**2008 IMSA Junior High Math Competition**

8th Grade Individual Contest

1. What is the perimeter of a regular hexagon with side length 3?

2. The circumference of a circle is 24****. What is its radius?

3. A rectangle with area 78 has one side one unit longer than twice the length of an adjacent side. What are the dimensions of the rectangle?

4. What is the sum of the first 9 prime numbers?

5. Emily and Sharon both live the same distance away from school. Emily leaves her home at 7:00, and arrives at school at 7:20 after bicycling at a constant speed of *e* miles/hour. Sharon leaves home at 6:56 and arrives at the same time as Emily after rollerblading at a constant speed of *s*. What is the ratio of Emily’s speed to Sharon’s speed, ?

6. Stephanie, Stefanie, Stephany, Stephene, and Stephen sit around a circular table. How many possible ways are there to arrange them if only their relative order matters, and not their placement around the table?

7. What are the sum of all the factors of 1690 (including 1 and itself)?

8. When Don says "hexagon," he means "square" 3/10 of the time and "hexagon" the rest of the time. When he says "circle," he means "triangle" 1/7 of the time and "circle" the rest. Finally, when he says "triangle," he means "hexagon" 2/3 of the time and "circle" the rest. If he says, "Draw a hexagon, a circle, a circle, then a triangle," what is the probability that he means "Draw a square, a triangle, a circle, then a hexagon"?

9. On a checker board with 5 rows and 5 columns of squares, a checker can only move from a box to an immediately diagonal box. If a checker begins in the bottom-left most box, how many different paths may the checker take to get to the opposite corner if it must get there in 6 moves or fewer, and if once the checker gets to the opposite corner it must remain there?

10. Evelyn rolls 3 six-sided fair dice. What is the probability their sum adds up to 6 or less?

11. Define . Find .

12. What is the sum of the degree measure of all the interior angles of a regular hexagon and one exterior angle of a regular pentagon?

13. A lattice point is a point on the Cartesian plane with integer coordinates. For example, (1,1), (2,5), and (2394, 23) are all lattice points. How many lattice points are found within the region enclosed by a circle of radius 4, centered at the origin?



14. In the figure, CAB is similar to DEB. If AD = 2, BD = 4, and BE= 3, find BC. [Note: figure not drawn to scale]

15. Nicholas gives Oliver 1/10 of all his money, then Peter 2/3 of the remaining money, then Quincy 3/4 of the remaining cash. He starts with $240. How much does he have left at the end?

16. The temperature of Jenny’s coffee is 150 degrees. She wants to drink it when it is at exactly 100 degrees, so she puts it in the refrigerator. The temperature of the coffee in the refrigerator is modeled by , where  is represents the temperature of the coffee  minutes after it is put in the refrigerator. However, after 11 minutes, the coffee is too cold, and Jenny takes the coffee out and heats it back up in the microwave. If the microwave raises the temperature of the coffee by 2/3 of a Fahrenheit degree each second, how long should she set the timer for, in seconds?

17. Backwards Bobby reads numbers from right to left, instead of left to right. For example, to him, the number 12,345 appears to be 54,321. Bobby sees a three digit number in a math problem and believes it is 9 more than twice its actual value. What is the actual number?

18. Emily and Evelyn run at 5 m/s and 4 m/s, respectively. In a race, they run 10 meters in the same direction, immediately turn around and run back to their starting point, turn and run 20, return to their starting point, etc. until they run 50 meters and return to the starting point. Assuming their speeds remain constant, how many times do they pass each other during the race?

19. Simplify: 

20. If each of the four letters I, M, S, A in the equation  represents a different positive digit in base 10, what is the numerical equivalent of *IMSA*?

**2009 IMSA Junior High Math Competition**

8th Grade Individual Contest

1. If the area of a square is 20, what is its perimeter?
2. If Orfeo has three baskets of apples and Eurydice has five baskets, how many apples do they have altogether? [One basket of apples contains four apples].
3. Merst and Melo are both standing at the same street corner. Suddenly, Merst begins running due north at 5 mph and Melo begins running due west at 12 mph. Assuming that both can keep up the pace indefinitely, how many miles apart will they be after two hours?
4. Sarastro’s temple has two rooms. If he can fit up to ten chairs in a room, what is the maximum number of chairs he can fit in the temple?
5. In a standard deck of 52 cards, a king is worth 13 points, a queen 12 points, a jack 11 points and a number card is worth its number. That is, an ace would be worth 1 and a 5 of hearts would be worth 5. Giovanni draws a 10 of spades from a standard deck and does not replace it. Elvira and Masetto both draw one card each after him (without replacement). What is the probability that they both draw cards that are worth fewer points than Giovanni’s card?
6. There is a river that runs east to west. Pamino lives fives miles north of the river, and everyday he needs to fetch water from the river, and go to his grandmother's house which is 3 miles north of the river and 6 miles west of his house. What is the length, in miles, of the shortest path Pamino can take?
7. What is the units digit of 22009 – 5?
8. What is the volume of the largest cube that can fit inside a sphere of radius ?
9. Find the sum of all positive primes less than 50.
10. Ravel needs to make enough whole 8-slice pizzas to feed 389 people. Each person will eat 2 slices. If each pizza requires 0.33 pounds of tomatoes, 0.50 pounds of flour and 0.17 pounds of cheese, how many total pounds of ingredients does Ravel need to buy?
11. Vivaldi draws three red dots on a piece of paper, five blue dots and ten black dots. Then he draws edges between the dots such that each dot is connected once and only once to each other dot. An edge connected by two dots of the same color will be that color; an edge connected by two dots of different colors will be the third color [For example, an edge between a red and blue dot will be black]. Find the number of black edges.
12. Salieri is thinking of a number between 1 and 1000; it is divisible by 14, 35, and 26. What is the number?
13. Mimi draws a regular 50-sided polygon on a piece of paper. What is the sum of the degrees of all the interior angles?
14. Sutherland, Damrau, Dessay, Netrebko and Callas randomly sit around a circular table. Find the probability that Damrau and Netrebko will **not** sit next to each other.
15. The area of an equilateral triangle is equal to its perimeter; what is its side length?
16. How many distinct ways are there to arrange the letters in MATHLETE?
17. On any given night, there is a 30% chance that Amina will sleep-talk, a 60% chance that she will sleep-walk, and a 25% chance she will sleep and do nothing else. What is the chance she will both sleep-talk and sleep-walk on a given night? Give your answer as a percentage.
18. Violetta invites 1000 people to a party at her house. Unfortunately, 35% of the guests reject the invitation outright. Then, an additional 10% of those remaining politely decline. Lastly, 20% of those remaining after that don’t show up the day of party. How many guests does she end up hosting?
19. There are 500 closed lockers in a row at IMSA. Hänsel walks up the row and opens every even-numbered locker. Then, Gretel walks up and changes the state of every third locker [locker 3, locker 6, locker 9 etc.]. That is, Gretel opens a locker that is already closed and closes one that is already open. Then Hänsel returns and changes the state of every fourth locker. After that, Gretel changes the state of every fifth locker. And so on, until Hansel has changed the state of every 500th locker. How many lockers are closed after Hansel and Gretel finish?
20. Juliette arrives randomly at her balcony sometime between 8:00 PM and 8:50 PM and stays there for 10 minutes before leaving if she doesn’t see Roméo. He, on the other hand, arrives at her garden, below the balcony, at some time between 8:00 PM and 8:50 PM and stays for 10 minutes before leaving if he does not see her. What is the probability that they miss each other?

**2010 IMSA Junior High Math Competition**

8th Grade Individual Contest

1. There is a square with perimeter 20. What is the area of this figure?
2. How many ways can the letters that spell ILLINOIS be distinctly rearranged?
3. In the diagram below, Dr. Max McGee starts at a point somewhere to the Northwest of IMSA and walks toward IMSA. If he only walks south or east on the lines one segment at a time, in how many different ways can he get to IMSA?



1. Alex can mow a lawn alone in 4 hours. Alex and his friend Bobby can mow the same lawn together in 1.5 hours. How many hours does it take Bobby to mow the lawn alone?
2. Sally has 4 shirts of different colors (red, blue, green, and yellow) and 3 pairs of pants (red, blue, and black). How many different outfits consisting of one shirt and one bottom can she wear, given that they are not the same color?
3. At how many times from noon to noon are the minute and hour hands of a clock directly opposite one another?
4. Cheng-Po Li is thinking of a two-digit number, and he bets that Kevin won’t be able to guess what it is even if three clues are given. He tells Kevin that when he divides his number by 5, he gets a remainder of 2, and when he divides his number by 2, he gets a remainder of 1, and when he divides his number by 9, he gets a remainder of 6. What is Cheng-Po Li’s number?
5. Find the last digit of the product of and 
6. A line segment is formed by connecting the points at (1,1) and (6,3). Find the distance from (1,1) to the point that divides this segment in half.
7. Irene is writing the solutions for the problems on the Junior High Math Competition at IMSA. As you read this problem, she is writing down the answers to all 85 of the problems. If she can answer 1 question in 2 minutes, how many minutes will it take her to finish this contest?
8. Milly spent of her money on CD’s, of her money on posters, and of her money on accessories. If she had a total of $30 remaining after her purchase, how much money (in dollars) did she spend on accessories?
9. I have 25 coins in my pocket, and the total amount is $4.00 exactly. The coins are nickels, dimes, and quarters. How many different combinations of coins could I have?
10. The average of Bob’s first two test scores is 84, and the average of Cindy’s two scores is 98. What is the average score of all four of these scores?
11. Dr. Matsko has an unfair coin that has different probabilities of landing heads and tails. The probability of flipping two straight heads is twice the probability of flipping 2 straight tails. What is the probability of getting heads on a single flip? Express your answer in the form  where *a* and *b* are positive integers.
12. There are 44 red marbles, 56 blue marbles and 3 green marbles in a bag. How many draws will Tim have to make in order to guarantee that he gets at least one marble of every color?
13. There are 25 students in Dr. Kiely’s history class. Twenty percent of the students like both math and ice cream, 12 students like math, and 14 like ice cream. Find the probability that a randomly chosen student does not like either math or ice cream.
14. Arrrg! Captain Blackbeard has found a pile of gold coins. When the pile is divided amongst 7 pirates evenly, there are 5 coins left over. When the pile is divided amongst 9 pirates evenly, there are 6 coins left over. What is the smallest number of coins the pile could have contained?
15. In how many ways can you rearrange the letters of “JHMCJHMC” such that the substring “JHMC” does not occur in the shuffled string?
16. A divisor *d* of a whole number *k* is a whole number such that  is also a whole number. If *k* = 23450, how many divisors does *k* have?
17. A store sells gum in packs of seven sticks and packs of five sticks. Jane wants to buy a certain number of sticks that is possible by buying a combination of seven and five stick packs. What is the largest possible number of sticks that Jane cannot buy?

**2011 IMSA Junior High Math Competition**

1. Dr. Condie has a collection of 40 songs that are each 3 minutes in length and 60 songs that are each 5 minutes in length. What is the maximum number of songs from his collection that he can play in 5 hours?
2. Vincent and Noah are playing a game where they flip three coins. If all three coins come up the same, Vincent wins. Otherwise, Noah wins. Who has the best chance of winning? For your answer simply write Vincent, Noah, or Same (if they both have the same chance to win.
3. If , what is the value of $\left|xy\right|$?
4. If , what is ?
5. Simplify the expression: ..
6. Find $x$*x* if  $\sqrt{x-\sqrt{x-\sqrt{x-…}}}=100.$ where means that the nested square roots go on indefinitely.
7. Ten percent less than 50 is one-eighth more than what number?
8. Depending on where parentheses are entered, the expression 1 x 2 + 3 x 4 can have a number of different values. How many different values are there?
9. If a line passes through the points  and (1, 2), what is its *x* -intercept?
10. Webster is thinking of a two-digit number less than 50. If you double his number and subtract 12, you get the original number with the digits reversed! What number is Webster thinking about?
11. What is the last digit of 22011?
12. How many distinct ways are there to arrange the letters IMSAJHMC?
13. If 15! is multiplied out, how many zeroes will there be at the end?
14. How many ways are there for Dr. Fogel to choose a group of three students to write problems for the JHMC from his Number Theory class of ten students?
15. A quadrilateral has all of its vertices on a circle and has side lengths AB=39, BC=52, CD=25, and AD=60. Calculate the area of this quadrilateral.
16. Find the number of different routes from point A to point B always heading north or east.

A

B

1. If it takes Peter 10 minutes total to do his 10 problem sets, each of which has 10 problems, how many minutes will it take him to do all 100 problem sets for his 100 friends if each of their problem sets has 100 problems?
2. What is the minimum number of people in a room before there is guaranteed to be at least 3 people who all know each other or at least 4 people who have never met? Assume that given any pair of people in the room, they either both know each other or they have never met.

1. How many integers *n* are there such that is an integer? Note: an integer is a number in the set .
2. Derek has 5 t-shirts, 4 sweaters, 3 pairs of jeans, and two pairs of shoes. If he always wears one t-shirt, one sweater, a pair of jeans, and a pair of shoes, how many possible outfits can he wear?

2012 IMSA Junior High Mathematics Competition

1. What is the area of a square with side length 8?
2. Aunt Anna is 42 years old. Caitlin is 5 years younger than Brianna, and Brianna is half as old as Aunt Anna. How old is Caitlin?
3. Ara and Shea were once the same height. Since then, Shea has grown 20% while Ara has grown half as many inches as Shea. Shea is now 60 inches tall. How tall, in inches, is Ara now?
4. The number 64 has the property that it is divisible by its units digit. How many whole numbers *strictly* between 10 and 40 have this property?
5. If 20% of a number is 12, what is 50% of the same number?
6. A group of children riding on bicycles and tricycles rode past Billy Bob’s house. Billy Bob counted 7 children and 19 wheels. How many tricycles were there?
7. Blake and Jenny each took four 100-point tests. Blake averaged 78 on the four tests. Jenny scored 10 points higher than Blake on the first test, 10 points lower than him on the second test, and 20 points higher on both the third and fourth tests. What is the difference between Jenny’s average and Blake’s average on these four tets?
8. A square and a triangle have equal perimeters. The lengths of the three sides of the triangle are 6.1 cm, 8.2 cm, and 9.7 cm. What is the area of the square in square centimeters?
9. What is the last digit of 282011+ 9?
10. Bill walks ½ mile south, then ¾ mile east, and finally ½ mile south. How many miles is he, in a direct line, from his starting point? Express your answer as a fraction reduced to lowest terms.
11. If the largest prime factor of 13! + 15! + *x*! is 421, find the smallest possible value of *x.*
12. A collection of nickels, dimes and pennies has an average value of 7 cents per coin. If a nickel were replaced by five pennies, the average would drop to 6 cents per coin. How many dimes are in the collection?
13. Adam, Benson, Carrie, David, and Eric leave their identical-looking backpacks in the open cubbies of their school hallway. Unfortunately, a little rascal decides to steal their backpacks and put them on the top of the cubbies. When the five students return to the cubbies, they cannot tell which backpack is which, so they all grab one of the backpacks at random. What is the probability that all five students grab the wrong backpack? Express your answer as a common fraction.
14. Karen, Peter, and Vignesh are eating a super-large pizza. Karen takes 30 minutes to eat the pizza by herself, Peter takes 20 minutes to eat the pizza by himself, and Vignesh takes 1.5 hours to eat the pizza by himself. Suppose all three of them work together to finish eating the pizza. How long will it take them to do so, if Vignesh gets sick after eating the pizza for 6 minutes, and cannot continue eating any further? Express your answer as a decimal, in minutes.
15. There are three different sizes of juice: small, medium, and large. The medium size costs 50% more than the small size and contains 40% less juice than the large size. The large size contains twice as much juice as the small size and costs 20% more than the medium size. Rank the three sizes from best to worst buy (best = cheapest per volume of juice). Give your answer as an ordered triple, e.g., (S,L,M) where the first letter represents the best buy, and the last the worst buy.
16. There are three consecutive even integers such that the product of the first and the second is 190 greater than the product of $-5$ and the third integer. What is the value of the largest integer?
17. Find the sum of all distinct elements in the set . By a factor we mean any whole number dividing 2012 including 1 and 2012.
18. Jacob tries to convert a base 10 number to a two digit base 7 but instead accidently switches digits. The first digit would have been 2 greater than the ones place digit if he had converted it correctly. When he converts his result back to base 10, by how much is the result less than his original number?
19. If *i* is the square root of $-1$, what is  ?
20. In how many ways can a 6 x 6 square with the center 2 x 2 square removed be tiled by 1 x 2 dominoes?