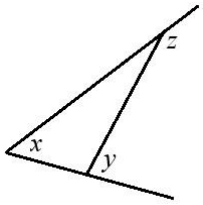
MathMania 2001

1. **In the diagram shown, all angle measures are in degrees. Given that y = 80 degrees and z = 120 degrees, find x.**



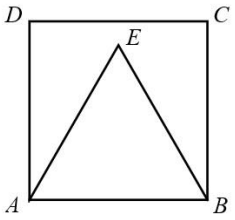
2. **Find the next term in the sequence: 4, 5, 8, 17, 44, 125, ...**
3. **If $2x^3 - 9x^2 + 15x + k$ is evenly divisible by $x - 2$, what is the value of k?**
4. **Find the equation of the circle passing through the points (0,0), (1,7), and (2,4).**
5. **Solve the equation $|x + 2| = 2|x - 3|$.**
6. **How many six-digit numbers contain at least one 7 in their decimal expansion?**

Answers

1. **x = 20 degrees**
2. **368**
3. **k = -10**
4. **$x^2 + 6x + y^2 - 8y = 0$ or $(x + 3)^2 + (y - 4)^2 = 25$**
5. **x = 4/3 or 8**
6. **427608**

MathMania 2002

1. **On a balance scale, three green balls balance six blue balls; two yellow balls balance five blue balls; six blue balls balance four white balls. How many blue balls are needed to balance four green, two yellow, and two white balls?**
2. **In the figure, ABCD is a square and ABE is an equilateral triangle, and E is in the interior of ABCD. Find the measure of angle DEA.**



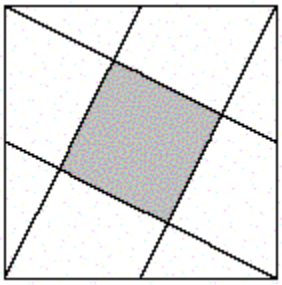
3. **Find the next term in the sequence: 1, 1, 1, 3, 5, 9, 17, 31, 57, …**
4. **If $\log_2(\log_3 x) = 4$, find x.**
5. **In a group of men and women, the average age is 31 years. If the average age of the men is 35 years and the average age of the women is 25 years, what is the ratio of the number of men to the number of women?**
6. **If a triangle has sides of length 10, 24, and 26, what is the radius of its circumscribed circle?**
7. **How many positive integer values of x are there such that $96/(x + 5)$ is an integer?**
8. **Find the two rightmost digits of 1! + 2! + 3! + ... + 100!.**
9. **How many ways are there to fill a 3×3 grid with 0's and 1's so there is at least one zero in each row and column?**

Answers

1. **16 blue balls**
2. **75 degrees [or 5pi/12 radians]**
3. **105 (each term is the sum of the previous three)**
4. **$3^{16} = 43046721$**
5. **3:2**
6. **13**
7. **8**
8. **13**
9. **265**

MathMania 2003

1. **A circle and a parabola are drawn in the plane. What is the largest number of regions they divide the plane into?**
2. **From a group of boys and girls, 15 girls leave. There are then two boys for each girl. After this, 45 boys leave. There are then 5 girls for each boy. What was the number of girls originally present?**
3. **What is the smallest positive integer x such that 750 x is a perfect square?**
4. **At 2:15, what is the angle between the hour hand and the minute hand of a clock?**
5. **The large square shown has area 1. The four interior lines each join a vertex of the square to the midpoint of a side as shown. What is the area of the small central square?**



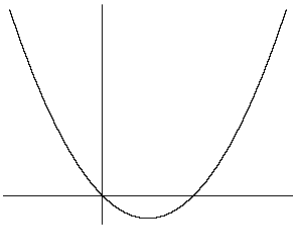
6. **Solve the equation $x^2 + x - 8 = |x|$.**
7. **What is the number of digits in 2003^{2003}?**

Answers

1. **six regions**
2. **40 girls**
3. **30**
4. **22.5 degrees or pi/8 radians**
5. **1/5**
6. $x = -4$ or $x = \sqrt{8} = 2\sqrt{2}$
7. **6614**

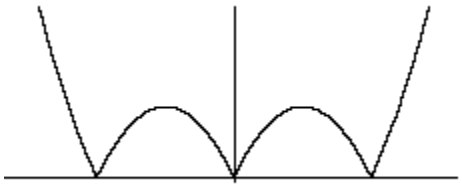
MathMania 2004

1. **Some marbles in a bag are red and the rest are blue. If one red marble is removed, then one-seventh of the remaining marbles are red. If two blue marbles are removed instead of one red one, then one-fifth of the remaining marbles are red. How many marbles were in the bag originally?**
2. **At 3:45, what is the angle (in degrees) between the hour hand and the minute hand of a clock**
3. **The graph of f(x) is shown below. Sketch the graph of |f(|x|)|.**



4. **If $\log_2(\log_3(\log_4 x)) = -1$, find x.**
5. **What are the last two digits of 2004^{2004}?**
6. **If a and b are two positive integers and c is their greatest common divisor, express the least common multiple of a and b as a rational function of a, b, and c.**
7. **Two students copy a quadratic equation incorrectly. The first student makes an error copying the constant term and obtains 2 and 5 as roots. The second student makes an error copying the linear term and obtains 2 and 6 as the roots. What are the actual roots of the equation?**

Answers

1. **22 marbles**
2. **157.5 degrees**
3. 
4. **$4^{sqrt(3)}$ or approximately 11.035**
5. **the last two digits are 56**
6. **ab/c**
7. **the roots are 3 and 4**

MathMania 2005

1. **A movie was attended by 500 people. Adults paid $10 each and children paid $4 each. The total amount taken in was $4160. How many children attended?**
2. **A regular decagon is a polygon with 10 congruent sides and 10 congruent interior angles. What is the degree measure of one of these interior angles?**
3. **A jar contains 7 blue balls, 9 red balls, and 10 white balls. One by one, balls are drawn at random from the jar until either four balls of the same color or at least two balls of each color have been drawn. What is the largest number of balls that would have to be drawn?**
4. **Find the next term in the sequence: 1, 1, 3, 7, 17, 41, 99, 239, 577, ...**
5. **A magic square is a square array of numbers such that the sum of the numbers in each row, in each column, and each of the two main diagonals is the same. Complete the magic square shown below.**

	1	8
5		

Answers

1. **140 children**
2. **144 degrees**
3. **8 balls**
4. **1393**
5.

9	1	8
5	6	7
4	11	3

MathMania 2006

1. **You have 21 dimes and quarters with a total value of $3. How many dimes do you have?**
2. **Find the next term in the sequence: 1, 2, 5, 12, 29, 70, 169, 408, ...**
3. **The sum of two numbers is 20 and the sum of their squares is 270. What is the product of the two numbers?**
4. **If $\log_3(\log_2 x)) = 2$, find x.**
5. **What is the radius of a circle inscribed in a triangle having sides of length 5, 12, and 13?**

Answers

1. **15 dimes**
2. **The next term is 985.**
3. **The product is 65.**
4. **$x = 512$**
5. **The inradius is 2.**

MathMania 2007

1. **In a certain motel, if two students share each room, then two students will be left without a room. If three students share each room, then two rooms will be left empty. How many rooms are in the motel?**
2. **A car went up a hill at an average speed of 30 mph and went down the hill at an average speed of 60 mph. What was the average speed for the entire trip?**
3. **What is the angle (in degrees) between the minute hand and hour hand of a clock that reads 6:20?**
4. **Find the next term in the sequence: 1, 4, 13, 31, 61, 106,...**
5. **What are the last two digits in the decimal expansion of 2007^{2007} ?**
6. **What is the smallest positive integer that is not a divisor of 90! = 90×89×...×3×2×1?**

Tiebreaker How many (decimal) digits are there in 2007! = 2007×2006×...×3×2×1? (after it is expanded out)? The team getting closest to the correct answer wins.

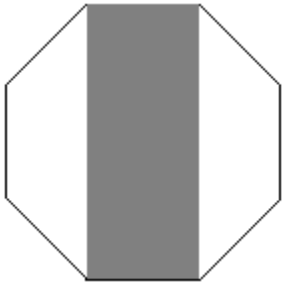
Answers

1. **8 rooms**
2. **40 mph**
3. **70 degrees**
4. **The next term is 169.**
5. **The last two digits are 43.**
6. **The smallest positive integer that is not a divisor is 97.**

Tiebreaker There are 5759 digits.

MathMania 2008

1. **If an item in a store is marked up 25%, how much must it then be marked down to result in the original price?**
2. **You have 45 dimes and quarters worth a total of $9. How many quarters do you have?**
3. **Each interior angle of a regular polygon has a measure of 165 degrees. How many sides does the polygon have?**
4. **What is the angle (in degrees) between the minute hand and hour hand of a clock that reads 7:50?**
5. **A regular octagon is shown below. What fraction of its area is shaded?**



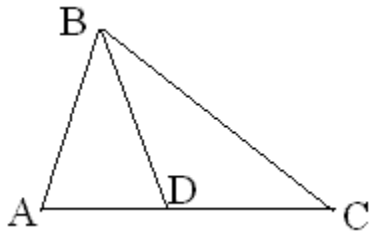
6. **The sum of two numbers is 10 and the sum of their squares is 70. What is the product of the two numbers?**

Answers

1. **It must be marked down 20%.**
2. **You have 30 quarters.**
3. **The polygon has 24 sides.**
4. **65 degrees**
5. **Half of the area is shaded.**
6. **The product of the numbers is 15.**

MathMania 2009

1. **Gizmos cost $3 each and doodads cost $4 each. If you buy a total of 20 gizmos and doodads for $75, how many doodads did you buy?**
2. **If the radius of a sphere is increased by 20%, by what percentage does the surface area of the sphere increase?**
3. **In the triangle shown, segments *AB*, *BD*, and *CD* are congruent. What is the measure of angle *ABC*?**



4. **What's the next most likely term in the sequence 1, 5, 15, 34, 65, 111, …?**
5. **Five people forget their backpacks in class. Their teacher returns the backpacks randomly. What is the probability that exactly two of them get their own backpacks?**

Answers

1. **15 doodads**
2. **The surface area increases by 44%.**
3. **The measure of angle *ABC* is 75 degrees.**
4. **The next term is 175.**
5. **The probability is 1/6.**

MathMania 2010

1. **If an item in a store is marked up 20%, exactly what percentage must it then be marked down to result in the original price?**
2. **At a bake sale, brownies cost 50 cents each and cookies cost 35 cents each. If 70 items were sold for a total of $29, how many cookies were sold?**
3. **Each interior angle of a regular polygon has a measure of 168 degrees. How many sides does the polygon have?**
4. **What's the first time after 12 noon that the angle between the minute hand and hour hand of a clock is 110 degrees?**
5. **Find the most likely next term in the sequence: 1, 2, 4, 7, 13, 24, 44, 81,…**
6. **Find all solutions to the equation $x^2 + x - 3 = |x|$.**
7. **What are the coordinates of the centroid of the triangle whose vertices are (0, 0), (1, 7), and (2,5)?**

TIEBREAKER: There are five ways to divide a set with three elements into nonempty disjoint subsets: If there is only one subset in our partition we must have {{*A*, *B*, *C*}}. If there are two subsets we could have {{*A*, *B*}, {*C*}}, {{*A*, *C*}, {*B*}}, or {{*B*, *C*}, {*A*}}. If there are three subsets we must have {{*A*}, {*B*}, {*C*}}. What is the number of ways to divide a set with 10 elements into nonempty disjoint subsets? The team getting closest to the correct answer wins.

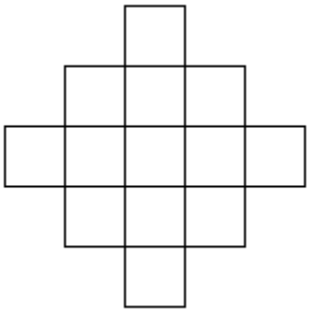
Answers

1. **It must be marked down 16 2/3 %.**
2. **There were 40 cookies sold.**
3. **The polygon has 30 sides.**
4. **The time is 12:20.**
5. **The next term is 149.**
6. **The solutions are $x = \sqrt{3}$ or $x = -3$,**
7. **The centroid is (1,4).**

TIEBREAKER: There are 115975 partitions

MathMania 2011

1. **You have a total of 46 quarters and dimes worth $7. How many of each type of coin do you have?**
2. **From a pool of 6 women and 4 men, a committee consisting of 3 women and 2 men must be formed. In how many ways can this be done?**
3. **Find the most likely next term in the sequence: 1, 1, 1, 4, 10, 25, 64, 163,…**
4. **In a 100 meter race, Alice beats Bob by 10 meters and Bob beats Charlie by 20 meters. By how many meters did Alice beat Charlie?**
5. **The sum of two numbers is 4 and the sum of their reciprocals is 2. What is the sum of their squares?**
6. **Find the total number of rectangles (of any size) in the figure shown.**

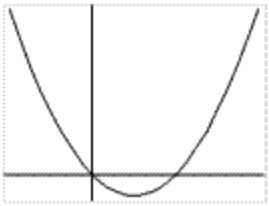


Answers

1. **You have 30 dimes and 16 quarters.**
2. **There were 120 such committees.**
3. **The next term is 415.**
4. **Alice beats Charlie by 28 meters**
5. **The sum of the squares is 12.**
6. **There are 54 rectangles in the figure.**

MathMania 2012

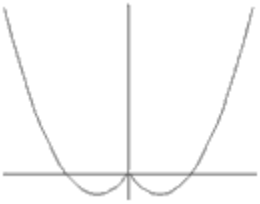
1. **A car goes up a hill at a constant speed of 20 mph and then back down the same hill at a constant speed. The average speed for the round trip is 32 mph. What was the downhill speed?**
2. **The graph of $f(x)$ is shown. Sketch the graph of $f(|x|)$.**



3. **What is the next most likely term in the sequence 1, 1, 3, 5, 11, 21, 43, 85, …?**
4. **If the polynomial $x^3 + 3x^2 + kx + 6$ has $x - 2$ as a factor, what must k be?**
5. **What is the radius of the circle inscribed in a triangle with sides of length 5, 5, and 6?**
6. **For how many values of n does an interior angle of a regular n-gon have a measure that is an integer number of degrees?**

Answers

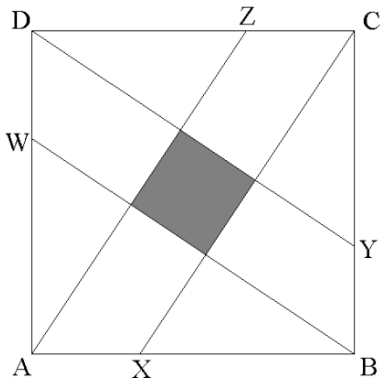
1. **The car's speed is 80 mph.**
2. **The graph is**



3. **The next most likely term is 171.**
4. **The coefficient must be $k = -13$.**
5. **The inradius is 3/2.**
6. **There are 22 values of n that give the desired polygons.**

MathMania 2013

1. **The price of an item is marked up 10% and then decreased 20%. What is the net decrease in the price?**
2. **If you have 62 dimes and quarters that are worth a total of $11, how many dimes do you have?**
3. **At 3:40, what is the angle between the minute hand and hour hand of a clock (in degrees)?**
4. **If $x + 1/x = 3$, then $x^3 + 1/x^3 =$**
5. **If $x - 2$ is a factor of $x^3 - kx + 6$, what must k be?**
6. **Find all solutions to the equation $x^2 = |3x + 2|$.**
7. **Square ABCD has area 1. Given that AX/XB = BY/YC = CZ/ZD = DW/WA = 1/2, find the area of the small shaded square.**



Answers

1. **The price decreases 12%.**
2. **You have 30 dimes.**
3. **The angle between the hands is 130 degrees.**
4. **The value is 18.**
5. **$k = 7$.**
6. **$x = -1, -2, (3 \pm \sqrt{17})/2$.**
7. **The area of the small square is 1/13.**

MathMania 2014

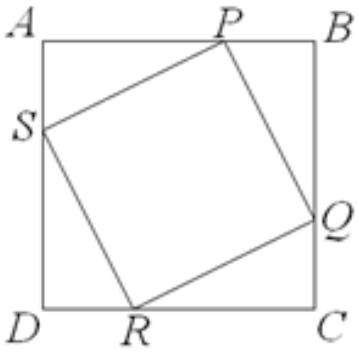
1. **At 2:30, what is the angle (in degrees) between the minute and hour hands of a clock?**

2. **What is the next most likely term in the sequence 1, 4, 10, 20, 35, 56, 84, 120, …?**

3. **One interior angle of a regular polygon has a measure of 170 degrees. How many sides does the polygon have?**

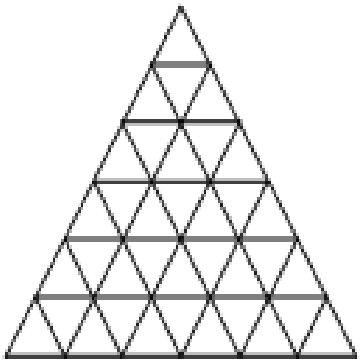
4. **If the radius of a sphere is increased 30%, by what percentage its surface area increased?**

5. **In the figure shown *ABCD* and *PQRS* are squares and *AP*/*PB* = *BQ*/*QC* = *CR*/*RD* = *DS*/*SA* = 2. What is the ratio of the area of *PQRS* to the area of *ABCD*?**



6. **In a group of people, the average age is 51. The average age of the women is 46 and the average age of the men is 53. What is the ratio of the number of men to the number of women?**

7. **What is the total number of triangles (of any size) in the figure shown?**



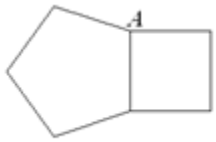
8. **When a quadratic polynomial is divided by $x - 1$, the remainder is 4, when divided by $x + 1$, the remainder is 6, and when divided by $x - 2$, the remainder is 9. Find the polynomial.**

MathMania 2014 Answers

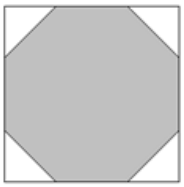
1. **The angle between the clock hands is 105 degrees.**
2. **The next most likely term is 165.**
3. **The polygon has 36 sides.**
4. **The surface area of the sphere is increased by 69%.**
5. **The ratio of the areas of the squares is 5:9.**
6. **The ratio of men to women is 5:2.**
7. **There are 78 triangles in the figure.**
8. **The polynomial is $2x^2 - x + 3$.**

MathMania 2015

1. **At a bake sale, cookies sell for $1.25 each and brownies sell for $1.50 each. If 120 items were sold for a total of $170, how many brownies were sold?**
2. **What is the angle between the hands of a clock at 3:45?**
3. **A square and a regular pentagon are joined along an edge as shown in the figure. A third regular polygon can be placed at vertex A so that it shares a side with each of the other two polygons. How many sides does the third polygon have?**

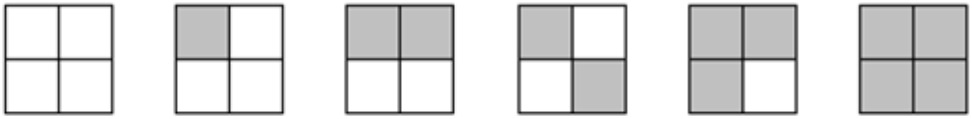


4. **If a fair coin is tossed six times, what is the probability that heads appear exactly three times?**
5. **If $x + 1$ is a factor of $x^3 + 3x^2 + kx + 6$, what must k be?**
6. **A regular octagon (shaded) is inscribed in a square as shown. What is the ratio of the length of a side of the square to the length of a side of the octagon?**

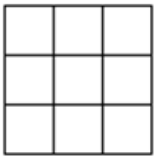


7. **What's the radius of the circle passing through the points (0,0), (6,0), and (4,2)?**
8. **Find all real solutions to the equation $|\log_2|\log_2 x|| = 1$.**

TIEBREAKER: If one considers patterns that differ by a rotation or by a reflection to be equivalent, there are six essentially different ways of coloring a 2×2 array of unit squares with two colors:



How many essentially different ways are there of coloring a 3×3 array of unit squares with two colors?



Note: The team getting closest to the correct answer wins.

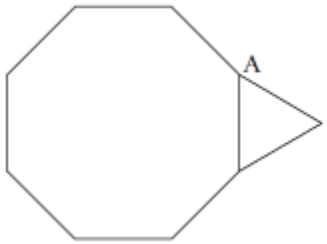
MathMania 2015 Answers

1. **80 brownies**
2. **157.5 degrees**
3. **The polygon has 20 sides.**
4. **The probability is 20/64 = 5/16 = .3125.**
5. **We must have $k = 8$.**
6. **The ratio of side lengths is $1+\sqrt{2}$.**
7. **The radius is $\sqrt{10}$.**
8. **The solutions are $x = 4, 1/4, \sqrt{2}$, and $\sqrt{2}/2$.**

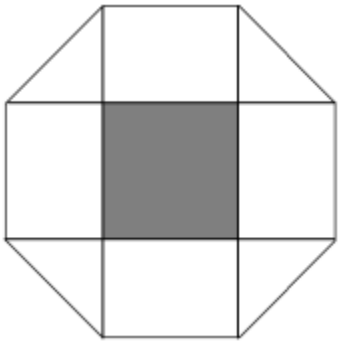
TIEBREAKER: There are 102 colorings.

MathMania 2016

1. **How many liters of a 10% salt solution must be added to 6 liters of a 20% salt solution to obtain a 13% salt solution?**
2. **What is the first time after 1 pm when the angle between the hands of a clock is 80 degrees?**
3. **An equilateral triangle and a regular octagon are joined along an edge as shown in the figure. A third regular polygon can be placed at vertex *A* so that it shares a side with each of the other two polygons. How many sides does the third polygon have?**



4. **If a standard six-sided die is rolled four times, what is the probability that at least one of the rolls is a 3?**
5. **When a polynomial is divided by $x - 1$, the remainder is 5; when it's divided by $x + 2$, the remainder is -4. What is the remainder when the polynomial is divided by $(x - 1)(x + 2)$?**
6. **Some of the diagonals of a regular octagon are drawn to form a square (shaded in the figure). What is the ratio of the area of the octagon to the area of the square?**



Answers

1. **14 liters**
2. **1:20 pm**
3. **The polygon has 24 sides.**
4. **The probability is $1 - (5/6)^4 = 671/1296$.**
5. **The remainder is $3x + 2$.**
6. **The ratio of the areas is $2 + 2\sqrt{2}$.**

MathMania 2017

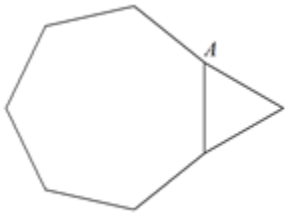
1. **You have a total of 50 quarters and dimes worth $8. How many coins of each type do you have?**
2. **What is the angle between the hands of a clock at 2:45 (in degrees)?**
3. **From a pool of 4 women and 7 men, a committee consisting of 5 people, at least one of which must be a woman, is to be formed. In how many ways can this be done?**
4. **Find all real x satisfying $\log_4(\log_3(\log_2 x)) = -1/2$.**
5. **Solve the equation $x^2 = |2x - 1|$.**
6. **If $x + 1/x = 3$, find $x^4 + 1/x^4$.**
7. **Find the first three digits of 2017^{2017}.**
8. **If $2x^3 - 9x^2 + ax + b$ has $x + 2$ and $x - 1$ as factors, what must a and b be?**

Answers

1. **20 quarters and 30 dimes**
2. **172.5 degrees**
3. **441 committees**
4. **$x = 2^{\sqrt{3}}$**
5. **$x = 1$ or $-1 \pm \sqrt{2}$**
6. **47**
7. **The first three digits are 390.**
8. **$a = -15$ and $b = 22$**

MathMania 2018

1. **You have a total of 23 dimes and quarters worth $5. How many quarters do you have?**
2. **What is the next most likely term in the sequence 1,2,3,6,11,20,37,68,...?**
3. **What is the angle (in degrees) between the minute hand and hour hand of a clock when it reads 3:14?**
4. **A regular heptagon (7-sided) and an equilateral triangle are joined along an edge as shown in the figure. A third regular polygon can be placed at vertex *A* so that is shares a side with each of the other two polygons. How many sides does the third polygon have?**



5. **What is the area of the triangle whose sides have lengths 13, 14, and 15?**
6. **Solve the equation $\log_2(\log_5(x)) = -1$.**
7. **What is the number of (decimal) digits in 2018^{2018}?**
8. **What is the probability that when you roll three standard six-sided dice, the sum of the values of the dice is 7?**

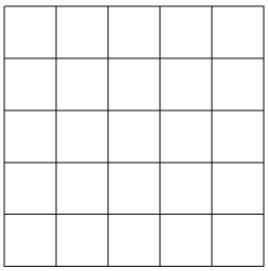
Answers

1. **18 quarters**
2. **the next term is 125**
3. **the angle between the hands is 13 degrees**
4. **the polygon has 42 sides**
5. **the area of the triangle is 84 square units**
6. **$x = \sqrt{5}$**
7. **6670 digits**
8. **the probability is 5/72**

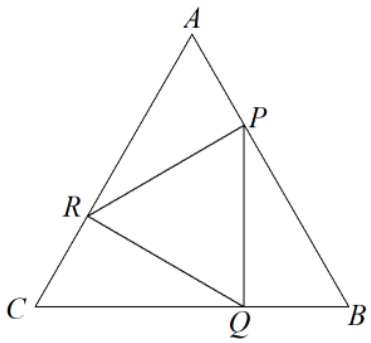
MathMania 2019

Rolla HS and Central HS duelled through all 12 questions, so we went to a tie-breaker. Rolla won the contest and Central received very honorable mention.

1. **What is the degree measure of an interior angle of a regular 30-sided polygon?**
2. **Find the next most likely term in the following sequence: 0, 1, 6, 20, 50, 105, 196, ...?**
3. **If the polynomial $x^4 + kx^3 + 5x^2 + k$ has $x - 2$ as a factor, what must k be?**
4. **Find all solutions to $|\log_3|\log_3 x|| = 1$.**
5. **A group consists of 8 Americans and 7 Canadians. How many ways are there to choose a committee of 3 people from this group if at least one committee member must be Canadian?**
6. **If a fair coin is tossed 8 times, what is the probability that exactly 4 of the tosses are heads? Please give your answer as a reduced fraction.**
7. **Find the first three digits of 2019^{2019}.**
8. **A car travels up a hill at an average speed of 36 mph and down the same hill at an average speed of 45 mph. What is the average speed for the round trip?**
9. **A spherical snow ball is melting. If its surface area decreases by 19%, by what percentage does its volume decrease?**
10. **Find the total number of squares (of any size) in the figure shown.**



11. **Find the last three digits of 1! + 2! + 3! + ... + 100!.**
12. **In the figure shown, $AP/PB = BQ/QC = CR/RA = 1/2$. Find the ratio of the area of triangle ABC to the area of triangle PQR.**



TIE BREAKER: The partition number of an integer *n* is the number of ways of writing *n* as a sum of positive integers where the order of the integers does not matter. For example, the partition number of 5 is 7 since 5 = 5, 4 + 1, 3 + 2, 3 + 1 + 1, 2 + 2 + 1, 2 + 1 + 1 + 1, or 1 + 1 + 1 + 1 + 1. What is the partition number of 50?

The team getting closest to the correct answer wins.

Answers

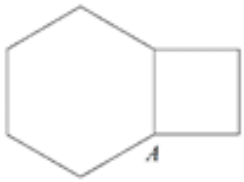
1. **The measure of the angle is 168 degrees.**
2. **The next most likely term is 336.**
3. **We must have $k = -4$.**
4. **The solutions are $x = 9, 1/9, \sqrt{3}$ or $1/\sqrt{3}$.**
5. **The number of conmmittees is 299.**
6. **The probability is 35/128.**
7. **The first three digits are 117.**
8. **The average speed is 40 mph.**
9. **The volume decreases 27.1%.**
10. **There are 55 squares.**
11. **The last three digits are 313.**
12. **The ratio of the areas is 3:1.**

TIE BREAKER: There are 204226 partitions of 50.

NOTE: There was no MathMania in 2020 or 2021 due to the COVID epidemic.

MathMania 2022

1. **What is the first time after 9 o'clock when the angle between the hands of a clock is 50 degrees?**
2. **A square and a regular hexagon are joined along an edge as shown in the figure. A third regular polygon can be placed at vertex A so that it shares a side with each of the other polygons. How many sides does the third polygon have?**



3. **What is the next most likely term in the following sequence: 1, 4, 13, 40, 121, 364, ...?**
4. **If a fair coin is tossed 6 times, what is the probability that the number of heads and tails is equal? Give your answer as a reduced fraction.**
5. **Alice and Bob can paint a room in 3 hours. Alice and Carol can paint the same room in 4 hours. Bob and Carol can paint the room in 6 hours. How long would it take to paint the room if Alice, Bob, and Carol all worked together?**

Answers

1. **The time is 9:40.**
2. **The polygon has 12 sides.**
3. **The next most likely term is 1093.**
4. **The probability is 5/16.**
5. **It would take them 2 2/3 hours or 2 hours and 40 minutes to paint the room.**

MathMania 2023

1. **What is the smallest positive integer that cannot be written as the difference of two (positive) prime numbers?**
2. **A 4×4 sudoku is an array such that the digits 1,2,3,4 appear exactly once in each row, in each column, and in each of the outlined squares. An example of a completed 4×4 sudoku is shown on the left. Complete the partial 4×4 sudoku shown at the right.**

4	1	2	3
2	3	4	1
1	4	3	2
3	2	1	4

1			
	2		
		3	
4			

3. **What is the next most likely term in the following sequence: 1, 1, 5, 13, 41, 121, …?**
4. **If a fair six-sided die is tossed four times, what is the probability that exactly two 6's occur?**
5. **On the planet Tralfamadore, a ball is tossed upward. It's height after t seconds is given by $h(t) = -8t^2 + 320t$ meters. What is the ball's velocity when it first reaches a height of 2400 meters?**
6. **If the polynomial $x^4 + k\,x^3 + 5x^2 + k$ has $x-1$ as a factor, what must k be?**

Answers

MathMania 2023 Answers

1. **The smallest such integer is 7.**
2.

1	4	2	3
3	2	4	1
2	1	3	4
4	3	1	2

3. **The next most likely term is 365.**
4. **The probability is 25/216.**
5. **The ball's velocity is 160 m/s.**
6. **We must have $k = -3$.**

MathMania 2024

1. **You have a total of 45 quarters and dimes worth $9. How many coins of each type do you have?**
2. **What is the area of a triangle with sides of length 10, 17 and 21?**
3. **Jane can paddle a canoe 4 mph in still water. If she paddles upstream 15 miles, then downstream 15 miles, it takes her 8 hours for the round trip. What is the speed of the current? You may assume the speed is constant.**
4. **The measure of an interior angle of a regular polygon is 176 degrees. How many sides does the polygon have?**
5. **What are the last two digits of 2024^{2024}?**
6. **Find all real solutions to the following: $\ln(\ln x \cdot \ln x) = 1$.**
7. **If four standard six-sided dice are thrown, what is the probability that the face values sum to 6? Please give your answer as a reduced fraction.**
8. **How many five-digit numbers in base 10 contain at least one 3?**

Answers

1. **There are 30 quarters and 15 dimes.**
2. **The triangle has an area of 84 square units.**
3. **The speed of the current is 1 mph.**
4. **The polygon has 90 sides.**
5. **The last two digits are 76.**
6. **The solutions are $x = e^{\sqrt{e}}$ and $x = e^{-\sqrt{e}}$**
7. **The probability is 5/648.**
8. **There are $9 \cdot 10^4 - 8 \cdot 9^4 = 37512$ such numbers.**