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1ST Edition

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1. $(x + 7)$ is a factor of the quadratic function $y = f(x)$, and $x = c$ is a positive zero of the function. If the minimum of the function is $(\frac{63}{8}, k)$, what is the value of c?

2. For two acute angles, $\angle A$ and $\angle B$, $\cos A = \sin B$. The measures, in degrees, of $\angle A$ and $\angle B$ are $13x + 10$ and $48 + 3x$, respectively. What is the value of x?

3. A baseball coach charges each athlete \$150 for the first month and \$95 for each additional month. Which of the following functions correctly represents the total revenue $R(m)$, in dollars, for m months and n athletes, where m and n are positive integers?

   A) $R(m) = 95mn + 55$
   B) $R(m) = 95mn + 150$
   C) $R(m) = 95mn + 55n$
   D) $R(m) = 95mn + 150n$

$$y = -3x^2 - 58$$
$$y = px - 46$$

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

   A) -2
   B) -4
   C) 12
   D) 16

5. $$f(x) = -7x + b$$

   For the given function $f(x)$, which of the following gives the equation for the function $f(x) + 20$, given that the point $(-4, 0)$ lies on the graph of $f(x) - 20$?

   A) $f(x) = -7x - 28$
   B) $f(x) = -7x - 8$
   C) $f(x) = -7x + 8$
   D) $f(x) = -7x + 12$

6. 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

7. $$f(x) = a^x - b$$

   The exponential function given above passes through points $(c, 8)$ and $(2c, 350)$. What is a possible value of b?

8.

Cylinder	Volume	Surface Area
A	$1{,}296\pi$	$k\pi$
B	$162{,}000\pi$	$j\pi$

   The table gives the volume of two similar cylinders. If the radius of cylinder A is 9 cm. What is the value of $j - k$?

   Volume $= \pi r^2 h$
   Surface area $= 2\pi r^2 + 2\pi rh$

9. For the function f, for every increase of $\frac{1}{2}$ 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 forms of function f displays the value of c as the base or coefficient?

   A) $f(x) = 56(2)^{6x}$
   B) $f(x) = 56(8)^{2x}$
   C) $f(x) = 56(64)^{x}$
   D) $f(x) = 56(4{,}096)^{\frac{x}{2}}$

10. The quadratic function $ax^2 + 200x + c$ has at least one real solution. What is the greatest possible value of ac?

11. A polygon has exactly 97 sides. If the measure of each of the 97 interior angles of this polygon is $(180p)°$, what is the value of p?

12. A certain town has an area of 5.48 square miles. Which of the following is closest to the area, in square yards, of this town? ($1 \text{ mile} = 1{,}760$ yards)

A) 552
B) 964
C) $9{,}645$
D) $16{,}974{,}848$

13. One of the two equations in a system of linear equations is given. The system has no solution. Which equation could be the second equation in this system?

$$7x = 105y - 133$$

A) $x = 15y$
B) $\frac{1}{7}x = 15y$
C) $x = 15y - 19$
D) $\frac{1}{7}x = 15y - 19$

14. In triangle ABC, the sum of the measures of angle A and angle B is 90 degrees. The value of $\sin(A)$ is $\frac{2\sqrt{7}}{8}$. What is the value of $\cos(B)$?

A) $\frac{2\sqrt{7}}{8}$
B) $\frac{2\sqrt{7}}{6}$
C) $\frac{6\sqrt{2}}{14}$
D) $\frac{8}{23\sqrt{2}}$

15. What is the value of $\frac{k}{25}$ if the given equation only has one solution?

$$25|x - 4| = k$$

A) -5 only
B) 5 only
C) 5 or -5
D) 0

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

$$\frac{3}{8}x + \frac{7}{5}y = \frac{9}{7} - \frac{7}{5}y$$
$$\frac{5}{4}x + \frac{9}{4} = ky + \frac{4}{3}$$

17. In the xy-plane, the graph of the given equation is a circle. Which point lies on this circle?

$$(x + 7)^2 + (y - 11)^2 = 25$$

A) $(-7, 11)$
B) $(11, -7)$
C) $\left(\sqrt{11} + 7,\ \sqrt{14} - 11\right)$
D) $\left(\sqrt{11} - 7,\ \sqrt{14} + 11\right)$

18. The area of a triangle is equal to x^2 square inches. The base of the triangle is $5 + 2x$ inches, and the height of the triangle is $x - 2$ inches. What is the value of x?

A) 2.5
B) 2.7
C) 5
D) 10

19. A circle in the xy-plane has its center at $(3, -7)$ and has a radius of 12. 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?

20. Sphere A has a radius of $7x$ and sphere B has a radius of $91x$. The volume of sphere B is how many times the volume of sphere A?

21. One gallon of resin costs $\$79$ and will cover 48 square feet of a countertop. The countertops in a given room have a total surface area of k square feet. Which equation represents the cost c, in dollars, of resin needed to cover the countertops twice?

A) $c = \frac{48k}{79}$
B) $c = \frac{96k}{79}$
C) $c = 79(\frac{k}{24})$
D) $c = 79(\frac{k}{96})$

22. 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?

$$10x + 8y = 15$$
$$25x + 20y = 37.5$$

A) $(r, -\frac{4r}{5} + \frac{15}{8})$
B) $(r, \frac{5r}{4} + \frac{4}{5})$
C) $(-\frac{4r}{5} + \frac{3}{2}, r)$
D) $(\frac{2r}{5} + 10, -\frac{2r}{5} + 25)$

23. A researcher selected 2 random samples of employees in a large company to estimate the percentage of employees that planned to vote in favor of a new division. Based on the first sample, the researcher estimated that 68% of the employees would vote in favor, with an associated margin of error of 9.7%. Based on the second sample, the researcher estimated that 84% of the employees would vote in favor, with an associated margin of error of 6.7%. Assuming the margins of error were calculated in the same way, which of the following best explains why the second sample obtained a smaller margin of error than the first sample?

A) The first sample contained fewer employees than the second sample.
B) The first sample contained more employees than the second sample.
C) The first sample contained a lower percentage of residents that planned to vote in favor of a new division.
D) The first sample contained a higher percentage of residents that planned to vote in favor of a new division.

24. The function f is defined by $f(x) = a^x + b$, where a and b are constants. In the xy-plane, the graph of $y = f(x)$ has an x-intercept at $(3, 0)$ and a y-intercept at $(0, -342)$. What is the value of $a + b$?

25. 684 is $p\%$ greater than 9. What is the value of p?

26. Two numbers a and b, are each greater than zero, and the fifth root of a is equal to the cube root of b. For what value of x is a^{8x-4} equal to b?

27. For the given system of equations, what is the value of $7(j - k)$?

$$(j - k) - 16(m + l) = 689$$
$$(j - k) + 12(m + l) = 1235$$

28. A model initially estimates that there are $24{,}000$ bacteria on a petri dish. 14 days later, the model estimates that there are $96{,}000$ bacteria on the petri dish. Assuming exponential growth, the formula $B = a(2)^{xd}$ gives the estimated number of bacteria on a petri dish, where a and x are constants and B is the number of bacteria on the petri dish d days after the initial measurement. What is the value of x?

A) $\frac{1}{14}$
B) $\frac{1}{7}$
C) 7
D) 14

29. 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?

30. In the xy-plane, there are 3 points a, b, and c. Point a has coordinates of $(1, 0)$, point b has coordinates of $(0, 0)$ and point c has coordinates of $(-1, 0)$. Which of the following gives a possible angle measure, in radians of $\angle abc$?

A) $\frac{456\pi}{6}$
B) $\frac{459\pi}{6}$
C) $\frac{462\pi}{6}$
D) $\frac{468\pi}{6}$

31. Two data Sets A and B have 56 values in total. The average of the two data sets is 193. Data set A contains 32 values with an average of 208. What is the average of data set B?

32. Lines k and l are perpendicular. If the point $(4, m)$ and $(9, m + 3)$ lies on line k and lines 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) $(24,\ m + 12)$

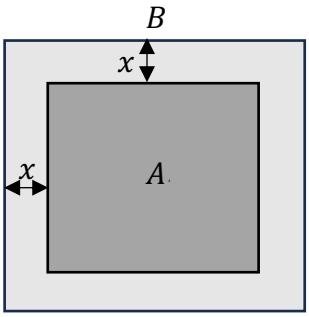
33. Data set A consists of 37 different values that have a minimum of 230, a maximum of 278, a mean of 244, and a standard deviation of 9. The values 230 and 278 are removed from the data set to create data set B. Which of the following statements is true?

A) Both the mean and standard deviation of data set B are less than those in data set A.
B) Both the mean and standard deviation of data set B are greater than those in data set A.
C) The standard deviation of data set B is less than the standard deviation in data set A but the mean of both data sets is the same.
D) The standard deviation of data set B is greater than the standard deviation in data set A but the mean of both data sets is the same.

34. If $a > 0$, $x^2 + y^2 = a$ and $xy = a - 10$, what is $(x + y)^2$ in terms of a?

A) $a - 20$
B) $2a - 10$
C) $2a - 20$
D) $3a - 20$

35. Rectangle A has a width of 50 feet and a length of 45 feet and is located inside rectangle B. A uniform distance x, in feet, separates the sides of rectangle A from rectangle B. The area of rectangle B is 2646 square feet, what is the value of x?



36. $f(x) = 200(b)^x$. When x increases by 1, $f(x)$ increases by $c\%$. Which of the following expresses c in terms of b?

A) $c = \frac{200b}{100}$
B) $c = \frac{2b}{100}$
C) $c = (b + 1)100$
D) $c = (b - 1)100$

37. A 34 pound dog eats two types of canned food: chicken and beef. The recommended amount of the chicken food is 1.25 cans per 16 pounds a dog weighs per day. The recommend amount of canned beef food is 0.85 cans per 23 pounds a dog weighs per day. If c is the number of cans of chicken food and b is the number of cans of beef food a 34 pound dog eats in a given day. Which equation describes all possible values of c and b?

A) $\frac{1.25}{16}c + \frac{0.85}{23}b = 34$
B) $\frac{16}{1.25}c + \frac{23}{0.85}b = 34$
C) $\frac{1.25}{16}b + \frac{0.85}{23}c = 34$
D) $\frac{16}{1.25}b + \frac{23}{0.85}c = 34$

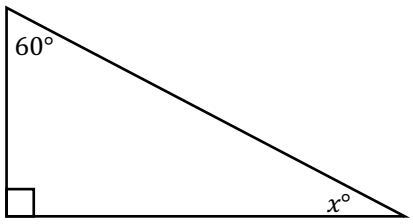
38. A quadratic function models the height, in feet, of an object above the ground in terms of time, in seconds, after the object is launched. The model indicates the object launched from the ground (0 feet) and reaches its maximum height of 576 feet above the ground 12 seconds after being launched. Based on the model, what is the height, in feet, of the object above the ground 16 seconds after being launched?

A) 384
B) 432
C) 480
D) 512

39. A small business owner budgets $\$3{,}600$ to purchase timber each year. The owner must purchase a minimum of 345 slats of timber each year to maintain the discounted pricing. If the owner pays $\$7.25$ to purchase each slat of pine pulpwood and $\$24.75$ to purchase each slat of pine sawtimber, what is the maximum number of slats of pine sawtimber the owner can purchase to stay within the budget and maintain the discounted pricing?

40. A 180 gram metal alloy is 50% aluminum. It contains a metal alloy that is 30% aluminum and a second metal alloy made up of 60% aluminum. What is the mass of the second metal alloy?

41. In the given figure, the hypotenuse is 64 what is the $\cos x$?



Note: Figure not drawn to scale.

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

42. The table shows the distribution of 88 basketball players and their positions on a basketball club. Each player is categorized in one position.

Position	Frequency
Point guard	26
Shooting guard	16
Small forward	11
Power forward or center	35

If one of the 88 players is selected at random, the probability of selecting a player who is categorized as a power forward, given the player is <u>not</u> categorized as a shooting guard, is $\frac{3}{12}$. How many of these players are categorized as a center?

43. A quadratic function models the height, in feet, of an object above the ground in terms of time, in seconds, after the object is launched off an elevated surface. The model indicates that at a time of 9 seconds, the object is 294 feet above the ground. At a time of 13 seconds, the object is 310 feet above the ground. If the object was at a height of 24 feet when it was launched, what is the height, in feet, of the object above ground 18 seconds after being launched?

A) 96
B) 192
C) 222
D) 240

44. A rectangular pyramid has a square base with an area of 324 square meters. What is the surface area, in square meters, of one of the triangular faces if the rectangular pyramid has a volume of $4{,}320$ cubic meters?

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

46. $3x^2 + bx - 112 = (ax + m)(x - l)$. Given that $a, m,$ and l are integers, which of the following must be true?

A) m is a factor of b
B) a is a factor or 112
C) a if a factor of b
D) l is a factor of 112

47. The perimeter of a right isosceles triangle is $76 + 76\sqrt{2}$. What is the length of the hypotenuse?

48.

Sample	Percent in favor	Margin of error
A	67.83%	7.8%
B	72.94%	4.5%

The results of two random samples of votes for a proposition are given in the table. The samples were selected from the same population, and the margins of error were calculated using the same method. Which of the following is the most appropriate reason that the margin of error for sample A is greater than the margin of error for sample B?

A) Sample A had a larger sample size.
B) Sample A had a smaller sample size.
C) Sample A had a smaller number of votes that could not be recorded.
D) Sample A had a lower percent of favorable responses.

49. 360 is $p\%$ of 10. What is the value of p?

50. The vertex of the function $f(x)$ is given as $(9, -13)$, and the point $(3, -4)$ lies on the parabola. If $g(x) = 4f(x - 2)$, what is the value of $g(0) - f(0)$?

51. $$-377x + k = 377x + k$$

If k is a constant, how many solutions does the given equation have?

A) No solutions
B) One solution
C) Two solutions
D) Infinite solutions

52. The density of a certain type of wood is 770 kilograms per cubic meter. A sample of this type of wood is in the shape of a cube, where each edge has a length of 0.7 meters. To the nearest whole number, what is the mass, in kilograms, of this sample?

A) 264
B) 377
C) 1,571
D) 2,245

53. The graph of the linear equation passes through the points $(-21, -\frac{89}{2})$ and $(12, \frac{65}{2})$. The graph also passes through the point $(\frac{27}{4}, a)$. What is the value of a?

54. In $\triangle ABC$, $\angle B$ is a right angle and the length of $\overline{AB}$ is 456 millimeters. If the $\cos C = \frac{7}{25}$, what is the length, in millimeters, of $\overline{BC}$?

55. In triangle ABC and triangle DEF, sides BC and EF each have a side length of 37 inches, and angles B and E each have an angle measure of $63°$. Which of the following additional pieces of information is(are) sufficient to prove whether triangle ABC is congruent to triangle DEF?

I. The measure of angles A and C are equal.
II. The length of sides AC and DF are equal.
III. The measures of angles A and D 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 and III are sufficient, but I is not.

56. $$77x^2 + (7j + 11k)x + jk = 0$$

In the given equation, j and k are positive constants. The product of the solutions to the given equation is ajk, where a is a constant. What is the value of a?

57. The number j is $2{,}400\%$ greater than the number k. The number k is 350% greater than 8. What is the value of j?

58. A square is inscribed in a circle with the equation $x^2 + y^2 - 8x + 10y = 27$. What is the area of the square?

59. The equation below relates distinct positive real numbers a, b and c. Which equation correctly expresses c in terms of a and b?

$$a = 19b \cdot \sqrt[5]{\left(\frac{c}{20}\right)^4}$$

A) $\frac{20}{19b}(a)^{\frac{5}{4}}$
B) $\frac{20}{19b}(a)^{\frac{4}{5}}$
C) $20\left(\frac{a}{19b}\right)^{\frac{5}{4}}$
D) $20\left(\frac{a}{19b}\right)^{\frac{4}{5}}$

60. Triangle ABC is inscribed in a circle with a radius of 85. The length of AC is 170 and the length of BC is 168. What is the value of $\frac{AB}{BC}$?

61. For the exponential function f, the value of $f(2)$ is k, where k is a constant. Which of the following equivalent forms of the function f shows the value of k as the coefficient or the base?

A) $f(x) = 729(3)^{x+2}$
B) $f(x) = 6{,}561(3)^x$
C) $f(x) = 177{,}147(3)^{x-3}$
D) $f(x) = 59{,}049(3)^{x-2}$

62. Two numbers r and s are each greater than zero, and the fourth root of r is equal to the seventh root of s. For what value of x is r^{4x-5} equal to s?

63. The given equation $ax^2 + 98x + c$ has at least 1 real root and a factor of $kx + j$. What is the greatest possible value of ac?

64. $$7kx + 13my = 20.5$$
$$6kx + 5my = -48$$

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?

65.

x	$g(x)$
4	9
2	0

The table gives two values of x and their corresponding values of $g(x)$, where $g(x) = \frac{f(x)+5}{x+8}$ and f is a linear function. What is the y-coordinate of the y-intercept of the graph $y = f(x)$ in the xy-plane?

66. What is the value of $\sin(x°)(\cos 90 - x°) + \sin(90 - x°)(\cos x°)$?

A) 0.5
B) 1
C) 2
D) 90

67. There are red, blue, green, and black marbles in a bag. There are 26 black marbles, 8 green marbles, and 26 blue and red marbles. Given that a randomly selected marble is not black, the probability of selecting a red marble is $\frac{5}{17}$. What is the number of blue marbles in the bag?

68. A gardener is purchasing topsoil for a new garden. The garden is in the shape of a rectangular prism. The dimensions of the garden are 54 feet by 192 feet by 2 feet. If it costs $96 per cubic yard of topsoil, how much does the gardener need to spend in dollars? $(1 \text{ yard} = 3 \text{ feet})$

69. In the xy-plane, which of the following points lies on a circle with the equation $(x + k)^2 + (y - j)^2 = 841$?

A) $(k + 20,\ j + 21)$
B) $(k - 20,\ j - 21)$
C) $(-k + 21,\ j + 20)$
D) $(-k - 21, -j - 20)$

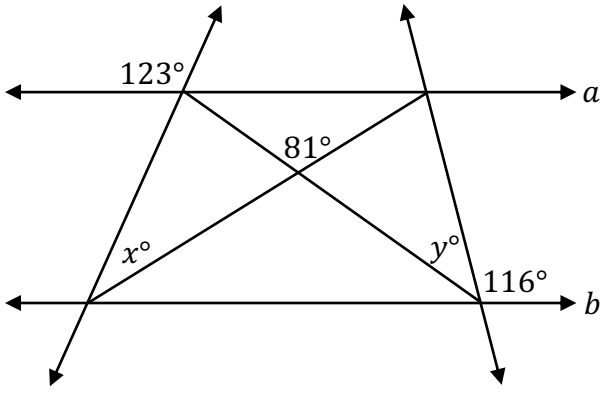
70. Which of the following inequalities gives all possible values of k where the equation below has no solution?

$$4 - 4\left|\frac{7}{8} + \frac{4}{5}x\right| = \frac{57}{12} + k$$

A) $k < -\frac{3}{4}$
B) $k > -\frac{3}{4}$
C) $k \leq \frac{3}{4}$
D) $k \geq \frac{3}{4}$

71. A table that weighs 348 pounds puts equal amounts of pressure on each of its 4 identical legs. If the pressure that each leg exerts on the floor is 12 pounds per square inch, what is the area, in square inches, of the bottom of each leg that is touching the floor?

72. In the figure below, lines a and b are parallel. What is the value of $x + y$?



Note: Figure not drawn to scale

73. 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. $f(x) = 232(0.4)^{x+2}$
II. $g(x) = 232(0.4)(0.4)(0.4)^{x-2}$

A) I only
B) II only
C) I and II
D) Neither I nor II

74. An equilateral triangle with side lengths of k is inscribed in a circle. Which of the following defines the radius, r, in terms of k?

A) $\frac{k}{2}$
B) $\frac{k\sqrt{3}}{6}$
C) $\frac{k\sqrt{3}}{3}$
D) $\frac{k\sqrt{3}}{2}$

75. The function f is defined by $f(x) = 3^x$. The function g is a increasing linear function. In the xy-plane, the graphs of $y = f(x)$ and $y = g(x)$ intersect at two points (a, j) and (b, k), where $j < k$. When $g(x) > f(x)$, which of the following must be true?

A) $x > k$
B) $x < j$
C) $x < j$ or $x > b$
D) $a < x < b$

76. If $\frac{2a}{b} = 4.25$ and $\frac{a}{bn} = 8.5$, what is the value of n?

77. An object's speed is increasing at a rate of 4.80 meters per second squared. What is the rate in miles per minute squared, rounded to the nearest tenth? (Use 1 mile $= 1609$ meters.)

78. 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.

79. The graph of the quadratic function $y = f(x)$ in the xy-plane intersects the x-axis when $x = 74$ and $x = k$, where k is a constant. The maximum value of $y = f(x)$ occurs at the point $(17, m)$, where m is a constant. What is the value of k?

80.

x	$f(x)$
-9	155
-3	227
3	155

Three points on the quadratic function $f(x)$ are given in the table. If $g(x) = f(x + 4)$, what is the y-intercept of the function $g(x)$?

81. Triangle ABC is an equilateral triangle with a height of 30 meters. What is the perimeter of triangle ABC in meters?

A) $60\sqrt{3}$
B) 90
C) $90\sqrt{3}$
D) $120\sqrt{3}$

82. $$-19(6x - 4)^2 + 6(6x - 3)^2$$

The given expression can be rewritten as $\frac{a}{9}x^2 + \frac{b}{9}x + \frac{c}{9}$, where a, b, and c are constants. What is the value of $a + b + c$?

83. A rectangular area consists of 3,179 equal squares where each square has an area of k. If the length of the rectangular area is 2.75 times the width and the width is equal to $x\sqrt{k}$, what is the value of x?

84. $$7x - 9y = 39$$
$$35x - 45y = 195$$

For any real number r, which of the following points lies on the graph of both equations?

A) $(3r, \frac{7r-13}{3})$
B) $(\frac{7r+13}{3}, 3r)$
C) $(-\frac{7r}{-9} + 39, \frac{7r}{9} + 195)$
D) $(\frac{r}{5} + 39, -\frac{r}{5} + 195)$

85. $$f(x) = x^2 + 5x - 6$$
$$g(x) = x^2 + 2x - 35$$

The quadratic function $f(x)$ has 2 solutions j and k, where $j < k$. The quadratic function $g(x)$ has 2 solutions l and m, where $l < m$. The quadratic function $h(x) = x^2 + 7x + c$ has solutions of $k + l$ and $m + j$, and can be rewritten as $(x + a)(x + b)$, what is the value of c?

86. For the exponential function $f(x) = 16^{x+4}$, which of the following answer choices expresses the minimum value as either a constant or a coefficient when $x \geq 0$?

A) $f(x) = 64(16)^x$
B) $f(x) = 65{,}536(16)^x$
C) $f(x) = 1{,}048{,}576(16)^x$
D) $f(x) = \frac{1}{65{,}356}(16)^x$

87. For the given parabola $ax^2 + bx + c$, a, b, and c are constants. The x-intercepts of the parabola are at $(14, 0)$ and $(k, 0)$. If $f(27) = f(11)$, what is the value of k?

88. A quadratic function models a projectile's height, in meters, above the ground in terms of in terms of time, in seconds, after it was launched. The model estimates that the projectile was launched from an initial height of a meters and reached a maximum height of 134 meters 6 seconds after it was launched. How many seconds after launch does the model estimate it will return to a height of a meters?

A) 6
B) 8
C) 9
D) 12

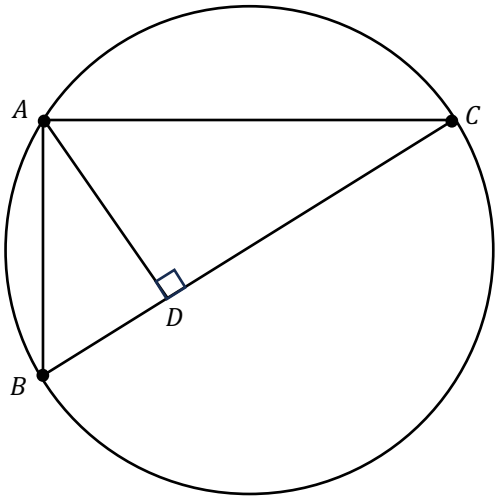
89. A 100 gram metal alloy is 40% silver. It contains a metal alloy that is 65% silver and a second metal alloy made up of 25% silver. What is the mass of the first metal alloy?

90. Joshua Tree National Park has an area of $1{,}242$ square miles. What is the area, in square yards, of Joshua Tree National Park? (1 mile $= 1{,}760$ yards).

A) $\frac{1{,}242}{1{,}760}$
B) $\frac{1{,}242}{(1{,}760)^2}$
C) $1{,}242(1{,}760)$
D) $1{,}242(1{,}760)^2$

91. There are two ranches. Ranch A and ranch B. The ratio of male horses to female horses is $1:15$ for the total number of horses on ranch A and B. The ratio of female horses on ranch A to ranch B is $7:17$. There are 168 horses on ranch A and 344 horses on Ranch B. How many more male horses are there on ranch A than on ranch B?

92. In the given figure, BC is the diameter of the circle. If the length of BC is equal to 132 and the length of AB is equal to $\sqrt{363}$, what is the value of $\frac{BC}{BD}$?



Note: Figure not drawn to scale.

93. A certain bacterial colony currently has $5{,}000$ spores. If the number of spores in this colony quadruples every 33 hours, which of the following functions N gives the number of spores in the colony $\underline{d \text{ days}}$ from now?

A) $N(d) = 5{,}000(4)^{\frac{11}{8}d}$
B) $N(d) = 5{,}000(4)^{\frac{8}{11}d}$
C) $N(d) = 5{,}000(4)^{\frac{5}{4}d}$
D) $N(d) = 5{,}000(4)^{\frac{4}{5}d}$

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

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

95. a is 3700% greater than b. a is also 5% less than c. What percent greater than c is b?

96. The proposal for a development project was included on a city's election ballots. A local tv station reported that 6 times as many people voted in favor of the proposal as people who voted against it. If $1{,}770$ more people voted in favor of the proposal than those who voted against the proposal. How many people voted against the proposal?

97. The table gives the volume and surface areas of two similar rectangles, where k is a constant.

	Volume (cubic inches)	Surface Area (square inches)
Rectangle A	$4{,}374$	$1{,}782$
Rectangle B	$1{,}500{,}282$	k

What is the value of k?

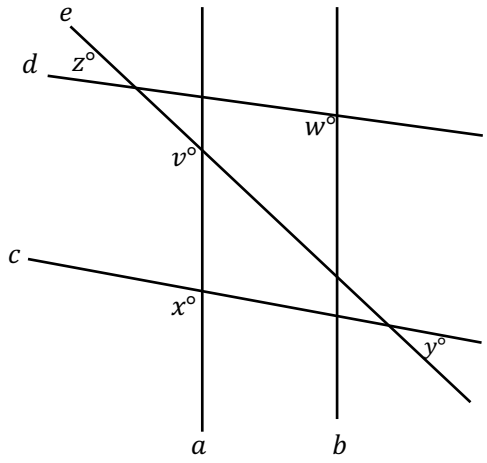
A) $5{,}346$
B) $12{,}474$
C) $87{,}318$
D) $611{,}226$

98. In the given system of equations, c is a constant. The system has two distinct real solutions. Which of the following could be the value of c?

$$y = x - c$$
$$y = -6(x - 5)^2$$

A) 2
B) 4
C) $\frac{119}{24}$
D) 7

99.



Note: Figure not drawn to scale.
In the figure, parallel lines a and b are intersected by lines c, d, and e. If $x = 54$, $v = 127$, and $w > x$, which statement about y and z must be true?

A) $z > y$
B) $z < y$
C) $z = y$
D) $z + y = 90$

100. An equilateral triangle has a perimeter of 1200 meters. If the height of the triangle is equal to $x\sqrt{3}$, what is the value of x?

101. $$f(x) = (x + a)(x + b)$$

For the given function $f(x)$, where a and b are integer constants, $f(-21) > 0$, $f(-15) > 0$, and $f(-18) < 0$, what is one possible value of $a + b$?

102. Which system of linear equations has no solution?

A) $-3x + 7y = -9$
$3x - 7y = 9$
B) $3x - 7y = 5$
$2x + 8y = 6$
C) $4x - 9y = 7$
$-12x + 27y = -21$
D) $-3x + 8y = 20$
$6x - 16y = 40$

103. Function f is a quadratic function. The graph of $y = f(x)$ in the xy-plane has a vertex at $(-7, 14)$ and passes through the point $(-4, -31)$ and has a y-intercept at $(0, a)$. The graph of $3f(x)$ has a y-intercept at $(0, b)$. What is the positive difference between a and b?

104. Each of the following frequency tables represents a data set. Which of these frequency tables represent the data set with the smallest standard deviation?

A)

Value	Frequency
2	1
10	5
15	3
20	5
24	1

B)

Value	Frequency
2	0
10	20
15	25
20	20
24	0

C)

Value	Frequency
2	100
10	50
15	25
20	0
24	25

D)

Value	Frequency
2	45
10	55
15	65
20	75
24	85

105. In the given equation, k is a positive constant. The product of the solutions to the equation is 154. What is the value of k?

$$\frac{3}{5}(5x+11)(x+\sqrt{5k+10})(x-\sqrt{5k+10})=0$$

106. Two lines intersect at exactly one point, forming two acute angles and two obtuse angles. The measure of one of these angles is $(7x-210)°$. Which of the following could NOT be the sum of the measures of any two of these angles?

A) $(-14x+780)°$
B) $(-14x+420)$
C) $180°$
D) $(14x-420)°$

107. $$\sqrt{a-x}=46-x$$

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

108. The mass of particles A, B, and C are a atomic mass units, b atomic mass units, and c atomic mass units, respectively. If the mass of particle A is $4{,}600\%$ of the mass of particle C, and the mass of particle C is 0.004% of the mass of particle B, which expression represents the value of $a+b$ in terms of c?

A) $2{,}960c$
B) $4{,}604c$
C) $4{,}850c$
D) $25{,}046c$

109. If $\frac{x-7}{5}=\frac{x-4}{3}$, the value $x-4$ is between which of the following pairs of values?

A) -9 and -4
B) -1 and 1
C) 2 and 5
D) 7 and 11

110. A circle with a center $B\ (0, 0)$ is a unit circle on the xy-plane. Point $A\ (1, 0)$ and C lie on the circle. If the measurement of angle ABC is $\frac{975\pi}{60}$ in radians, what is the x-coordinate of point C?

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

111. A handyman charges a flat rate of $\$218$ for the first 3 hours of work and $\$68$ for each additional hour of work. Which equation gives the total amount y, in dollars, that the handyman charges for x hours of work, where $x > 3$?

A) $y = 68x + 218$
B) $y = 218x + 68$
C) $y = 68x + 14$
D) $y = 68x + 422$

112. 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 $\frac{CV^3}{P} = \sqrt{PR}$, where P, C, V, and R are positive. When $R = 34$, which equation correctly expresses P in terms of C and V?

A) $P = \frac{CV^3}{\sqrt{34}}$
B) $P = \frac{CV^3}{\sqrt{34P}}$
C) $P = \sqrt[3]{\frac{34}{C^2V^4}}$
D) $P = \sqrt[3]{\frac{c^2V^6}{34}}$

113. $$f(x) = x + 7$$
$$g(x) = 5x^2 - kx + 245$$

The functions f and g are given. In function g, k is a constant. If $f(x) \cdot g(x) = 5x^3 + 1{,}715$, what is the value of k?

114. A circle is inscribed inside of square $ABCD$. Segment AC is the diagonal of the square, and its length is 30cm. What is the radius of the circle in cm?

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

115. Which of the following has $x + 2a$ as a factor where a is a positive integer?

A) $3x^2 + 7x + 14a = 0$
B) $3x^2 + 28x + 14a = 0$
C) $3x^2 + 42x + 14a = 0$
D) $3x^2 + 49x + 14a = 0$

116. A metal mold in the shape of a rectangular prism has a length of 27 inches, a width of 48 inches, and a height of 180 inches. The equation $c = v(d)$ calculates the cost of filling the metal mold, where c is the total cost in dollars, v is the volume in cubic yards, and d is the cost per cubic yard. If c is equal to $\$970$, what is the value of d in dollars? (Note $1\text{ yard} = 36\text{ inches}$)

117. The expression $\frac{x^{27}(x-7)}{3x^3} + \frac{7x^{27}}{3x^3}$ is equivalent to $\frac{1}{3}x^k$, where k is a constant and $x > 0$. What is the value of k?

A) 3
B) $\frac{27}{3}$
C) 25
D) 28

118. Megan engages in up to 3 types of exercise each week for a total of 14 hours while training for an ironman competition. Megan runs the same number of minutes each week. The equation $y = 780 - x - 200$ represents the situation where Megan swims for x minutes during a week and bikes for any remaining training time y, in minutes. If this equation is graphed in the xy-plane, which of the following statements is true?

A) During a week when Megan runs for 780 minutes, she bikes for 200 minutes.
B) Each week, Megan swims and bikes for a total of 780 minutes.
C) During a week when Megan doesn't swim, she runs for 260 minutes.
D) During a week when Megan doesn't bike, she swims for 390 minutes.

119. 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 a coefficient, the maximum of the graph of the corresponding function when $x \geq 0$.

I. $f(x) = b(0.97)^{x+a}$
II. $g(x) = b(0.97)^x + a$

A) I only
B) II only
C) I and II
D) Neither I nor II

120. An equilateral triangle is inscribed in a circle with a diameter of 16. Which of the following gives the area of the equilateral triangle?

A) $6\sqrt{3}$
B) $24\sqrt{3}$
C) $32\sqrt{3}$
D) $48\sqrt{3}$

121. The given equation $ax^2 + 88x + c = 0$, where a and c are constants has no real solutions and a factor of $kx + j$. What is the least possible integer value of ac?

122. $f(t) = 34{,}000(1.07)^{6t}$

The given function f models the balance of an investment account, in dollars, t years after it is opened. Which statement is the best interpretation of $(1.07)^{6t}$?

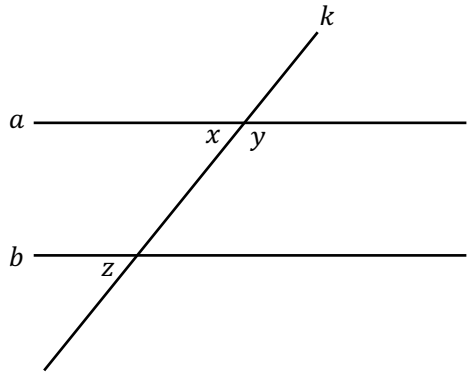
A) Every 6 years, the balance increases by $2{,}380$ dollars.
B) Every 6 years, the balance increases by 7% of the previous 6 years balance.
C) Every 2 months, the balance increases by $2{,}380$ dollars.
D) Every 2 months, the balance increases by 7% of the previous 2 months balance.

123. The quadratic function $a(x + 4.5)^2 - d$ can be rewritten as $(x - 9.5)(x + c)$. If a is equal to 1, what is the value of d?

124. $g(x)$ is a quadratic function. In the xy-plane, the graph of $y = g(x)$ passes through the points $(12, 540)$ and $(16, 908)$. If $g(0) = 12$, what is the value of $g(24)$?

125. The surface area of rectangle prism A is $312\ \text{m}^2$. The surface area of area of rectangle prism B is $11{,}232\ \text{m}^2$. Rectangular prism A has a volume of $224\ m^3$. If both rectangular prisms are similar, what is the volume of rectangular prism B?

126.



Note: Figure not drawn to scale.

The given figure shows lines a and b intersected by line k. Which of the following is sufficient to prove that a and b are parallel?

A) $180 - y = x$
B) $x = 180 - z$
C) $y + z = 180 - x$
D) $180 - z = y$

127. 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?

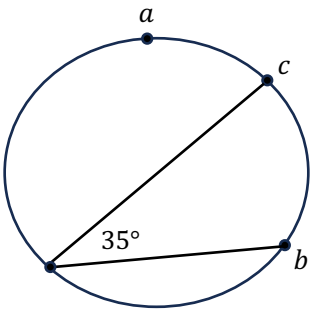
A) $7a$
B) $6a$
C) $-6a$
D) $-7a$

128. $f(x) = 1.6^x + 6$
$g(x) = 1.8x + b$

The given system of equations intersects at points (j, k) and (h, r), where $r < k$. What is the least possible value of b?

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

129.



For the given circle, the measure of arc $abc = 130 + 7x$ degrees and the measure of arc $acb = 90 - 3x$ degrees. What is the value of x?

130. The function f is defined by $f(x) = 78(0.39)^x$. For any positive integer n, the value of $f(n)$ is $p\%$ less than the value of $f(n-1)$. What is the value of p?

A) 78
B) 61
C) 39
D) 22

131. For which value of a does the quadratic $(7x-8)^2 + 9 = a$ only have one solution?

132. $$f(x) = a^x - b$$

The exponential function given above passes through points $(c, 12)$ and $(2c, 768)$. What is a possible value of b?

133. If $r = \sqrt[3]{k}$, for the equation $r^{12a-9} = k$, what is the value of a for which r and k are equal?

134. What is the perimeter of an equilateral triangle with an area of $289\sqrt{3}$?

135. $$92x - 1{,}789 = kx - 1{,}790$$

In the given equation, k is a positive integer constant greater than 91. The equation has exactly one solution. What is the least possible value of k?

136. $$4x^3 + bx^2 - 528x = 0$$

In the given equation, b is a positive integer constant. Which value could be a solution to the equation?

A) -13
B) -12
C) -6
D) 12

137. Circle A has the equation $(x-18)^2 + y^2 = 27$. Circle B has the equation $(x-18)^2 + (y-m)^2 = 50$. If Circle B passes through the center of circle A, what is a possible value of m?

A) $3\sqrt{3}$
B) $5\sqrt{2}$
C) $5\sqrt{2} - 3\sqrt{3}$
D) $5\sqrt{2} + 3\sqrt{3}$

138. If $x^2 = j + k$ and $y^2 = j + m$, which of the following is equal to $(x^2 - y^2)^2$?

A) $k^2 - 2jm + m^2$
B) $k^2 - 2km + m^2$
C) $4j^2 - 4jkm + m^2$
D) $4j^2 - 2jkm + k^2m^2$

139. $-x^2 + kx - 3{,}786$

In the given equation, k is a positive integer. The If the equation has no real solution, what is the greatest possible value of k?

140. A circle with center $(-7, -4)$ has a radius equal to 14. The equation $x^2 + y^2 + ax + by + c = 0$ represents the circle. What is the value of c?

141. 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 units, what is the length of $\overline{BE}$, in units?

142. If $k = l + m$, which of the following is equivalent to the expression $x^2 - l^2 - 2lm - m^2$?

A) $(x + k)^2$
B) $(x - k)^2$
C) $(x - k)(x + k)$
D) $x^2 - kx - k^2$

$ax^2 + 148x + c$

143. In the given expression, a and c are positive constants. If $jx + k$ is a factor of the expression, where j and k are positive constants, what is the greatest possible value of ac?

144. Lines c and d are perpendicular. If the equation of line c is $y = mx + b$ and the lines intersect at point $(7, 6)$. Which point lies on line b?

A) $(7 + m,\ 7)$
B) $(2m,\ 8)$
C) $(7 + 2m,\ 4)$
D) $(7 - 3m, 3)$

145. The given quadratic function $54x^4 + 219x^2 + 105$ has factors in the form $(k)(ax^2 + b)(cx^2 + d)$. If a, b, c, d, and k are integers, what is the smallest possible value of ab?

146. What is the value of k if the given equation only has one solution?

$$\frac{1}{4}|x - 4| - 30 = 2k$$

147. 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?

$$13x + 17y = 10$$
$$ax + by = 10$$

A) $39x + 17y = 10$
$ax - 3by = 10$
B) $52x + 34y = 10$
$2ax + 4by = 10$
C) $65x + 17y = 10$
$5ax + by = 10$
D) $13x - 17y = 10$
$ax + by = 10$

148. Which equation correctly gives c in terms of d, e, and f?

$$\frac{73}{c} = \frac{73}{d} + \frac{73}{e} + \frac{73}{f}$$

A) $c = d + e + f$
B) $c = \frac{def}{d+e+f}$
C) $c = \frac{d+e+f}{def}$
D) $c = \frac{def}{de+df+ef}$

149. For the exponential function f, the value of $f(3)$ is k, where k is a constant. Which of the following equivalent forms of the function f shows the value of k as the coefficient or the base?

A) $f(x) = 3(4)(4)^{x+1}$
B) $f(x) = 3{,}072(4)(4)^{x-4}$
C) $f(x) = 12(4)(4)^{x}$
D) $f(x) = 768(4)(4)^{x-3}$

150. A rocket's speed is increasing at a rate of 14.6 meters per second squared. What is the rate in miles per minute squared?
$(1 \text{ mile} = 1{,}609 \text{ meters})$

Answer Key:

1. $22.75, \frac{91}{4}$
2. 2
3. C
4. A
5. D
6. D
7. 11
8. $10{,}800$
9. B
10. $10{,}000$
11. $\frac{95}{97}$
12. D
13. A
14. A
15. D
16. $-\frac{28}{3}, -9.333$
17. D
18. D
19. -86
20. $2{,}197$
21. C
22. C
23. A
24. -336
25. $7{,}500$
26. $\frac{23}{40}, 0.575$
27. $7{,}007$
28. B
29. 4
30. C
31. 173
32. C
33. A
34. D
35. 2
36. D
37. B
38. D
39. 62
40. 120
41. A
42. 17
43. D
44. 369
45. $\frac{19}{24}, 0.792$
46. D
47. 76
48. B
49. $3{,}600$
50. 61.75
51. B
52. A
53. $20.25, \frac{81}{4}$
54. 133
55. C
56. $\frac{1}{77}$
57. 900
58. 136
59. C
60. $\frac{13}{84}, 0.155$
61. D
62. $\frac{27}{16}, 1.686$
63. $2{,}401$
64. -11
65. -113
66. B
67. 16
68. $73{,}728$
69. C
70. B
71. $\frac{29}{4}, 7.25$
72. 22
73. B
74. C
75. D
76. $\frac{1}{4}, 0.25$
77. 10.7
78. A
79. -40
80. 129
81. A

82. -198
83. 34
84. A
85. 6
86. B
87. 24
88. D
89. 37.5
90. D
91. 4
92. 48
93. B
94. $\frac{27}{21}, 1.286$
95. $3{,}900$
96. 354
97. C
98. D
99. B
100. 200
101. $35, 36, 37$
102. D
103. 462
104. B
105. 12
106. B
107. 183
108. D
109. A
110. A
111. C
112. D
113. 35
114. A
115. D
116. 194
117. C
118. C
119. D
120. D
121. $1{,}937$
122. D
123. 196
124. $1{,}932$
125. $48{,}384$
126. D
127. C
128. C
129. 52.5
130. B
131. 9
132. 16
133. 1
134. 102
135. 93
136. B
137. B
138. B
139. 123
140. -131
141. $\frac{10}{3}, 3.333$
142. C
143. $5{,}476$
144. C
145. 14
146. -15
147. B
148. D
149. B
150. 32.67