B 9

C 11

D -7

170.

Given $n^{\frac{5}{3}} = k^{\frac{2}{5}}$ and $n^{4a+1} = k$, what is the value of a?

171.

$$f(x) = (1.84)^{\frac{x}{4}}$$

The function f is defined by the given equation. The equation can be rewritten as $f(x) = \left(1 + \frac{p}{100}\right)^x$, where p is a constant. Which of the following is closest to the value of p?

A 16

B 21

C 46

D 96

172.

$$0 = (x - k)(7x + t) - (x - k)$$

In the given equation, k and t are positive constants. A solution to the equation is $x = -\frac{22}{7}$. What is the value of t?

173.

$$-12(5x - 3)^2 + 6(5x - 4)^2$$

The given expression can be rewritten as $\frac{a}{6}x^2 + \frac{b}{6}x + \frac{c}{6}$, where a, b, and c are constants. What is the value of $a + b + c$?

A -252

B -126

C -42

D -7

174.

$$y = 2x^2 - 19x + 40$$

$$y = x + a$$

In the given system of equations, a is a constant. The graphs intersect at exactly one point (x, y) in the xy-plane. What is the value of x?

A -10

B -5

C 5

D 10

175.

In the xy-plane, a parabola has vertex $(7, 12)$ and intersects the x-axis at two points. If the equation of the parabola is written in the form $y = ax^2 + bx + c$ where a, b, and c are constants, which of the following could be the value of $a + b + c$?

A 10

B -14

C -18

D 36

176.

The function h is defined by $h(x) = -\sqrt{x^2 + bx + c}$, where b and c are constants. In the xy-plane, the graph of $y = h(x)$ contains the points $(2, 0)$ and $(0, -\sqrt{358})$. If $h(m) = 0$, what is the greatest possible value of m?

177.

The function f is defined by $f(x) = \frac{|x|}{a} - 14$, where $a < 0$. What is the product of $f(15a)$ and $f(8a)$?

178.

The functions f and g are defined by the equations shown, where a and b are integer constants, $a < b$ and $b < 0$. If $y = f(x)$ and $y = g(x)$ are graphed in the xy-plane, which of the following equations displays, as a constant or coefficient, the y-coordinate of the y-intercept of the graph of the corresponding function?

I. $f(x) = a(4.2)^{x+b}$

II. $g(x) = a(4.2)^x + b$

A I only

B II only

C I and II

D Neither I nor II

179.

Which of the following expressions has a factor of $2x + 3b$, where b is a positive integer constant?

A $4x^2 + 10x + 9b$

B $4x^2 + 21x + 18b$

C $4x^2 + 24x + 18b$

D $4x^2 + 33x + 18b$

180.

$$f(x) = 15(b)^x$$

In the given function, b is a positive constant. For every increase in the value of x by 1, the value of $f(x)$ increases by c%, where $0 < c < 100$. Which expression gives the value of c in terms of b?

A $1 + \frac{b}{100}$

B $b + 100$

C $100(b + 1)$

D $100(b - 1)$

Answers: Advanced Math

Number	Answer	Number	Answer
1	B	**26**	C
2	140	**27**	A
3	7	**28**	B
4	C	**29**	31
5	136	**30**	-6.4
6	6	**31**	8.5
7	A	**32**	11
8	4	**33**	179
9	A	**34**	0.9
10	A	**35**	D
11	845	**36**	76
12	C	**37**	-6
13	B	**38**	923
14	2381	**39**	-2268
15	C	**40**	2381
16	B	**41**	D
17	B	**42**	1456
18	14	**43**	-5
19	A	**44**	D
20	C	**45**	D
21	1	**46**	B
22	D	**47**	C
23	D	**48**	D
24	B	**49**	-112
25	-5	**50**	A

Number	Answer	Number	Answer
51	C	**76**	18;28
52	A	**77**	231.84
53	-32	**78**	A
54	A	**79**	B
55	A	**80**	A
56	D	**81**	C
57	D	**82**	C
58	B	**83**	18
59	171	**84**	B
60	184	**85**	A
61	A	**86**	C
62	A	**87**	B
63	D	**88**	C
64	D	**89**	A
65	C	**90**	18
66	A	**91**	A
67	D	**92**	B
68	630	**93**	C
69	1021	**94**	12
70	9	**95**	D
71	D	**96**	B
72	D	**97**	D
73	B	**98**	1458
74	1215	**99**	188.5
75	B	**100**	D

Number	Answer	Number	Answer
101	D	**126**	9
102	2	**127**	3
103	-11	**128**	1
104	C	**129**	-4
105	10	**130**	-1/14
106	-72	**131**	C
107	2	**132**	B
108	A	**133**	9
109	A	**134**	D
110	C	**135**	A
111	B	**136**	B
112	5	**137**	A
113	B	**138**	B
114	B	**139**	A
115	A	**140**	C
116	A	**141**	A
117	B	**142**	A
118	D	**143**	203
119	D	**144**	D
120	3	**145**	C
121	B	**146**	−1
122	A	**147**	B
123	B	**148**	54.5
124	A	**149**	D
125	74	**150**	11.46

Number	Answer	Number	Answer
151	$-13/3$	**166**	A
152	33	**167**	B
153	B	**168**	127
154	4.8	**169**	C
155	4	**170**	19/24
156	C	**171**	A
157	329	**172**	23
158	-4.2	**173**	-252
159	A	**174**	C
160	6.5	**175**	C
161	C	**176**	179
162	D	**177**	638
163	22/21	**178**	D
164	D	**179**	C
165	D	**180**	D

Geometry

Geometry

1.
In the xy-plane, a circle has center C with coordinates (h,k). Points A and B lie on the circle. Point A has coordinates $(h,k+231)$, and $\angle ACB$ is a right angle. What is the length of $\overline{AB}$?

A) $231\sqrt{3}$

B) $231\sqrt{2}$

C) $2\sqrt{230}$

D) 462

2.
A circle has center O, and points A and B lie on the circle. The measure of arc AB is $20°$, and the length of this arc is 4 inches. What is the circumference, in inches, of the circle?

A) 4

B) 8

C) 16

D) 72

3.
A line intersects two parallel lines, forming four acute angles and four obtuse angles. The measure of one of these eight angles is $(7x-250)°$. The sum of the measures of four of the eight angles is $k°$. Which of the following could NOT be equivalent to k, for all values of x?

A) $-14x+1,540$

B) $14x-320$

C) $-28x+1,720$

D) 360

4.
In triangle ABC and triangle DEF, sides AB and DE each have a side length of 10 inches, and angles A and D each have an angle measure of $40°$. Which of the following additional pieces of information is (are) sufficient to prove whether triangle ABC is congruent to triangle DEF?

I. The measures of angles B and C are equal.

II. The lengths of sides AC and DF are equal.

III. The lengths of sides BC and EF are equal.

A) I is sufficient, but II and III are not.

B) II is sufficient, but I and III are not.

C) III is sufficient, but I and II are not.

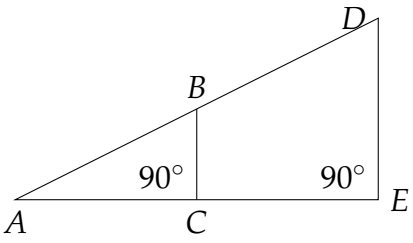
D) II is sufficient and III is sufficient, but I is not.

5.
In triangle RST, the measure of angle R is $39°$, the measure of angle S is $x°$, and the measure of angle T is $(8x-3)°$. Point L lies on RS, point K lies on ST, and LK is parallel to RT. What is the measure, in degrees, of angle SKL? (Disregard the degree symbol when entering your answer.)

6.
If the perimeter of an equilateral triangle with a height of 21 is $a\sqrt{3}$, what is the value of a?

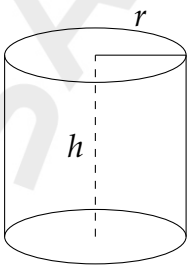
7.

Note: Figure not drawn to scale.



In the figure shown, $AB = \sqrt{89}$ units, $AC = 8$ units, and $CE = 24$ units. What is the area, in square units, of triangle ADE?

8.



The figure shown is a right circular cylinder with a radius of r and height of h. A second right circular cylinder (not shown) has a volume that is 576 times as large as the volume of the cylinder shown. Which of the following could represent the radius R, in terms of r, and the height H, in terms of h, of the second cylinder?

A) $R = 9r$ and $H = 8h$

B) $R = 9r$ and $H = 64h$

C) $R = 8r$ and $H = 9h$

D) $R = 64r$ and $H = 9h$

9.

For triangle PQR and triangle STU, angles P and S each measure 30°, $QR = 16$ and $TU = 12$. Which additional piece(s) of information is (are) sufficient to prove that triangle PQR is similar to triangle STU?

I. The length of PQ is $\frac{4}{3}$ the length of ST

II. The length of PR is $\frac{4}{3}$ the length of SU

A) I is sufficient, but II is not.

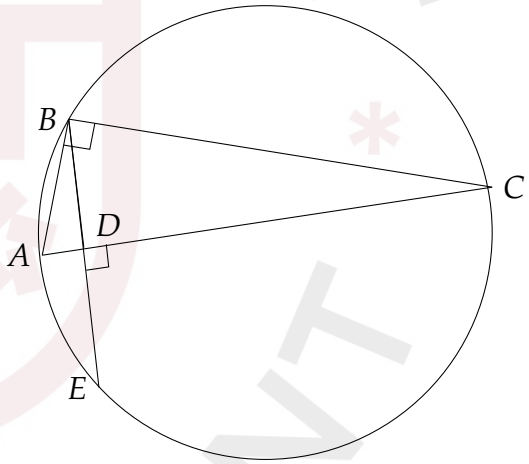
B) II is sufficient, but I is not.

C) I is sufficient, and II is sufficient.

D) Neither I nor II is sufficient.

10.

Note: Figure not drawn to scale.



In the figure shown, points A, B, C, and E lie on the circle, and $AB < BC$. Segment AC is perpendicular to segment BE at point D, and $BD = \sqrt{346}$. The diameter of the circle is 175. If $\frac{CD}{AD} = r$ what is the value of r?

11.

The volume of a right rectangular prism with a square base is 539 cubic centimeters. If the area of each of the four lateral faces is 77 square centimeters, what is the height, in centimeters, of the prism?

A) 77

B) 49

C) 11

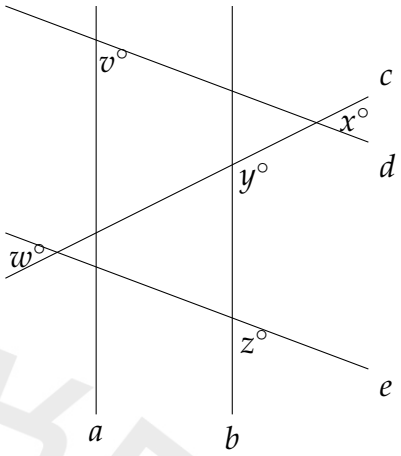
D) 7

12.

Right rectangular prism X is similar to right rectangular prism Y. The surface area of right rectangular prism X is 52 square centimeters cm^2, and the surface area of right rectangular prism Y is 3,328 cm^2. The volume of right rectangular prism X is 10.5 cubic centimeters cm^3. What is the volume, in cm^3, of right rectangular prism Y?

13.

Note: Figure not drawn to scale.



In the figure, parallel lines a and b are intersected by lines c, d, and e. If $z = 49$, $y = 136$, and $v < z$, which statement about x and w must be true?

A) $x < w$

B) $x > w$

C) $x = w$

D) $x + w = 90$

14.

A polygon has exactly 87 sides. If the measure of each of the 87 interior angles of this polygon is $(180p)^\circ$, what is the value of p?

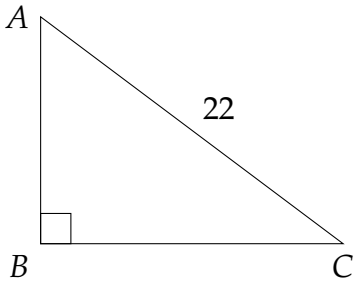
15.

Right rectangular prism X is similar to right rectangular prism Y. The surface area of right rectangular prism X is 59 square centimeters (cm^2), and the surface area of right rectangular prism Y is 1,475cm^2. The volume of right rectangular prism Y is 1,500 cubic centimeters (cm^3). What is the sum of the volumes, in cm^3, of right rectangular prism X and right rectangular prism Y?

TASHKENT SATASHKENT

16.

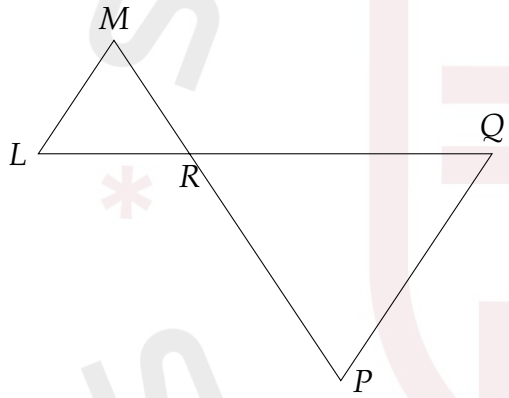
Note: Figure not drawn to scale.



For triangle ABC, the length of $\overline{AB}$ is 11 less than the length of $\overline{AC}$. Point D (not shown) lies on $\overline{AC}$ such that $\overline{BD}$ (not shown) is perpendicular to $\overline{AC}$. What is the value of $\frac{BC}{BD}$?

17.

Note: Figure not drawn to scale.



In the figure, $\overline{LQ}$ intersects $\overline{MP}$ at point R and $\overline{LM}$ is parallel to $\overline{PQ}$. The lengths of $\overline{MR}$ and $\overline{RP}$ are 8 and 14 units, respectively. The area of $\triangle LMR$ is 36 square units. What is the area of $\triangle PQR$, in square units?

A) $\frac{576}{49}$

B) $\frac{144}{7}$

C) 63

D) $\frac{441}{4}$

18.

A circle is inscribed in a square such that the circumference of the circle touches the midpoint of each side of the square. The length of the diagonal of the square is 228 units. What is the area, in square units, of the circle?

A) $6,498\pi$

B) $12,996\pi$

C) $25,992\pi$

D) $51,984\pi$

19.

A right square pyramid has a total surface area of 28,160 square inches, and the combined surface area of the four lateral faces of this pyramid is 16,060 square inches. What is the height, in inches, of this pyramid?

A) 48

B) 55

C) 73

D) 110

20.

Point F lies on a unit circle in the xy-plane and has coordinates (1, 0). Point G is the center of the circle and has coordinates (0, 0). Point H also lies on the circle and has coordinates $(-1, y)$, where y is a constant. Which of the following could be the positive measure of angle FGH, in radians?

A) $\frac{27\pi}{2}$

B) $\frac{29\pi}{2}$

C) 24π

D) 25π

21.

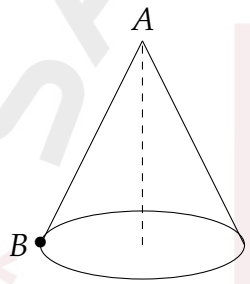
A rectangular region of land is divided into 88 square lots of equal area R, in square units. The length of the region is 5.5 times the width of the region. If the width of the region is $x\sqrt{R}$ units, what is the value of x?

22.

The perimeter of an equilateral triangle is 876 centimeters. The three vertices of the triangle lie on a circle. The radius of the circle is $w\sqrt{3}$ centimeters. What is the value of w?

23.

Note: Figure not drawn to scale.



For the right circular cone shown, B is a point on the circumference of the base, and the length of segment AB (not shown) is 84 centimeters. If the height of the cone is 42 centimeters and the volume of the cone is $k\pi$ cubic centimeters, what is the value of k?

24.

A line intersects two parallel lines, forming four acute angles and four obtuse angles. The measure of one of the acute angles is $(7x - 610)°$. The sum of the measures of one of the acute angles and three of the obtuse angles is $(-14x + w)°$. What is the value of w?

25.

In triangle FGH and triangle KLM, the measures of angles G and L are each 60°. The lengths of GH and LM are each 34 centimeters, and

$$\frac{GH}{GF} = \frac{LM}{LK}$$

Which additional piece of information would be necessary to prove that triangle FGH is congruent to triangle KLM:

A) The lengths of FG and KM are each 17 centimeters.

B) The measures of angles H and M are each 30°.

C) The measures of angles F and K are each 90°.

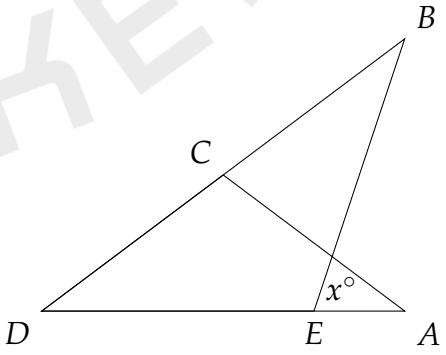
D) No additional information is necessary.

26.

In triangle RST, the measure of angle R is 18 degrees and the measure of angle T is 72 degrees. Point L lies on $\overline{RS}$, point K lies on $\overline{ST}$, and LK is parallel to $\overline{RT}$. What is the measure, in degrees, of angle SKL? (Disregard the degree symbol when entering your answer.)

27.

Note: Figure not drawn to scale.



In the figure, $AC = CD$. The measure of angle EBC is 29°, and the measure of angle ACD is 108°. What is the value of x?

28.

A line intersects two parallel lines, forming four acute angles and four obtuse angles. The measure of one of the acute angles is $(9x - 490)°$. The sum of the measures of one of the acute angles and three of the obtuse angles is $(-18x + w)°$. What is the value of w?

29.

In isosceles triangle ABC, sides AB and AC are congruent. Point D divides side BC such that the length of BD is $\frac{4}{7}$ of the length of BC. Point E lies on side AB and point F lies on side AC such that when segments DE and DF are drawn, angle BED is congruent to angle CFD. If the length of BE is 8, what is the length of CF?

A) 6

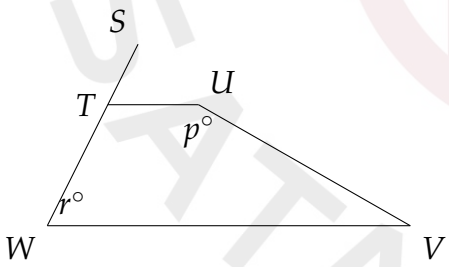
B) 14

C) 32

D) 56

30.

Note: Figure not drawn to scale.



In the figure shown, point T lies on segment SW, and segment TU is parallel to segment VW. The measure of angle V is 26°, and the measure of angle STU is 74°. What is the value of $p - r$?

31.

The perimeter of an isosceles right triangle is $52 + 52\sqrt{2}$ inches. What is the length, in inches, of the hypotenuse of this triangle?

A) 26

B) $26\sqrt{2}$

C) 52

D) $52\sqrt{2}$

32.

Triangles PQR and LMN are graphed in the xy-plane. Triangle PQR has vertices P, Q, and R at (5, 2), (5, 4), and (7, 2); respectively. Triangle LMN has vertices L, M, and N at $(5, 2)$, $(5, 4 + k)$, and $(7 + k, 2)$, respectively, where k is a positive constant. If the measure of $\angle Q$ is $t°$, what is the measure of $\angle N$?

A) $(90 - (t - k))°$

B) $(90 - (t + k))°$

C) $(90 - t)°$

D) $(90 + k)°$

33.

A right rectangular prism has a base area of 16t square centimeters (cm^2). The length of the base of the rectangular prism is $\frac{8}{3}$ cm, and the height of the rectangular prism is 9 cm. Which expression represents the surface area, in cm^2, of the right rectangular prism?

A) $32t + 96$

B) $140t + 48$

C) $800t + 48$

D) $144t$

34.

A cube has an edge length of 82 inches. A solid sphere with a radius of 41 inches is inside the cube, such that the sphere touches the center of each face of the cube. To the nearest cubic inch, what is the volume of the space in the cube not taken up by the sphere?

A) 262,672

B) 288,532

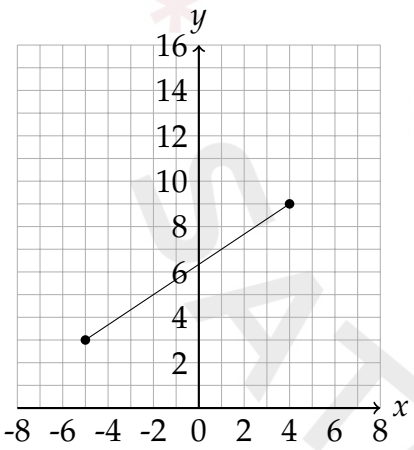
C) 334,846

D) 546,087

35.

In triangle PQR, the measure of angle P is $(3x + 5)°$, the measure of angle Q is $(2x + 9)°$, and the measure of angle R is $(4y + 5)°$. If side QR is extended through point R to point S and the measure of angle PRS is $(x + y)°$, what is the value of $x + y$?

36.



The line segment shown in the xy-plane represents one of the legs of a right triangle. The area of this triangle is $48\sqrt{13}$ square units. What is the length, in units, of the other leg of this triangle?

A) 16

B) 32

C) $3\sqrt{13}$

D) $6\sqrt{13}$

37.

A right circular cone has a volume of $2{,}700\pi$ cubic centimeters and the area of its base is 225π square centimeters. What is the slant height, in centimeters, of this cone?

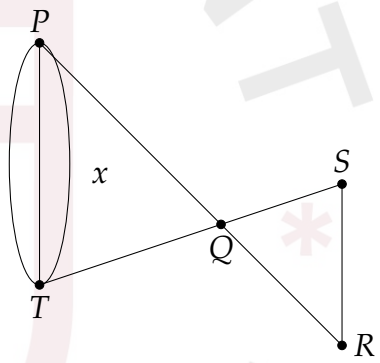
A) 12

B) 15

C) 36

D) 39

38.



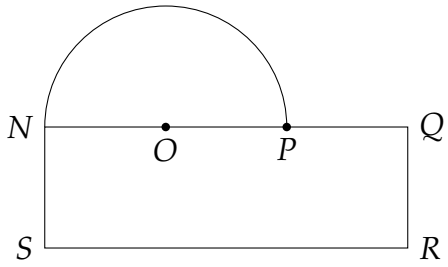
A property owner wants to find the length x, in feet, across a pond as represented in the figure. PR intersects ST at point Q, and $\angle PTQ$ is congruent to $\angle RSQ$. The lengths represented by PQ, TQ, QS, and RS were determined to be 4,200 feet, 8,400 feet, 1,400 feet, and 1,600 feet, respectively. What is the value of x?

39.

A right square pyramid has a surface area of 75,264 square inches, which includes a base area of 36,864 square inches. What is the slant height, in inches, of this pyramid?

40.

Note: Figure not drawn to scale.



In the given figure, NP is the diameter of semicircle O. Angles Q, R, and S are right angles, and point P is the midpoint of NQ. If $PQ = 52$ feet and $NS = 18$ feet, the area of the figure can be expressed as $a\pi + b$ square feet, where a and b are integers. What is the value of $a - b$?

41.

The volume of a right rectangular prism with a square base is 2,448 cubic centimeters. If the area of the square base is 144 square centimeters, what is the area, in square centimeters, of one of the four lateral faces of the prism?

A) 17

B) 204

C) 540

D) 816

42.

A right square pyramid has a height of 11 centimeters (cm). A second right square pyramid has a height of 22 centimeters. The area of the bases of each of the two pyramids is 100 cm^2. Which of the following is closest to the difference in the surface area of the second pyramid and the surface area of the first pyramid, in cm^2?

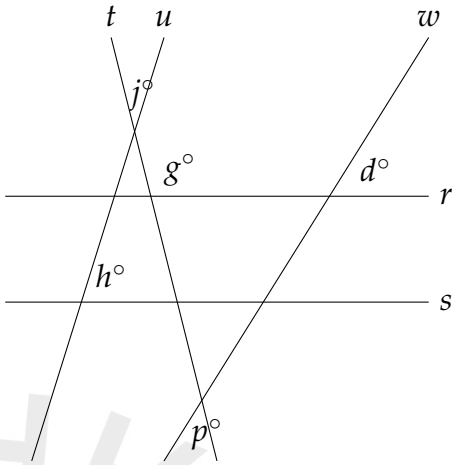
A) 209

B) 220

C) 367

D) 551

43.



In the figure, parallel lines r and s are intersected by lines t, u, and w. If $d = 42$, $g = 143$, and $h > d$, which statement about j and p must be true?

A) $j = p$

B) $j + p = 90$

C) $j > p$

D) $j < p$

44.

A right triangular pyramid has exactly six edges. Each of these edges is 96 centimeters long. If the surface area of the pyramid is $k\sqrt{3}$ square centimeters, what is the value of k?

45.

A right rectangular prism has a base area of 28p square centimeters (cm^2). The length of the base of the rectangular prism is 12 cm, and the height of the rectangular prism is 4 cm. Which expression represents the surface area, in cm^2, of the right rectangular prism?

A) $\frac{512p}{3}$

B) $\frac{224p}{3} + 96$

C) $56p + 192$

D) $560p + 96$

46.

	Volume(cubic units)
Cylinder A	72π
Cylinder B	$4,608\pi$

The table shows the volume of two similar solids, right circular cylinder A and right circular cylinder B.The radius of right circular cylinder A is 3 units. The surface area of right circular cylinder A is $k\pi$ square units, and the surface area of right circular cylinder B is $n\pi$ square units, where k and n are constants. What is the value of $n - k$? (The surface area of a right circular cylinder with radius r and height h is $2\pi r^2 + 2\pi rh$.)

47.

$$x^2 - 6x + y^2 - 12y - 36 = 0$$

In the xy-plane, the graph of the given equation is a circle. If this circle is inscribed in a square, what is the perimeter of the square?

A) 18

B) 36

C) 72

D) 144

48.

$(x + 3)^2 + (y - 18)^2 = 169$

The graph of the given equation is a circle in the xy-plane. The point (a, b) lies on the circle. Which of the following is a possible value for a?

A) -16

B) -10

C) 3

D) 10

E) 16

49.

$$x^2 - 16x + y^2 - 10y - 55 = 0$$

In the xy-plane, the graph of the given equation is a circle. If this circle is inscribed in a square, what is the perimeter of the square?

A) 24

B) 48

C) 96

D) 220

50.

A circle in the xy-plane has a diameter with endpoints (a, 11) and (a, d), where a and d are constants. An equation of this circle is $(x - a)^2 + (y - 17)^2 = r^2$, where r is a positive constant. What is the value of d?

A) 5

B) 12

C) 17

D) 23

51.

In the xy-plane, a unit circle with center at the origin O contains point A with coordinates $(1, 0)$ and point B with coordinates $(\frac{5}{\sqrt{34}}, -\frac{3}{\sqrt{34}})$. If the measure of angle AOB is p radians, what is the value of $\frac{\cos p}{\sin p}$?

52.

In the xy-plane, a unit circle with center at the origin O contains point A with coordinates $(1, 0)$ and point B with coordinates $\left(-\frac{5}{\sqrt{89}}, \frac{8}{\sqrt{89}}\right)$. If the measure of angle AOB is w radians, what is the value of $\tan w$?

53.

	Volume (cubic units)
Cylinder A	112π
Cylinder B	$3,024\pi$

The table shows the volume of two similar solids, right circular cylinder A and right circular cylinder B. The radius of right circular cylinder A is 4 units. The surface area of right circular cylinder A is $k\pi$ square units, and the surface area of right circular cylinder B is $n\pi$ square units, where k and n are constants. What is the value of $n - k$? (The surface area of a right circular cylinder with radius r and height h is $2\pi r^2 + 2\pi rh$.)

54.

Point M lies on a unit circle in the xy-plane and has coordinates $(1, 0)$. Point C is the center of the circle at $(0, 0)$. Point N also lies on the unit circle, and the measure of angle MCN is $\frac{385\pi}{6}$ radians. If the coordinates of point N are (p, q), where p and q are constants, what is the value of q?

A) $-\frac{1}{2}$

B) $\frac{\sqrt{3}}{2}$

C) $-\frac{\sqrt{3}}{2}$

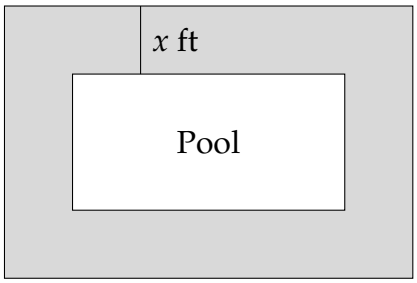
D) $\frac{1}{2}$

55.

$$2x^2 + 2y^2 + tx + ty - 78 = 0$$

The given equation, where t is a positive constant, defines a circle in the xy-plane. The radius of this circle is $\sqrt{41}$. What is the value of t?

56.



The figure shows a rectangular pool surrounded by a concrete path that is x feet (ft) wide on all sides. The pool is 21 ft long and 13 ft wide. The area of the concrete path is 240 ft². What is the value of x?

A) 3

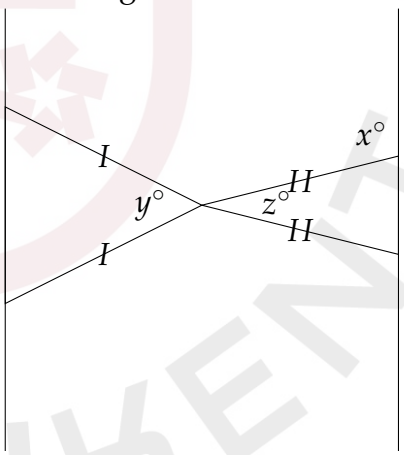
B) 6

C) 20

D) 40

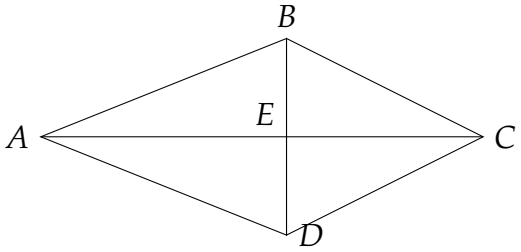
57.

Note: Figure not drawn to scale.



Two isosceles triangles are shown above. If $180 - z = 3y$ and $y = 50$, what is the value of x?

58.



In the figure above, $AB = AD$, $BC = CD$, $BE = 4$, $BC = 8$, and $AC = 12$. What is the area of triangle ABD?

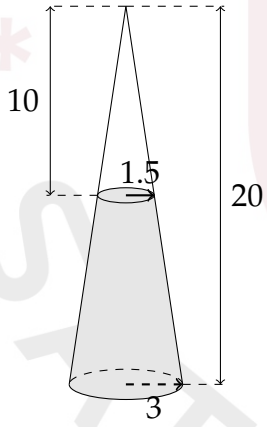
A) $96 - 32\sqrt{3}$

B) $48 - 16\sqrt{3}$

C) $24 - 8\sqrt{3}$

D) $12 - 4\sqrt{3}$

59.



The solid in the figure below is the shaded part of a cone with a height of 10 cm obtained by cutting its top parallel to the base, 10 cm from its tip. The volume of the solid is

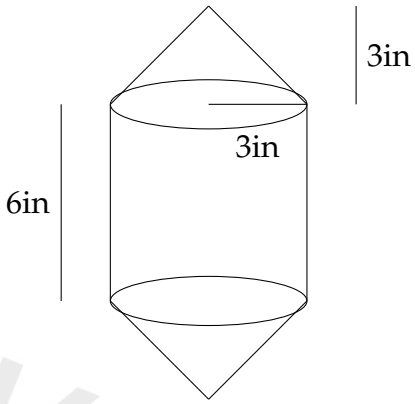
A) $188.52\,\text{cm}^3$

B) $23.57\,\text{cm}^3$

C) $164.93\,\text{cm}^3$

D) $145.29\,\text{cm}^3$

60.



A futuristic football is built from two right circular cones and a right circular cylinder with internal measurements represented by the figure above. Of the following, which is closest to the volume of the football, in cubic inches?

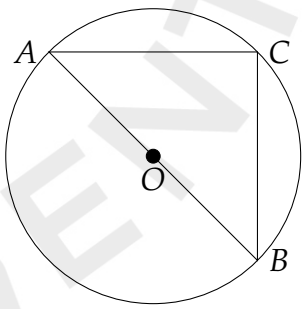
A) 56.1

B) 169.6

C) 197.9

D) 226.2

61.



The area of an isosceles right triangle inscribed in the circle with center at O and radius $5\sqrt{2}$ is

A) 100

B) 50

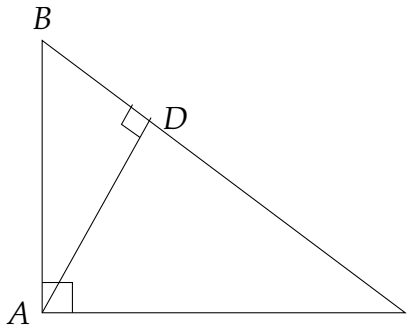
C) $10\sqrt{2}$

D) $25\sqrt{2}$

E) $50\sqrt{2}$

62.

Note: Figure not drawn to scale.



In the figure, $\angle ABD = w°$, $\angle CAD = z°$, and $\cos w = \frac{9}{41}$. What is the value of $\tan z$?

63.

In the xy-plane, a circle has center C with coordinates $(p, 8)$, where p is a constant. Points G and H lie on the circle. Point G has coordinates $(p + 3\sqrt{5}, 14)$, and point H has coordinates $(q, 8)$, where q is a constant greater than p. What is the area, in square units, of triangle CGH?

A) $27\sqrt{5}$

B) 27

C) $5\sqrt{27}$

D) $27\sqrt{6}$

64.

In the xy-plane, the line $y = 3x - 14$ is tangent to a circle with center $(h, 1)$. Which of the following is a possible value for h if the center lies to the right of the tangent line?

A) 2

B) 3

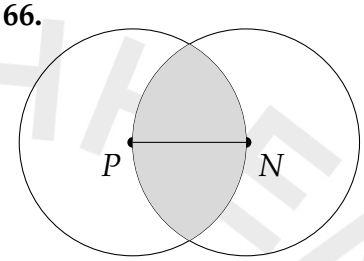
C) 5

D) 7

65.

Identical rectangles X and Y each have an area of $\frac{49}{5}$ square meters and a perimeter of P meters. If one of the shorter sides of rectangle X is glued to one of the shorter sides of rectangle Y, the resulting rectangle has a perimeter of $\frac{14}{9}P$ meters. What is the value of P?

66.



In the figure above, P and N are the centers of the circles and $PN = 6$. What is the area of the intersection?

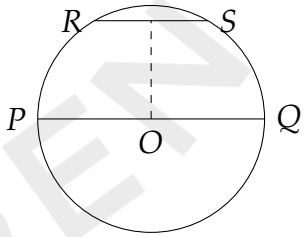
A) $18\pi - 9\sqrt{3}$

B) $24\pi - 9\sqrt{3}$

C) $24\pi - 18\sqrt{3}$

D) $36\pi - 18\sqrt{3}$

67.



In the circle above, chord $\overline{RS}$ is parallel to diameter $\overline{PQ}$. If the length of $\overline{RS}$ is $\frac{3}{4}$ of the length of $\overline{PQ}$ and the distance between the chord and the diameter is $2\sqrt{7}$, what is the radius of the circle?

A) 6

B) $3\sqrt{7}$

C) 8

D) $4\sqrt{7}$

68.

The ratio of the internal angles of triangle A is 1:2:3. Triangle B is an equilateral triangle with a side of 12 cm. If the area of triangle A and B are equal and the perimeter of triangle A is $m\sqrt{2}+n\sqrt{6}$, what is the value of $m+n$?

A) 6

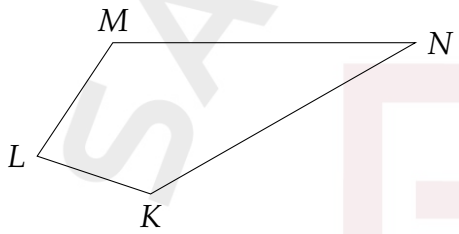
B) 12

C) 18

D) 24

69.

Note: Figure not drawn to scale.



In quadrilateral $KLMN$ shown, $KL = 3$, $LM = 3$, $KN = 27$, and $MN = 27$. Diagonals KM and LN (not shown) intersect at point G (not shown), where $GK = 1$ and $GM = 1$. If the length of diagonal LN is $\sqrt{p}+\sqrt{w}$, where p and w are integers, what is the value of $p+w$?

70.

A hollow steel pipe is in the shape of a right circular cylinder. The steel pipe has an outside diameter of 48 inches, a wall thickness of $\frac{3}{5}$ inches, and a height of 144 inches. Which of the following is closest to the volume, in cubic inches, of the wall of this steel pipe?

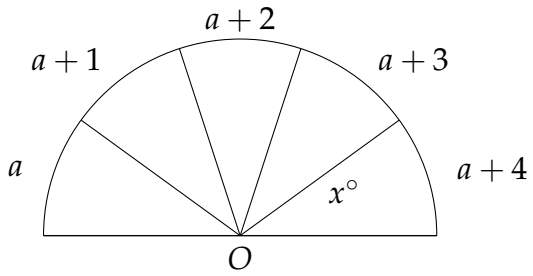
A) 177

B) 565

C) 2,160

D) 13,395

71.



The figure above shows a semicircle with the lengths of the adjacent arcs a, $a+1$, $a+2$, $a+3$, and $a+4$. If the value of x is 42, what is the value of a?

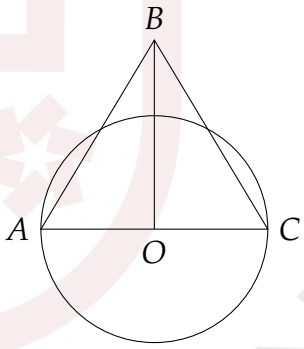
A) 7

B) 8

C) 9

D) 10

72.



In the figure, $\overline{AC}$ is a diameter of the circle with center O, and $AC = 10$. Triangle $\triangle ACB$ is equilateral. The length of BP is n times the length of AO. What is the value of n?

A) $\sqrt{5}$

B) $\sqrt{3}$

C) $\sqrt{3}-1$

D) $\sqrt{5}-1$

73.

In the xy-plane, a circle has center D with coordinates $(m, 16)$, where m is a constant. Points E and F lie on the circle. Point E lies on the circle and has coordinates $(m + 4\sqrt{10}, 34)$, and point F has coordinates $(n, 16)$, where n is a constant greater than m. What is the area, in square units, of triangle DEF?

A) 198

B) $72\sqrt{10}$

C) 242

D) $99\sqrt{10}$

74.

A right square pyramid has a total surface area of 36,864 square inches, and the combined surface area of the four lateral faces of this pyramid is 20,480 square inches. What is the height, in inches, of this pyramid?

A) 48

B) 64

C) 80

D) 128

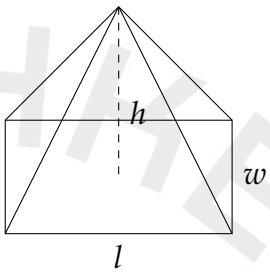
75.

A line intersects two parallel lines, forming four acute angles and four obtuse angles. The measure of one of the acute angles is $(9x - 490)$. The sum of the measures of one of the acute angles and three of the obtuse angles is $(-18x + w)$. What is the value of w?

76.

Right rectangular prism X is similar to right rectangular prism Y. The surface area of right rectangular prism X is 59 cm^2, and the surface area of right rectangular prism Y is 1,475 cm^2. The volume of right rectangular prism Y is 1,500 cm^3. What is the sum of the volumes, in cm^3, of right rectangular prism X and right rectangular prism Y?

77.



The figure shown is a right rectangular pyramid, where $l = 18$ units, $w = 9$ units, and $h = 12$ units. What is the surface area, in square units, of the pyramid?

A) $297 + 27\sqrt{73}$

B) $162 + 54\sqrt{73}$

C) $162 + 27\sqrt{193}$

D) $324 + 18\sqrt{73}$

78.

	Area	Perimeter
Rectangle A	2,450	490
Rectangle B	9,800	n

The table gives the areas (square inches) and perimeters (inches) of two similar rectangles, where n is a constant. What is the value of n?

A) 980

B) 1,960

C) 3,920

D) 4,900

79.

A right square pyramid has a height of 11 centimeters (cm). A second right square pyramid has a height of 22 centimeters. The area of the base of each of the two pyramids is $100\,cm^2$. Which of the following is closest to the difference in the surface area of the second pyramid and the surface area of the first pyramid, in cm^2?

A) 209

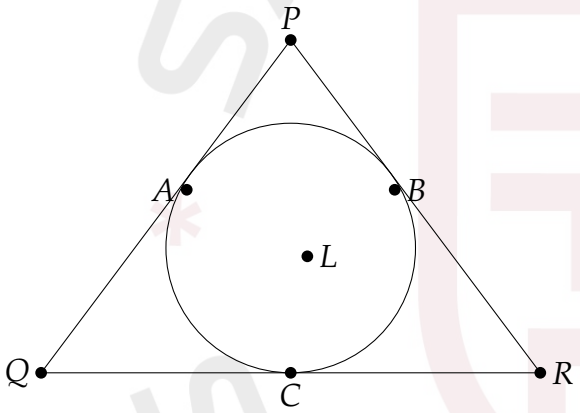
B) 220

C) 367

D) 551

80.

Note: Figure not drawn to scale.



A circle is inscribed in an equilateral triangle as shown above. Point L is the center of the circle. Points A, B, and C all lie on the circle and the sides of the triangle. The perimeter of the triangle is $90\sqrt{3}$. The length of arc AC is equal to $k\pi$. What is the value of k?

81.

$5x^2 - 40px + 5y^2 + 70py = 325p^2$

In the xy-plane, the graph of the given equation is a circle, where p is a constant. The center of the circle is $(-8, 14)$. If a square is inscribed in the circle, what is the area of the square?

82.

In triangle DEF, angle F is a right angle, point Q lies on DE, point J lies on EF, and QJ is parallel to DF. If the length of EF is 45 units, the length of FJ is 24 units, and the area of triangle DEF is 630 square units, what is the perimeter of triangle QEJ, in units?

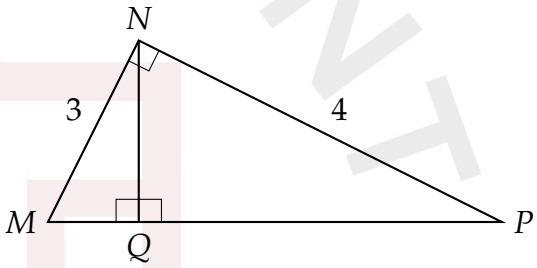
A) $\frac{294}{5}$

B) 63

C) $\frac{441}{5}$

D) 126

83.



In the figure above, what is the length of NQ?

A) 2.2

B) 2.3

C) 2.4

D) 2.5

84.

An equilateral triangle is inscribed in a circle with a radius of 8 inches. What is the area of the region that lies within the circle but outside the triangle, in square inches? Round your answer to the nearest tenth.

A) $64\pi - 48\sqrt{3}$

B) $64\pi - 24\sqrt{3}$

C) $64\pi - 32\sqrt{3}$

D) $16\pi - 12\sqrt{3}$

85.

In triangles PQR and XYZ, angles R and Z each have a measure of 38°. The length of side QR is equal to 11. The length of side YZ is equal to 27.5. Which additional piece of information is sufficient to prove that triangle PQR is similar to triangle XYZ?

A) The measure of angle P is 46°

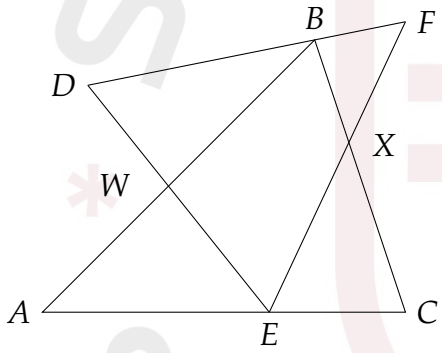
B) The length of side PR is 14 and the length of side XZ is 35

C) The measure of angle Q is 49° and the measure of angle Y is 94°

D) No additional information is necessary

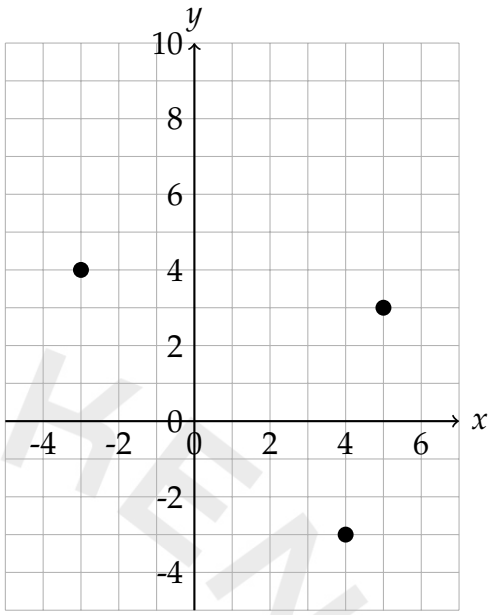
86.

Note: Figure not drawn to scale.



In the figure shown, point B lies on line segment DF, point E lies on line segment AC, line segments AB and DE intersect at point W, and line segments BC and EF intersect at point X. The measure of $\angle A$ is 40°, the measure of $\angle C$ is 60°, the measure of $\angle D$ is 68°, and the measure of $\angle FBC$ is 72°. What is the measure, in degrees, of $\angle AED$?

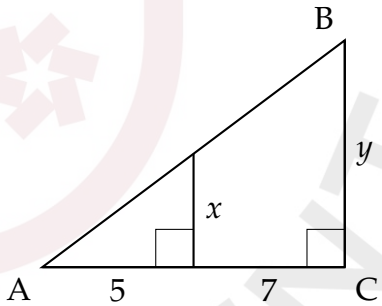
87.



What is the area, in square units, of the triangle formed by connecting the three points shown?

88.

Note: Figure not drawn to scale.



The area of triangle ABC above is at least 48 but no more than 60. If y is an integer, what is one possible value of x?

89.

In triangle ABC and triangle DEF, sides AB and DE each have a side length of 10 inches, and angles A and D each have an angle measure of 40°. Which of the following additional pieces of information is (are) sufficient to prove whether triangle ABC is congruent to triangle DEF?

I. The measures of angles B and C are equal.

II. The lengths of sides AC and DF are equal.

III. The lengths of sides BC and EF are equal.

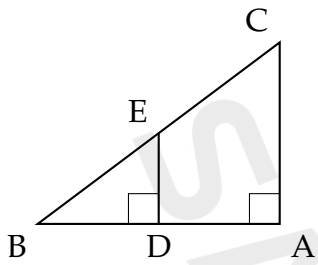
A) I is sufficient, but II and III are not.

B) II is sufficient, but I and III are not.

C) III is sufficient, but I and II are not.

D) II is sufficient and III is sufficient, but I is not.

90.



In the figure above, $\tan B = \frac{3}{4}$ if $BC = 15$ and $DA = 4$, what is the length of DE?

91.

	Volume
Square pyramid A	16
Square pyramid B	5488

In geometry, a square pyramid is a pyramid that has a square base and four lateral faces. Square Pyramid A is similar to Square Pyramid B. The table gives the volumes, in cubic inches, of the two square pyramids. If the height of Square pyramid A is 8 inches, what is the perimeter of the square base of Square pyramid B, in inches? (Round your answer to the nearest tenth of an inch)

A) $28\sqrt{6}$

B) $4\sqrt{6}$

C) $196\sqrt{6}$

D) $7\sqrt{6}$

92.

A circle has a center A, and points B and C lie on the circle. Line segments BD and CD are tangent to the circle at points B and C, respectively. The measure of angle BDC is 120°. The length of line segment CD is 12 inches. What is the area of the region that is both inside quadrilateral $ABDC$ and outside the circle, in square inches? (Round your answer to the nearest hundredth of a square inch)

A) $144\sqrt{3} - 72\pi$

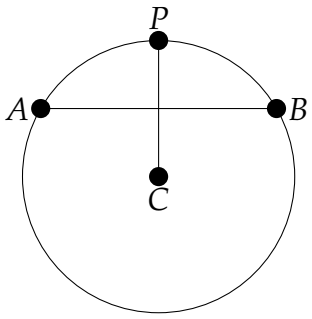
B) $72\sqrt{3} - 36\pi$

C) $144\sqrt{3} - 24\pi$

D) $144 - 36\pi$

93.

Note: Figure not drawn to scale.



In the circle shown, point C is the center, and radius PC bisects AB at point Q. The diameter of the circle has a length of 22. Line segment QP has a length of 3. If the length of line segment AQ is equal to $\sqrt{x}$, what is the value of x?

94.

A right circular cone has a volume of $71,148\pi$ cubic centimeters and the area of its base is $5,929\pi$ square centimeters. What is the slant height, in centimeters, of this cone?

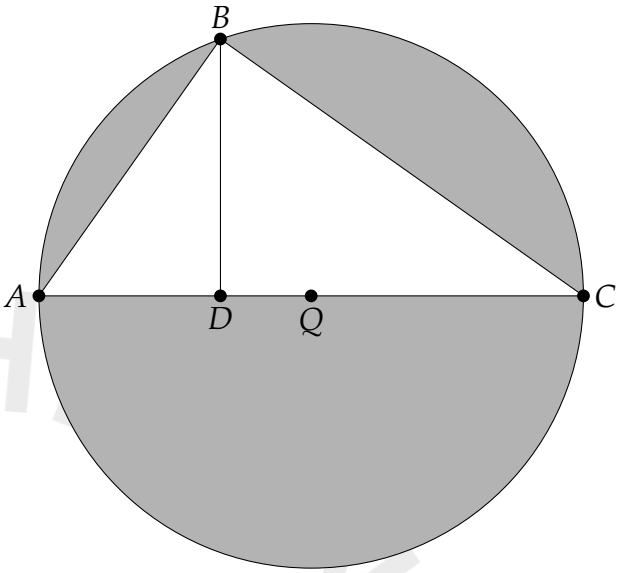
A) 12

B) 36

C) 77

D) 85

95.



Point Q is the center of the circle. Point A, point B, and point C all lie on the circle. Point D lies on segment AC as shown. Segment BD is perpendicular to segment AC. In the figure shown, $AB = 58$ and $AD = 40$. If a point within the figure is selected at random, what is the probability that the point is within the shaded region? (Express your answer as a decimal or fraction, not as a percent.) Round your answer to the nearest thousandth.

96.

1. In circle O, there are two diameters, AC and BD. The circumference of the circle is 96π and arc AB is three times the length of arc AD. What is the length of arc BC?

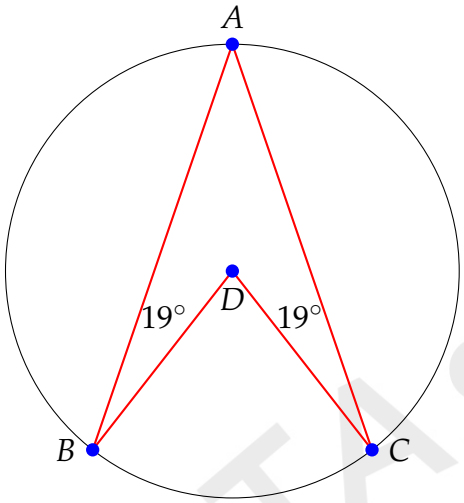
A) 12π

B) 24π

C) 36π

D) 48π

97.



The measure of angle BDC, in radians, is equal to $\frac{a\pi}{b}$ where a and b are positive integer constants. What is the smallest possible value of $a + b$?

98.

A regular hexagonal prism has a volume of 350 cubic inches and a height of 14 inches. What is the perimeter of each of the hexagonal bases, in inches? Round your answer to the nearest tenth of an inch.

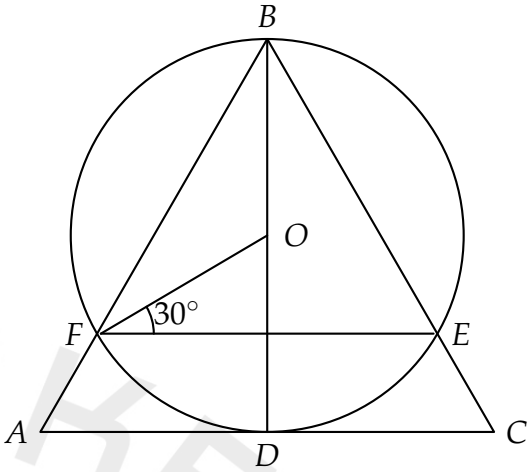
A) $10\sqrt[4]{12}$

B) $10\sqrt{3}$

C) $6\sqrt{25}$

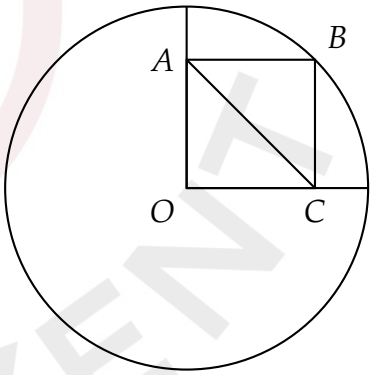
D) $25\sqrt{3}$

99.



In the figure above, O is the center of the circle and AC is tangent to the circle at D. If triangle ABC is equilateral, what is the ratio $\frac{FE}{AC}$?

100.



In the figure below, if the radius of circle O is 10, what is the length of diagonal AC of rectangle OABC?

A) $\sqrt{2}$

B) $\sqrt{10}$

C) $5\sqrt{2}$

D) 10

101.

Two identical rectangular prisms each have a height of 90 centimeters (cm). The base of each prism is a square, and the surface area of each prism is K cm^2. If the prisms are glued together along a square base, the resulting prism has a surface area of $\frac{92}{47}K$ cm^2. What is the side length, in cm, of each square base?

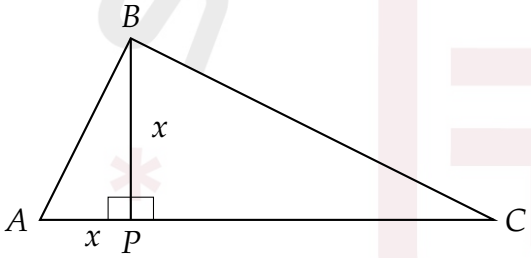
A) 4

B) 8

C) 9

D) 16

102.



In the figure above, the area of triangle ABC is equal to $2x^2$. What is the cosine of $\angle BCP$?

A) $1/\sqrt{10}$

B) $3/\sqrt{10}$

C) $1/3$

D) 3

103.

	Radius	Height
Cylinder A	R	H
Cylinder B	4R	3H + 24

Cylinders A and B are similar. The volume of cylinder A is 1176π cm^3. If the surface areas of cylinder B and A are $n\pi$ cm^2 and $k\pi$ cm^2, respectively, what is the value of (n - k)?

104.

For triangles PQR and KLM, the angles Q and L are equivalent and $PR = \frac{3}{4}KM$. Which of the following information is enough to claim that PQR and KLM are similar?

I. The length of PQ is $\frac{3}{4}$ of the length of KL.

II. The length of LM is $\frac{3}{4}$ of the length of QR.

A) Only I

B) I and II

C) Only II

D) Neither I nor II

105.

A circle with radius of 8 cm is inscribed in an equilateral triangle. If the length of the triangle is $k\sqrt{3}$ cm, what is the value of k?

106.

Right triangle ABC is inscribed in a circle with angle $B = 90$ degrees, $BC > AB$ and AC is a diameter of the circle. BD is perpendicular to AC with point D on AC. $AC = 113$ and $BD = \sqrt{222}$. What is the ratio of CD/AD?

A) $\frac{111}{2}$

B) $\frac{2}{111}$

C) $\frac{\sqrt{222}}{2}$

D) 111

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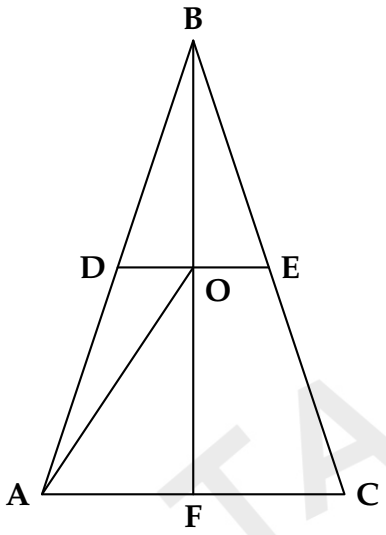
107.



In the diagram below, OB=OA, AB=BC, the measure of angle $FAO = 30°$, DE is parallel to AC, and $AB = 58$. What is the length of BE?

A) $\frac{116}{3}$

B) 29

C) $\frac{87}{2}$

D) 58

108.

A triangular pyramid with edge length 48 has a surface area equal to $k\sqrt{3}$. Find the value of k.

109.

In isosceles triangle RST, $SR = ST$ and the length of RT is 76. If $\tan(\angle R) = \frac{2}{35}$, what is the area of triangle RST?

110.

The perimeter of an isosceles right triangle is $48 + 48\sqrt{2}$ inches. What is the length, in inches, of the hypotenuse of this triangle?

A 24

B $24\sqrt{2}$

C 48

D $48\sqrt{2}$

111.

A right square pyramid has a surface area of $64 + 16\sqrt{357}$ square inches, which includes a base area of 64 square inches. What is the height, in inches, of this pyramid?

112.

A circle in the xy-plane has its center at $(-3, 3)$. Line t is tangent to this circle at the point $(6, -3)$. Which of the following points also lies on line t?

A $(0, \frac{5}{2})$

B $(3, 12)$

C $(12, 6)$

D $(15, 3)$

113.

In the xy-plane, the line $y = 3x - 14$ is tangent to a circle with center $(h, 1)$. Which of the following is a possible value for h if the center lies to the right of the tangent line?

A) 2

B) 3

C) 5

D) 7

114.

$$x^2 - 16x + y^2 - 10y - 55 = 0$$

In the xy-plane, the graph of the given equation is a circle. If this circle is inscribed in a square, what is the perimeter of the square?

A) 24

B) 48

C) 96

D) 220

115.

In triangles PQR and XYZ, angles R and Z each have a measure of 38°. The length of side QR is equal to 11. The length of side YZ is equal to 27.5. Which additional piece of information is sufficient to prove that triangle PQR is similar to triangle XYZ?

A) The measure of angle P is 46°

B) The length of side PR is 14 and the length of side XZ is 35

C) The measure of angle Q is 49° and the measure of angle Y is 94°

D) No additional information is necessary

116.

A hollow steel pipe is in the shape of a right circular cylinder. The steel pipe has an outside diameter of 48 inches, a wall thickness of $\frac{3}{5}$ inches, and a height of 144 inches. Which of the following is closest to the volume, in cubic inches, of the wall of this steel pipe?

A) 177

B) 565

C) 2,160

D) 13,395

117.

In triangle ABC and triangle DEF, sides AB and DE each have a side length of 10 inches, and angles A and D each have an angle measure of 40°. Which of the following additional pieces of information is (are) sufficient to prove whether triangle ABC is congruent to triangle DEF?

I. The measures of angles B and C are equal.

II. The lengths of sides AC and DF are equal.

III. The lengths of sides BC and EF are equal.

A) I is sufficient, but II and III are not.

B) II is sufficient, but I and III are not.

C) III is sufficient, but I and II are not.

D) II is sufficient and III is sufficient, but I is not.

118.

An equilateral triangle is inscribed in a circle with a radius of 8 inches. What is the area of the region that lies within the circle but outside the triangle, in square inches?

A) $64\pi - 48\sqrt{3}$

B) $64\pi - 24\sqrt{3}$

C) $64\pi - 32\sqrt{3}$

D) $16\pi - 12\sqrt{3}$

119.

A circle in the xy-plane has its center at $(-3, 3)$. Line t is tangent to this circle at the point $(6, -3)$. Which of the following points also lies on line t?

A $\left(0, \frac{5}{2}\right)$

B $(3, 12)$

C $(12, 6)$

D $(15, 3)$

120.

In triangles RST and XTZ, XZ is parallel to RS, and $\tan R = \frac{216}{713}$. What is the value of $\sin X$ in triangle XYZ?

A $\frac{216}{929}$

B $\frac{216}{745}$

C $\frac{713}{745}$

D $\frac{713}{216}$

121.

A circle in the xy-plane has its center at $(-7, 3)$ and has a radius of 9. An equation of this circle is $x^2 + y^2 + ax + by + c = 0$, where a, b, and c are constants. What is the value of c?

122.

Point M lies on a unit circle in the xy-plane and has coordinates $(1, 0)$. Point C is the center of the circle at $(0, 0)$. Point N also lies on the unit circle, and the measure of angle MCN is $\frac{385\pi}{6}$ radians. If the coordinates of point N are (p, q), what is the value of q?

A $-\frac{1}{2}$

B $\frac{\sqrt{3}}{2}$

C $-\frac{\sqrt{3}}{2}$

D $\frac{1}{2}$

123.

A right square pyramid has a total surface area of 36,864 square inches, and the combined surface area of the four lateral faces is 20,480 square inches. What is the height, in inches, of this pyramid?

A 48

B 64

C 80

D 128

124.

A circle has center G, and points M and N lie on the circle. Line segments MH and NH are tangent to the circle at M and N, respectively. If the radius is 168 mm and the perimeter of quadrilateral $GMHN$ is 3,856 mm, what is the distance, in mm, between G and H?

A) 168

B) 1,752

C) 1,760

D) 1,768

125.

A triangular prism has an equilateral triangle base with side length x and a prism height of $x\sqrt{3}$. If the volume of the prism is $\frac{2187}{4}$, what is the value of x?

A 3

B 9

C 27

D 81

126.

$(x-5)^2+(y+12)^2=169$

The given equation represents a circle. If the point (r,s) lies on the circle, which of the following could NOT be the point (r,s)?

A $(-7,-7)$

B $(10,-24)$

C $(\sqrt{140}+5,\ \sqrt{29}-12)$

D $(\sqrt{140}-5,\ \sqrt{29}+12)$

127.

A regular polygon has exactly 45 sides. If the measure of each exterior angle is $(180k)^\circ$, what is the value of k?

128.

A regular polygon has exactly 57 sides. If the measure of each interior angle is $(180p)^\circ$, what is the value of p?

129.

Point N lies on a unit circle in the xy-plane and has coordinates $(1,0)$. Point O is the center at $(0,0)$. Point M also lies on the unit circle, and the measure of angle NOM is $\frac{272\pi}{3}$ radians. If the coordinates of point M are (a,b), what is the value of a?

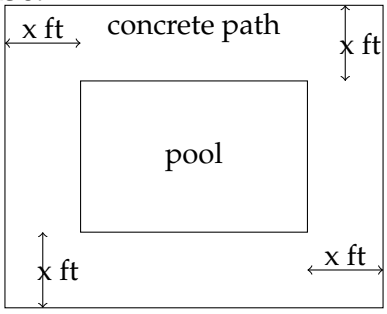
A $\frac{1}{2}$

B $\frac{\sqrt{3}}{2}$

C $-\frac{1}{2}$

D $-\frac{\sqrt{3}}{2}$

130.



The figure shows a rectangular pool surrounded by a concrete path that is x feet (ft) wide on all sides. The pool is 21 ft long and 13 ft wide. The area of the concrete path is 240 ft^2. What is the value of x?

A 3

B 6

C 20

D 40

131.

Right rectangular prism X is similar to right rectangular prism Y. The surface area of right rectangular prism X is 59 cm^2, and the surface area of right rectangular prism Y is 1,475 cm^2. The volume of right rectangular prism Y is 1,500 cm^3. What is the sum of the volumes, in cm^3, of right rectangular prism X and right rectangular prism Y?

132.

In the xy-plane, a unit circle with center O contains point A with coordinates $(1, 0)$ and point B with coordinates $\left(\frac{5}{\sqrt{34}}, -\frac{3}{\sqrt{34}}\right)$. If the measure of angle AOB is p radians, what is the value of $\frac{\cos p}{\sin p}$?

133.

In triangle ABC, $\angle C$ is a right angle. Point D lies on $\overline{AB}$, point E lies on $\overline{BC}$, and $\overline{DE}$ is parallel to $\overline{AC}$. If the length of $\overline{AB}$ is 39 units, $\overline{DE}$ is 8 units, the length of $\overline{AC}$ is greater than the length of $\overline{BC}$, and the area of triangle ABC is 270 square units, what is the length of $\overline{BE}$, in units?

134.

The perimeter of a right isosceles triangle is $52 + 52\sqrt{2}$. What is the length of the hypotenuse?

135.

The points $(0, 15)$, $(10, 8)$, and $(10, 3)$ define one base of a triangular prism. The distance between the two bases of the prism is 20 units. What is the volume, in cubic units, of the prism?

136.

$$2x^2 + 2y^2 + tx + ty - 78 = 0$$

The given equation, where t is a positive constant, defines a circle in the xy-plane. The radius of this circle is $\sqrt{41}$. What is the value of t?

137.

$$8x^2 + 112px + 8y^2 - 64py = -448p^2$$

In the xy-plane, the graph of the given equation is a circle. The length of the radius is np, where n and p are positive constants. What is the value of n?

138.

A line intersects two parallel lines, forming four acute angles and four obtuse angles. The measure of one of the acute angles is $(9x - 490)°$. The sum of the measures of one of the acute angles and three of the obtuse angles is $(-18x + w)°$. What is the value of w?

139.

$$2x^2 + 2y^2 + tx + ty - 78 = 0$$

The given equation, where t is a positive constant, defines a circle in the xy-plane. The radius of this circle is $\sqrt{41}$. What is the value of t?

140.

Point M lies on a unit circle in the xy-plane and has coordinates $(1, 0)$. Point C is the center of the circle at $(0, 0)$. Point N also lies on the unit circle, and the measure of angle MCN is $\frac{385\pi}{6}$ radians. If the coordinates of point N are (p, q), where p and q are constants, what is the value of q?

A $-\frac{1}{2}$

B $\frac{\sqrt{3}}{2}$

C $-\frac{\sqrt{3}}{2}$

D $\frac{1}{2}$

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Geometry Answers

Number	Answer	Number	Answer
1	B	**26**	72
2	D	**27**	65
3	A	**28**	1520
4	B	**29**	A
5	125	**30**	108
6	42	**31**	52
7	320	**32**	C
8	C	**33**	B
9	D	**34**	A
10	86.5	**35**	39
11	C	**36**	B
12	5376	**37**	D
13	A	**38**	9600
14	0.977	**39**	100
15	1512	**40**	-1534
16	2	**41**	B
17	D	**42**	A
18	A	**43**	D
19	A	**44**	9216
20	D	**45**	B
21	4	**46**	990
22	97.33	**47**	C
23	74088	**48**	A
24	1760	**49**	C
25	D	**50**	D

Number	Answer	Number	Answer
51	-1.667	**76**	1512
52	-1.6	**77**	A
53	704	**78**	A
54	D	**79**	A
55	4	**80**	10
56	A	**81**	1040
57	100	**82**	A
58	B	**83**	C
59	C	**84**	A
60	D	**85**	B
61	B	**86**	32
62	40/9	**87**	25
63	B	**88**	$4\sqrt{2}$; 5,66
64	D	**89**	B
65	12.6	**90**	6
66	C	**91**	A
67	C	**92**	A
68	D	**93**	57
69	736	**94**	D
70	D	**95**	0.101
71	D	**96**	A
72	C	**97**	64
73	A	**98**	B
74	64	**99**	$\frac{\sqrt{3}}{3}$
75	1520	**100**	D

Number	Answer	Number	Answer
101	B	**121**	-23
102	B	**122**	D
103	6510	**123**	A
104	D	**124**	D
105	16	**125**	B
106	A	**126**	D
107	A	**127**	2/45
108	2304	**128**	55/57
109	2888/35	**129**	C
110	C	**130**	A
111	$\sqrt{341}$	**131**	1512
112	C	**132**	-5/3
113	D	**133**	10/3
114	C	**134**	52
115	B	**135**	500
116	D	**136**	4
117	B	**137**	3
118	A	**138**	1520
119	C	**139**	4
120	B	**140**	D

Problem Solving and Data Analysis

Problem Solving and Data Analysis

1.

To determine if age and gender are related to pet ownership at his school, Mark selected a random sample of 50 male 14- to 15-year-old students from the school and a random sample of 60 female 17- to 18-year-old students from the school. For each student, he recorded the student's age, gender, and whether the student owned a pet. Which of the following provides the best explanation for why Mark cannot draw a valid conclusion from this study?

A The sample sizes are too small.

B The two samples are not of equal size.

C Mark will be unable to tell whether a difference in pet ownership is related to age because the two age groups are too close in age.

D Mark will be unable to tell whether a difference in pet ownership is related to gender because of the difference in age. Similarly, he will be unable to tell whether a difference in pet ownership is related to age.

2.

A science class studied the feeding behavior of the birds that visited a bird feeder each school day for a period of time. The table summarizes the number of birds the class observed visiting the bird feeder each school day during this period of time.

Number of birds	Number of days
14	3
15	3
16	4
17	1
18	3
19	9

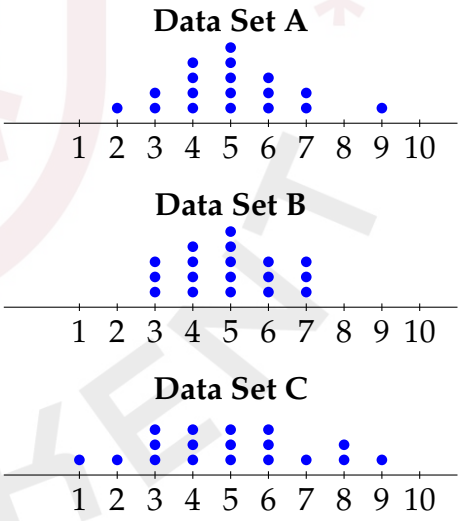
What is the median number of birds the class observed visiting the bird feeder each school day during this period of time?

3.

A researcher surveyed undergraduate students, graduate students, and postgraduate students. The number of undergraduate students surveyed was 7450% of the number of postgraduate students surveyed, and the number of graduate students surveyed was 24% of the undergraduate students surveyed. If there were 3576 graduate students surveyed, what was the sum of the number of undergraduate students and postgraduate students surveyed?

4.

Each of the three data sets represented by the three dot plots has 18 values. The median of data sets A, B, and C are a, b, and c respectively. What is the relationship between a, b, and c?



A $a < b < c$

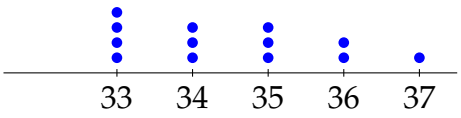
B $c < b < a$

C $b < c < a$

D $a = b = c$

5.

The dot plot represents 13 values in data set A. Data set B is created by adding 39 to each of the values in data set A. Which of the following correctly compares the median and standard deviations of data sets A and B?



A The median of data set B is equal to the median of data set A, and the standard deviation of data set B is equal to the standard deviation of data set A.

B The median of data set B is greater than the median of data set A, and the standard deviation of data set B is equal to the standard deviation of data set A.

C The median of data set B is greater than the median of data set A, and the standard deviation of data set B is greater than the standard deviation of data set A.

D The median of data set B is less than the median of data set A, and the standard deviation of data set B is equal to the standard deviation of data set A.

6.

The positive number a is 2,800% of the number c, and c is 20% of the number b. What is the value of $a - b$ in terms of c?

A 23c

B 140c

C 560c

D 2,240c

7.

A researcher selected 26 guinea pigs from one habitat and 18 wild cavies from another habitat at random in Venezuela. The researcher found that in early adolescence, the number of virtual squares the wild cavies crossed was significantly more than the number of virtual squares the guinea pigs crossed. The researcher also found that the number of virtual squares crossed by both the wild cavies and the guinea pigs decreased from early adolescence to late adolescence.

Based on the researcher's findings, which of the following statements is an appropriate conclusion that can be drawn from this study?

A The statistically significant difference in behavior between the two species was caused by the differences in habitat.

B The statistically significant difference in behavior between the two species was caused by the biological differences between guinea pigs and wild cavies.

C The statistically significant difference in behavior during early adolescence between the two groups of animals can be generalized to all guinea pigs and wild cavies.

D The statistically significant difference in behavior during early adolescence between the two groups of animals can only be generalized to the habitats in the study.

8.

A real estate company offers a series of three webinars. 1,250 people attended the first webinar. 68% of the people who attended the first webinar attended the second webinar, and 32% of the people who attended the first and second webinars attended the third webinar. How many people attended all three webinars?

9.

Each of the following frequency tables represents a data set. Which of these frequency tables represents the data set with the smallest standard deviation?

A)

Value	Frequency
5	0
6	10
7	55
8	10
9	0

B)

Value	Frequency
5	11
6	17
7	19
8	17
9	11

C)

Value	Frequency
5	15
6	15
7	15
8	18
9	15

D)

Value	Frequency
5	18
6	14
7	11
8	14
9	18

10. The positive number a is 3,700% of the number c, and c is 20% of the number b. If $a - b = wc$, where w is a constant, what is the value of w?

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11.

Researchers must conduct an experiment to see whether a new vaccine is effective in relieving certain allergies. They have selected a random sample of 100 patients suffering from allergies. Some of the patients are assigned to the new vaccine while the rest are assigned to the traditional treatment. Which of the following methods of assigning each patient's treatment is most likely to lead to a reliable conclusion about the effectiveness of the new vaccine?

A Those who have more than one allergy are assigned to the new vaccine.

B The median weight of the patients is found. Those who weigh less than the median weight are assigned to the new vaccine.

C The patients divide themselves evenly into two groups. A coin is tossed to decide which group is assigned to the new vaccine.

D Each patient is given a random number. Those with an even number are assigned to the new vaccine.

12.

$$a, 26, 29, b, 33, 49, c$$

For the given data set, the data values are listed in ascending order, where a, b, and c are constants. For this data set, the mean is 36, the median is 29, and the range is 72. What is the value of c?

A 53

B 72

C 79

D 98

13.

A biologist wanted to study the effectiveness of a fertilizer on the growth of corn seeds. The greenhouse was split down the middle: half A was treated with fertilizer, half B was not. The biologist obtained two 750-seed packages. The seeds from one package were planted in the soil treated by the fertilizer, and the seeds from the other package were planted in the soil not treated by the fertilizer. How should the experiment be changed to allow the researcher to conclude whether the fertilizer has an effect on the growth of corn seeds?

A No changes to the experiment are required.

B All 1,500 corn seeds should receive the fertilizer.

C One of the packages of corn seeds should be planted in a field rather than the greenhouse.

D Half of the seeds from each package should be randomly assigned to each half of the greenhouse.

14.

Data set A consists of 18 different values that have a minimum of 12, a maximum of 80, a mean of 46 and a standard deviation of 17. The values 12 and 80 are removed from the set to create data set B, which consists of 16 different values. Which of the following statements is true?

A The mean of data set B is greater than 46.

B The mean of data set B is less than 46.

C The standard deviation of data set B is greater than 17.

D The standard deviation of data set B is less than 17.

15.

Each of the following frequency tables represents a data set. Which data set has the greatest mean?

A)

Value	Frequency
60	2
70	3
80	4
90	5

B)

Value	Frequency
60	6
70	3
80	3
90	6

C)

Value	Frequency
60	4
70	4
80	4
90	4

D)

Value	Frequency
60	5
70	4
80	4
90	5

16.

The positive number a is 480% of the number b, and a is 70% of the number c. If c is p% of b, which of the following is closest to the value of p ?

A 267

B 336

C 550

D 685

17.

Harold is writing a book. To finish by his deadline, he needs to write an average of 3,000 words per week for 4 weeks. He wrote 4,500 words in the first week, 2,800 words in the second week, and 2,400 words in the third week. Which inequality represents the number of words, x, Harold needs to write in the 4th week to meet or exceed his goal?

A) $4,500 + 2,800 + 2,400 + x \geq 4(3,000)$

B) $\frac{4,500+2,800+2,400}{3} + x \geq 3,000$

C) $4,500 + 2,800 + 2,400 \geq x(3,000)$

D) $\frac{4,500}{4} + \frac{2,800}{4} + \frac{2,400}{4} + x \geq 3,000$

18.

The mass of object A is 450% of the mass of object B, and the mass of object A is 0.090% of the mass of object C. If the mass of object C is p% of the mass of object B, what is the value of $\frac{p}{1,000}$?

19.

Data set A contains 23 positive integers and has mean score of 83. The highest and two lowest values in data set A are removed to create data set B. The average of data set B is 87. What is the greatest possible range of the 3 values that were removed to create data set B?

20.

Each of the following frequency tables represents a data set. Which of these frequency tables represents the data set with the smallest standard deviation?

A)

Value	Frequency
4	0
5	10
6	40
7	10
8	0

B)

Value	Frequency
4	8
5	14
6	16
7	14
8	8

C)

Value	Frequency
4	12
5	12
6	12
7	12
8	12

D)

Value	Frequency
4	15
5	11
6	8
7	11
8	15

21.

For a poll, an organizer randomly selected 21 professors from a certain liberal arts program at a university. These professors were asked whether they were interested in using a new textbook for their classes, and 14 of them responded "Yes." What is the largest group to which the results of the poll can be generalized?

A) The 14 professors who responded "Yes"

B) All liberal arts professors at the university

C) All professors in the program

D) All professors at the university

22.

The result of increasing a positive quantity by 11% is x. Which expression represents the original quantity in terms of x?

A $1.11x$

B $\dfrac{x}{1.11}$

C $1.11\left(\dfrac{100+x}{100}\right)$

D $1.11\left(\dfrac{100}{100+x}\right)$

23.

While the mass of an object is the same everywhere, the weight of an object is not the same on different planets. An object has a weight of 170.00 pounds on Earth and a weight of 186.32 pounds on Neptune. The object's weight on Jupiter is 252.8% of its weight on Earth. If the object's weight on Neptune is x% of its weight on Jupiter, which of the following is closest to the value of x?

A 43.35

B 71.73

C 277.07

D 429.76

24.

The mass of object A is 483% of the mass of object B, and the mass of object A is 0.069% of the mass of object C. If the mass of object C is p% of the mass of object B, what is the value of $\frac{p}{1,000}$?

25.

The value of a video game console increased by 285% from the end of 2015 to the end of 2016. The value of the console then decreased by 21% from the end of 2016 to the end of 2017. Finally, the value of the console increased by 63% from the end of 2017 to the end of 2018. What was the net percentage increase in the value of the video game console from the end of 2015 to the end of 2018? (Round to the nearest hundredth of a percent)

26.

Ashley wanted to save an average of $20 per week over the past 15 weeks. For the first 5 weeks, she saved an average of $15 per week. For the next 5 weeks, she saved an average of $19 per week. For the last 5 weeks, she saved an average of $23 per week. How much more should she have saved each week to hit her goal?

A) $0.75

B) $0.80

C) $1.00

D) $1.50

27.

In a collection of items, 10% are red, 25% are green, 35% are blue, and 30% are yellow. If there are 40 green items, how many blue items are in the collection?

A 14

B 16

C 48

D 56

28.

A data set consists of 5 numbers. The minimum is 5 and the range is 25. If we delete the minimum the median will not change, but if we delete the maximum the median will decrease by 1 unit. If the mean of the data set is 15, what is the median of the data set?

29.

A development company is advertising that the mean area of the apartments in a new complex is 1,450 square feet. The complex consists of 10 buildings with a total of 1,000 apartments. A sample of 50 apartments will be selected from the complex to test the company's statement about the mean apartment area. Which of the following is an unbiased sampling method?

A) Select the first 50 apartments built.

B) Select the first 50 apartments that are occupied.

C) Select at random 5 top-floor apartments from each of the buildings.

D) Select at random 50 apartments from all the apartments in the 10 buildings.

30.

To determine if eating chocolate has an effect on men's standardized test scores, researchers surveyed a random population of 8,000 men. Study participants were identified as regular chocolate eaters or non-chocolate eaters and were given a standardized test. They found that the regular chocolate eaters had higher scores than the non-chocolate eaters. What is the most appropriate conclusion for this study?

A) Eating chocolate regularly causes higher standardized test scores for men and women.

B) Eating chocolate regularly causes higher standardized test scores for men but not necessarily for women.

C) There is an association between eating chocolate and higher standardized test scores for men and women, but it is not necessarily a cause-and-effect relationship.

D) There is an association between eating chocolate and higher standardized test score for men, but it is not necessarily a cause-and-effect relationship and it does not necessarily exist for women.

31.

For the positive quantities h, j, and k, 94% of h is equivalent to 47% of j, and j is equivalent to 30% of k. What percentage of k is h? (Disregard the % sign when entering your answer. For example, if you answer is 39%, enter 39).

32.

To study the effect of magnesium supplementation on the sleep quality of adults, a researcher selected 190 adults at random from a community center to participate in a study. Each participant was randomly assigned to take a magnesium supplement or a placebo each day for 6 weeks. At the end of the 6 weeks, the researcher found that the magnesium supplement caused statistically significant improved sleep quality. What feature of this study allowed the researcher to conclude that the magnesium supplement caused the improved sleep quality?

A) There were more than 100 participants in the study.

B) The participants were selected at random from the community center.

C) The sleep efficiency of each participant was measured again at the end of 6 weeks.

D) Each participant was randomly assigned to take a magnesium supplement or a placebo.

33.

80 people each bowled one game at Brick Alley Bowling last Friday. 60 people scored between 50 and 100, 18 people scored between 101 and 185, and the remaining two players bowled a score between 280 and 300. Which of the following statements about the mean and median of the 80 scores is true?

A) The mean is less than the median.

B) The median is less than the mean.

C) The median and mean are equal.

D) There is not enough information to determine whether the mean or median is greater.

34.

A researcher conducted a study to determine if certain memorization strategies could improve the performance of chess players. For the study, the researcher selected a random sample of adults who are competing in a chess tournament. At the end of the study, 80% of those sampled reported that they did not find the memorization strategies to be useful during their chess games. Which of the following is the largest population to which the results of this study can be applied?

A) All chess players who compete in tournaments

B) All adults who compete in chess tournaments

C) All chess players competing in the tournament

D) All adults competing in the tournament

35.

John and Karen work at the bakery. John works 7 hours per day, and Karen works 6 hours per day. John produces x brownies per hour and Karen produced y brownies per hour. Which of the following expressions gives the average number of brownies John and Karen produce per hour?

A) $\frac{x+y}{13}$

B) $\frac{7x+6y}{13}$

C) $\frac{xy}{13}$

D) $\frac{6x+7y}{13}$

36.

Each of the following frequency tables represents a data set. Which of these frequency tables represents the data set with the smallest standard deviation?

A)

Value	Frequency
3	0
4	10
5	55
6	10
7	0

B)

Value	Frequency
3	11
4	17
5	19
6	17
7	11

C)

Value	Frequency
3	15
4	15
5	15
6	15
7	15

D)

Value	Frequency
3	17
4	15
5	11
6	15
7	17

37.

The composition of an animal is defined as the muscles, bones, and fat of the animal. A scientist studied the composition of one young swamp buffalo and determined that the buffalo had 139.2 kilograms of muscle, which made up approximately 67.7% of its composition. Of the remaining composition of this buffalo, approximately 51.4% was bone, and the remainder was fat. Based on these approximations, to the nearest tenth, how many kilograms of this buffalo's composition was bone?

38.

A clothing store buys shirts at a wholesale price of 5.00 dollars each and resells them each at a price that is 270% of the wholesale price. At the end of the season, any remaining shirts are marked at a discounted price that is 70% of the retail price. What is the discounted price of each remaining shirt, in dollars?

39.

A juice mixture has a total volume of 125 liters and is 45% juice by volume. The mixture was created by mixing two different solutions (solution A and solution B). Solution A was 24% juice by volume. Solution B was 64% juice by volume. The volume, in liters, of juice in solution A is equal to a. The volume, in liters, of juice in solution B is equal to b. The numbers a, b, and p are all positive constants. If a is p% less than b, what is the value of p? (Round your answer to the nearest hundredth)

40.

A set of five consecutive even integers is ordered from least to greatest. The sum of the first and fourth even integers is 5,860% more than the quotient of the fifth even integer and 30. The first even integer is p% less than the fifth even integer, where p is a constant. What is the value p?

41.

A digital marketing agency has three groups of clients. The first group consists of 8 clients who are charged a monthly fee of at least \$170 but no more than \$190. The second group consists of 11 clients who are charged a monthly fee of at least \$200 but no more than \$230. The third group consists of 21 clients who are charged a monthly fee of at least \$240 but no more than \$300. If a new client who is charged a monthly fee of \$250 is added to the third group, what will be the effect on the mean monthly fee charged by the agency?

A) The mean will increase.

B) The mean will decrease.

C) The mean will remain the same.

D) There is not enough information to determine how the mean will change.

42.

A chemist mixed x liters of a 2% saline solution with y liters of a 5% saline solution to produce a 3% saline solution. Which equation best represents this situation? (Assume the volumes of the solutions are additive.)

A $0.02x + 0.05y = 3(x + y)$

B $0.02x + 0.05y = 0.03(x + y)$

C $0.2x + 0.5y = 3(x + y)$

D $0.2x + 0.5y = 0.3(x + y)$

43.

On a plot of land, 52.0% of the square footage is farmland and the remaining square footage is pasture. There are buildings on exactly 21.5% of the square footage of the farmland, and there are buildings on exactly 14.0% of the square footage of the pasture. If there are buildings on exactly p% of the square footage of the plot of land, what is the value of p ?

44.

The standard deviation of data set A is x, and the standard deviation of data set B is y.

Data Set A**:** 19, 19, 21, 21, 23, 24, 24
Data Set B**:** 1, 1, 3, 3, 5, 6, 6

Which of the following statements about the standard deviation of the data sets is true?

A) $x > y$

B) $x = y$

C) $x < y$

D) The relationship between x and y cannot be determined.

45.

The value of an autographed baseball increased by 178% from the end of 2012 to the end of 2013 and then decreased by 21% from the end of 2013 to the end of 2014. What was the net percentage increase in the value of the autographed baseball from the end of 2012 to the end of 2014?

A 119.62%

B 140.62%

C 157.00%

D 236.38%

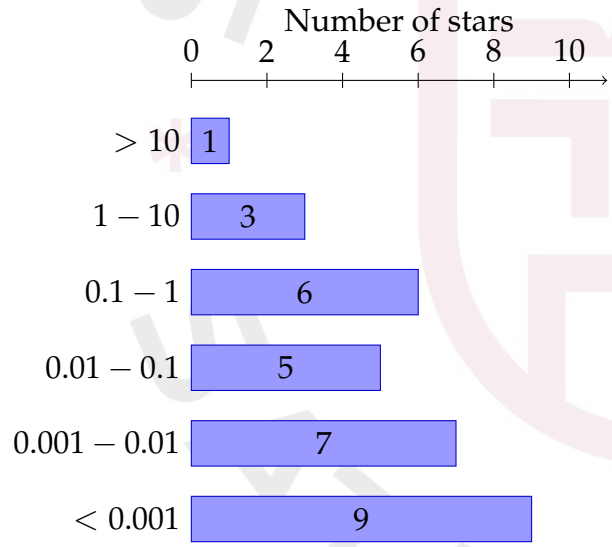
46.

A field study tracked two animal populations: lions and antelopes. At the start of a week, the two populations were equal in number. By the end of the week, the number of antelopes had increased by 2106% of its starting number, and the number of lions had increased by 300% of its starting number. At the end of the week, the number of antelopes was p% greater than the number of lions. What is the value of p?

47.

The graph below shows the distribution of all stars within 12 light-years of Earth by total energy output per second, or luminosity.

Luminosity of Stars within 12 Light-Years



Which of the following could be the median luminosity of all the stars within 12 light-years of Earth?

A) 0.18

B) 0.052

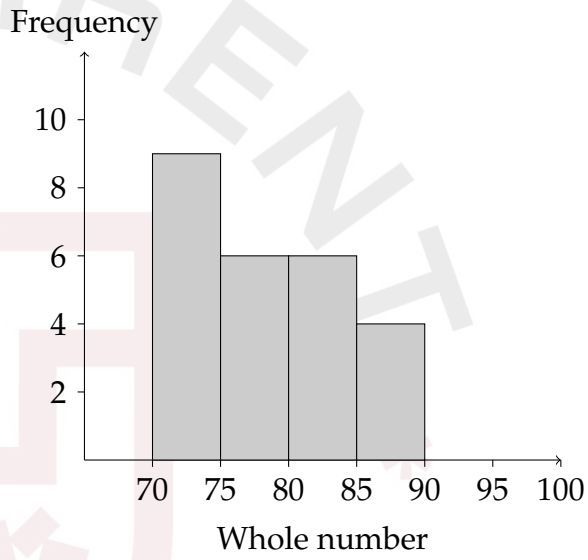
C) 0.0063

D) 0.0003

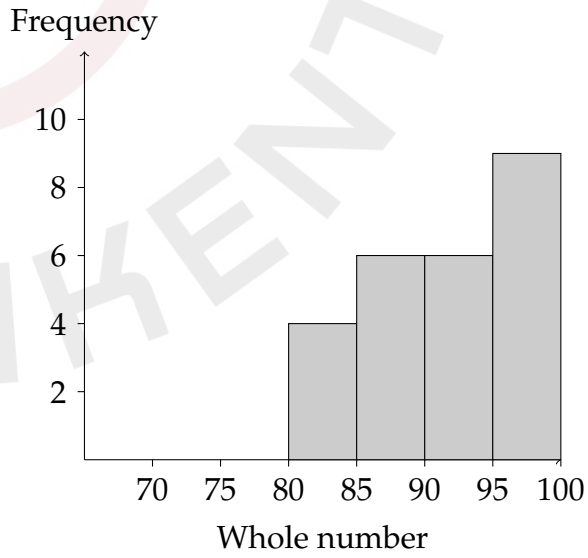
48.

The histograms shown summarize two data sets, X and Y. Each data set consists of 25 whole numbers. In each histogram, the first interval represents the frequency of whole numbers greater than or equal to 70, but less than 75. The second interval represents the frequency of whole numbers greater than or equal to 75, but less than 80, and so on. What is the **largest possible difference** between the median of data set Y and the mean of data set X?

Data set X



Data set Y



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49.

The speeds of particles A, B, and C are a meters per second, b meters per second, and c meters per second, respectively. If the speed of particle A is 6,000% of the speed of particle C and the speed of particle C is 0.008% of the speed of particle B, which expression represents the value of $a + b$ in terms of c?

A) 12,560c

B) 6,125c

C) 6,008c

D) 1,850c

50.

A data set of 27 different numbers has a mean of 18 and a median of 18. A new data set is created by adding 20 to all of the values greater than the median while leaving all other numbers in the data set unchanged. Which of the following values will not change?

A Mean

B Range

C Median

D Sum of the numbers

51.

A survey of 500 adults finds a correlation coefficient of 0.7 between the number of hours spent reading per week and their vocabulary test scores. The survey also reports that 60% of participants read more than 5 hours per week, with a margin of error of $\pm 5\%$. Which conclusion is most appropriate?

A Reading more hours per week causes higher vocabulary scores.

B There is a strong positive relationship between reading hours and vocabulary scores, but causation cannot be determined.

C Between 55% and 65% of adults read more than 5 hours per week, and this improves their vocabulary.

D The correlation of 0.7 means 70% of vocabulary scores are explained by reading hours.

52.

The composition of an animal is defined as the muscles, bones, and fat of the animal. A scientist studied the composition of one young swamp buffalo and determined the buffalo had 133 kilograms of muscle, which made up approximately 65.9% of its composition. Of the remaining composition of this buffalo, approximately 46.2% was bone, and the remainder was fat. Based on these approximations, to the nearest tenth, how many kilograms of this buffalo's composition was bone?

53.

A data set of 77 different numbers has a mean of 1,073. A new data set is created by adding 93 to each number in the original data set that is greater than the median and subtracting 93 from each number in the original data set that is less than the median. Which of the following measures does NOT have the same value in both the original and the new data sets?

A Sum of the numbers

B Mean

C Standard deviation

D Median

54.

There are 50 unique numbers in a data set. If the value of each number increases by 25%, which of the following will be true?

A The new mean will remain the same, but the new standard deviation will be 25% more than the previous standard deviation.

B The new mean will be 25% more than the previous mean, but the standard deviation will remain the same.

C The new mean will be 25% more than the previous mean, but the standard deviation will increase.

D Neither the mean nor the standard deviation of the values will change.

55.

The mass of object A is 144% of the mass of object B, and the mass of object A is 0.740% of the mass of object C. If the mass of object C is p% of the mass of object B, what is the value of $\frac{p}{1{,}000}$?

56.

A nutritionist wants to conduct a survey to estimate the mean number of servings of vegetables eaten by a certain group of people each day. The nutritionist has not yet decided which group of people to survey. Surveying a random sample from which of the following groups would most likely result in the smallest margin of error?

A Residents of the same city

B Customers of a certain restaurant

C Viewers of the same television show

D Students who are following the same daily diet plan

57.

The value of a collectible comic book increased by 167% from the end of 2011 to the end of 2012 and then decreased by 16% from the end of 2012 to the end of 2013. What was the net percentage increase in the value of the collectible comic book from the end of 2011 to the end of 2013?

A 124.28%

B 140.28%

C 151.00%

D 209.72%

58.

A data set consists of 5 numbers. The minimum is 5 and the range is 25. If we delete the minimum the median will not change, but if we delete the maximum the median will decrease by 1 unit. If the mean of the data set is 15, what is the median of the data set?

59.

The principal of a local high school is conducting a survey on whether students felt online learning was still effective during the COVID-19 pandemic. Of the 200 students who were randomly sampled, 43% felt that online learning is still effective. Based on the margin of error, the principal expects that somewhere between 35% and 51% of all students feel that online learning is still effective during the COVID-19 pandemic. What is the margin of error?

A) 43%

B) 16%

C) 8%

D) 2%

60.

The scatterplot shows the relationship between the square footage of 12 clothing stores and their annual sales, in millions of dollars. According to the trend shown in the data, which of the following is the best prediction for the annual sales, in millions of dollars, of a clothing store that has 8 thousand square feet?

A 4.1

B 5.4

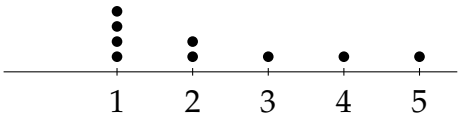
C 7.5

D 10.2

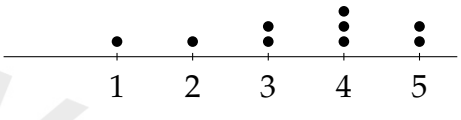
61.

For which of the following sets of 9 data points is the median less than the mean?

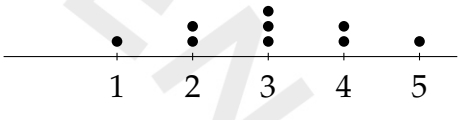
A)



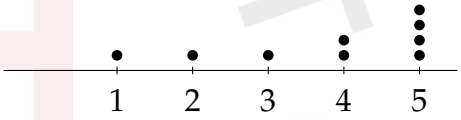
B)



C)



D)



62.

A biologist mixed a solution that is 0.3% sodium chloride by mass with a solution that is 0.15% sodium chloride by mass to obtain a new solution, which has a mass of 80 grams and contains 0.21 grams of sodium chloride. How many grams of 0.3% sodium chloride solution did the biologist use?

A 0.14

B 20

C 60

D 79.86

63.

The tables give the distribution of daily travel times between two towns for bus A and bus B over a 40-day period.

Bus A

Time (min)	Frequency
44	5
45	10
47	15
48	10

Bus B

Time (min)	Frequency
25	5
30	10
35	15
40	10

Which statement correctly compares the standard deviations of travel times for bus A and bus B?

A The standard deviation of travel times for bus A is less than the standard deviation of travel times for bus B.

B The standard deviation of travel times for bus B is less than the standard deviation of travel times for bus A.

C The standard deviation of travel times for bus A is equal to the standard deviation of travel times for bus B.

D There is not enough information to compare these standard deviations.

64.

The scatter plot and the line of best fit of data set A with the equation $y = 0.07x^2 + 0.05x + 6.33$ is shown. If the point h is removed from data set A to create data set B with the equation $y = ax^2 + bx + c$, which of the following is true?

I. $a > 0.07$
II. $c < 6.33$

A I only

B II only

C I and II

D Neither I nor II

65.

In 2005, Aster earned 12% more than in 2004, and in 2006 Aster earned 6% more than in 2005. If Aster earned y times as much in 2004 as in 2006, which of the following is closest to the value of y?

A 0.5000

B 0.7200

C 0.8423

D 1.1872

66.

A survey was conducted in Arlington to estimate the percent of adult residents who support the addition of a gas station at a popular intersection in their town. Based on the survey, it is estimated that 51% of all adult residents of Arlington support the addition of a gas station at a popular intersection in their town, with an associated margin of error of 7%. Which of the following is the most appropriate conclusion about all adult residents of Arlington?

A The addition of a gas station at a popular intersection in the town is supported by more than 58% of all adult residents of Arlington.

B Plausible values for the percent of all adult residents of Arlington who support the addition of a gas station at a popular intersection in their town are between 44% and 58%.

C Plausible values for the percent of all adult residents of Arlington who support the addition of a gas station at a popular intersection in their town are either less than 44% or more than 58%.

D The addition of a gas station at a popular intersection in the town is supported by exactly 44% of all adult residents of Arlington.

67.

The value of a painting increased by 186% from the end of 2011 to the end of 2012 and then decreased by 21% from the end of 2012 to the end of 2013. What was the net percentage increase in the value of the painting from the end of 2011 to the end of 2013?

A 125.94%

B 146.9%

C 165.00%

D 246.00%

68.

The area of a rectangular region is increasing at a rate of 210 square feet per hour. Which of the following is closest to this rate in square meters per minute? (Use 1 meter = 3.28 feet.)

A 0.33

B 1.07

C 11.48

D 19.52

69.

A store sells notebooks individually and in packs of 8. Individual notebooks are sold for \$3 each, and packs of 8 are sold for \$19 per pack. Last week, the store received a total of \$589 from notebook sales. If the store sold n individual notebooks and p packs, which equation represents this situation?

A $3n + 19p = 589$

B $8n + 19p = 589$

C $3n + 8p = 589$

D $19n + 3p = 589$

70.

A survey was conducted asking adults which of three streaming services — A, B, and C — they subscribe to. The results showed that 55% subscribe to service A, 40% subscribe to service B, and 25% subscribe to both A and B. None of the respondents subscribe to service C. A person who subscribes to service A is selected at random. What is the probability that this person also subscribes to service B?

A $\frac{1}{4}$

B $\frac{5}{11}$

C $\frac{4}{11}$

D $\frac{1}{2}$

71.

A college student earns \$12 per hour working part-time. After working for a number of hours, the student's total earnings can be modeled by the equation $E = 12h$. If the student works an additional 5 hours per week for 4 weeks, which of the following represents the change in total earnings?

A \$48

B \$60

C \$240

D \$480

72.

The scatterplot below shows the relationship between the number of practice hours x and test scores y for 12 students. A line of best fit is drawn through the data. Which of the following statements about the line of best fit must be true?

A The line passes through all 12 data points.

B As x increases, y tends to increase.

C The data has no outliers.

D The correlation is negative.

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73.
A researcher surveyed 200 randomly selected adults and found that 84 of them regularly exercised. Based on the survey, which of the following is the best estimate for the proportion of adults in the population who regularly exercise?

A 0.22

B 0.35

C 0.38

D 0.42

74.
A data set has a mean of 72 and a standard deviation of 8. A new data set is created by multiplying each value in the original data set by 2. What are the mean and standard deviation of the new data set?

A Mean: 144, Standard deviation: 16

B Mean: 144, Standard deviation: 8

C Mean: 72, Standard deviation: 16

D Mean: 72, Standard deviation: 8

75.
A hotel offers two types of rooms: single and double. On a given night, the hotel has 120 rooms available. Single rooms cost \$90 per night and double rooms cost \$130 per night. On that night, all rooms were booked and the total revenue was \$13,400. How many double rooms were booked?

A 35

B 50

C 65

D 85

76.
A population of bacteria doubles every 3 hours. If there are initially 500 bacteria, which of the following expressions gives the number of bacteria after t hours?

A $500(2)^t$

B $500(2)^{t/3}$

C $500(3)^t$

D $500(3)^{t/2}$

77.
To investigate the effect of magnesium supplementation on sleep quality, a researcher selected 190 adults at random from a community center. Each participant was randomly assigned to take a magnesium supplement or a placebo each day for 6 weeks. The researcher found that the magnesium supplement caused statistically significant improved sleep quality. What feature of this study allowed the researcher to conclude that the supplement *caused* the improved sleep quality?

A There were more than 100 participants in the study.

B The participants were selected at random from the community center.

C The sleep efficiency of each participant was measured again at the end of 6 weeks.

D Each participant was randomly assigned to take a magnesium supplement or a placebo.

78.

The histogram summarizes the distribution of points scored per game by a basketball team in its last 50 games. The bars represent: 30–40: 1 game, 40–50: 5 games, 50–60: 28 games, 60–70: 15 games. If the team scores 18 points in the next game, which of the following must be true about the new 51-value data set?

I. The median number of points per game for the new data set is less than the median for the original data set.

II. The mean number of points per game for the new data set is less than the mean for the original data set.

A I only

B II only

C I and II

D Neither I nor II

79.

A company surveyed employees in departments A, B, and C from 2,500 randomly selected employees across several regional offices in the US. If the results show a connection between time spent remote and job satisfaction, which factor would limit applying these findings to all employees in departments A, B, and C across the entire company?

A The employees came from multiple regional offices.

B The sample size was too small.

C There were more employees from departments B and C than department A.

D Employees were not randomly chosen from all departments A, B, and C throughout the company.

80.

A department store sells pants in three lengths: short, regular, and long. The table shows the distribution of pant length and color. A pair of pants is selected at random. What is the probability of selecting a pair of pants that is brown, given that the pair of pants is regular length?

	Black	Brown	Blue	Total
Short	25	14	24	63
Regular	23	15	22	60
Long	20	19	19	58
Total	68	48	65	181

81.

A science club from a high school in Ohio conducted an experiment on the effect of smell on taste. 80 students were selected at random. 32 were able to correctly identify the pureed food sample while wearing nose plugs. Which of the following is the largest population to which the results of the experiment can be generalized?

A All students from high schools in Ohio

B The 80 students who participated in the experiment

C All students from the high school

D The 32 students who correctly identified the food sample

82.

A research manager selected 2 random samples of ovens to estimate average preheat time to 325°F. The first sample gave an estimate of 15.2 minutes with a margin of error of 1 minute. The second sample gave 15.4 minutes with a margin of error of 2.2 minutes. Why did the first sample obtain a smaller margin of error?

A The first sample contained more ovens than the second sample.

B The first sample contained fewer ovens than the second sample.

C The first sample took more time on average to preheat.

D The first sample took less time on average to preheat.

83.

A researcher surveyed undergraduate, graduate, and postdoctoral students. The number of undergraduate students surveyed was 6,950% of postdoctoral students surveyed, and the number of graduate students surveyed was 35% of the undergraduate students surveyed. If there were 4,865 graduate students surveyed, what was the sum of the number of undergraduate and postdoctoral students surveyed?

84.

The floor of a business office has an area of 1,575 square meters. An architect creates a scale model where each side of the model is $\frac{1}{15}$ times the length of the corresponding side of the actual floor. What is the area, in square meters, of the scale model?

85.

When a collection of books is sorted, 20% are nonfiction and the remaining are fiction. Of the fiction books, 55% are mysteries and the rest are romance. If there are 1,224 romance books, what is the total number of books in the collection?

86.

A beekeeper's initial observation of the population of a certain bee colony was 1,100 bees. The beekeeper set a goal to increase the population to 2,600 bees. The beekeeper uses a model that predicts the population of this bee colony begins at 1,100 and increases by 120 bees per week in the first two weeks after the initial observation, and then increases by 180 bees per week until the beekeeper's goal is reached. According to this model, at the end of week w after the initial observation, where $w > 2$, which of the following functions gives the predicted number of bees still needed to reach the beekeeper's goal?

A $p(w) = 2{,}600 - 180w$

B $p(w) = 2{,}480 + 180w$

C $p(w) = 1{,}620 - 180w$

D $p(w) = -120 + 180w$

87.

A square map has a side length of 30 inches, and 1 inch on the map represents an actual distance of 17 miles. A smaller version of the same map is printed as a square with the side length 65% shorter than the side length of the previous map. On the smaller map, which of the following is closest to the actual distance, in miles, represented by 1 inch?

A 5.95

B 10.30

C 19.50

D 48.57

88.

To investigate the effect of magnesium supplementation on the sleep quality of adults, a researcher selected 190 adults at random from a community center to participate in a study. The researcher first measured the sleep efficiency of each participant. Each participant was then randomly assigned to take a magnesium supplement or a placebo each day for 6 weeks. At the end of the 6 weeks, the researcher measured the sleep efficiency of all participants again and found that the magnesium supplement caused statistically significant improved sleep quality for the adults at the community center. What feature of this study allowed the researcher to conclude that the magnesium supplement caused the improved sleep quality?

A) There were more than 100 participants in the study.

B) The participants were selected at random from the community center.

C) The sleep efficiency of each participant was measured again at the end of 6 weeks.

D) Each participant was randomly assigned to take a magnesium supplement or a placebo.

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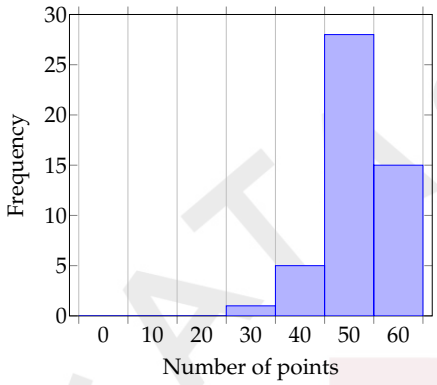
89.

The histogram summarizes the distribution of an original data set that represents the number of points per game a basketball team has scored in the last 50 games played. If the team scores 18 points in the next game and this game is added to the original data set to create a new data set of 51 values, which of the following must be true?



I. The median number of points per game for the new data set is less than the median number of points per game for the original data set.

II. The mean number of points per game for the new data set is less than the mean number of points per game for the original data set.

A I only

B II only

C I and II

D Neither I nor II

90.

The scatterplot shows the relationship between variables x and y for data set P. A line of best fit for the data is also shown (approximately $y = 0.02x + 12.2$). Data set Q is created by adding 649 to each x-value. Which could be an equation of a line of best fit for data set Q?

A $y = 28 + \frac{35}{1{,}301}x$

B $y = 18 + \frac{1}{131}x$

C $y = 9 + \frac{1}{131}x$

D $y = -6 + \frac{35}{1{,}301}x$

91.

The composition of a young swamp buffalo: 128.2 kg of muscle, comprising approximately 64.4% of its composition. Of the remaining composition, approximately 44.2% was bone. Based on these approximations, to the nearest tenth, how many kilograms of this buffalo's composition were bone?

92.

How many liters of a 30% chlorine solution must be added to 12 liters of a 10% chlorine solution to obtain a 15% chlorine solution?

93.

A 180-gram metal alloy is 50% aluminum. It contains one metal alloy that is 30% aluminum and a second metal alloy that is 60% aluminum. What is the mass, in grams, of the second metal alloy?

94.

The result of increasing a positive quantity by 11% is x. Which expression represents the original quantity in terms of x?

A $1.11x$

B $\dfrac{x}{1.11}$

C $1.11\left(\dfrac{100+x}{100}\right)$

D $1.11\left(\dfrac{100}{100+x}\right)$

95.

The positive number a is 480% of the number b, and a is 70% of the number c. If c is p% of b, which of the following is closest to the value of p?

A 267

B 336

C 550

D 685

96.

While the mass of an object is the same everywhere, the weight of an object differs on different planets. An object has a weight of 170.00 pounds on Earth and 186.32 pounds on Neptune. The object's weight on Jupiter is 252.8% of its weight on Earth. If the object's weight on Neptune is x% of its weight on Jupiter, which of the following is closest to the value of x?

A 43.35

B 43.33

C 277.07

D 429.76

97.

In a collection of items, 10% are red, 25% are green, 35% are blue, and 30% are yellow. If there are 40 green items, how many blue items are in the collection?

A 14

B 16

C 48

D 56

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98.

The value of an autographed baseball increased by 178% from the end of 2012 to the end of 2013 and then decreased by 21% from the end of 2013 to the end of 2014. What was the net percentage increase in the value from 2012 to 2014?

A 119.62%

B 140.62%

C 157.00%

D 236.38%

99.

At the start of a field study, populations of lions and antelopes were equal. By end of the week, antelopes increased by 2,106% of their starting number and lions increased by 300% of their starting number. At the end of the week, the number of antelopes was p% greater than the number of lions. What is the value of p?

100.

On a plot of land, 52.0% of the square footage is farmland and the rest is pasture. Buildings cover exactly 21.5% of the farmland and 14.0% of the pasture. If buildings cover exactly p% of the total plot, what is the value of p?

101.

The speeds of particles A, B, and C are a, b, and c meters per second, respectively. The speed of particle A is 6,000% of the speed of particle C, and the speed of particle C is 0.008% of the speed of particle B. Which expression represents $a + b$ in terms of c?

A $12{,}560c$

B $6{,}125c$

C $6{,}008c$

D $1{,}850c$

102.

The positive number a is 2,800% of the number c, and c is 20% of the number b. What is the value of $a - b$ in terms of c?

A $23c$

B $140c$

C $560c$

D $2{,}240c$

103.

A square map has a side length of 45 inches, and 1 inch on the map represents an actual distance of 19 miles. A smaller version of the same map is printed as a square with the side length 70% shorter than the side length of the previous map. On the smaller map, which of the following is closest to the actual distance, in miles, represented by 1 inch?

A 5.70

B 11.18

C 31.50

D 63.33

104.

The mass of object A is 483% of the mass of object B, and the mass of object A is 0.069% of the mass of object C. If the mass of object C is p% of the mass of object B, what is the value of $\frac{p}{1{,}000}$?

105.

A researcher surveyed undergraduate students, graduate students, and postdoctoral students. The number of undergraduate students surveyed was 6,950% of the number of postdoctoral students surveyed and the number of graduate students surveyed was 35% of the number of undergraduate students surveyed. If there were 4,865 graduate students surveyed, what was the sum of the number of undergraduate students and postdoctoral students surveyed?

106.

A company surveyed employees in departments A, B, and C of a large corporation to understand their average daily time spent on remote work and their overall job satisfaction score. They randomly picked 2,500 employees across several regional offices in the US. Employees were asked to categorize their daily remote work hours as less than 2 hours, between 2 and 5 hours, or more than 5 hours. If the results show a connection between time spent remote and job satisfaction, which factor would limit applying these findings to all employees in departments A, B, and C across the entire company?

A) The employees came from multiple regional offices.

B) The sample size was too small.

C) There were more employees from departments B and C than department A.

D) Employees were not randomly chosen from all departments A, B, and C throughout the company.

107.

When a collection of books is sorted, 20% are nonfiction and the remaining books are fiction. Of those that are fiction, 55% are mysteries and the remaining fiction books are romance. If there are 1,224 romance books in this collection, what is the total number of books in the collection?

108.

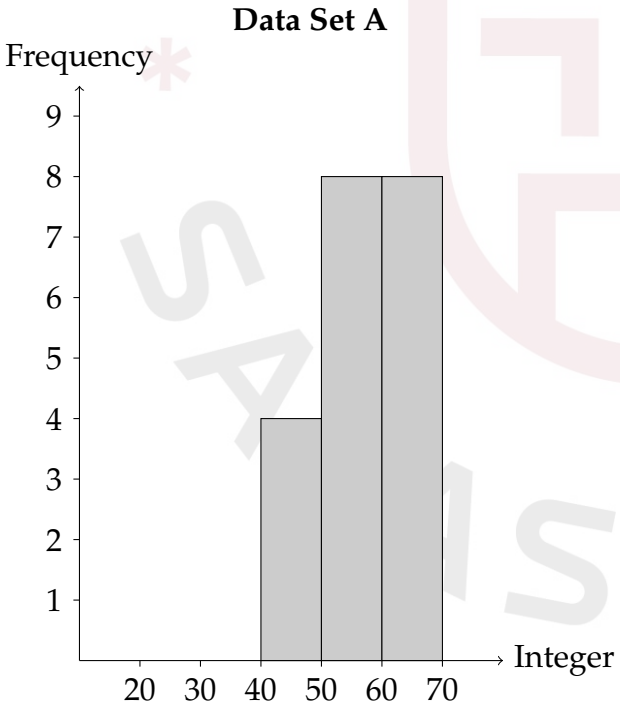
For 100 neurons, the table summarizes the distribution of classification and cell body diameter.

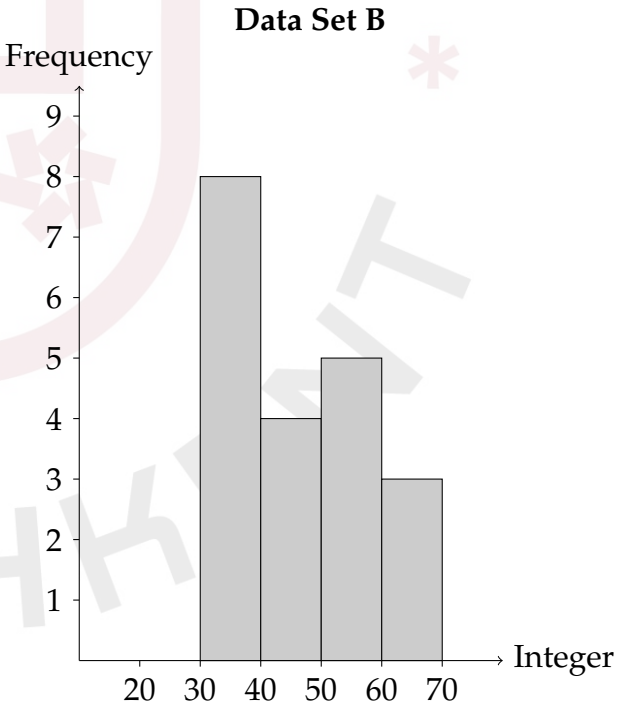
Classification	Cell body diameter (micrometers)		
	Less than 20	20 to 30	Greater than 30
Sensory neuron	12	3	5
Motor neuron	0	17	18
Interneuron	10	32	3

One of these neurons will be selected at random. What is the probability of selecting an interneuron that has a cell body diameter between 20 and 30 micrometers? (Express your answer as a decimal or fraction, not as a percent.)

109.

Two data sets each containing 20 integers are summarized in histograms. For the histogram, the first interval represents the frequency of integers greater than or equal to 40, but less than 50. The second interval represents the frequency of integers greater than or equal to 30, but less than 40, and so on. The mean of Data Set A is equal to a. The mean of Data Set B is equal to b. What is the smallest possible value of $\frac{b}{a}$?





Answers: Problem Solving

Number	Answer	Number	Answer
1	D	**26**	C
2	18	**27**	D
3	15100	**28**	14
4	D	**29**	D
5	B	**30**	D
6	A	**31**	15
7	D	**32**	D
8	272	**33**	B
9	A	**34**	D
10	32	**35**	B
11	D	**36**	A
12	C	**37**	34.1
13	D	**38**	9.45
14	D	**39**	66.07
15	A	**40**	1.07
16	D	**41**	D
17	A	**42**	B
18	500	**43**	17.9
19	166	**44**	B
20	A	**45**	A
21	C	**46**	451.5
22	B	**47**	C
23	A	**48**	18
24	700	**49**	A
25	395.76	**50**	C

Number	Answer	Number	Answer
51	B	**76**	B
52	31.8	**77**	D
53	C	**78**	B
54	C	**79**	D
55	19.459	**80**	15/60
56	D	**81**	C
57	A	**82**	A
58	14	**83**	14100
59	C	**84**	7
60	B	**85**	3400
61	A	**86**	C
62	C	**87**	D
63	A	**88**	D
64	D	**89**	B
65	C	**90**	D
66	B	**91**	31.3
67	A	**92**	4
68	A	**93**	120
69	A	**94**	B
70	B	**95**	D
71	C	**96**	A
72	B	**97**	D
73	D	**98**	A
74	A	**99**	451.5
75	C	**100**	17.9

Number	Answer	Number	Answer
101	A	**106**	D
102	A	**107**	3,400
103	D	**108**	0.32
104	700	**109**	83/122
105	14,100		

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We've reached the end of the Hard Book by @satashkent's R&D Team. Before we close, let's acknowledge the dedicated team who brought this project to life.

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Every question in this book has been carefully selected, entered, and reviewed to ensure accuracy and exam-level quality.

Powered by @satashkent's Research and Development Team.

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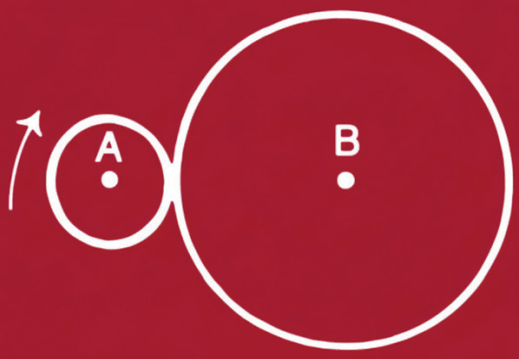
College Prep Community

Before you finish, try solving this real SAT Math question — one that challenged even the College Board itself 😉



In the figure above, the radius of circle A is ⅓ the radius of circle B. Starting from the position shown in the figure, circle A rolls around circle B. At the end of how many revolutions of circle A will the center of circle first reach its starting point?

(A) $\frac{3}{2}$ (B) 3 (C) 6 (D) $\frac{9}{2}$ (E) 9

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