

2020
INTERNATIONAL
MATH CONTEST

Practice Problems

Grade 7

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Grade 8

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IMC 2019 Grade 7

1. Find x , if $\frac{x-3}{15} = \frac{18}{5}$

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2. Chelsea is a chess champion. She's played 132 games; her ratio of wins to draws to losses is 6 : 3 : 2. How many games has she won?



3. Calculate: $\frac{2^{64}}{64^{10}}$.

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4. 42% of 42 is 84% of what number?
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5. Calculate: $\left(-\frac{5}{9}\right) \cdot (10.8 - 3.6) + 27$

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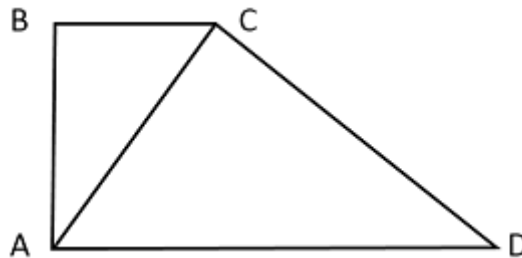
6. A caterpillar started at point $(-2.5, -5.5)$ on a coordinate plane. She crawled in a straight line through the origin to point $(45, y)$. What is y ?



7. Every sunny day, the Always Philadelphia Bakery bakes 100 cakes and 60 muffins. In any other weather, it bakes 40 cakes and 120 muffins per day. This April, the Always Philadelphia Bakery made the same number of cakes as muffins. How many of this April's 30 days were sunny?



8. ABCD is a trapezoid ($\overline{AD} \parallel \overline{BC}$). $BC = 5$ cm, $m\angle ACD = m\angle ABC = 90^\circ$, $m\angle BAC = 30^\circ$. Find the length of \overline{AD} (the picture is not drawn to scale).



9. Find the sum of all solutions to this equation:

$$\frac{2x - 4}{x + 1} \cdot \frac{2x + 8}{2} \cdot \frac{2x - 70}{x + 2} = 0$$

10. When they are both racing on hoverboards, Victoria is 3 times as fast as her brother Max. When she is on foot, she is 3 times slower than Max on his hoverboard. They took off on hoverboards at the same time, but after 12 minutes, Victoria's hoverboard broke and she immediately started to run. If the race was a tie, how long, in minutes, did it last from start to finish?



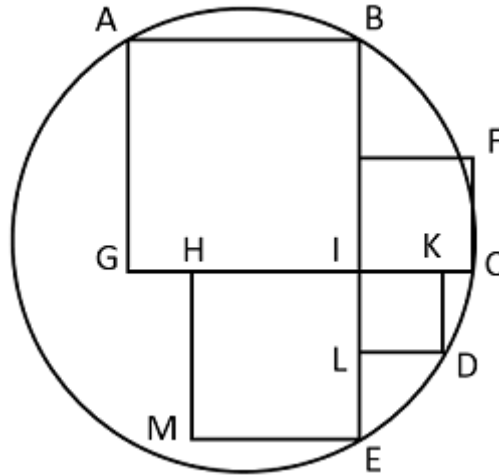
11. How many natural numbers n satisfy the inequality: $\frac{1}{7} < \frac{n}{10} < \frac{4}{5}$?

12. From three chocolate bars we can make at most five chocolate rabbits and have some leftover. What is the greatest possible number of chocolate rabbits that can be made from sixteen chocolate bars (maybe with some leftover)?
-



13. Find the number of zeroes at the end of the number $55! = 1 \cdot 2 \cdot \dots \cdot 54 \cdot 55$
-

14. Points A, B, C, D, and E lie on the given circle. Point I is the common vertex of four squares shown on the picture. Area of square ABIG is 144 square units. Area of square MEIH is 100 square units. Find area of square DKIL.



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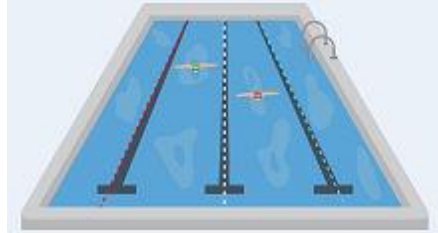
Answers

Question No.	Answer
1	$x = 57.$
2	Chelsea won 72 games.
3	16
4	21
5	23
6	$y = 99$
7	There were 20 sunny days this April.
8	The length of \overline{AD} is 20 cm.
9	The sum of all solutions is 33.
10	The race lasted 48 minutes.
11	6 natural numbers n satisfy the inequality.
12	31 chocolate rabbits.
13	13 zeroes.
14	The area of square DKIL is 25 square units.

Grade 7

IMC 2018

1. Shreya beat her school's 50 meter freestyle record by swimming 25% faster than the previous record of 48 seconds. What is the new school record that Shreya set?



-
2. Calculate:

$$\frac{12}{7} \cdot (9 - 0.6) - 2.4$$

-
3. How many times is:

$$3^{27} \text{ less than } 9^{15}?$$

-
4. Jacob is helping his father's bakery to make their huge holiday fruitcake, which requires 84 ounces of dried fruit. If the recipe says the ratio of dried pineapple to currants to cranberries is $9 : 7 : 5$, how many ounces of currants should Jacob fold into the batter?



-
5. Solve the equation:

$$7^{2x-70} = 49$$

6. Find the product of all solutions of the equation $(10x + 33) \cdot (11x + 60) = 0$

7. If we take 30% of some number and add 60.2, we get the original number. What is it?

8. If $\frac{2}{3}$ of the distance from the y -axis to point A $(-30, -45)$ is equal to $\frac{1}{4}$ of the distance from the x -axis to point B (a, a) , where $a > 0$, what is the value of a ?

9. Karen is hosting a pizza party for herself and 29 guests. She wants to order enough pizzas so that each person gets more than $\frac{1}{5}$, but less than $\frac{2}{3}$ of a pizza. How many different quantities of pizza could Karen order?



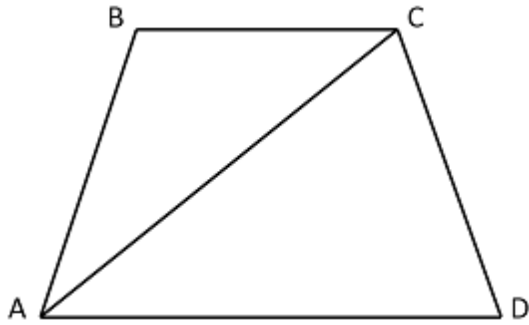
$$\text{If } \frac{x + 28y}{x} = 50, \text{ find } \frac{y + 28x}{y}.$$

10.

11. An old-fashioned bicycle has two differently sized wheels. The circumference of the front wheel is 9 feet larger than the circumference of the back wheel. Thomas biked for a while and, according to his equipment, the front wheel went all the way around 500 times and the smaller wheel went all the way around 1400 times. How far, in feet, did Thomas bike?

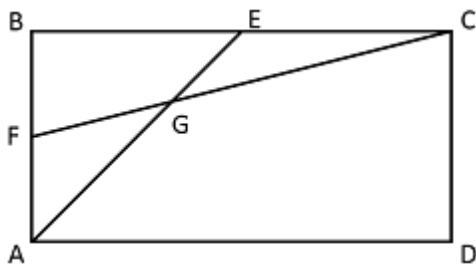


12. ABCD is a quadrilateral. $\overline{AD} \parallel \overline{BC}$, $AB = BC = CD$, $AC = AD$. Find $m\angle ADC$.



13. Find x , if $\sqrt{x} + 2y^2 = 15$ and $\sqrt{4x} - 4y^2 = 6$.

14. ABCD is a rectangle. E is the midpoint of \overline{BC} , F is the midpoint of \overline{AB} and G is the point of intersection of \overline{AE} and \overline{CF} . If the area of ABCD is 1260 square units, find the area of the quadrilateral BFGC.



Answers

Question No.	Answer
1	The new school record is 36 seconds.
2	12
3	27 times less.
4	Jacob should fold in 28 ounces of currants.
5	$x = 36$
6	The product of all solutions is 18.
7	The original number is 86.
8	$a = 80$
9	Karen could order 13 different quantities of pizza.
10	17
11	Thomas biked 7000 feet.
12	72
13	$x = 81$
14	The area of the quadrilateral BFGE is 210 square units.

Grade 7

IMC 2017

1. Last month, Ella took 600 selfies. She took 35% more selfies this month than she did last month. How many selfies did Ella take this month?



-
2. What percent of the cube of 5 is 5?

-
3. Three friends, Jim, Jack, and John, hunted for Pokemon. Jack caught three times as many Pokemon as Jim, and John caught twice as many Pokemon as Jim. How many Pokemon did Jack catch if together they caught 72 Pokemon?

-
4. Solve the equation: $4^{7x} = 2^{60} \cdot 16^{x/2}$

-
5. How many times is $4^{16} \cdot 8^{32}$ greater than $16 \cdot 2^{120}$?

-
6. An ant walked on the coordinate plane from point A(- 3,1) to point B(1,25) by the shortest path. Find y -coordinate of the point where the ant intersected y -axis.

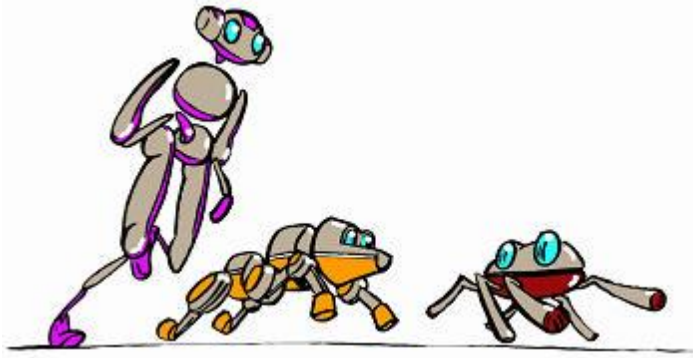


7. What is the sum of (-5.5) and the product of $\frac{5}{3}$ and the number that is 100 greater than (-5.5) ?

8. The sum of all the solutions of the equation: $(10x - 3a)(3x + 39)(5x - 3) = 0$ is (-1) .
Find a .

9. Find x , if $3x - 5(y + x)^2 = 16$ and $4x + 2(y + x)^2 = 30$.

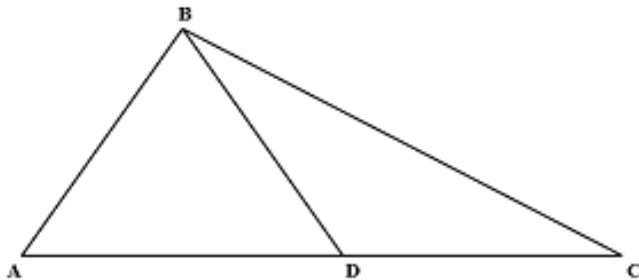
10. Three robots ran the same distance. The first robot ran 150 meters per minute. The second robot ran 150 meters per minute faster than the first robot and 120 meters per minute faster than the third robot. The winner finished 2 minutes before the robot that finished in second place. What distance (in meters) did the robots run?



11. If $\frac{x+12y}{x} = 19$, find:

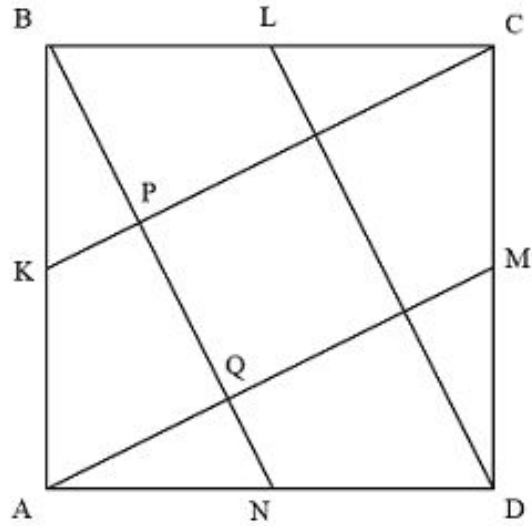
$$\frac{144x^2 + 24xy + y^2}{y^2}$$

12. In $\triangle ABC$, point D is on side AC, $\overline{AB} = \overline{BD} = \overline{DC} = 12$ inches, and the measure of $\angle BDC$ is twice the measure of $\angle ABD$. Find AC.



13. For what value of a is the equation:
 $(x + 7)^2 = (x - 7)^2 + ax$ an identity?
(An identity is an equation in which any number is solution. For example, $x + 3 = 3 + x$ is an identity.)

-
14. Square ABCD has area of 320 square units. Points K, L, M, N are midpoints of the sides of ABCD, P is the point of intersection of \overline{KC} and \overline{BN} , and Q is the point of intersection of \overline{AM} and \overline{BN} . Find \overline{PQ} .



Answers

Question No.	Answer
1	810 selfies
2	4 percent
3	36
4	$x=5$
5	16 times
6	The y -coordinate of this point is 19
7	152
8	$a=38$
9	$x=7$
10	900 meters
11	81
12	AC = 24 inches
13	$a=28$
14	PQ = 8 units

Grade 7

IMC 2016

1. If a tree was 150 feet high last year and in a year it grew by 6%, how many feet high is it now?
-

2. 60% of what number is 4.2?
-

3. The total number of watermelons, cantaloupes, and melons in Albert's Grocery store is 231. If it is known that the ratio of watermelons to cantaloupes to melons is 4 : 8 : 9, how many watermelons are in the store?
-

4. Solve the equation:

$$5^{x \div 2 - 6} = 25$$

5. Calculate:

$$\frac{9^2 \cdot 27^3}{3^3 \cdot (3^3)^3}$$

6. Calculate:

$$1 - (12 - 2 \cdot 8) \div 0.2$$

7. Find the sum of all solutions to this equation:

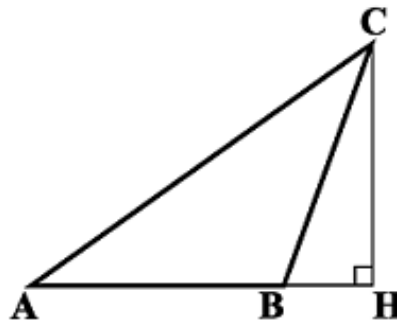
$$(x - 1)(3x - 19)(3x + 1) = 0$$

8. Points A(-1, 7), B(2, 19), and C(3, y) are on the same line. Find y.

9. Solving 8 problems per minute, Fast Finn can finish his test in time. He was, however, working faster, solving 10 problems per minute. That is why he finished 6 minutes early. How many problems were on the test?

10. Find x, if $3x + 2y^2 = 22$ and $6x + y^2 = 29$

11. $\triangle ABC$ is isosceles, $AB=BC$, and \overline{CH} is an altitude. How long is AC, if $CH = 84$ cm and $m\angle HBC = m\angle BAC + m\angle BCH$?



12. For what value of a is the equation $(x - 5)^2 = (x + 5)^2 - ax$ an identity. (An identity is an equation where any number is solution. For example, $x + 2 = 2 + x$ is an identity.)

13. If $xy = 6$ and $x^2y + xy^2 + x + y = 63$, find $x^2 + y^2$

-
14. In $\triangle ABC$, the median \overline{AM} ($M \in \overline{BC}$) is perpendicular to the angle bisector \overline{BK} ($K \in \overline{AC}$). Find AB , if $BC = 12$ inches.
-

Answers

Question No.	Answer
1	159 ft high
2	7
3	44 watermelons
4	$x=16$
5	3
6	21
7	Sum = 7
8	$y = 23$
9	240 problems
10	$x=4$
11	$AC = 168$ cm
12	$a=20$
13	$X^2+y^2 = 69$
14	$AB = 6$ inches

IMC 2019 Grade 8

1. In the film, *Zeke the Zombie Slayer Versus the Zombies from Space*, Zeke slayed 140 zombies. In the sequel, *Zeke the Zombie Slayer Versus the Zombies from Space, Part 2*, he slayed 5% more zombies. How many zombies were slain by Zeke in the sequel?
-



2. Find the greatest integer x that satisfies the inequality: $\frac{|x| + 15}{16 - x} \geq 0$
-

3. A caterpillar started at point $(-2.5, -5.5)$ on a coordinate plane. She crawled in a straight line through the origin to point $(45, y)$. What is y ?



4. Every sunny day, the Always Philadelphia Bakery bakes 100 cakes and 60 muffins. In any other weather, it bakes 40 cakes and 120 muffins per day. This April, the Always Philadelphia Bakery made the same number of cakes as muffins. How many of this April's 30 days were sunny?



5. If a^{16} is the same as 2^{64} , what is the absolute value of a ?
-

6. When they are both racing on hoverboards, Victoria is 3 times as fast as her brother Max. When she is on foot, she is 3 times slower than Max on his hoverboard. They took off on hoverboards at the same time, but after 12 minutes, Victoria's hoverboard broke and she immediately started to run. If the race was a tie, how long, in minutes, did it last from start to finish?



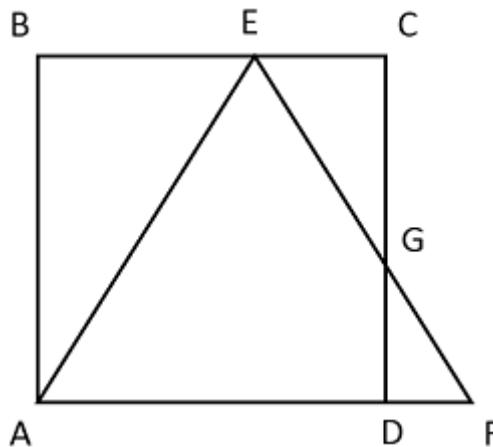
7. If $\sqrt{x} = 5$, $\sqrt{y} = \sqrt{9x}$, $\sqrt{z} = \sqrt{81x}$, find $\sqrt{x} + \sqrt{y} + \sqrt{z}$.

8. What is the largest three-digit palindrome divisible by 18?
(A palindrome is an integer that remains the same when its digits are reversed. For example, 77, 151, 8338, and *etc.*)

9. Find the sum of all solutions to this equation:

$$\frac{2x-4}{x+1} \cdot \frac{2x+8}{2} \cdot \frac{2x-70}{x-2} = 0$$

10. ABCD is a square. $AB = 30$ cm. $\triangle AEF$ is isosceles, $AE = EF$, $E \in \overline{BC}$. Point G is the point of intersection of \overline{DC} and \overline{EF} . $DF = 6$ cm. Find area of $\triangle DGF$.



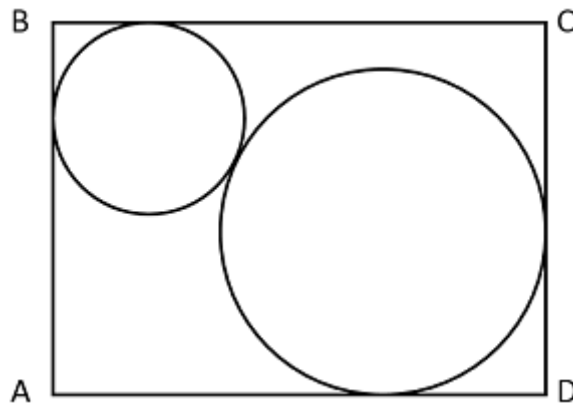
11. If the distance from the y -axis to point $A(x, y)$ is equal to 5, and the distance from the x -axis to point $A(x, y)$ is 20, what is the maximum possible value of $(5x - 20y)$?

12. Mrs. Munch and Mrs. Crunch each bought the same number of identical cookie boxes from their local troop. Both women took either 2 or 3 days to finish each box of cookies. It took Mrs. Munch 43 days to empty every last one of her cookie boxes; it took Mrs. Crunch 62 days to empty all of hers. How many boxes of cookies did each woman buy?
-



13. Points A, B, C, D, and O have coordinates $(0, 3)$, $(4, 4)$, $(4, y)$, $(4, 0)$, and $(0, 0)$, respectively. The area of ACDO is 5 times greater than the area of ABDO. Find y .
-

14. ABCD is rectangle. $BC = 45$. Two circles are drawn inside ABCD such that the circles are tangent to each other. The circle with radius 10 is tangent to \overline{AB} and \overline{BC} , and the circle with radius 15 is tangent to \overline{AD} and \overline{CD} . Find AB.



Answers

Question No.	Answer
1	Zeke slayed 147 zombies.
2	The greatest integer x that satisfies the inequality is 15.
3	$y = 99$
4	There were 20 sunny days this April.
5	$ a = 16$.
6	The race lasted 48 minutes.
7	65
8	828 is the greatest three-digit palindrome divisible by 18.
9	The sum of all solutions is 31.
10	The area of $\triangle DGF$ is 30 cm ² .
11	The maximum possible value is 425.
12	Each woman bought 21 boxes.
13	$y = 32$
14	$AB = 40$.

Grade 8

IMC 2018

1. The top of a square table is covered with four equal square tiles. If the side length of each tile is decreased by 75%, how many tiles of the new size would be needed to cover the same table?



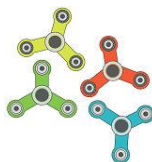
-
2. 3^{30} is the same as 9 to what power?

-
3. The battery life of Becky's new phone, without recharging, is 20% longer than the battery life of her old phone. If her old phone had a battery life of 22.5 hours, how many hours of battery life does her new phone have without charging?



-
4. Find the product of all solutions of the equation $(10x + 33) \cdot (11x + 60) = 0$

-
5. Eleven fidget spinners cost less than \$12. Twelve fidget spinners cost more than \$13. How many cents does one fidget spinner cost?



6. Find the greatest integer that satisfies the inequality: $\frac{|2x|-2018}{|x|+2018} \leq 0$

7. Katie and 11 of her friends split the cost of the birthday gift for John evenly. The rest of the people invited to John's party decided to join in on the gift giving. After evenly splitting the cost of the gift among all of the guests, the amount of money that Katie had to spend dropped by 4 dollars and 50 cents. If there were 18 guests at the birthday party, including Katie, what is the cost of the gift?



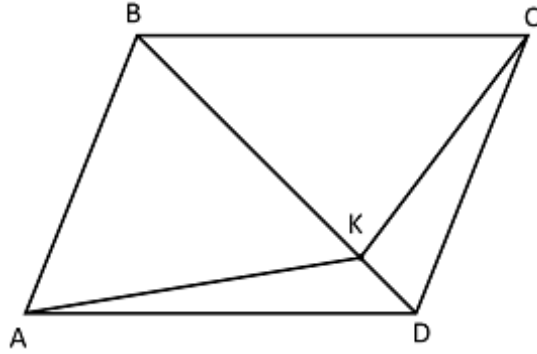
8. If $\frac{2}{3}$ of the distance from the y -axis to point $A(-30, -45)$ is equal to 14 of the distance from the x -axis to point $B(5a, 2a)$, where $a > 0$, what is the value of a ?

9. A perfectly straight 24 ft tall tree grows on the edge of the bank of a 45 foot wide river. A bird sitting at the top of the tree sees a fish in the middle of the river. At the same time as the fish begins to dive straight down, the bird flies in a straight line towards where it knows it will catch the fish. If the fish dives at a constant speed of 3 feet per second and the bird catches it in 2 seconds, how far from the top of the tree is the point where the bird meets the surface of the river?



10. The quadratic equation $2x^2 - 48x + q = 0$ has two roots, where one root is three times greater than the other. What is the value of q ?

11. ABCD is a parallelogram. $K \in \overline{BD}$, such that $BK : KD = 4 : 1$. The area of parallelogram ABCD is 120 square units. Find the area of the triangle AKD.



12. If $2^x = 10$ and $10^y = 128$, find xy .

13. Points $A(-10, 0)$ and $B(10, 0)$ are vertices of a triangle with an area of 60 square units. The third vertex of the triangle lies on the circle $x^2 + y^2 = 100$. Find how many such triangles exist.

14. In rectangle ABCD, \overline{AB} is parallel to the x -axis, and $AB = 2$. Points A and B lie on the parabola $y = x^2$ and points C and D lie on the parabola $y = -4x^2 + k$, where $k > 0$. If $BC = 17$, find k .

Answers

Question No.	Answer
1	64 new tiles would be needed to cover the table.
15	15
3	Becky's new phone has 27 hours of battery life without charging
4	The product of all solutions is 18.
5	One fidget spinner costs 109 cents.
6	The greatest integer that satisfies the above inequality is 1009
7	The gift cost 162 dollars.
8	$a = 40$
9	30 ft.
10	$q = 216$
11	The area of the triangle AKD is 12 square units.
12	$xy = 7$
13	4 such triangles exist.
14	$k = 22$

Grade 8

IMC 2017

1. Three times 3^{81} is equal to 9 to what power?
-

2. An ant walked on the coordinate plane from the point A(- 3,1) to the point B(1,25) by the shortest path. Find the y -coordinate of the point where the ant intersected y -axis.



3. Find the greatest integer that satisfies the inequality: $\frac{x - 16}{|x| - 7} < 0$
-

4. On Sunday John spent 20% more time playing his favorite game than he spent watching a movie, and he spent 28% less time reading a book than he spent watching the movie. The time he spent reading the book is what percent of the time he spent playing his favorite game?
-

5. The sum of all the solutions of the equation:

$$(10x - 3a)(3x + 39)(5x - 3) = 0 \text{ is } (-1).$$

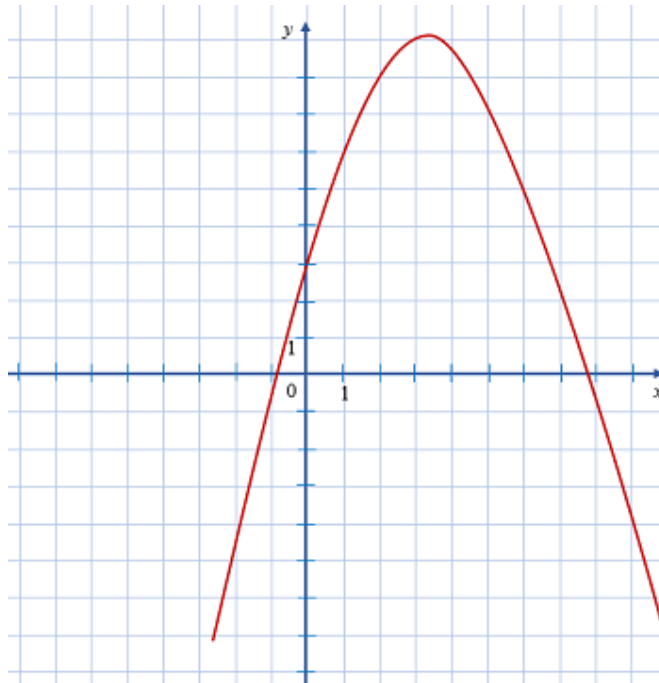
Find a .

6. The two top NBA players played a basketball game against the RSM team. Together the NBA players made 85 baskets, scoring one point for free throws and two or three points for field goals. They scored a total of 184 points during the

game. If they made 22 free throws, how many three-point field goals did they make?



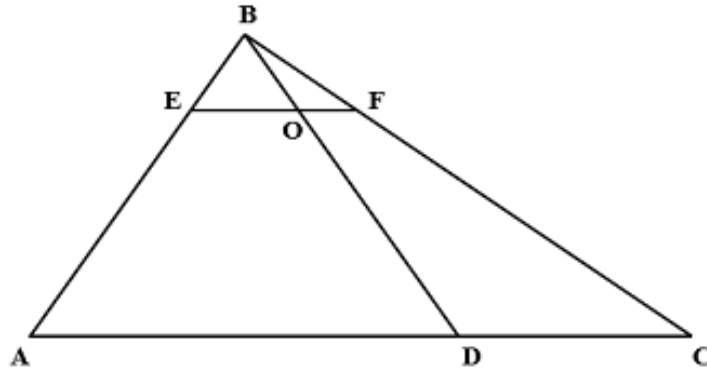
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7. The graph of the quadratic function $y = ax^2 + bx + c$ is given.
Find $a + b + c$.



-
8. The equation $(x^2 - 4ax + b)(x + a) = 0$ has three solutions and the sum of all solutions is 60.
Find a .

-
9. Given: $\triangle ABC$, $D \in \overline{AC}$, $AD : DC = 2 : 1$. $E \in AB$, $EB : AE = 1 : 3$,

$F \in \overline{BC}$, $\overline{EF} \parallel \overline{AC}$, O is the point of the intersection \overline{BD} and \overline{EF} . Area of $\triangle ABC = 216$ square units. Find area of $\triangle BOE$.



10. How many natural (counting) numbers satisfy this inequality:

$$\frac{|5 - x| \cdot (x - 2)}{x - 9} < 0$$

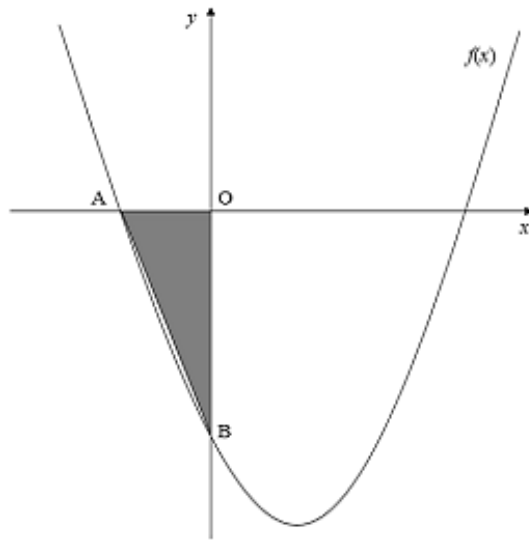
11. On the first day, a tourist hiked 9 miles to the east from the camp. On the second day, the tourist hiked a few miles to the north. On the third day, the tourist returned to the camp by straight way. If the tourist hiked a total of 90 miles, how many miles did the tourist hike on the third day?



12. Find the value of k , if $2^{2017} + 2^{2016} - 2^{2015} + 2^{2014} = k \cdot 2^{2014}$

13. The graph of $f(x) = a(4x + 5)^2$ intersects with the graph of $g(x) = (11x + 7)^2$ at the point with x -coordinate equals to 1. Find $f(1) + f(-1)$.
-

14. Graph $f(x) = (x + 4)(x - c)$, where $c > 0$ is shown on the picture. The area of $\triangle AOB$ is 192. Find c .



Answers

Question No.	Answer
1	41
2	The y -coordinate of this point is 19
3	15
4	60%
5	$a=38$
6	36
7	$a+b+c=6$
8	$a=20$
9	9 square units
10	5
11	41 miles
12	$k=11$
13	$f(1) + f(-1) = 328$
14	$c=24$

Grade 8

IMC 2016

1. 2^{12} is the same as 4 to what power?

2. Points A(- 1, 7), B(2, 19), and C(3, y) are on the same line. Find y .

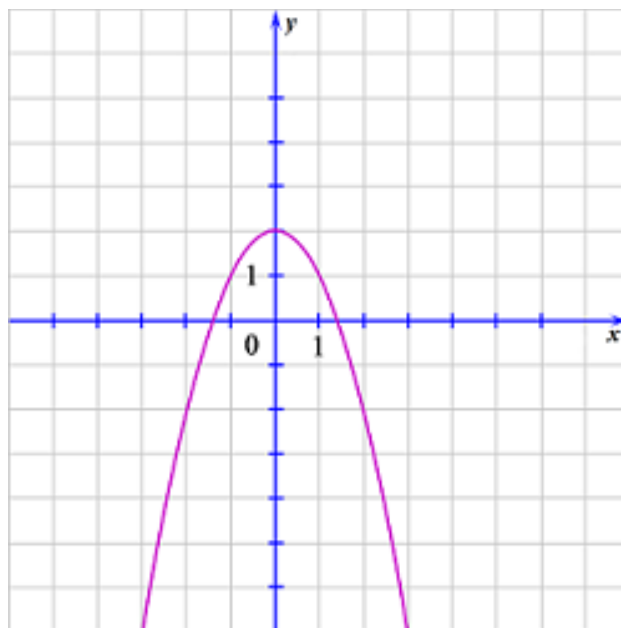
3. James has \$1100 invested at $r\%$ and \$900 invested at 5%. If his annual income on these two investments is \$89, find r .

4. Find the greatest integer that satisfies the inequality:
 $(|x| + 3)(x - 7) < 0$

5. Find the sum of all solutions to this equation:
 $(x - 1)(3x - 19)(3x + 1) = 0$

6. If 7 marshmallows and 11 lollipops cost \$1.93 altogether, and 11 marshmallows and 7 lollipops cost \$2.21 altogether, then how many cents does 1 lollipop cost?

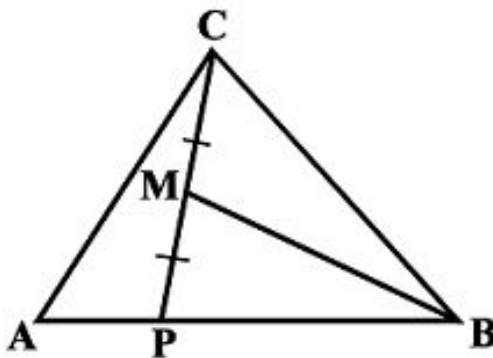
7. The graph of the quadratic function $y = ax^2 + c$ is given. Find $c + a$.



8. Find the length of the hypotenuse of a right triangle if one of its legs is 11 cm long and its perimeter is 132 cm.

9. The quadratic equation $3x^2 + px + q = 0$ has roots 3 and -4 . Find $p - q$.

10. In $\triangle ABC$, point $P \in \overline{AB}$ so that $AP:BP = 1 : 3$ and point M is the midpoint of segment \overline{CP} . Find the area of $\triangle ABC$ if the area of $\triangle BMP$ is equal to $21m^2$



11. How many natural (counting) numbers satisfy this inequality?

$$(x - 3) \cdot (x - 14) \cdot (x - 37) \leq 0$$

12. Find n such, that $8^n + 8^n + 8^n + 8^n = 2^{2015}$

13. At how many points does the graph of $y = x$ intersect the graph of the function $y = x \cdot \sqrt{2x + 5}$?

14. The base \overline{AB} of the isosceles triangle ABC is parallel to the x -axis and has both endpoints on the parabola $y = x \cdot (10 - x)$. The vertex C is on the x -axis. Find area of the triangle ABC if $AB = 8$ units.

Answers

Question No.	Answer
1	6
2	$y=23$
3	$r=4\%$
4	6
5	Sum = 7
6	8 cents
7	$c+a=1$
8	61 cm
9	$p-q=39$
10	$56m^2$

11	27
12	$n=671$
13	The graphs intersect at 2 distinct points
14	36 square units