



Advanced Digital Sat Math Course

**150 Hard Questions For
Students Aiming for 800**

Question 1



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$(x + 7)$ 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 ?

Question 2



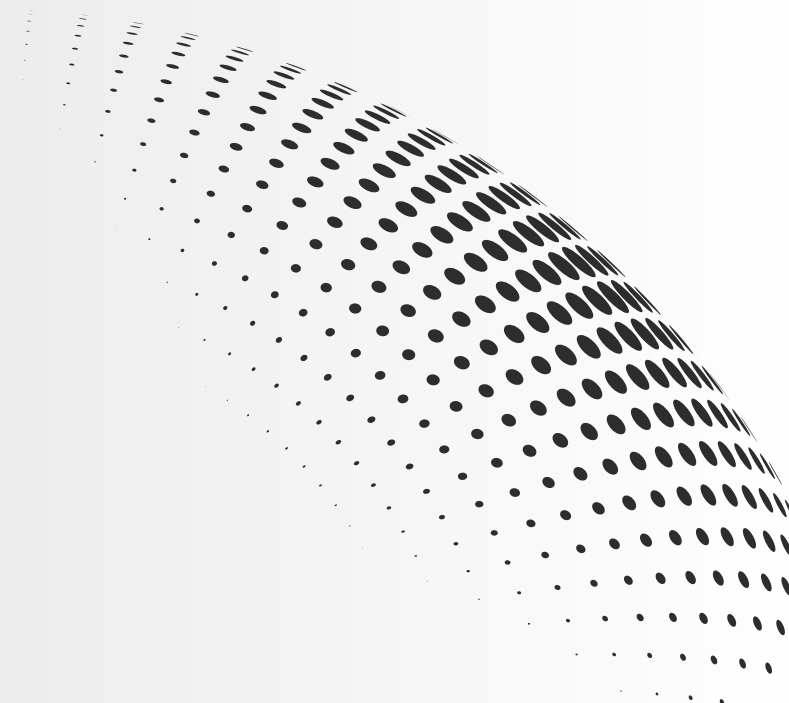
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$$g(x) = ab^{\frac{x}{n}}$$

In the given function, $g(6) = 11$ and $g(9) = 704$, what is the value of $g(11)$?



Question 3



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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) $R(m) = 95mn + 150n$

Question 4



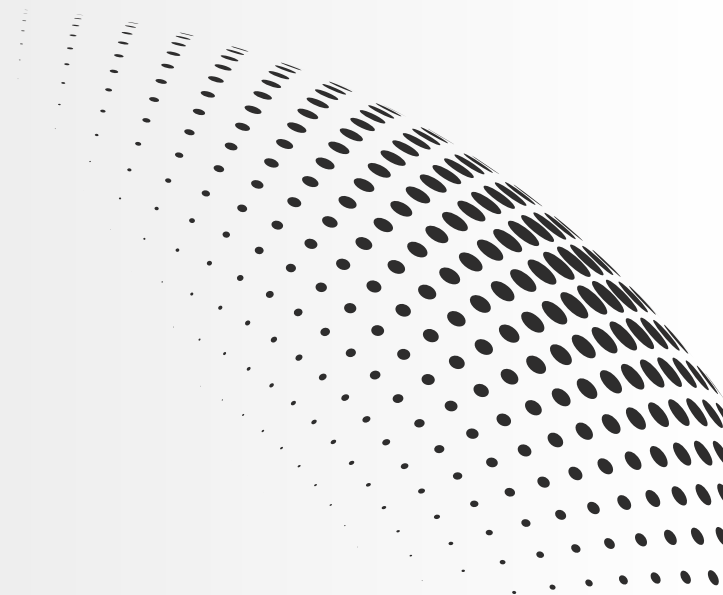
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A rectangle is inscribed in a circle such that the length of the diagonal of the rectangle is twice the length of its shortest side. The area of the circle is $5,929\pi$. What is the area, in square units, of the rectangle?

- A) $77\sqrt{2}$
- B) $77\sqrt{3}$
- C) $5,929\sqrt{2}$
- D) $5,929\sqrt{3}$



Question 5



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

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) $f(x) = -7x + 12$

Question 6



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In triangle ABC and triangle DEF , sides BC and EF each have a side length of 23 inches, and angles C and F each have an angle measure of 43° . Which of the following pieces of information is(are) sufficient to prove whether triangle ABC is congruent to triangle DEF ?

- I. The measures of angles D and E are equal.
- II. The lengths of sides AB and DE 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) II and III are sufficient, but I is not.
- D) III is sufficient, but I and II are not.

Question 7



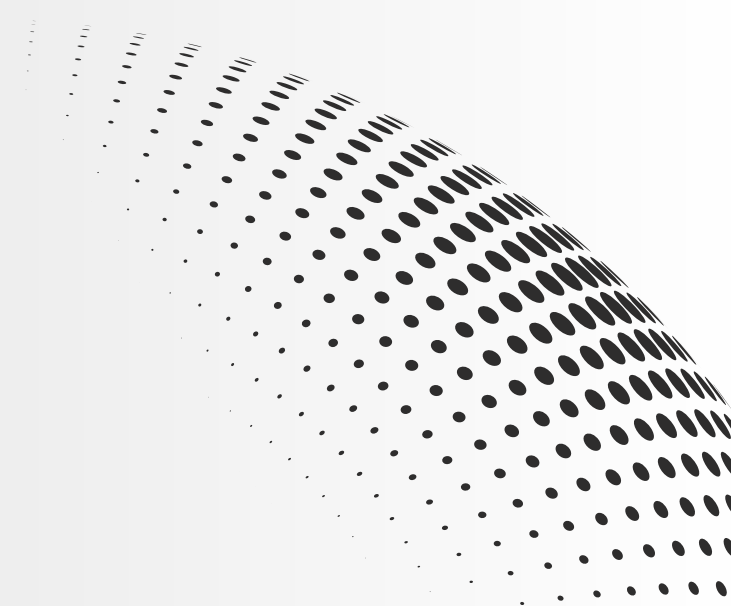
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$$f(x) = a^x - b$$

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



Question 8

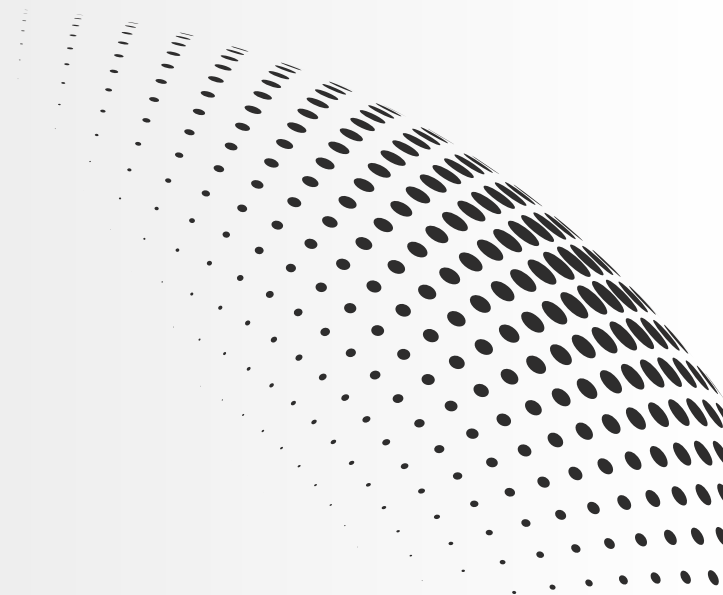


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The speed of object K is 9,525% of the speed of object J , and the speed of object K is 0.025% of the speed of object L . If the speed of object L is $x\%$ of the speed of object J , what is the value of $\frac{x}{1,000}$?



Question 9



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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) $f(x) = 56(4,096)^{\frac{x}{2}}$

Question 10



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In the xy -plane, circle A is the graph of the equation $(x + 14k)^2 + (y + 27k)^2 = 81k^2$, where k is a positive constant. Circle B is obtained by shifting circle A up $13k$ units. Which equation represents circle B ?

- A) $(x + 14k)^2 + (y + 40k)^2 = 81k^2$
- B) $(x + 14k)^2 + (y + 14k)^2 = 81k^2$
- C) $(x + 27k)^2 + (y + 27k)^2 = 81k^2$
- D) $(x - k)^2 + (y + 27k)^2 = 81k^2$

Question 11

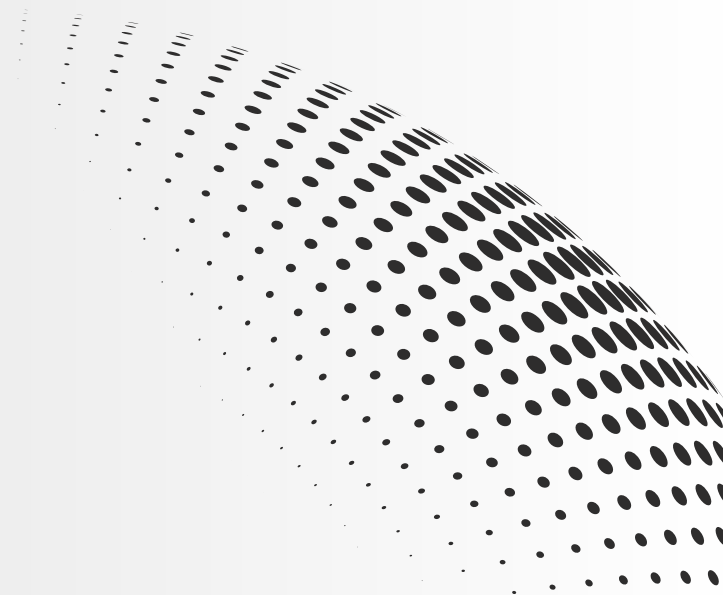


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A polygon has exactly 97 sides. If the measure of each of the 97 interior angles of this polygon is $(180k)^\circ$, what is the value of k ?



Question 12



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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 $(18, 0)$ and $(-11, 0)$. If a is an integer greater than 1, which of the following could be the value of $a + b$?

- A) -12
- B) -6
- C) 7
- D) 14

Question 13



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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) $\frac{1}{7}x = 15y - 19$

Question 14



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$$g(x) = a(1.36)^x$$

The function g is defined by the given equation, where a is a constant. The value of $g(x)$ increases $p\%$ for every increase of x by 1. For which of the following functions, where a is a constant, does the value of $g(x)$ increase by $p\%$ for every increase of x by 5?

- A) $g(x) = a(1.36)^{x-5}$
- B) $g(x) = a(1.36)^{x+5}$
- C) $g(x) = a(1.36^x)^5$
- D) $g(x) = a(1.36^x)^{\frac{1}{5}}$

Question 15



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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

Question 16



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A company conducted a study on the time spent studying per night by students in grades 9, 10, and 11 and their average grade point average. A total of 5,600 students were selected at random from all students in grades 9, 10, and 11 in a large school district in the US. The selected students were asked to report their number of hours studied as less than 1, from 1-3 hours, or more than 3 hours per night. If the results of the study suggest a relationship between the self-reported number of hours studied and students average grade point average, which of the following aspects of the study will prevent these results from being generalized to all students in grades 9, 10, and 11 in the US?

- A) The selected students are not all from the same school in the district.
- B) The number of selected students is too small.
- C) The number of selected students from grades 10 and 11 is greater than grade 9.
- D) The students were not selected at random from all students in grades 9, 10, and 11 in the US.

Question 17



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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) $(\sqrt{11} + 7, \sqrt{14} - 11)$
- D) $(\sqrt{11} - 7, \sqrt{14} + 11)$

Question 18

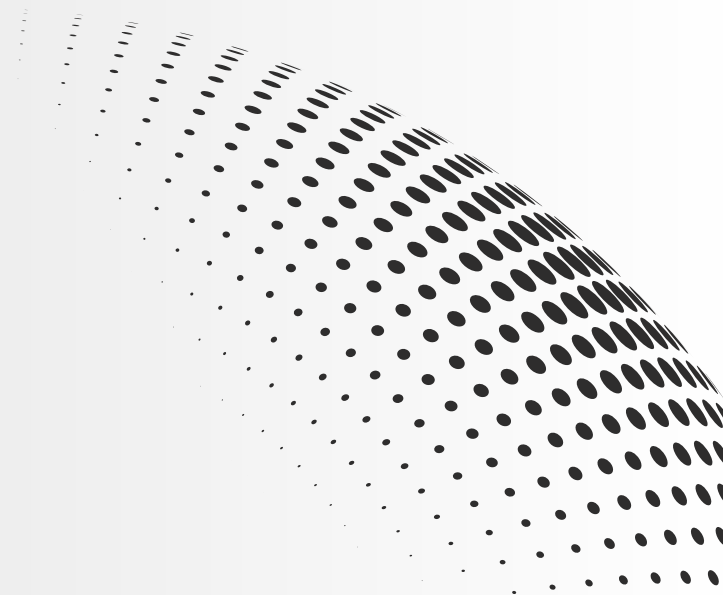


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When the price of a particular product is \$120, no products are sold. As the number of products sold increases by 1, the price decreases by \$2.50. If the total revenue for all products sold was \$1,440, what was the total number of products sold? (revenue = price $\times$ number of products sold)



Question 19

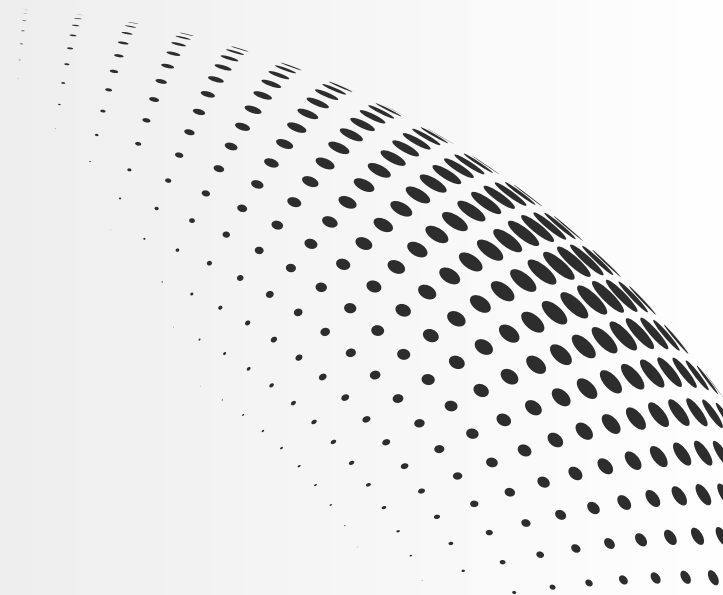


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A circle in the xy -plane has its center at $(3, -7)$ and has a radius of 12. An equation of this circle is $x^2 + y^2 + ax + by + c = 0$, where a , b , and c are constants. What is the value of c ?



Question 20



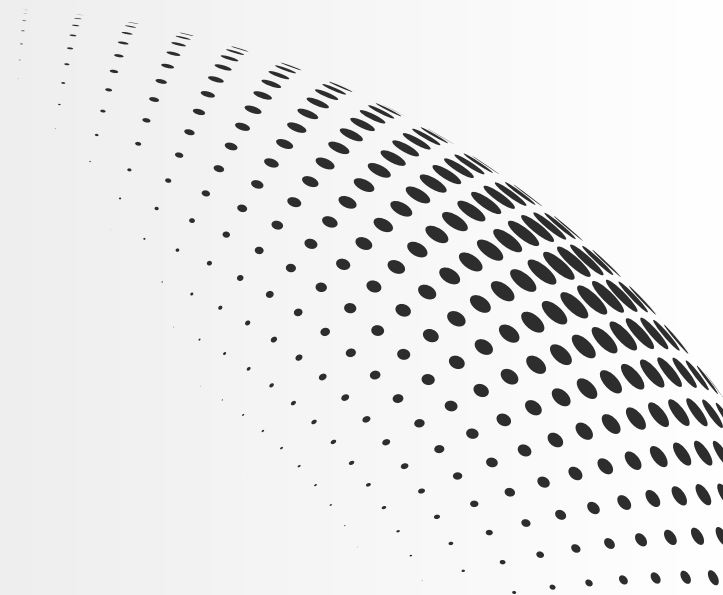
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$$7x(x - 7) = 63$$

One solution to the given equation can be written as $x = \frac{a + \sqrt{b}}{2}$, where a and b are positive integers. What is the value of ab ?



Question 21



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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) $c = 79\left(\frac{k}{24}\right)$
- D) $c = 79\left(\frac{k}{96}\right)$

Question 22



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$$77(x - k) = 77y + 77k$$

One of the equations in a system of two linear equations is given, where k is a positive constant. The system has no solution. Which equation could be the second equation in this system?

- A) $11x + 11y = 11k$
- B) $11x + 11y = 22k$
- C) $11x - 11y = 11k$
- D) $11x - 11y = 22k$

Question 23



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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.

Question 24

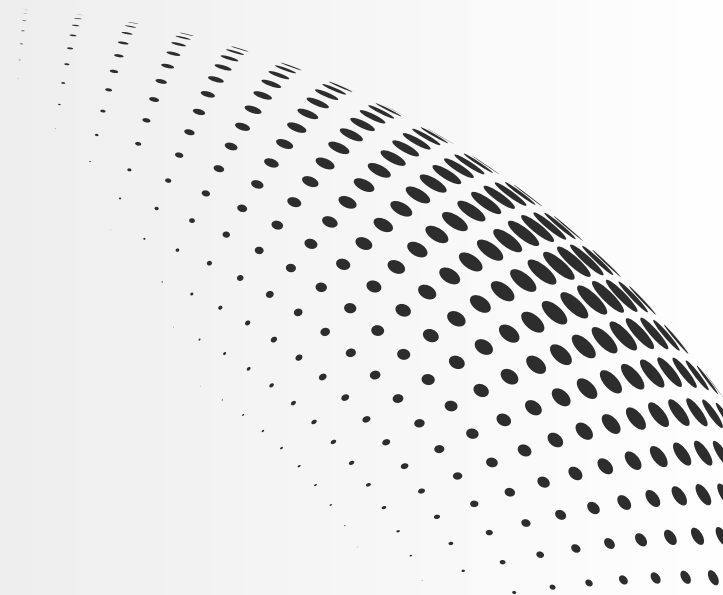


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Substance D is made up of substances A , B , and C . The total mass of substance B is 621.6 grams, which makes up 42% of substance D . Of the remaining mass of substance D , 60% was substance A , and the remainder was substance C . Based on this information, how many grams of substance D is substance C ?



Question 25

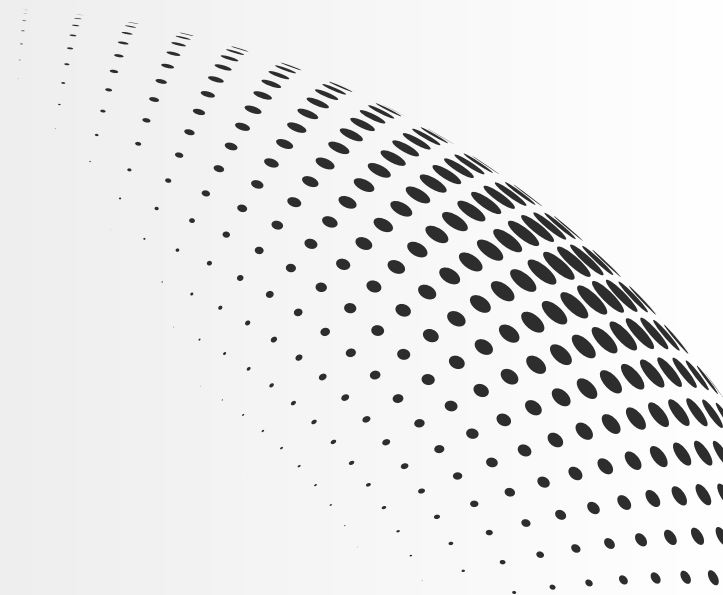


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684 is $p\%$ greater than 9. What is the value of p ?



Question 26



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The function g is defined by $g(x) = a\sqrt{b-x}$, where a and b are constants. In the xy -plane, the graph of $y = g(x)$ passes through the point $(36, 0)$ and $f(16) < 0$. Which of the following must be true?

- A) $a > 0$
- B) $b < 0$
- C) $a < b$
- D) $f(0) = 36$

Question 27



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

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

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

Question 28

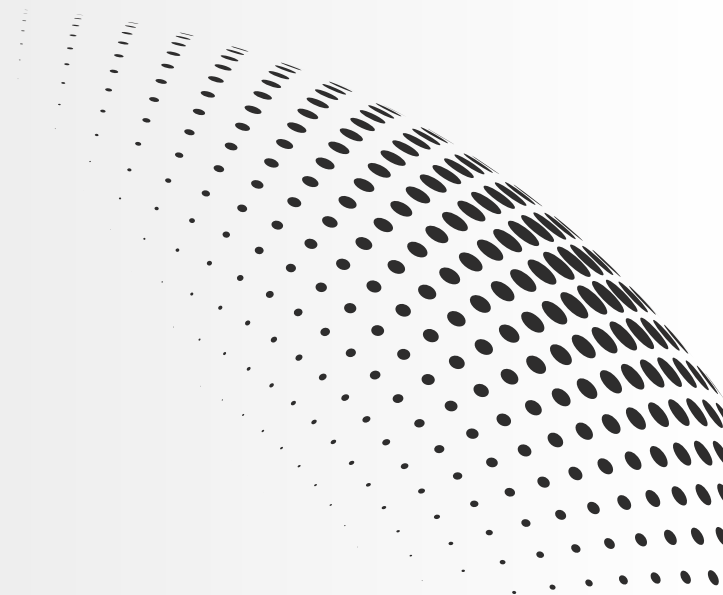


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The positive number k is 3,700% of the number j , and j is 12.5% of the number m . If $k - m = aj$, what is the value of a ?



Question 29

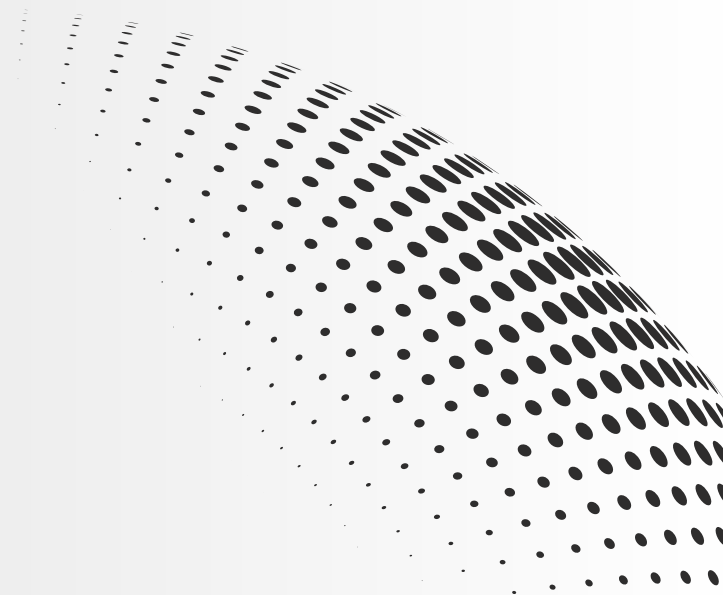


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How many liters of a 30% chlorine solution must be added to 12 liters of a 10% chlorine solution to obtain a 15% chlorine solution?



Question 30

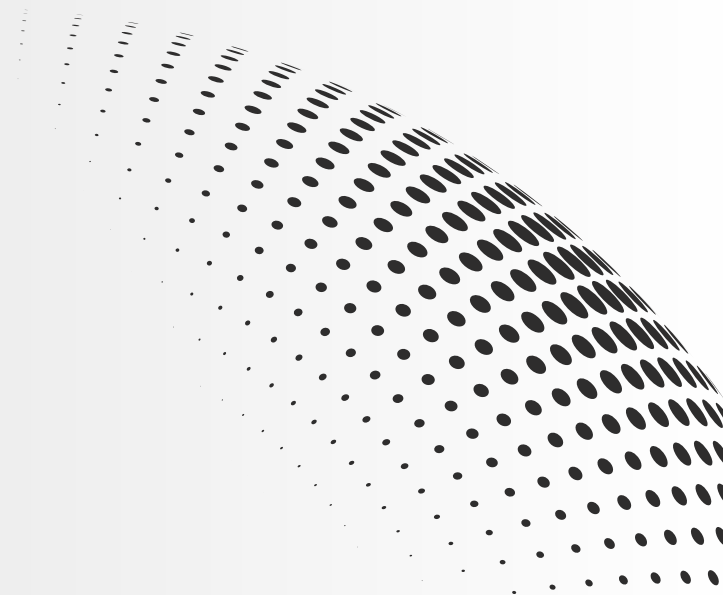


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A circle in the xy -plane has its center at $(-5, -7)$. Line a is tangent to this circle at $(-13, -4)$.
What is the slope of line a ?



Question 31

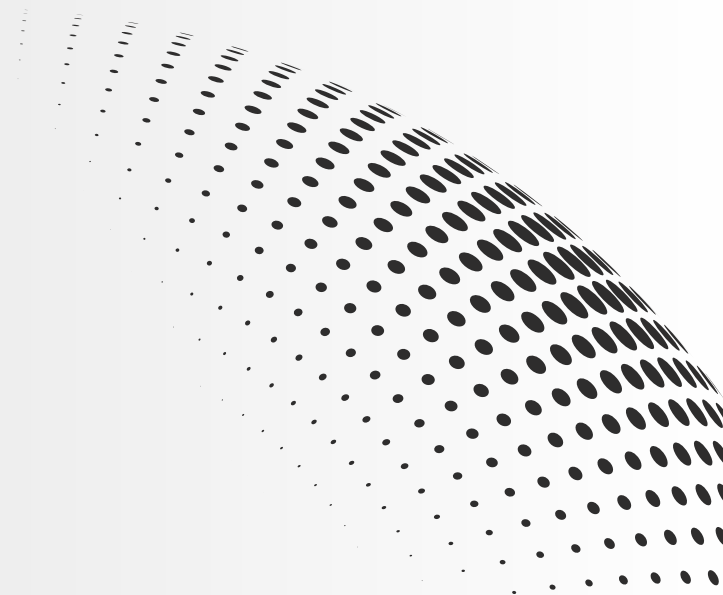


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Two data Sets A and B have 56 values in total. The average of the two data sets is 193. Data set A contains 32 values with an average of 208. What is the average of data set B ?



Question 32



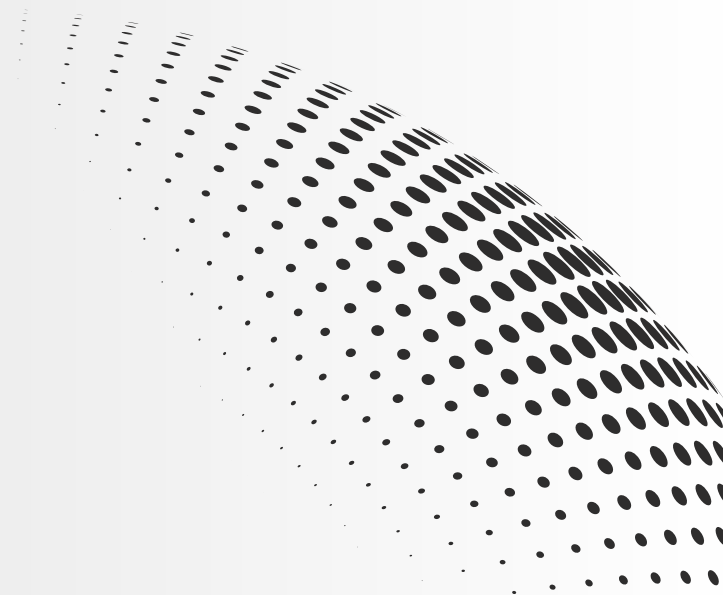
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$$x(kx - 72) = -8$$

In the given equation, k is an integer constant. If the equation has no real solution, what is the least possible value of k ?



Question 33



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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.

Question 34

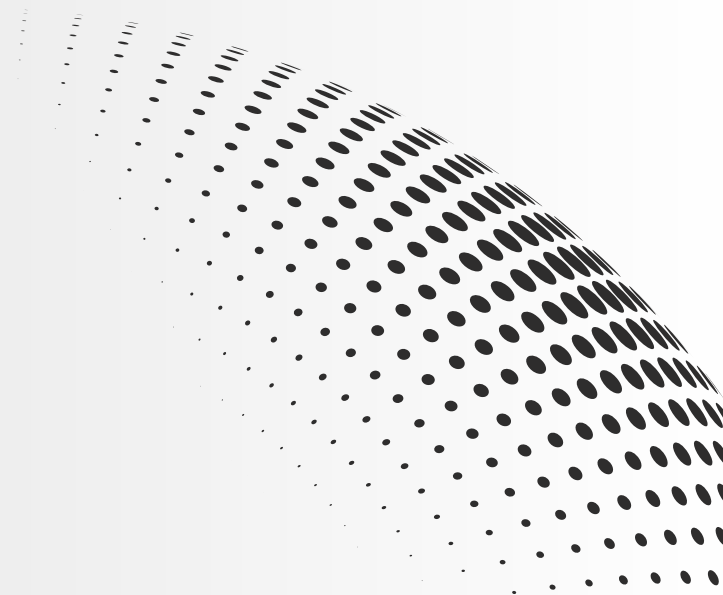


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A business analyst is developing a model to set the selling price of a product. The analyst determined that for a selling price of \$260, zero products would be sold. For each \$4 decrease in the selling price, the number of products sold would increase by one. For a revenue of \$3,600, what is a possible number of products that could be sold? (revenue = price $\times$ number of products sold)



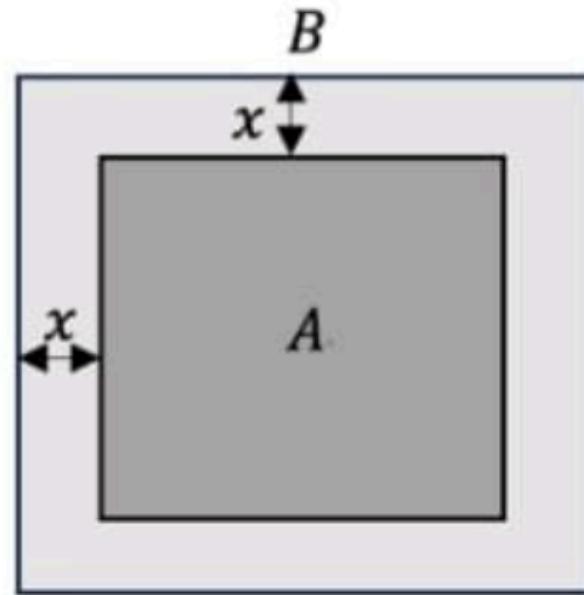
Question 35



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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 ?



Question 36



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Point K lies on a unit circle in the xy -plane and has coordinates $(1, 0)$. Point O is the center of the circle and has coordinates $(0, 0)$. Point J also lies on the unit circle and the measure of angle KOJ is $\frac{478\pi}{3}$ radians. If the coordinates of point J are (a, b) , where a and b are constants, what is the value of b ?

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

Question 37



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A 34 pound dog eats two types of canned food: Greg's feed and John's feed. The recommended amount of the Greg's feed is 1.25 scoops per 16 pounds a dog weighs per day. The recommend amount of John's feed is 0.85 cans per 23 pounds a dog weighs per day. If g is the number of scoops of Greg's feed and j is the number of scoops of John's feed a 34 pound dog eats in a given day. Which equation describes all possible values of g and j ?

- A) $\frac{1.25}{16}g + \frac{0.85}{23}j = 34$
- B) $\frac{16}{1.25}g + \frac{23}{0.85}j = 34$
- C) $\frac{1.25}{16}j + \frac{0.85}{23}g = 34$
- D) $\frac{16}{1.25}j + \frac{23}{0.85}g = 34$

Question 38

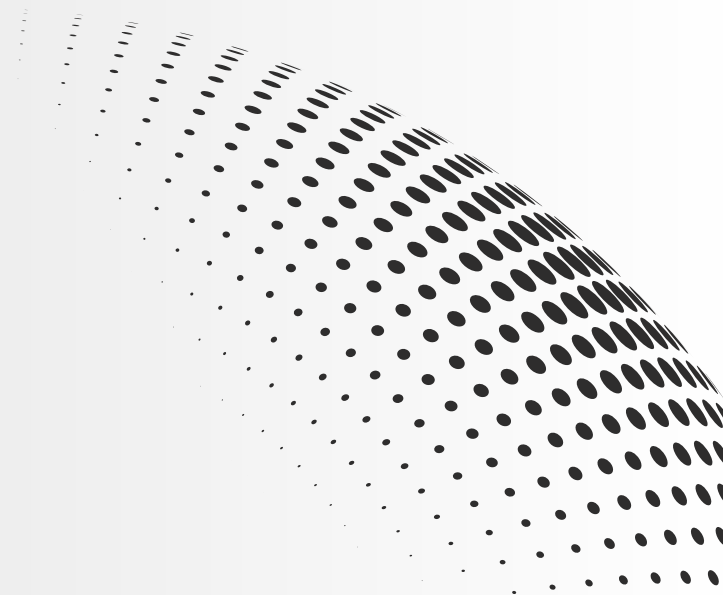


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Line a is defined by $7x + 8y = 96$. Line a is parallel to line b . An equation of line b is $42x = ky - 96$, where k is a constant. What is the y -intercept of line b ?



Question 39



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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?

Question 40

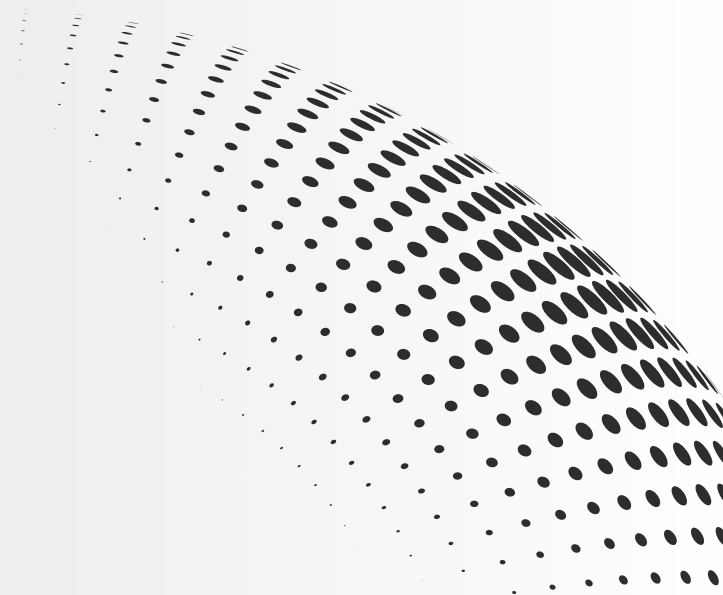


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The exponential function g is defined by $g(x) = ab^x$, where a and b are positive constants. If $g(k - 1) = g(k) + \frac{18}{100}g(k - 1)$, where k is a constant, what is the value of b ?

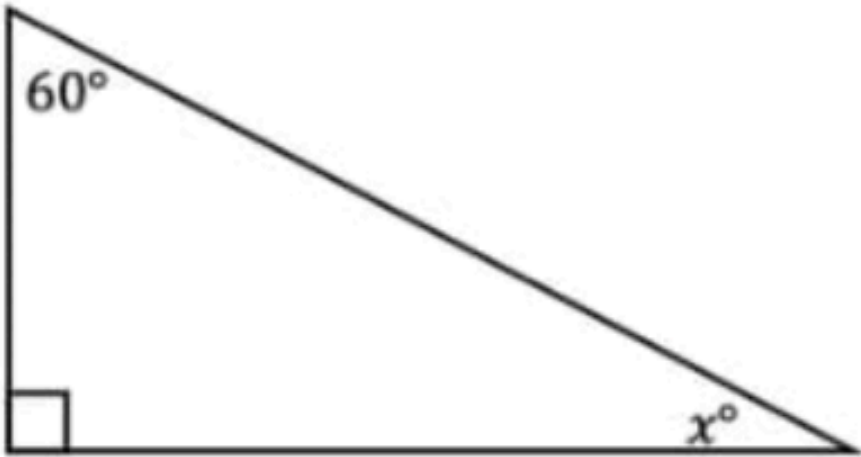


Question 41



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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

Question 42



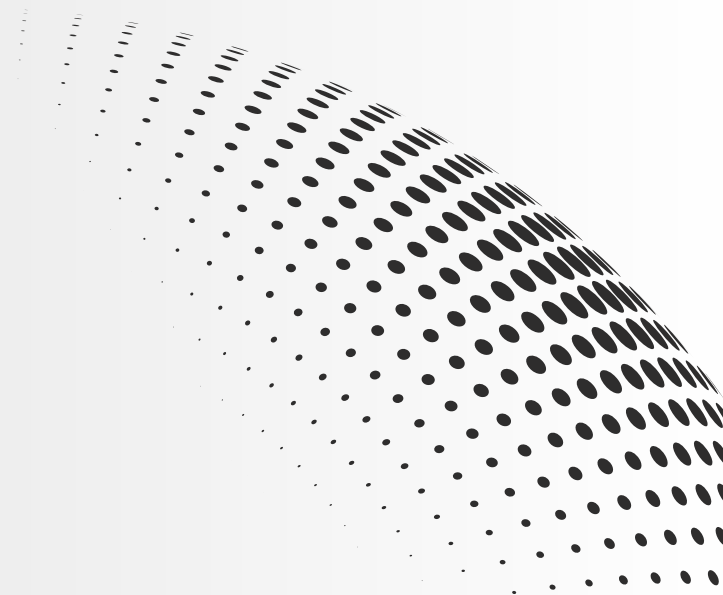
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Which of the following expressions has a factor of $x + 3k$, where k is a positive integer constant?

- A) $4x^2 + 9x + 27k$
- B) $4x^2 + 15x + 27k$
- C) $4x^2 + 27x + 27k$
- D) $4x^2 + 45x + 27k$



Question 43



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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

Question 44



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At a depth of x meters below the surface, the estimated total pressure P_1 , in millibars, a submarine experiences is given by $P_1 = 1,013x + 12,000$. After the submarine descends a certain depth, k , it descends h additional meters. The estimated total pressure P_2 , in millibars, the submarine experiences after descending k additional meters is given by $P_2 = 1,013h + 721,100$. Which of the following is the best interpretation of 721,100 in this context?

- A) The estimated total pressure in millibars the submarine experienced after the submarine began to descend k additional meters.
- B) The estimated increase in millibars the submarine experienced at a depth of h meters.
- C) The estimated total pressure in millibars the submarine experienced when the submarine began to descend h additional meters.
- D) The estimated increase in millibars the submarine experienced for each increase in depth by h meters.

Question 45

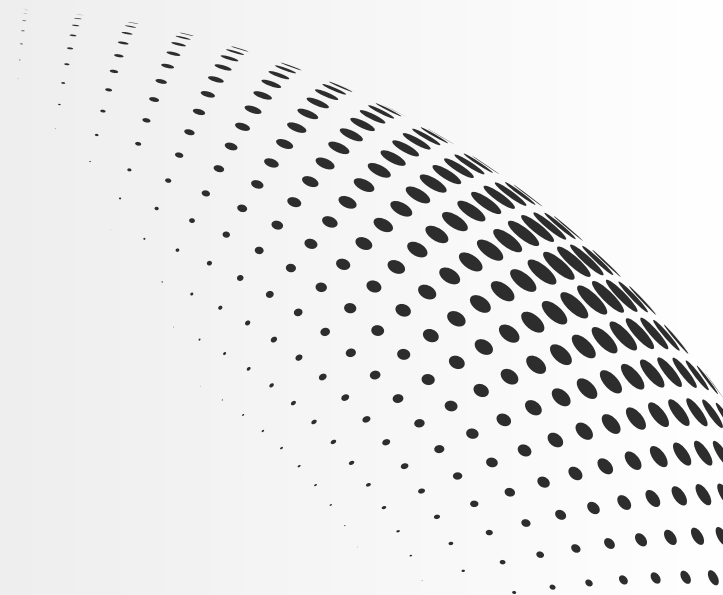


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$n^{\frac{5}{3}} = k^{\frac{2}{5}}$ and $n^{4a+1} = k$, what is the value of a ?



Question 46

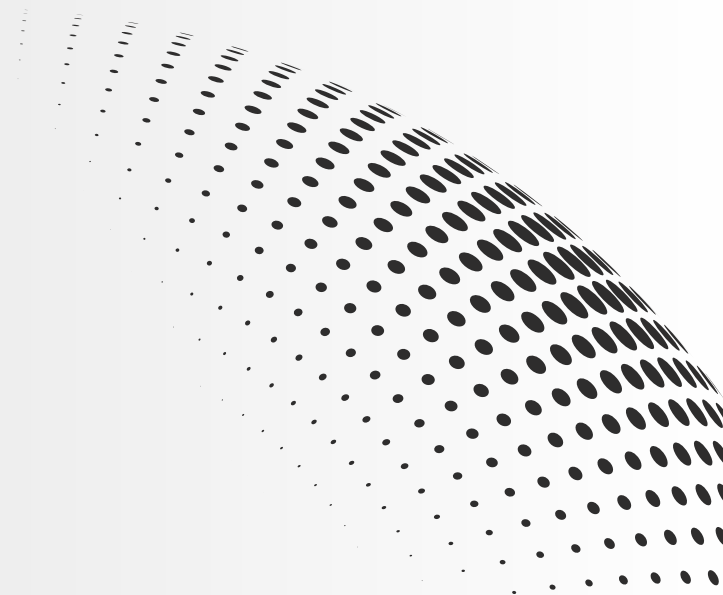


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The function f is defined by $f(x) = a(2.5)^x$. For any positive integer n , the value of $f(n - 1)$ is $p\%$ of the value of $f(n)$. What is the value of p ?



Question 47

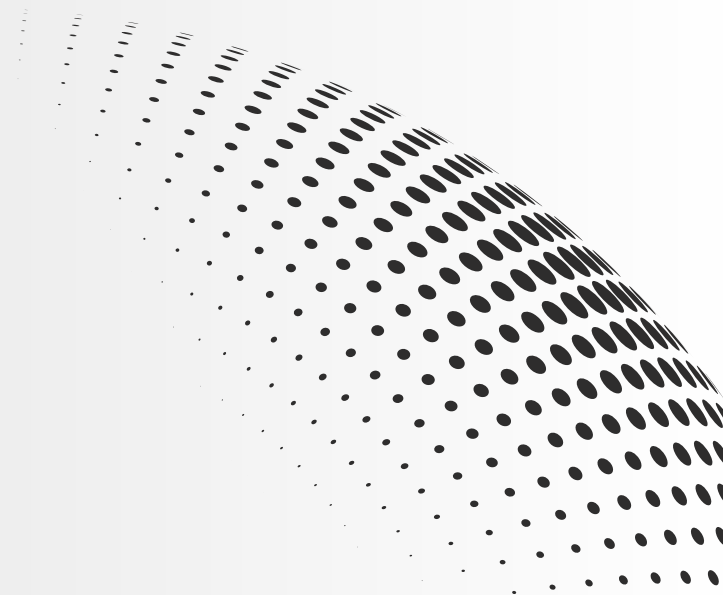


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The perimeter of a right isosceles triangle is $76 + 76\sqrt{2}$. What is the length of the hypotenuse?



Question 48



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A bakery makes 9-inch, 12-inch, and 14-inch pies. During a certain day, the number of 14-inch pies the bakery makes is 4 times the number n of 12-inch pies, and the number of 9-inch pies is 48. During this day, the bakery makes 190 pies in total. Which equation represents this situation?

- A) $9(48) + 12n + 14(4n) = 190$
- B) $9n + 12n + 14n = 190$
- C) $4n + 48 = 190$
- D) $5n + 48 = 190$

Question 49

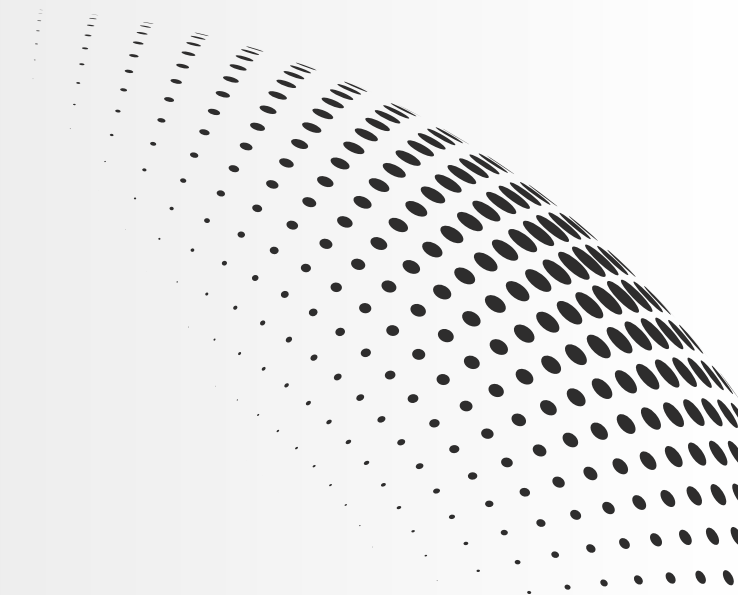


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360 is $p\%$ of 10. What is the value of p ?



Question 50

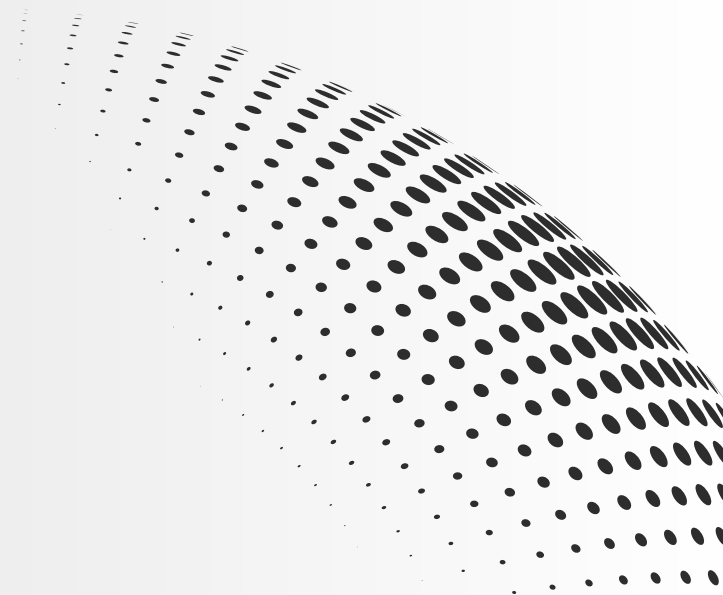


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The speed of object A is 764% greater than the speed of object B , and the speed of object A is 0.96% of the speed of object C . If the speed of object C is $p\%$ of the speed of object B , what is the value of p ?



Question 51



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$$-377x + k = 377x + k$$

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

Question 52

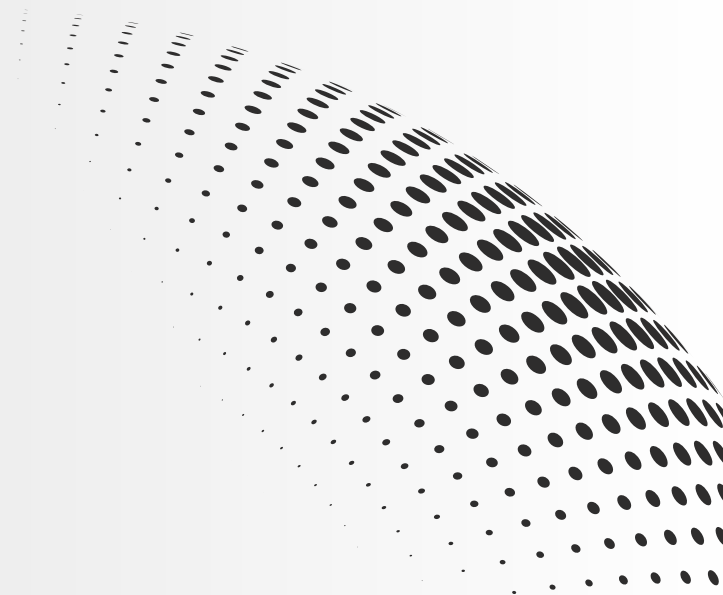


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A right square pyramid has a surface area of 51,984 square centimeters, which includes a base area of 23,104 square centimeters. What is the slant height, in centimeters, of this pyramid?



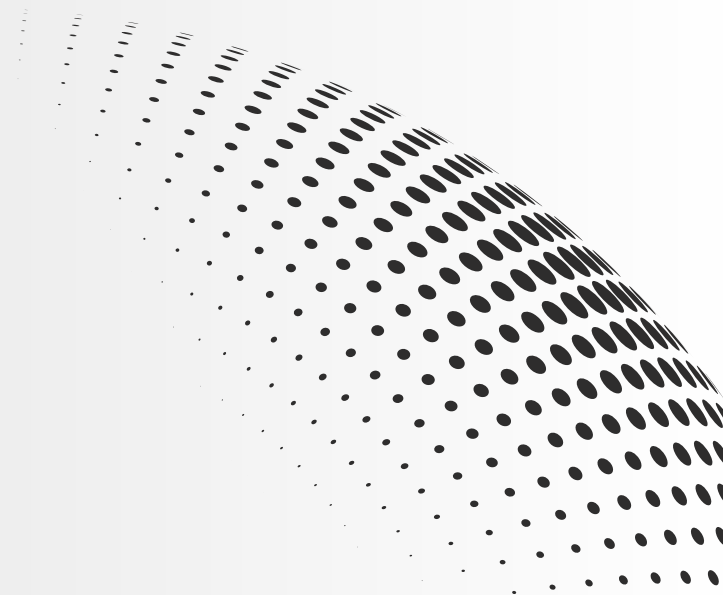
Question 53



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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 ?



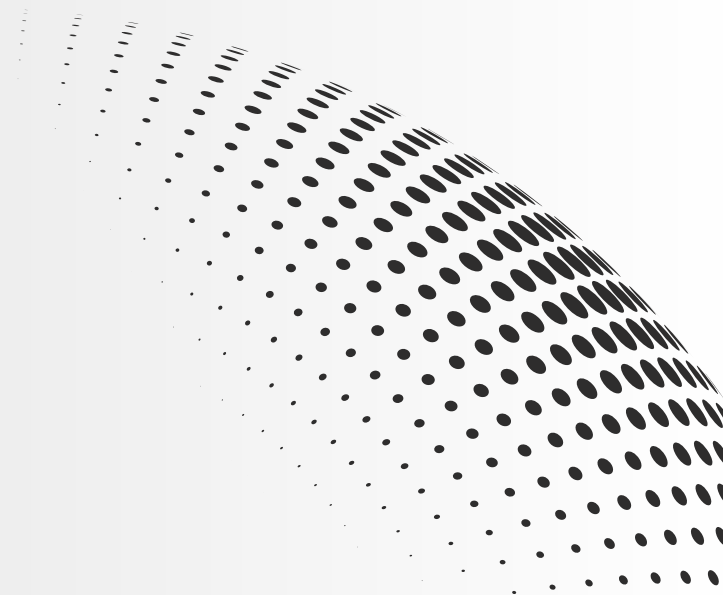
Question 54



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For the positive quantities, a , b , and c , 78% of c is equivalent to 0.096% of b , and b is equivalent to 250% of a . What percentage of c is a ?



Question 55



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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.

Question 56



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For triangle ABC and triangle DEF , angle A and D each measure 45° , $BC = 36$ and $EF = 54$. Which additional piece(s) of information is(are) sufficient to prove that triangle ABC is similar to triangle DEF ?

- I. The length of $\overline{AB}$ is $\frac{2}{3}$ the length of $\overline{DE}$
- II. The length of $\overline{AC}$ is $\frac{2}{3}$ the length of $\overline{DF}$

- 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.

Question 57

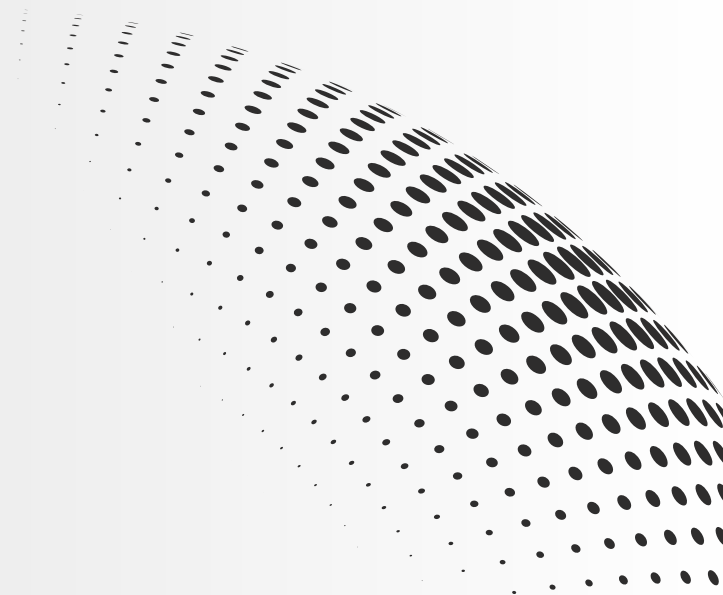


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The number j is 2,400% greater than the number k . The number k is 350% greater than 8. What is the value of j ?



Question 58



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$$f(x) = 14,000(1.007)^{4x}$$

The given function f models the balance of a bank account, in dollars, x years after it is opened. Which statement is the best interpretation of $(1.007)^{4x}$?

- A) Every 3 months, the balance increases by about 7% of the balance at the beginning of the 3-month interval.
- B) Every 3 years, the balance increases by about 7% of the balance at the beginning of the 3-year interval.
- C) Every 3 months, the balance increases by about 0.7% of the balance at the beginning of the 3-month interval.
- D) Every 3 years, the balance increases by about 0.7% of the balance at the beginning of the 3-year interval.

Question 59



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

Question 60

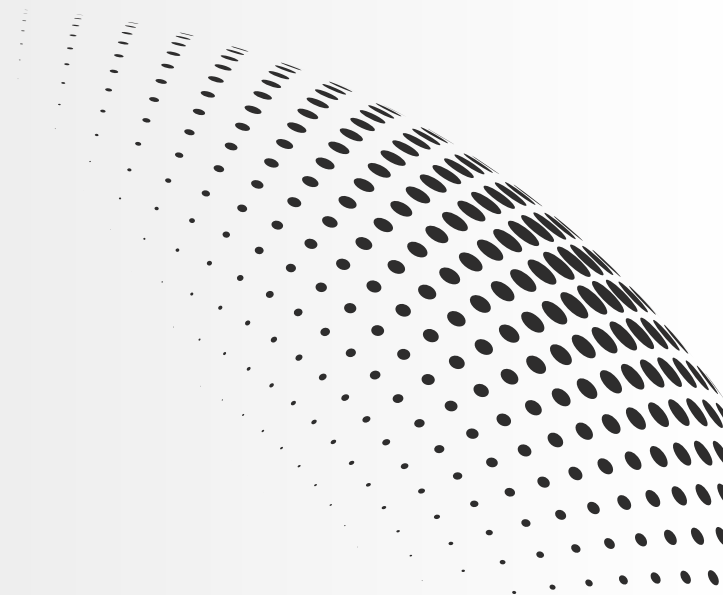


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If $x \geq -13$ represents all solutions to the inequality $ax - 75 \leq 42$, where a is a constant, what is the greatest possible value of a ?



Question 61



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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) $f(x) = 59,049(3)^{x-2}$

Question 62

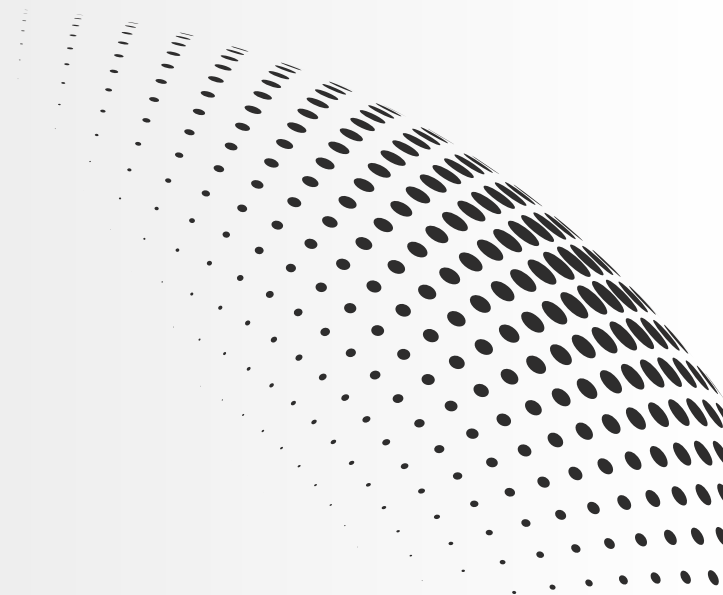


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The expression $0.0004x$ represents the result of decreasing a positive quantity x by $p\%$. What is the value of p ?



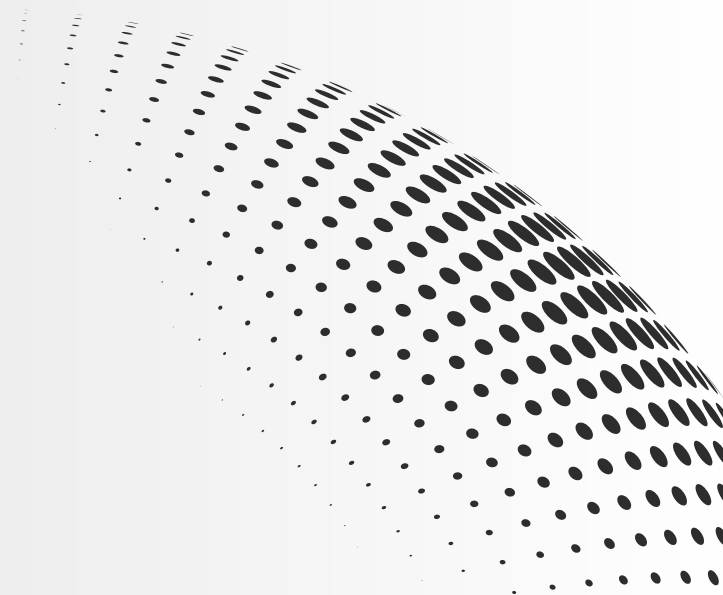
Question 63



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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 ?



Question 64



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$$\frac{1}{k} + \frac{x}{118} = \frac{1}{kx}$$

In the given equation, k is an integer constant. If the equation has no solutions, what is the greatest possible value of k ?

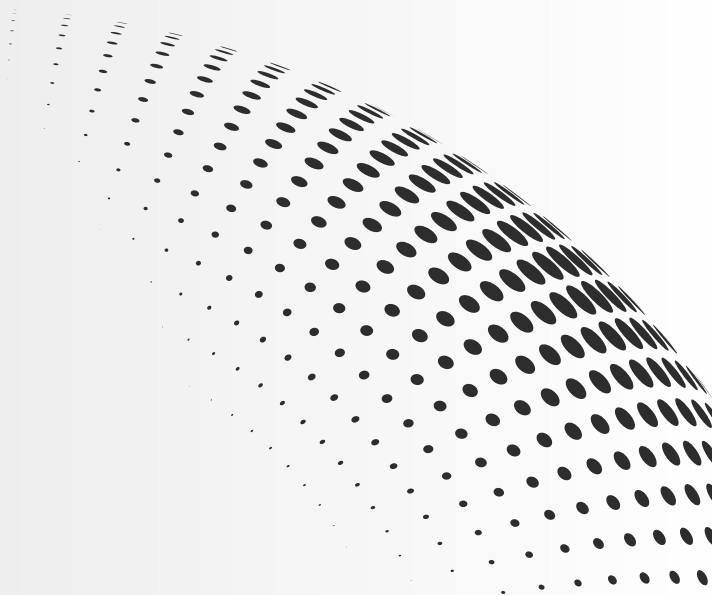
Question 65



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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?



Question 66



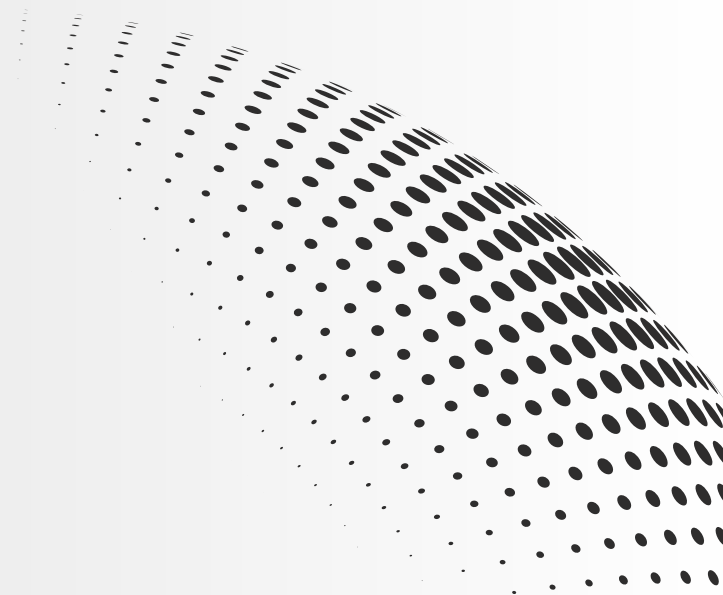
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$$-4x^2 + bx - 34 = x^2$$

In the given equation, b is a positive integer. The equation has no real solution. What is the largest possible value of b ?



Question 67

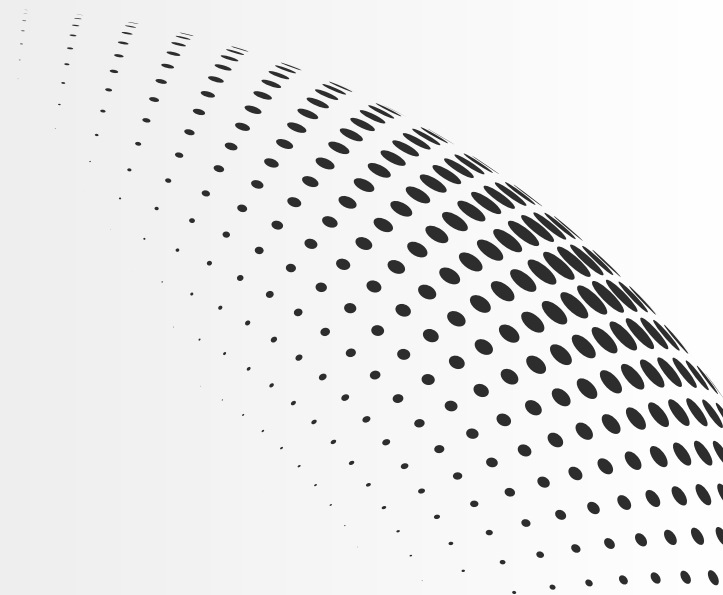


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There are red, blue, green, and black marbles in a bag. There are 26 black marbles, 8 green marbles, and 26 blue and red marbles. Given that a randomly selected marble is not black, the probability of selecting a red marble is $\frac{5}{17}$. What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



Question 68



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An architectural model of a square campus has a side length of 405 inches, and 1 inch on the model is equal to an actual distance of 270 feet. A smaller version of the same campus is constructed with the side length of the square 65% shorter than the side length of the previous model. On the smaller model, which of the following is closest to the actual distance, in feet, represented by 1 inch?

- A) 94.5
- B) 175.5
- C) 415.38
- D) 771.43

Question 69



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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) $(-k - 21, -j - 20)$

Question 70

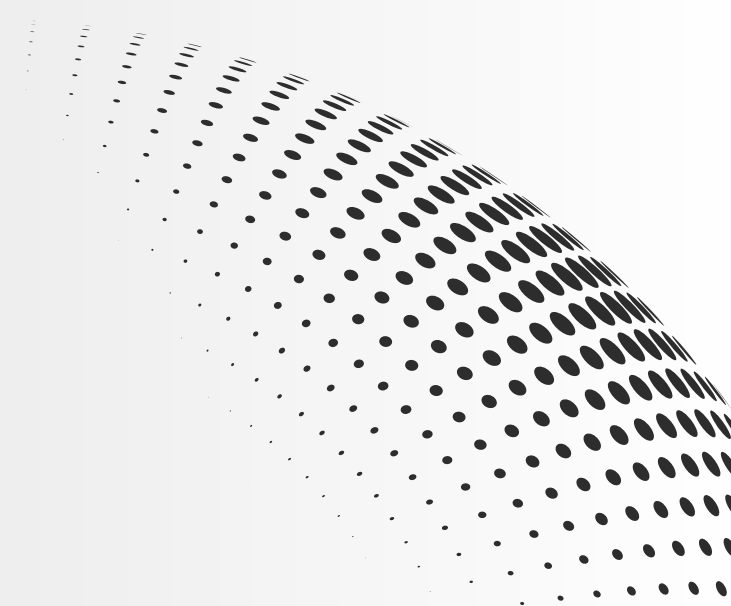


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The expression $6x^4 + 35x^2 + 11$ can be rewritten as $(3x^2 + j)(2x^2 + k)$, where j and k are positive integers, or as $(3x^2 + l)(2x^2 + m)$, where l and m are positive nonintegers, what is the value of $k + l$?



Question 71

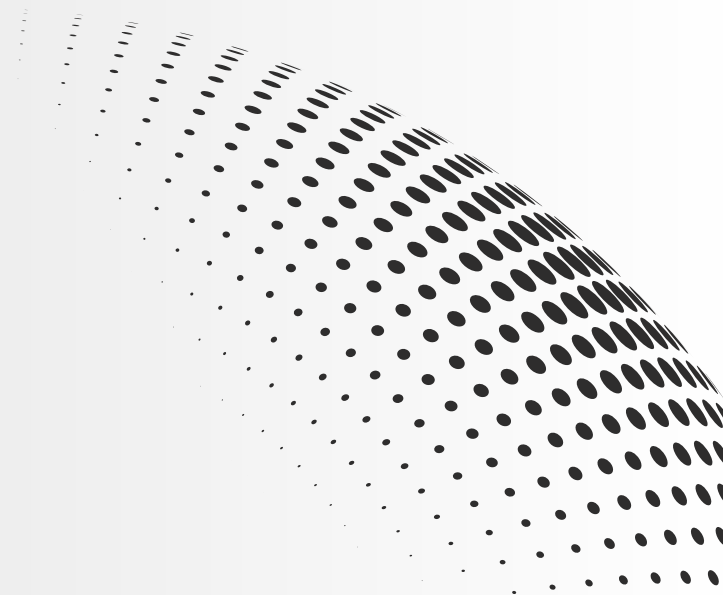


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A table that weighs 348 pounds puts equal amounts of pressure on each of its 4 identical legs. If the pressure that each leg exerts on the floor is 12 pounds per square inch, what is the area, in square inches, of the bottom of each leg that is touching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



Question 72

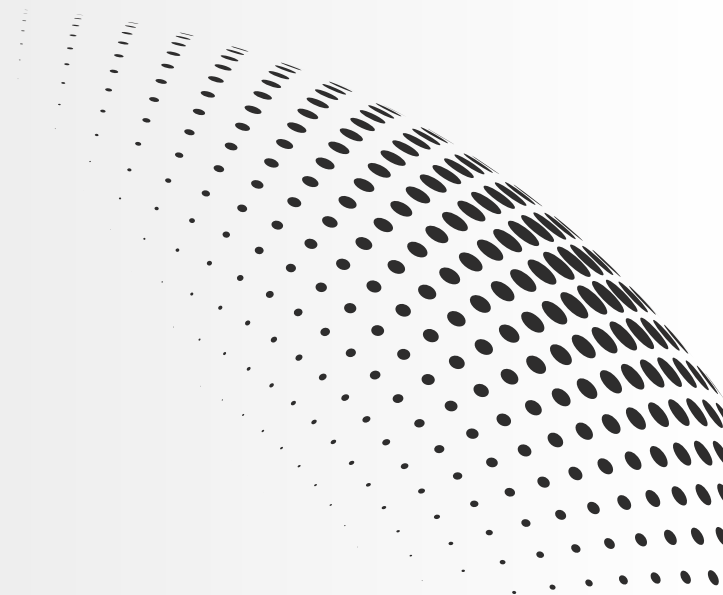


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The perimeter of an equilateral triangle is 954 inches. The three vertices of the triangle lie on a circle. The radius of the circle is $k\sqrt{3}$ inches. What is the value of k ?



Question 73



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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

Question 74



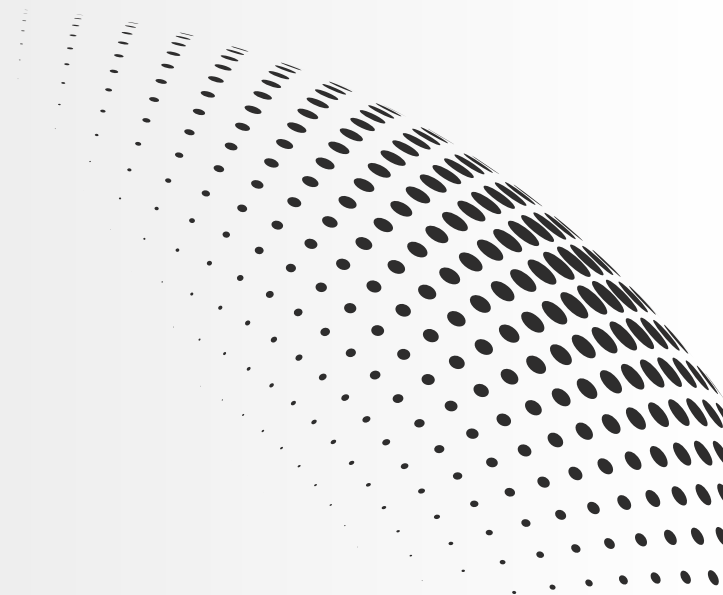
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$$\frac{14x + 35}{4} - \frac{b}{12} = a(x - 7)$$

In the given equation, a and b are constants. If the equation has infinitely many solutions, what is the value of b ?



Question 75



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The function f is defined by $f(x) = 3^x$. The function g is an 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) $a < x < b$

Question 76



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$$\begin{aligned}9x + 5y &= 7 \\45x + 25y &= 35\end{aligned}$$

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) $\left(\frac{r}{5} + 7, -\frac{r}{5} + 35\right)$
- B) $\left(-\frac{5r}{9} + \frac{7}{9}, r\right)$
- C) $\left(r, \frac{9r}{5} + \frac{7}{5}\right)$
- D) $\left(r, -\frac{5r}{9} + \frac{7}{9}\right)$

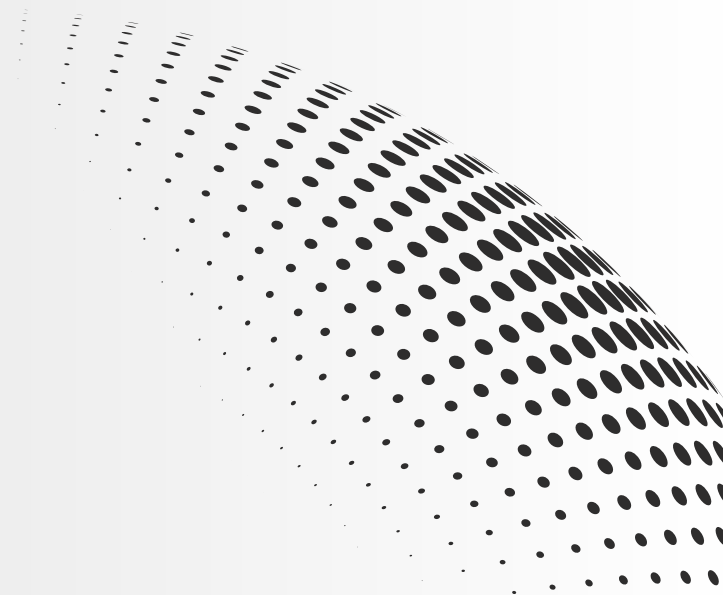
Question 77



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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.)



Question 78



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A right square pyramid has a height of 13 inches. A second right square pyramid has a height 39 inches. The area of the bases of the two pyramids is 400 square inches. Which of the following is closest to the difference in surface area of the second pyramid and the surface area of the first pyramid, in square inches, rounded to the nearest integer?

Question 79

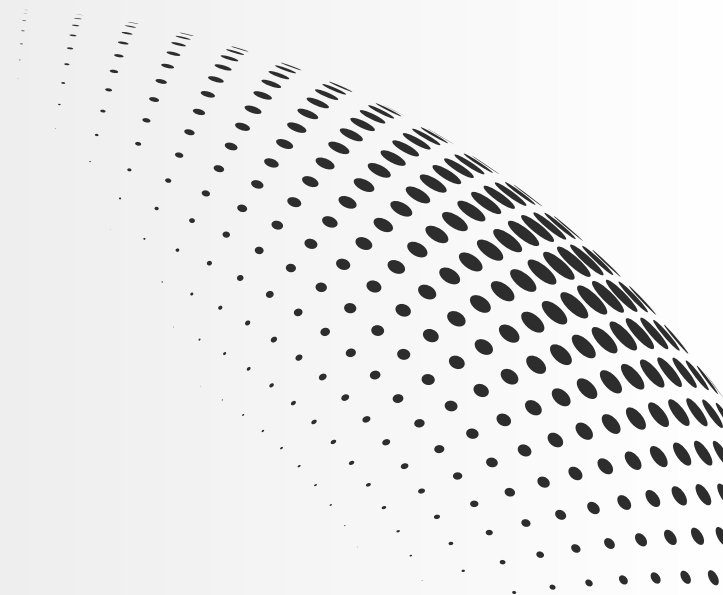


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The graph of the quadratic function $y = f(x)$ in the xy -plane intersects the x -axis when $x = 74$ and $x = k$, where k is a constant. The maximum value of $y = f(x)$ occurs at the point $(17, m)$, where m is a constant. What is the value of k ?



Question 80

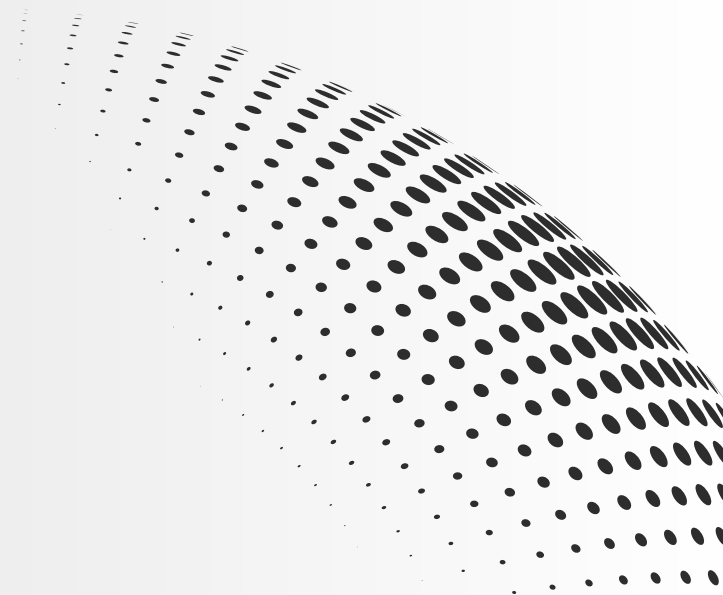


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The function f is defined by $f(x) = (x + 19)(k - x)(x + 8)$, where k is a constant. In the xy -plane, the graph of $y = f(x)$ passes through the point $(32, 0)$. What is the value of $f(0)$?



Question 81



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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) $120\sqrt{3}$

Question 82



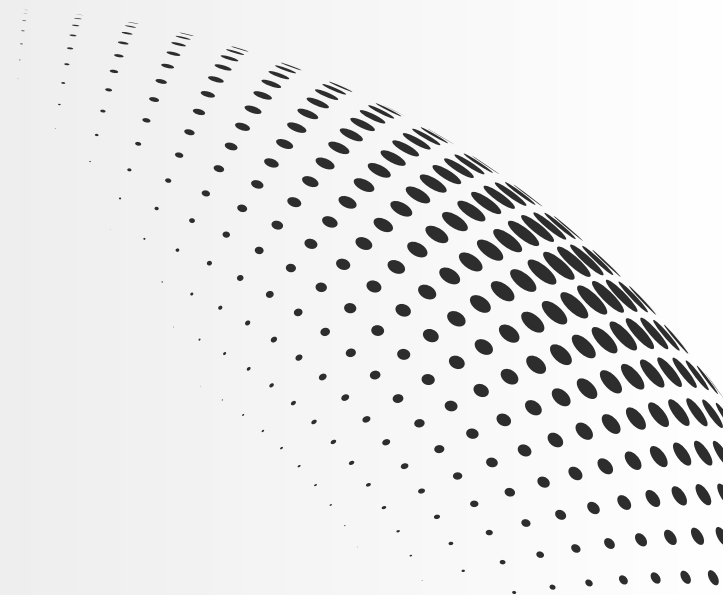
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$$2x^2 - 16x - 19 = 0$$

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



Question 83

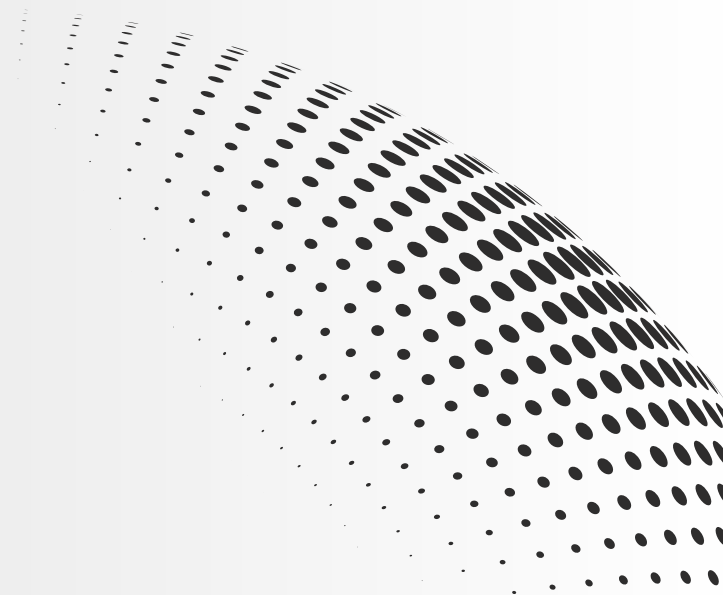


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A rectangular area consists of 3,179 equal squares where each square has an area of k . If the length of the rectangular area is 2.75 times the width and the width is equal to $x\sqrt{k}$, what is the value of x ?



Question 84



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A petri dish had x number of bacteria. A month later the number of bacteria increased by 17,456%. What is the resulting number of bacteria on the petri dish in terms of x ?

- A) $17.456x$
- B) $174.56x$
- C) $175.56x$
- D) $17,456x$

Question 85



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$$f(x) = x^2 + 5x - 6$$

$$g(x) = x^2 + 2x - 35$$

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 ?

Question 86



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On average, a certain weed grows 63 centimeters every m months. At this rate, which expression represents the number of centimeters, on average, the weed grows every t years?

- A) $\frac{21m}{4t}$
B) $\frac{21t}{4m}$
C) $\frac{756m}{t}$
D) $\frac{756t}{m}$

Question 87

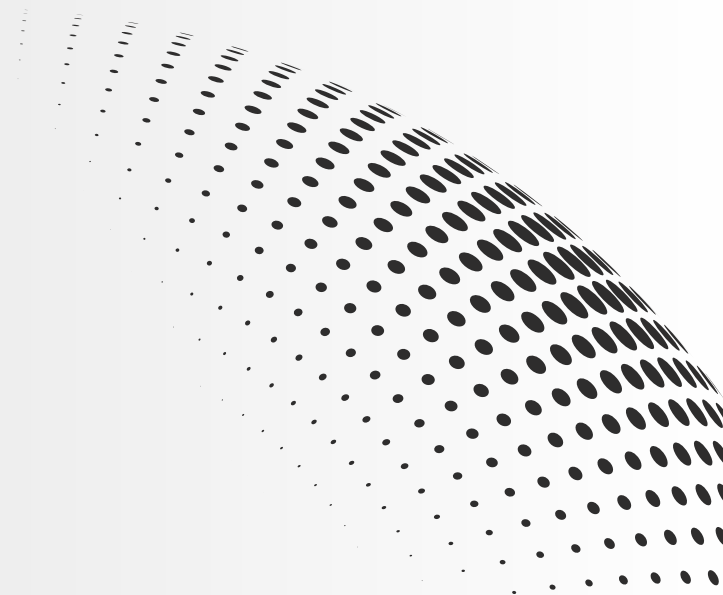


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For the given parabola $ax^2 + bx + c$, a , b , and c are constants. The x -intercepts of the parabola are at $(14, 0)$ and $(k, 0)$. If $f(27) = f(11)$, what is the value of k ?



Question 88

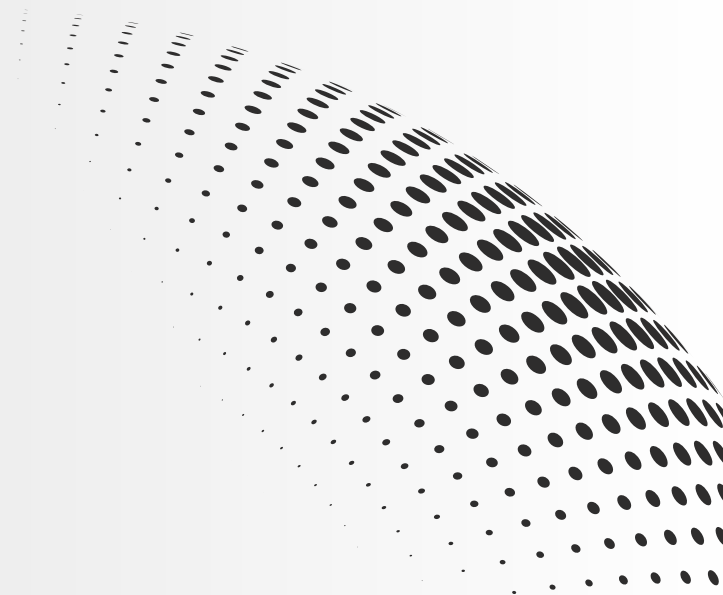


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A line intersects two parallel lines, forming four obtuse and four acute angles. The measure of one of the obtuse angles is $(-6x + 380)^\circ$. The sum of the measures of two of the acute angles and one of the obtuse angles is $(ax - k)^\circ$, where a and k are both positive constants. What is the value of $a + k$?



Question 89

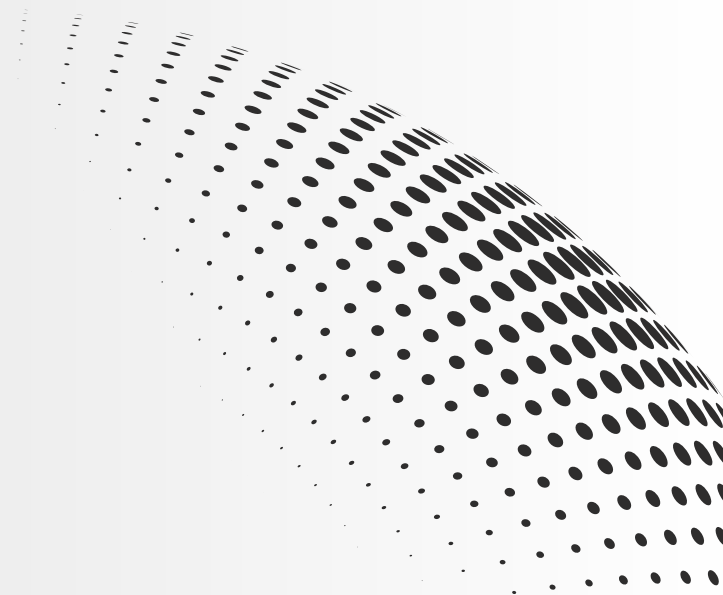


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A 100 gram metal alloy is 40% silver. It contains a metal alloy that is 65% silver and a second metal alloy made up of 25% silver. What is the mass of the first metal alloy?



Question 90

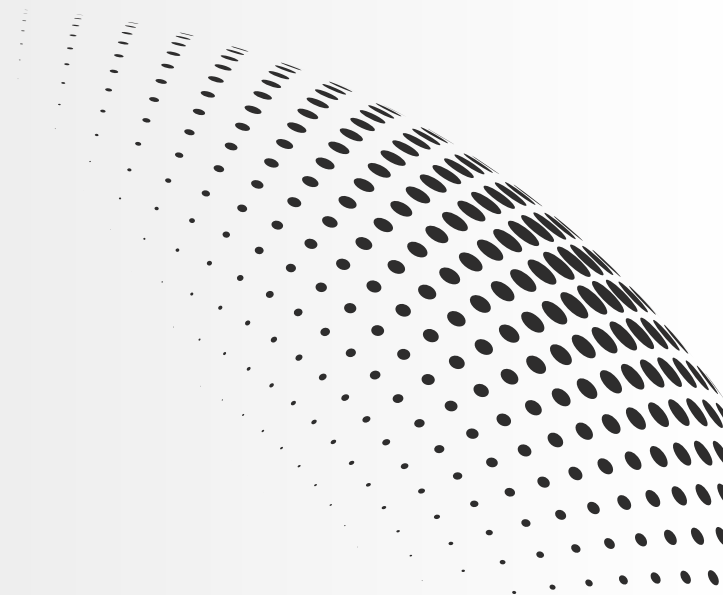


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The function f is defined by $f(x) = \frac{2x-8}{(x+7)(x-3)}$. If $f(k+6) = 0$, where k is a constant, what is the value of k ?



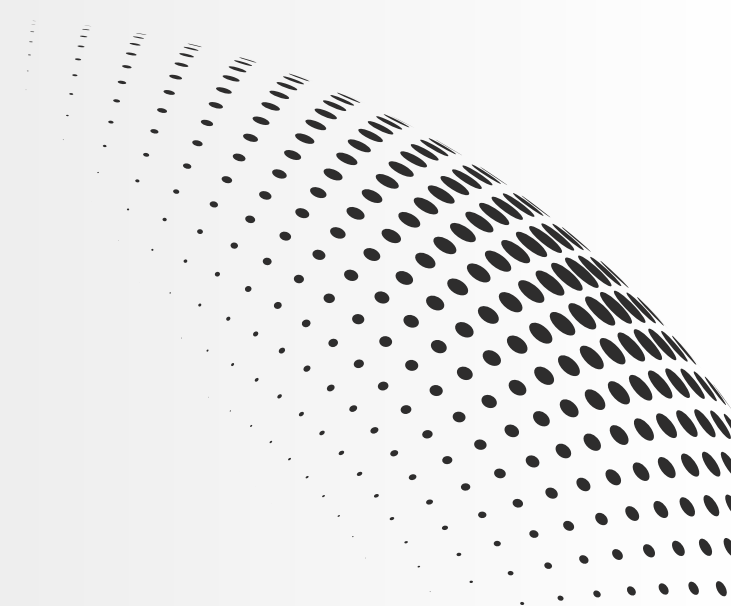
Question 91



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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 ?



Question 92



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

$$\frac{1}{c} = \frac{1}{d} + \frac{1}{e} + \frac{1}{f} + \frac{1}{17}$$

- A) $c = \frac{17def}{d+e+f+17}$
- B) $c = \frac{17def}{17ef+17df+17de+def}$
- C) $c = \frac{17ef+17df+17de+def}{17def}$
- D) $c = d + e + f + 17$

Question 93



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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 d 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) $N(d) = 5,000(4)^{\frac{4}{5}d}$

Question 94



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$$\frac{1}{7}x + \frac{3k}{13}y = \frac{9}{14}$$

One of the equations in a system of two linear equations is given, where k is a nonzero constant. The system has no solution. If the other equation in the system is graphed in the xy -plane, what is the slope of the graph?

- A) $\frac{13k}{21}$
- B) $-\frac{13}{21k}$
- C) $\frac{21k}{13}$
- D) $-\frac{21}{13k}$

Question 95

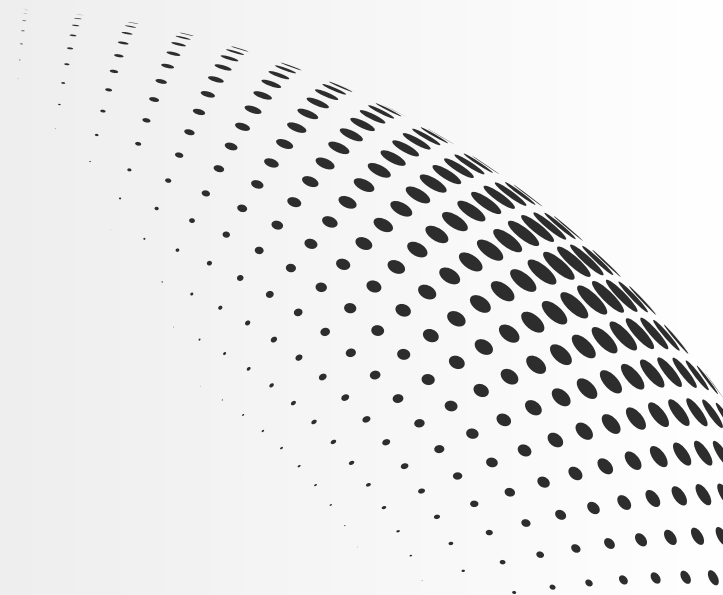


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a is 3700% greater than b . a is also 5% less than c . What percent greater than b is c ?



Question 96



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$$g(x) = 8(x - d)(x - e)(x - f)$$

The function g is defined by the given equation, where d , e , and f are distinct constants. When $d < x < f$, the value of $g(x)$ is positive. The graph of $y = g(x)$ in the xy -plane contains the point (p, q) where p and q are constants. If $q = 7$, which of the following could be true?

- I. $e < p$
- II. $p < d$
- III. $f < p < e$

- A) I only
- B) II only
- C) I and II only
- D) I and III only

Question 97



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

	Volume (cubic inches)	Surface Area (square inches)
Rectangular Prism A	4,374	1,782
Rectangular Prism B	1,500,282	k

What is the value of k ?

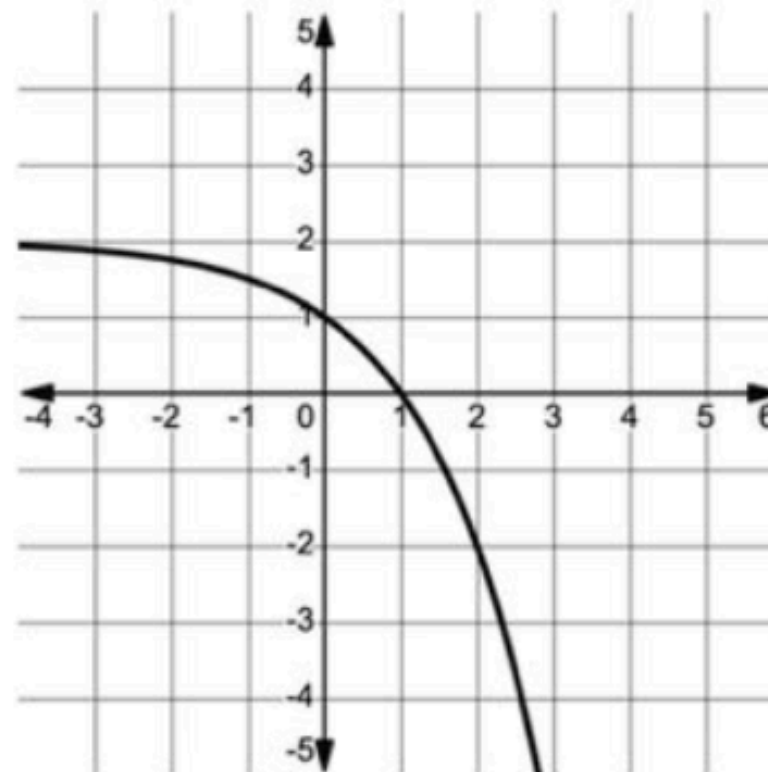
- A) 5,346
- B) 12,474
- C) 87,318
- D) 611,226

Question 98



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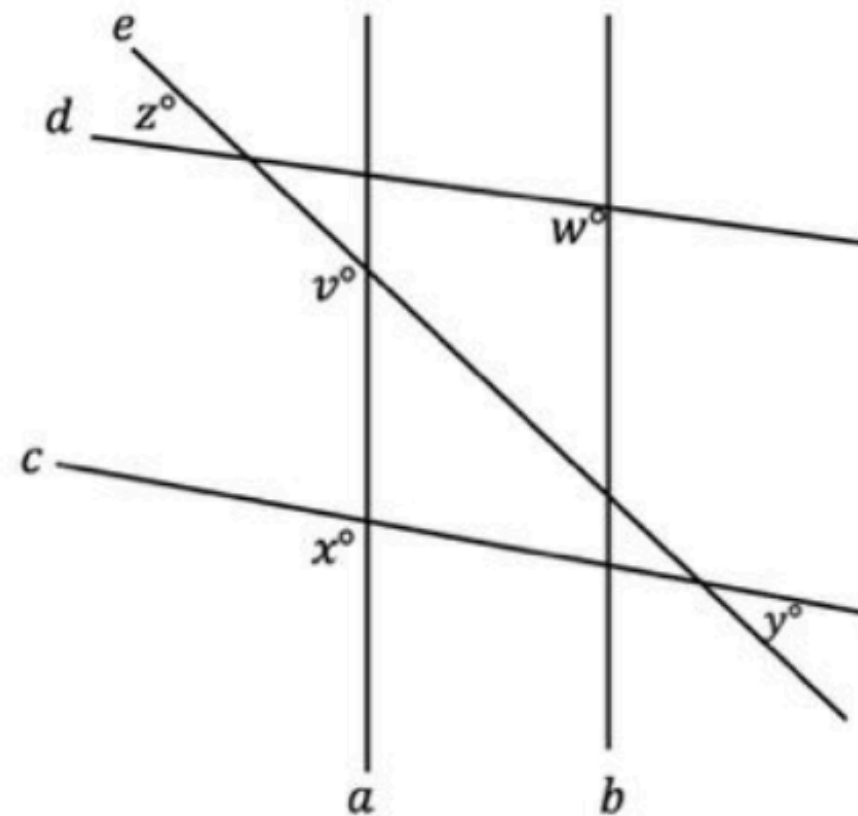
The graph of $y = f(x) + 6$ is shown. Which equation defines f ?

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

Question 99



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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) $z + y = 90$

Note: Figure not drawn to scale.

Question 100



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In a set of three consecutive odd integers, where the integers are ordered from least to greatest, the first integer is represented by k . The product of 17 and the second odd integer in the set is at most the value of 40 less than the sum of the first and third odd integers in the set. What is the greatest possible value of k ?

Question 101



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

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 $a + b$?

Question 102



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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. $f(x) = 19(0.74)^x + 43$
- II. $g(x) = 7(0.98)^x$

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

Question 103

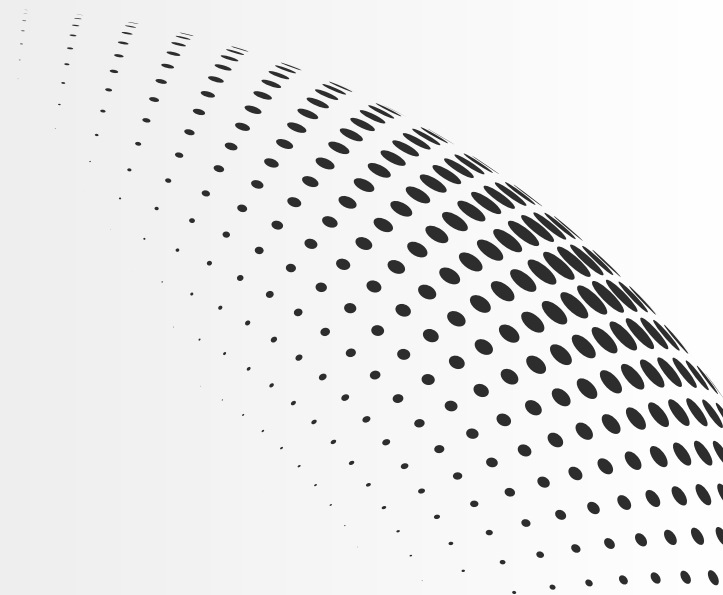


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Function f is a quadratic function. The graph of $y = f(x)$ in the xy -plane has a vertex at $(-7, 14)$ and passes through the point $(-4, -31)$ and has a y -intercept at $(0, a)$. The graph of $3f(x)$ has a y -intercept at $(0, b)$. What is the positive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



Question 104



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$$g(a) = 77a - 4a^2$$

The function g is defined by the given equation. The function h is defined by $h(a) = g(a) + 5$. Which expression represents the maximum value of $h(a)$?

- A) $5 + \left(\frac{77}{4}\right)^2$
- B) $5 + \left(\frac{77}{8}\right)^2$
- C) $5 - \left(\frac{77}{4}\right)^2$
- D) $5 - \left(\frac{77}{8}\right)^2$

Question 105



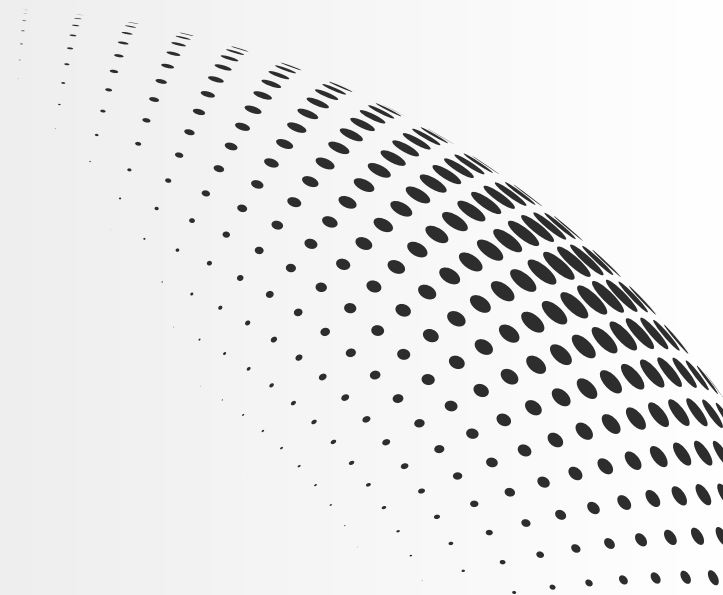
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In the given equation, k is a positive constant. The product of the solutions to the equation is 154. What is the value of k ?

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



Question 106

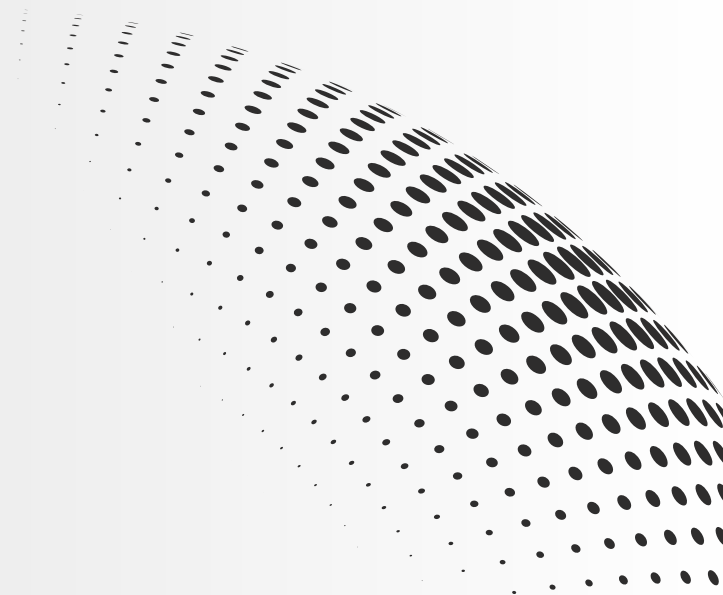


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The positive number a is 7,848% of the sum of positive numbers b and c , and c is 32% of b .
What percent of c is a ?



Question 107



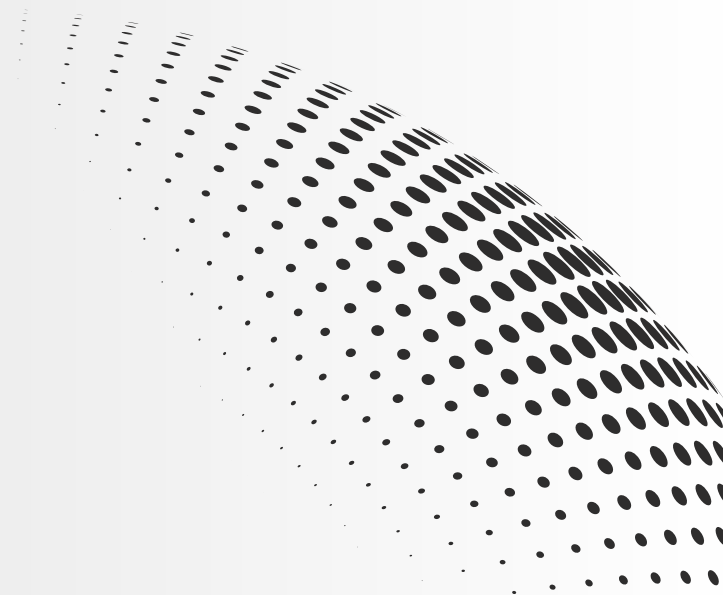
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$$\sqrt{a - x} = 46 - x$$

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



Question 108

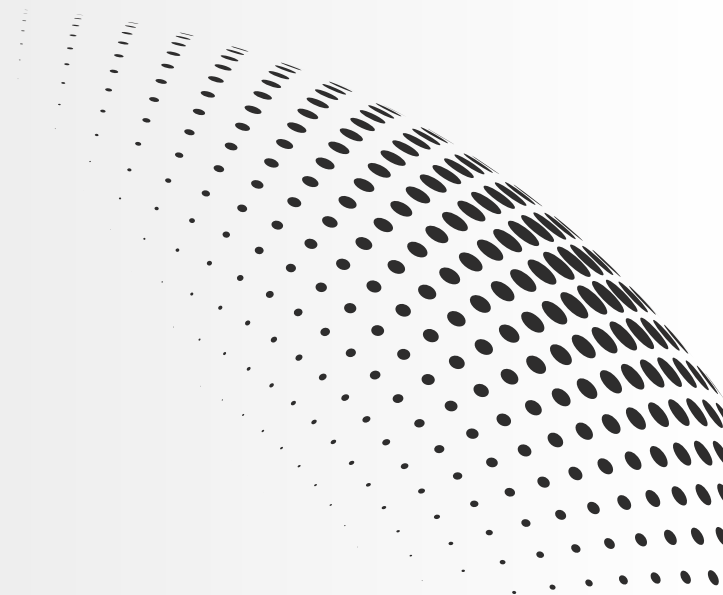


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For the linear function k , $k(a) = -24$, where a is a constant, $k(4) = 30$, and the slope of the graph $y = k(x)$ in the xy -plane is 7. For the linear function p , $p(a) = 26$ and $p(6) = 38$. What is the slope of the graph of $y = p(x)$ in the xy -plane?



Question 109



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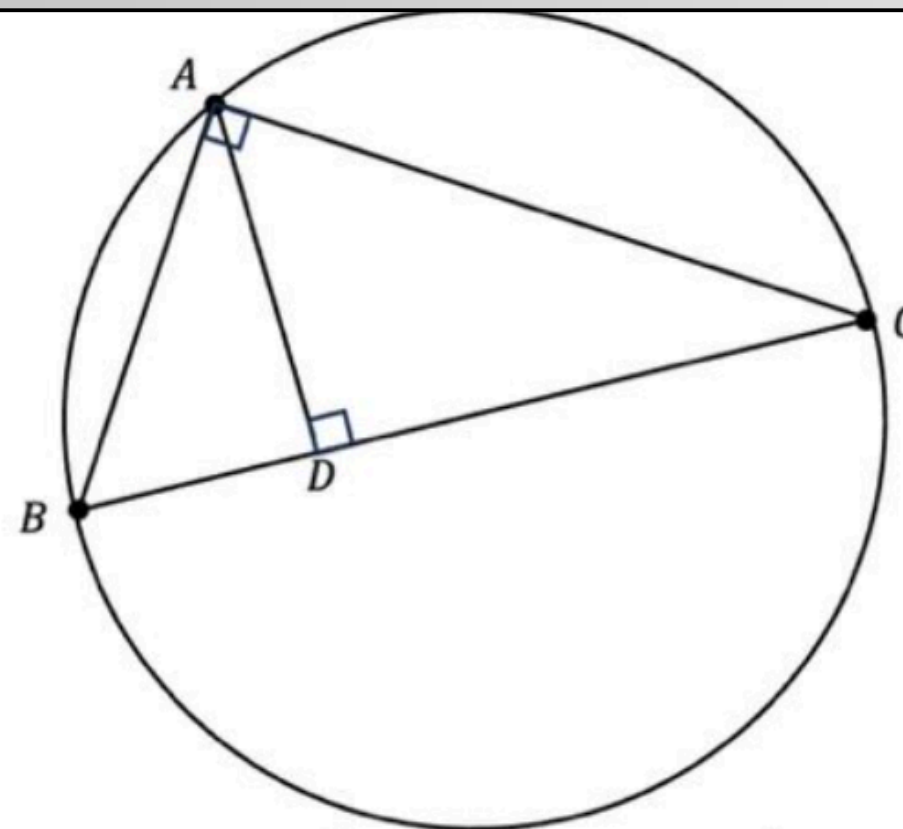
If $\frac{x-7}{5} = \frac{x-4}{3}$, the value $x - 4$ is between which of the following pairs of values?

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

Question 110



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Note: Figure not drawn to scale.

In the figure shown, points A , B , and C lie on the circle and $AC > AB$ and $AD = \sqrt{592}$. The diameter of the circle is 82. If $\frac{CD}{BD} = k$, what is the value of k ?

Question 111



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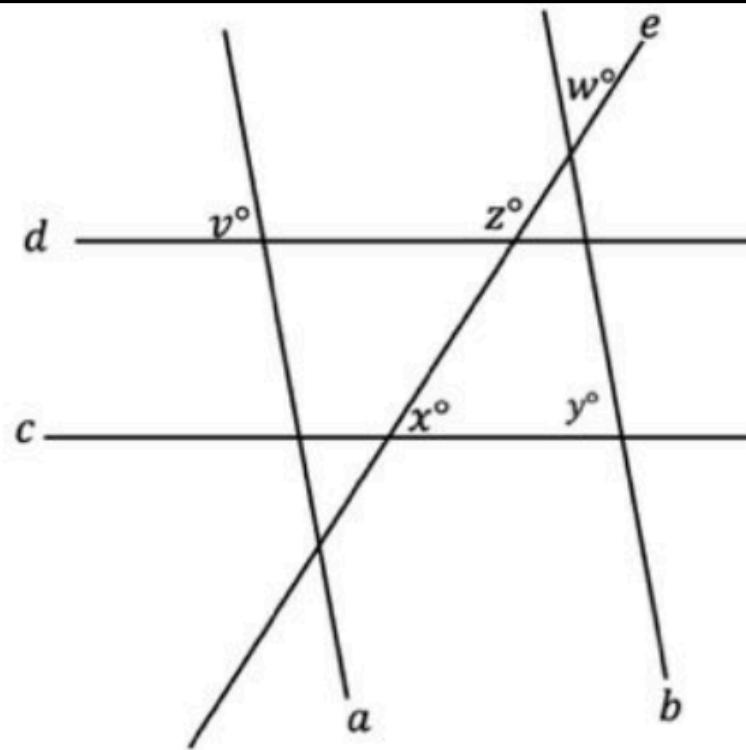
A handyman charges a flat rate of \$218 for the first 3 hours of work and \$68 for each additional hour of work. Which equation gives the total amount y , in dollars, that the handyman charges for x hours of work, where $x > 3$?

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

Question 112



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In the figure, parallel lines a and b are intersected by lines c , d , and e . If $v = 37$ and $z = 144$, y and x are integers, and $y < v$, which statement about x must be true?

- A) $x < y$
- B) $x > y$
- C) $x = w$
- D) $w < x$

Question 113



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$$\begin{aligned}f(x) &= x + 7 \\g(x) &= 5x^2 - kx + 245\end{aligned}$$

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 ?

Question 114



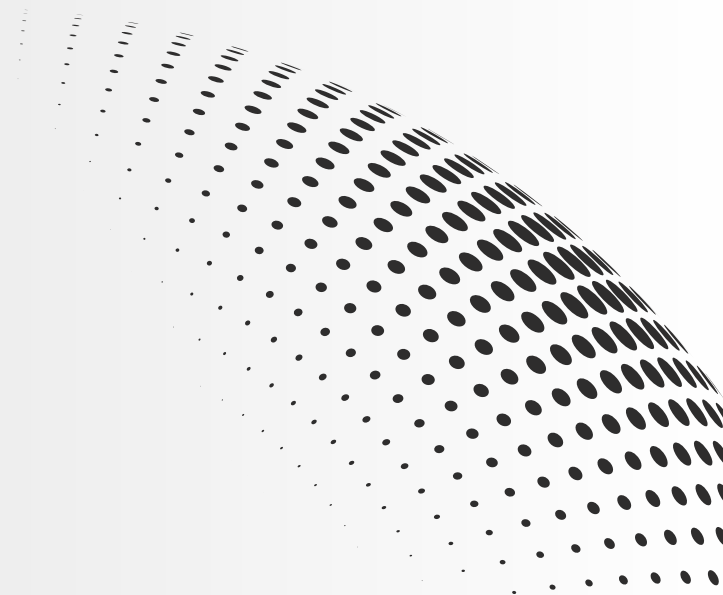
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$$x(7x - 4k) + j(7x - 4k) - (x + j) = 0$$

In the given equation, j and k are positive constants. A solution to the equation is $x = 81$. What is the value of k ?



Question 115



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Which of the following expressions has a factor of $x - 3a$, where a is a negative integer constant?

- A) $5x^2 + 35x - 21a$
- B) $5x^2 + 46x - 21a$
- C) $5x^2 + 67x - 21a$
- D) $5x^2 + 90x - 21a$

Question 116



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The perimeter of an equilateral triangle with a height of 58 units is $k\sqrt{3}$ units, what is the value of k ?

- A) $\frac{58}{3}$
- B) $\frac{116}{3}$
- C) $\frac{174}{3}$
- D) 116

Question 117



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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 ?

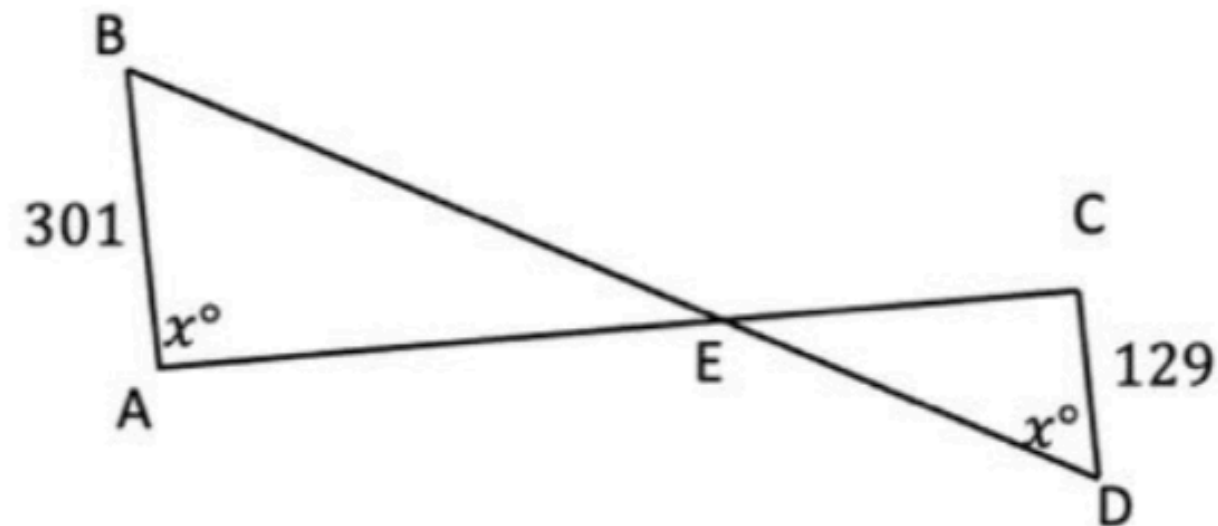
- A) 3
- B) $\frac{27}{3}$
- C) 25
- D) 28

Question 118



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Note: Figure not drawn to scale.

In the figure shown, $\overline{AC}$ and $\overline{BD}$ intersect at point E , $AC = 1,080$ and $\overline{ED} = \frac{4}{5}\overline{EC}$. What is the length of $\overline{ED}$?

Question 119



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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

Question 120



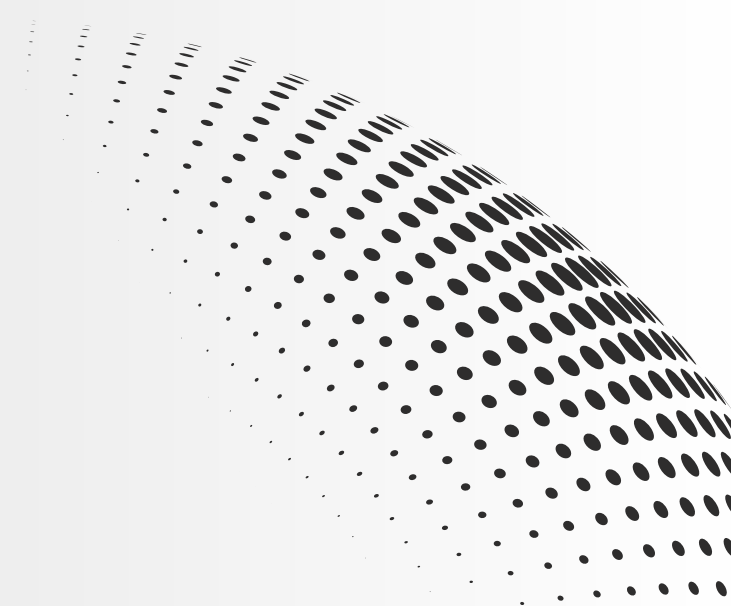
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$$4x^2 + 4y^2 + bx + by = 32$$

The given equation where b is a positive constant, defines a circle in the xy -plane. The radius of the circle is $\sqrt{106}$. What is the value of b ?



Question 121

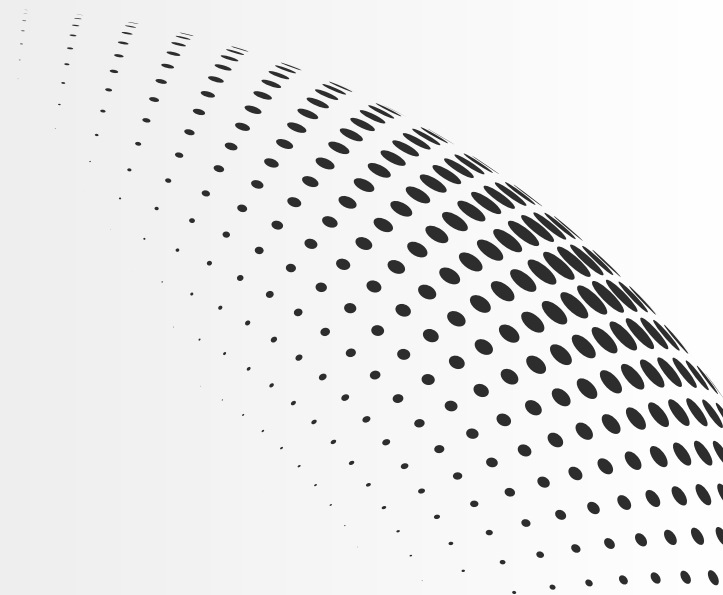


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The given equation $ax^2 + 88x + c = 0$, where a and c are constants has no real solutions and a factor of $kx + j$. What is the least possible integer value of ac ?



Question 122

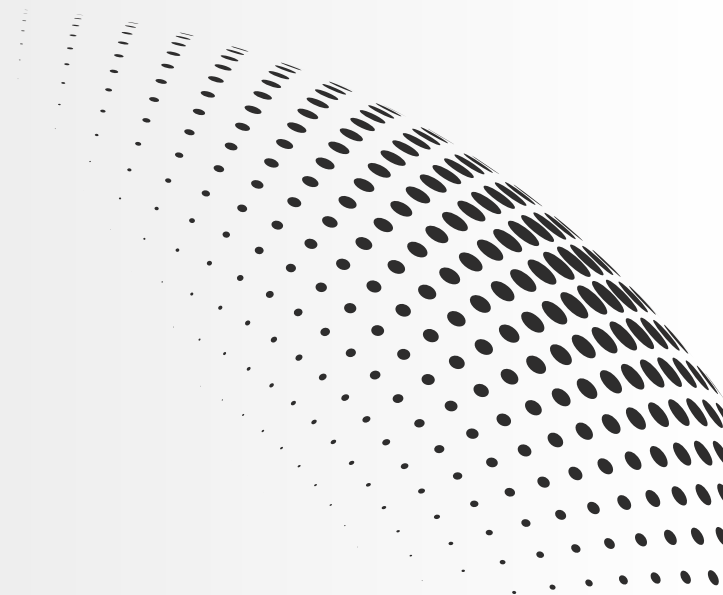


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The edge length of the square base and the height of a right square pyramid are integers, and the pyramid has a volume of 16,464 cubic inches. If the slant height is 35 inches, what is the height, in inches, of this pyramid?



Question 123

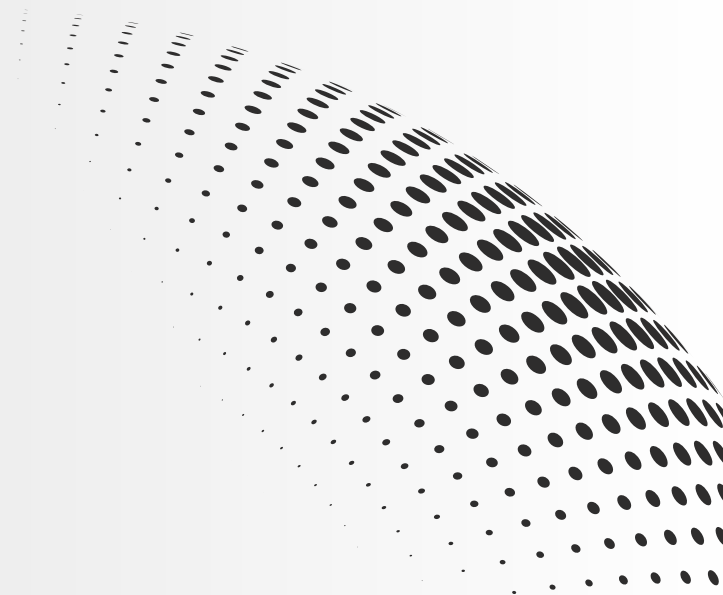


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The quadratic function $a(x + 4.5)^2 - d$ can be rewritten as $(x - 9.5)(x + c)$. If a is equal to 1, what is the value of d ?



Question 124



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$$3x = 30y - 12$$

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?

- A) $x = 5y$
- B) $\frac{1}{2}x = 5y$
- C) $x = 10y - 4$
- D) $\frac{1}{2}x = 10y - 4$

Question 125

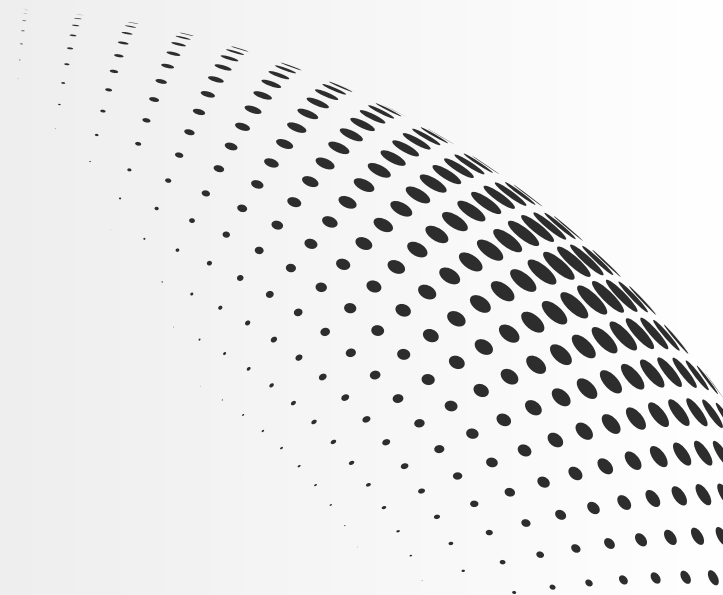


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The surface area of rectangular prism A is 312 m^2 . The surface area of area of rectangular prism B is $11,232 \text{ m}^2$. Rectangular prism A has a volume of 224 m^3 . If both rectangular prisms are similar, what is the volume of rectangular prism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



Question 126

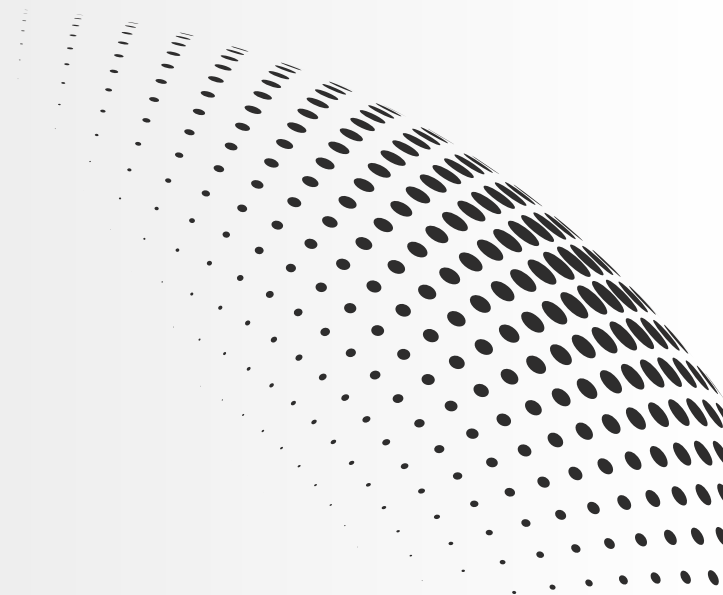


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The function g is defined by $g(x) = k|x - 13|^2 - 47|x - 13| + m$, where k and m are constants and $k > m > 47$. If $g(397) = a$ and $g(-371) = b$, where a and b are constants, what is the value of $43(-397)^{a-b} + 371(43)^{b-a}$?



Question 127



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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) $-7a$

Question 128



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Line a in the xy -plane passes through the points $(\frac{7}{k}, -\frac{3}{k} + \frac{9}{15})$ and $(\frac{5}{k}, -\frac{7}{k} + \frac{9}{15})$, where k is a constant. Which of the following defines the y value of the y -intercept of line a ?

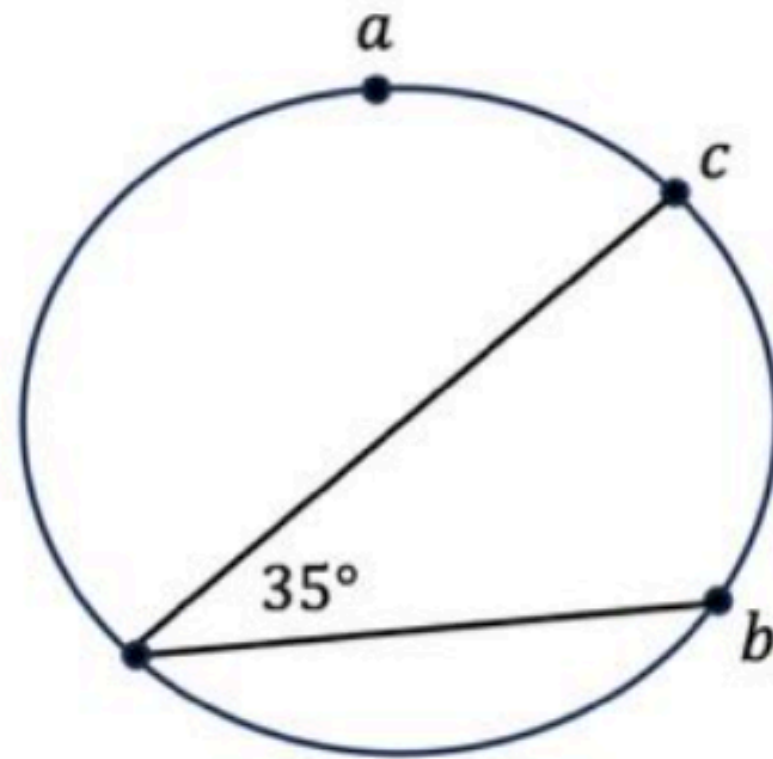
- A) $-\frac{38}{k} + \frac{3}{5}$
- B) $-\frac{32}{k} + \frac{3}{5}$
- C) $-\frac{17}{k} + \frac{3}{5}$
- D) $-\frac{70}{k} + \frac{3}{5}$

Question 129



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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 ?

Question 130

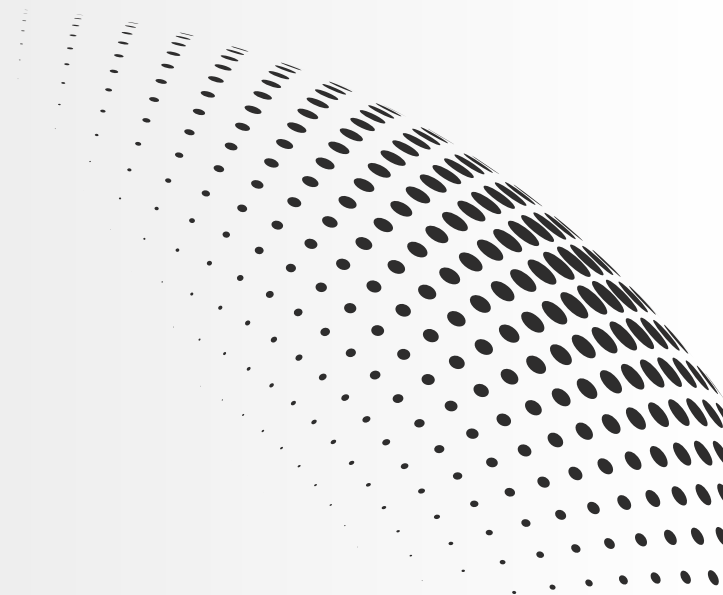


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A rectangular gameboard is divided into 480 square regions of equal area k , in square units. The length of the gameboard is 7.5 times the width of the gameboard. If the width of the gameboard is $x\sqrt{k}$ units, what is the value of x ?



Question 131

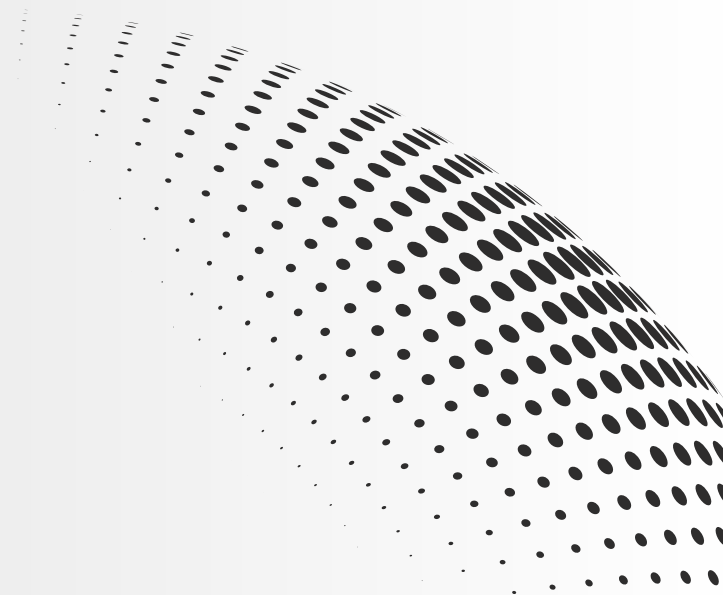


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For which value of a does the quadratic $(7x - 8)^2 + 9 = a$ only have one solution?



Question 132

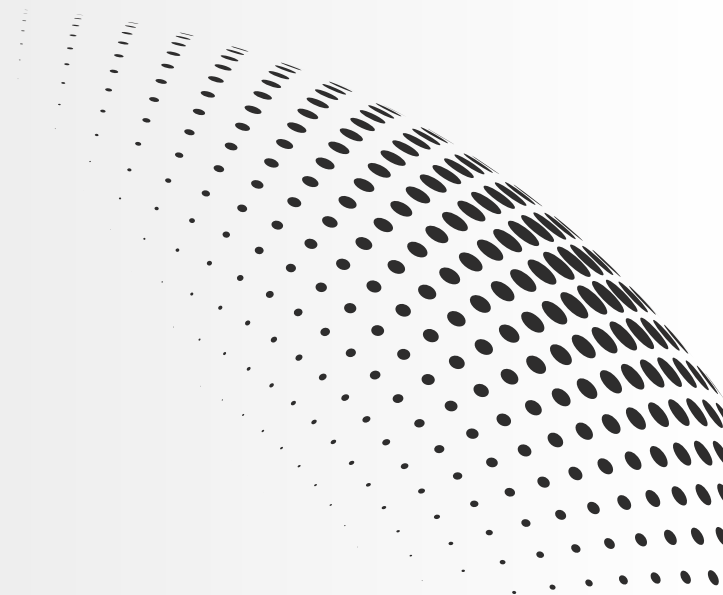


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The area of a triangle is 340 square inches. The length of the base of the triangle is 6 greater than 2 times the height of the triangle. What is the height, in inches, of the triangle?



Question 133

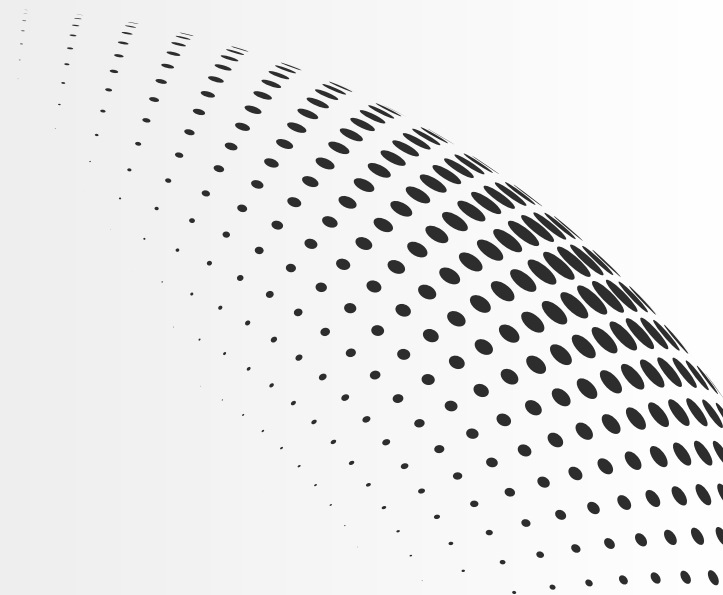


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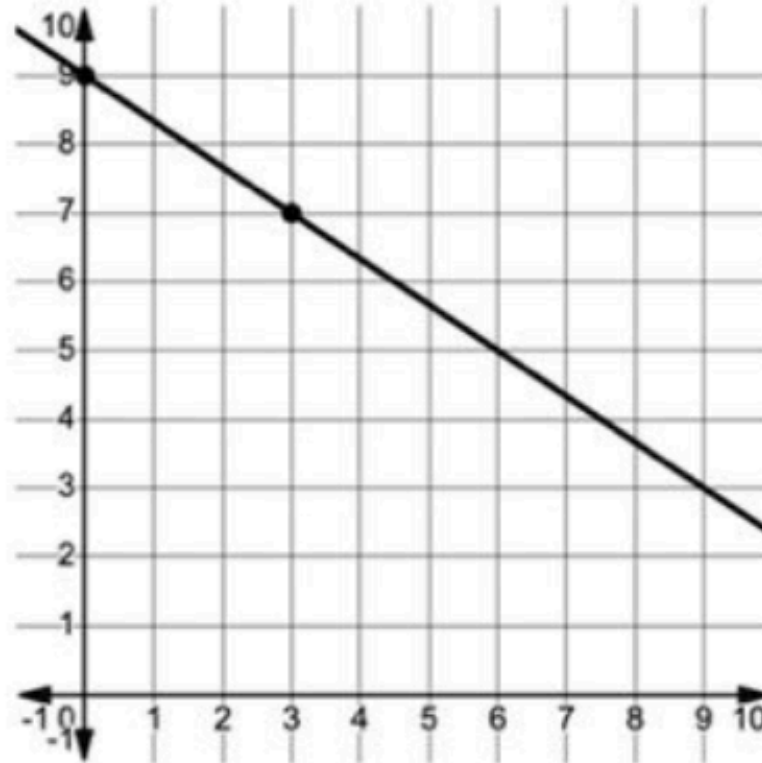
If $r = \sqrt[3]{k}$, for the equation $r^{12a-9} = k$, what is the value of a for which r and k are equal?



Question 134



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The graph of the line a is shown in the xy -plane. Line b is defined by $178x + ky = j$, where k and j are constants. If line b is graphed in this xy -plane, resulting in a graph of a system of two linear equations, the system of two linear equations will have infinitely many solutions. What is the value of $k + j$?

Question 135



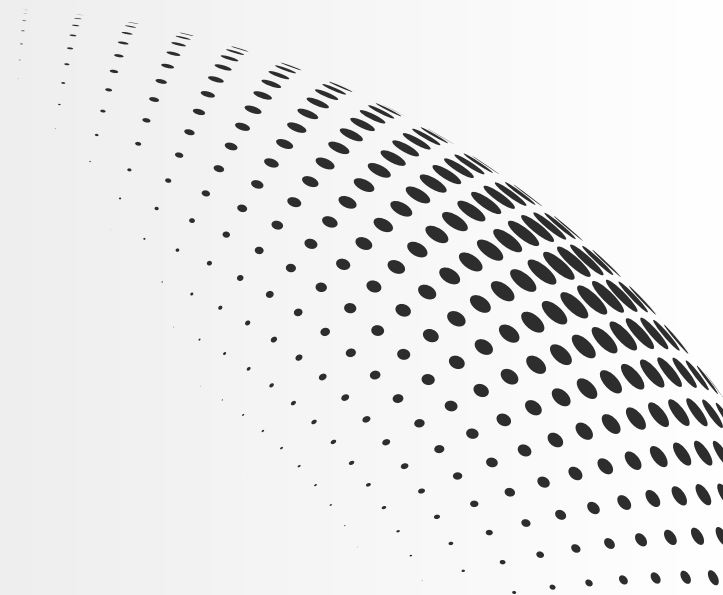
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$$92x - 1,789 = kx - 1,790$$

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 ?



Question 136



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For a study, a group of beavers will be selected from a population of 370 beavers, and a group of otters will be selected from a population of 420 otters. Some of the beavers and otters will be in a treatment group, and some of the beavers and otters will be in a control group. Which of the following is necessary for this study to attempt to establish a cause-and-effect relationship between two variables?

- A) The total number of beavers in the study is equal to the total number of otters in the study.
- B) The beavers and otters are randomly selected from their habitats.
- C) The proportion of female to male otters in the treatment group is equal to the proportion of female to male beavers in the treatment group.
- D) The beavers and otters are randomly assigned to the treatment and control groups.

Question 137



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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 ?

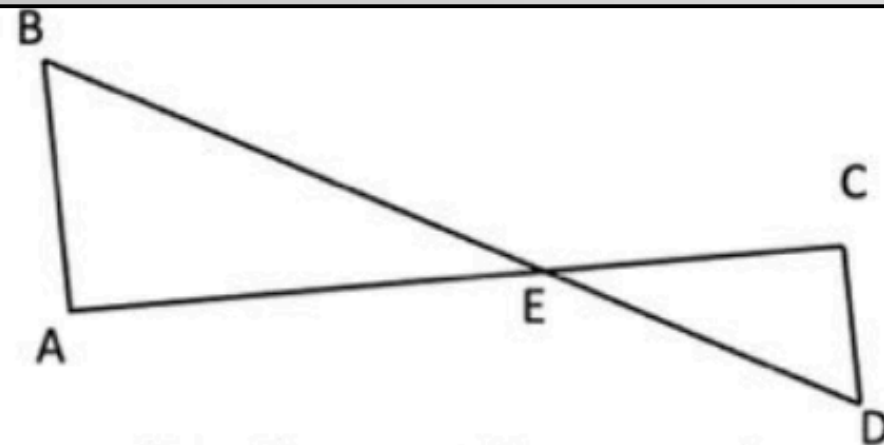
- A) $3\sqrt{3}$
- B) $5\sqrt{2}$
- C) $5\sqrt{2} - 3\sqrt{3}$
- D) $5\sqrt{2} + 3\sqrt{3}$

Question 138



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Note: Figure not drawn to scale.

In the figure, $\overline{AC}$ intersects $\overline{BD}$ at point E , and $\overline{AB}$ is parallel to $\overline{DC}$. The lengths of $\overline{AC}$, $\overline{BE}$, and $\overline{EC}$ are 23, 17, and 7, respectively. What is the length of $\overline{ED}$?

- A) $\frac{16}{119}$
- B) $\frac{23}{119}$
- C) $\frac{119}{23}$
- D) $\frac{23}{16}$

Question 139



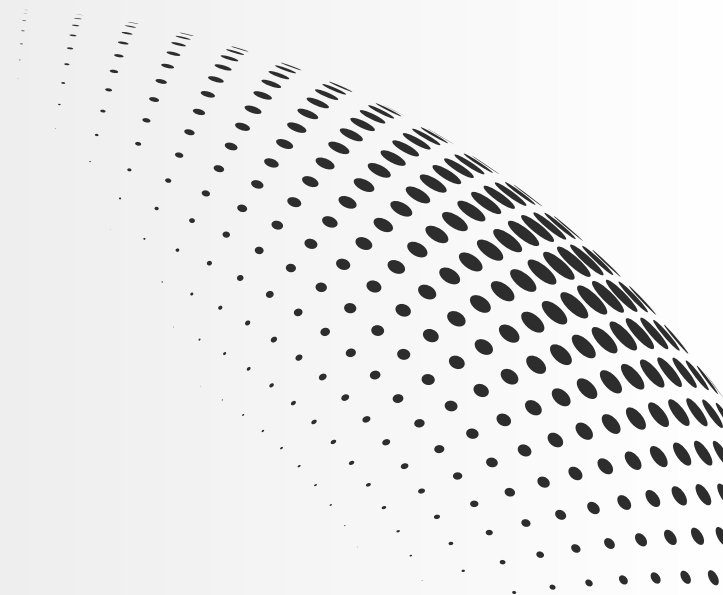
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$$-x^2 + kx - 3,786$$

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 ?



Question 140



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Point A lies on a unit circle in the xy -plane and has coordinates $(1, 0)$. Point B is the center of the circle and has coordinates $(0, 0)$. Point C also lies on the unit circle and has coordinate $(-\frac{1}{2}, \frac{\sqrt{3}}{2})$. Which of the following could be the positive measure of angle ABC , in radians?

- A) $\frac{454\pi}{6}$
- B) $\frac{458\pi}{3}$
- C) $\frac{460\pi}{3}$
- D) $\frac{462\pi}{3}$

Question 141

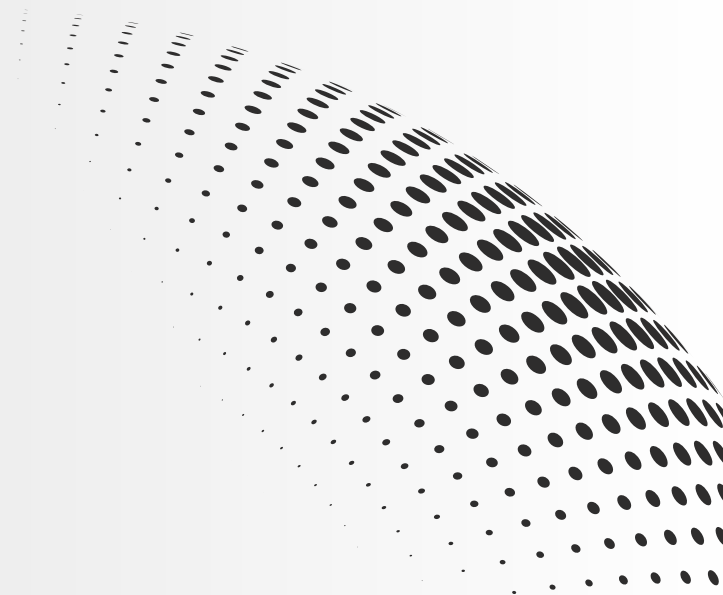


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In triangle ABC , angle C is a right angle, point D lies on $\overline{AB}$, point E lies on $\overline{BC}$, and $\overline{DE}$ is parallel to $\overline{AC}$. If the length of $\overline{AB}$ is 39 units, $\overline{DE}$ is 8 units, the length of $\overline{AC}$ 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?



Question 142



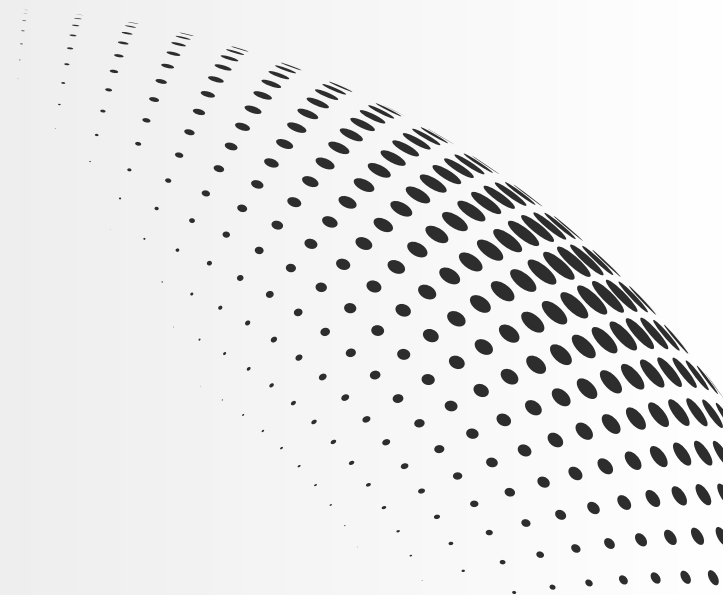
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$$x^2 - 9x + y^2 + 27y + \frac{67}{2} = 0$$

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



Question 143



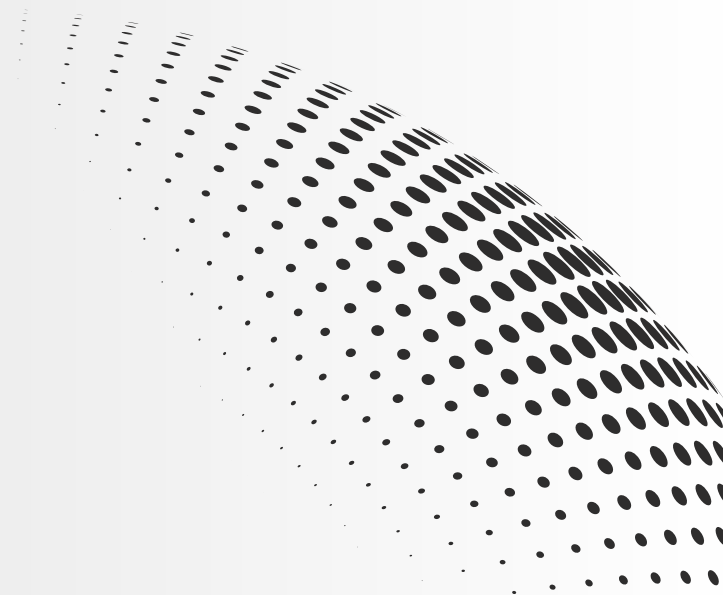
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$$ax^2 + 148x + c$$

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 ?



Question 144

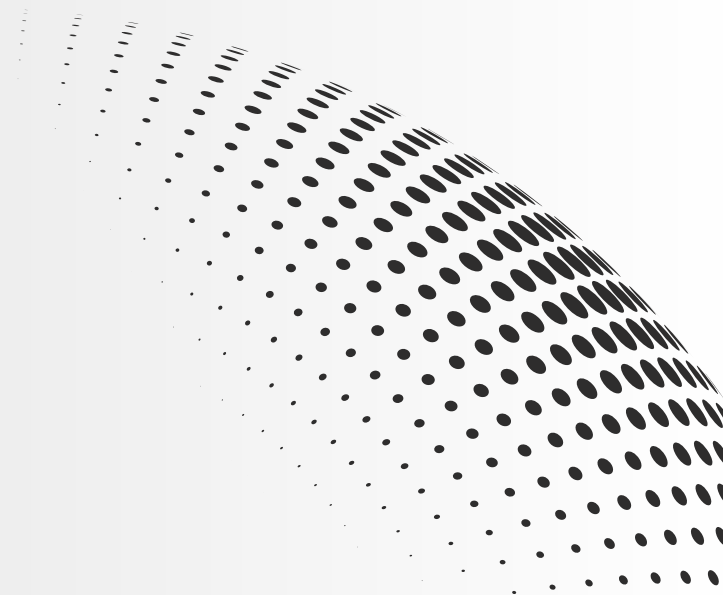


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The exponential function h is defined by $h(x) = ab^x$, where a and b are positive constants. If $h(k) = p$ and $h(k + 1) = 0.45p$, where k and p are constants, what is the value of b ?



Question 145

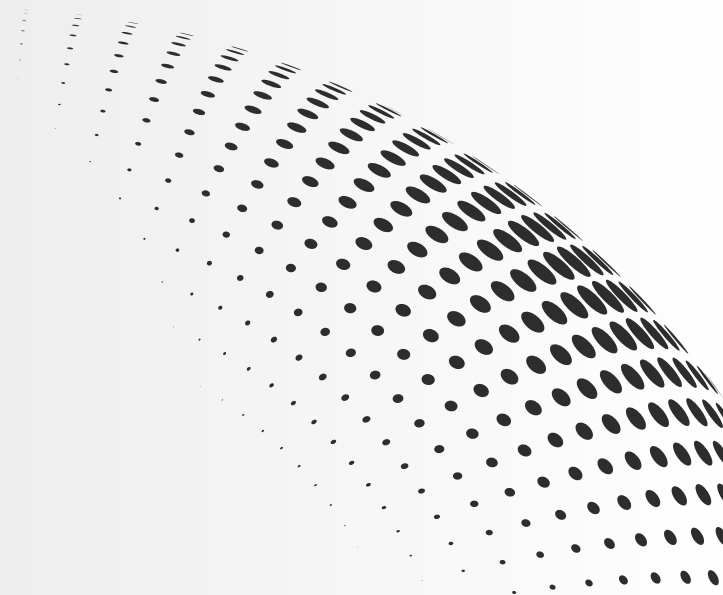


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The given quadratic function $54x^4 + 219x^2 + 105$ has factors in the form $(k)(ax^2 + b)(cx^2 + d)$. If a, b, c, d , and k are integers, what is the smallest possible value of ab ?

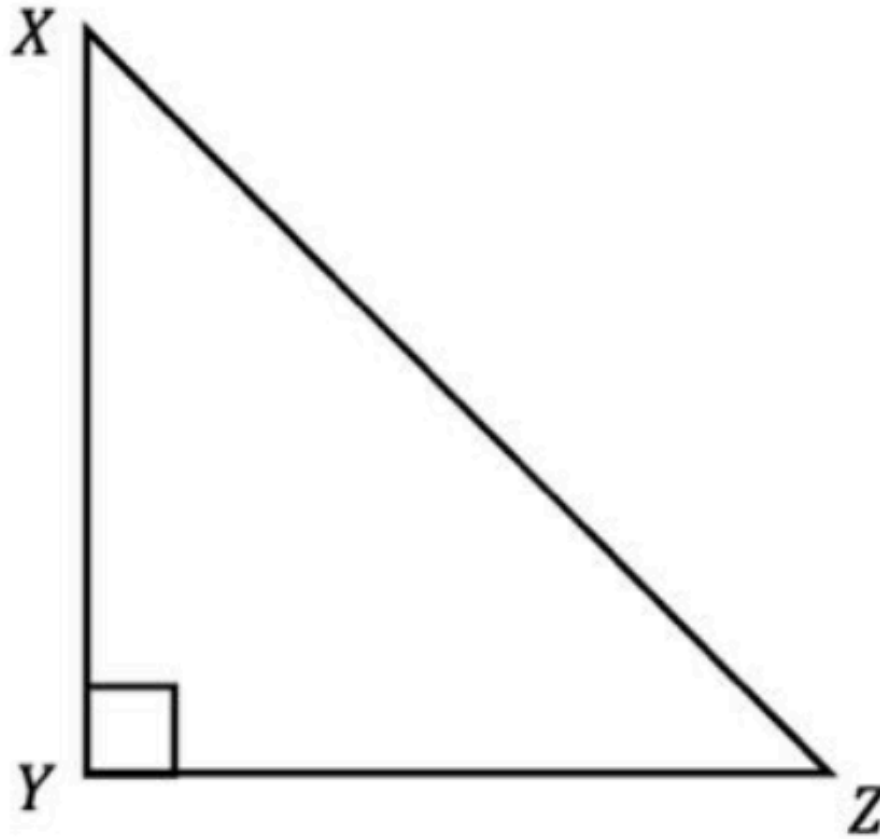


Question 146



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For triangle XYZ , the length of $\overline{XZ}$ is 37 and the length of $\overline{XY}$ is 27. Point K (not shown) lies on $\overline{XY}$ such that $\overline{YK}$ is perpendicular to $\overline{XZ}$. What is the value of $\frac{YK}{YZ}$?

Question 147



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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?

$$\begin{aligned}13x + 17y &= 10 \\ ax + by &= 10\end{aligned}$$

- A) $\begin{aligned}39x + 17y &= 10 \\ ax - 3by &= 10\end{aligned}$
- B) $\begin{aligned}52x + 34y &= 10 \\ 2ax + 4by &= 10\end{aligned}$
- C) $\begin{aligned}65x + 17y &= 10 \\ 5ax + by &= 10\end{aligned}$
- D) $\begin{aligned}13x - 17y &= 10 \\ ax + by &= 10\end{aligned}$

Question 148



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$$\begin{aligned}\frac{3}{5}x + \frac{7}{4}y &= a \\ \frac{7}{11}x + by &= c\end{aligned}$$

In the given system of equations, a , b , and c are constants. The system has infinitely many solutions. What is the value of $\frac{a}{c}$?

Question 149



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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) $f(x) = 768(4)(4)^{x-3}$

Question 150



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At the start of a stock trading competition, John's and Julia's stock portfolios were of equal value. At the end of the stock trading competition, John's portfolio had increased by 330%. Julia's portfolio has increased by 2,480%. At the end of the competition Julia's portfolio is worth $p\%$ more than John's portfolio, what is the value of p ?



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ANSWER KEY

1) 22.75	11) 95/97	21) C	31) 173	41) A
2) 11,264	12) A	22) C	32) 163	42) D
3) C	13) A	23) A	33) A	43) D
4) D	14) D	24) 343.36	34) 20, 45	44) C
5) D	15) D	25) 7500	35) 2	45) 19/24
6) D	16) D	26) C	36) B	46) 40
7) 11	17) D	27) 7,007	37) B	47) 76
8) 38,100	18) 24	28) 29	38) -2	48) D
9) B	19) -86	29) 4	39) 62	49) 3,600
10) B	20) 595	30) 8/3	40) 0.82	50) 90,000



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ANSWER KEY

51) B	61) D	71) $29/4$	81) A	91) 24
52) 95	62) 99.96	72) 106	82) 106	92) B
53) 20, 25, $81/4$	63) 2,401	73) B	83) 34	93) B
54) 32500	64) -30	74) 399	84) C	94) B
55) C	65) -113	75) D	85) 6	95) 3,900
56) D	66) B	76) B	86) D	96) A
57) 900	67) 16	77) 10.7	87) 24	97) C
58) C	68) D	78) 954	88) 26	98) C
59) C	69) C	79) -40	89) 37.5	99) B
60) -9	70) 27.5	80) 4,864	90) -2	100) -5



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ANSWER KEY

101) 35,36,37

102) B

103) 462

104) A

105) 12

106) 32,373

107) 183

109) A

110) $37/4$

111) C

112) B

113) 35

114) 141.5

115) C

116) D

117) C

118) 259.2

119) D

120) 56

121) 1,937

122) 28

123) 196

124) B

125) 48,384

126) 414

127) C

128) C

129) 52.5

130) 8

131) 9

132) 17

133) 1

134) 2,670

135) 93

136) D

137) B

138) D

139) 123

140) B

141) $10/3$

142) 104

143) 5,476

144) 0.45

145) 14

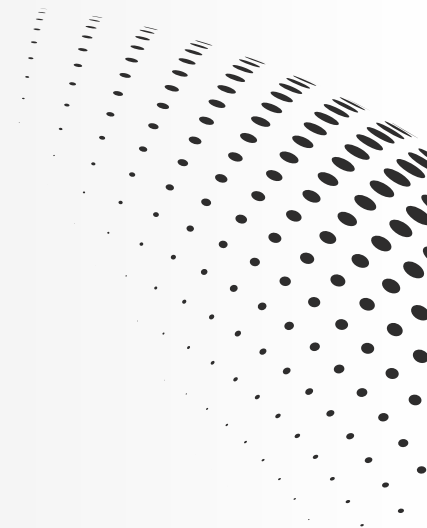
146) $27/37$

147) B

148) $33/35$

149) B

150) 500





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SUCCESS !

