UNIVERSITY OF WATERLOO
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Centre for Education in
Mathematics and Computing

Grade 7/8 Math Circles

November $26^{th}/27^{th}/28^{th}$, 2019

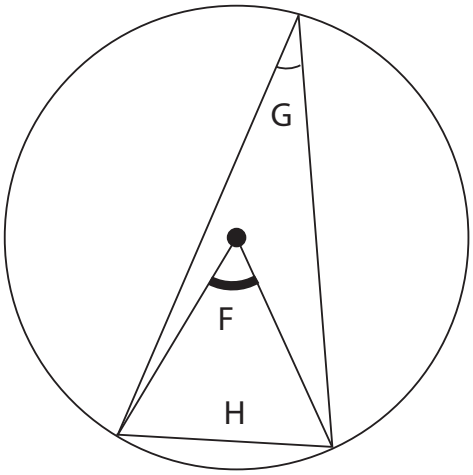
Math Jeopardy

Introduction

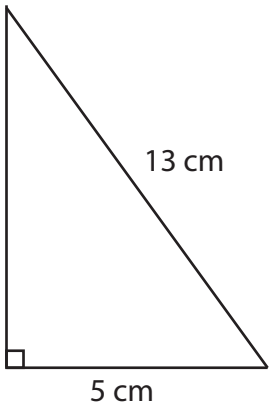
Questions will vary in difficulty with \$100 questions tending to be the easiest, and \$500 questions tending to be the hardest. Do your best, good luck and have fun!

Shapes, Shapes, Shapes

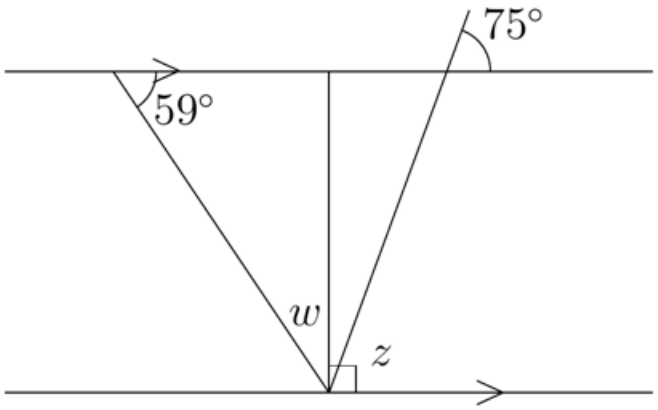
\$100 What does each label represent?



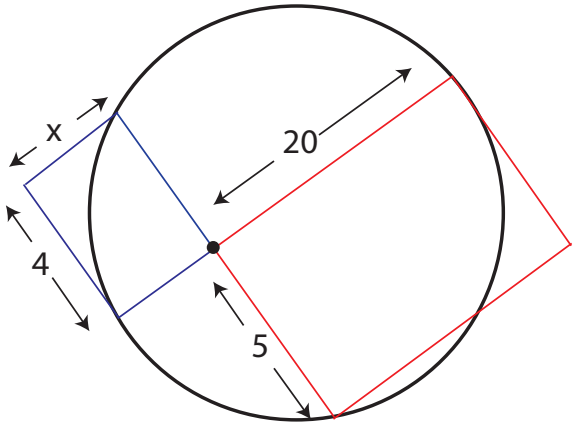
\$200 What is the area of this triangle?



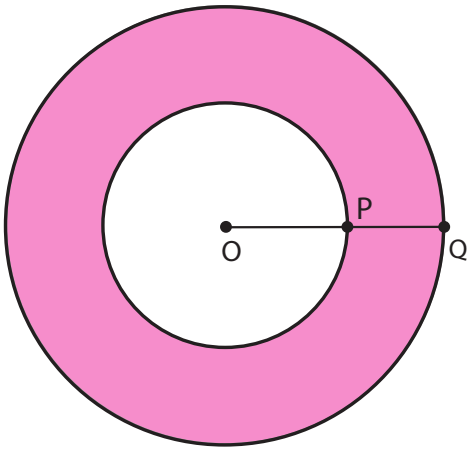
$300 Find the missing angles:



$400 Find the ration between the areas of the two rectangles.



$500 In the diagram, each of the two circles have centre O. Also, $OP : PQ = 1 : 2$. If the radius of the large circle is 9, what is the area of the shaded region?



Physics

$100 Express the following in scientific notation.

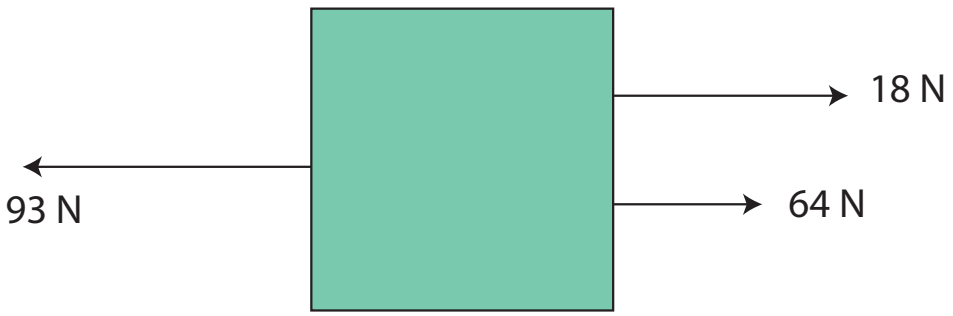
$$0.00000327$$

$200 What is Newton's First Law?

$300 *Proportionality* A circle has area A. If I multiply the diameter of the circle by 3, what is my new area in terms of A?

$400 Nicolas pushes open a 4kg door. The door accelerates at a rate of $9\frac{m}{s^2}$ away from him. How much force did Nicolas apply to the box?

$500 If the following box is accelerating at a rate of $2\frac{m}{s^2}$, what is its mass?



It's Probable

$100 How big is the sample space if you roll three 6-sided die?

$200 Six balls, numbered 2, 3, 4, 5, 6, 7, are placed in a hat. You select 2 balls without replacement. What is the probability that both balls you choose are prime numbers?

$300 The Ministry of Magic is holding a lottery and has sold 2000 tickets. If Hermione has a $\frac{1}{16}$ chance of winning, how many tickets did she purchase?

$400 Sam rolls a fair 4-sided die containing 1, 2, 3, 4. Tyler rolls a fair 6-sided die containing 1, 2, 3, 4, 5, 6. What is the probability that Sam rolls a number larger than Tyler?

$500 Two different numbers are randomly selected from the set {-3, -1, 0, 2, 4} and then multiplied together. What is the probability that the product of the two numbers chosen is 0?

Sorting Remainders

$100 What are all possible remainders when you divide by 9?

$200 Evaluate the following:

$$63 \equiv \_\_\_\_\_ \mod 9$$
$$42 \equiv \_\_\_\_\_ \mod 5$$
$$765 \equiv \_\_\_\_\_ \mod 4$$

$300 Reduce the expression:

$$(81 + 26) \times (70 + 52) \mod 7$$

$400 Sort the following list of numbers in descending ordering using the insertion method covered in class. How many steps did it take you?

38 4 13 72 96

$500 Reduce the following:

$$2^{82} \mod 3$$
$$5^{46} \mod 3$$
$$2^{164} \times 5^{138} \mod 3$$

Miscellaneous

$100 Adam and Eve play rock-paper-scissors 10 times. Knowing the following, who won and by how much?

- Eve uses 3 rocks, 6 scissors, 1 paper
- Adam uses 2 rocks, 4 scissors, 4 paper
- There were no ties in all 10 games
- The order of the games is unknown

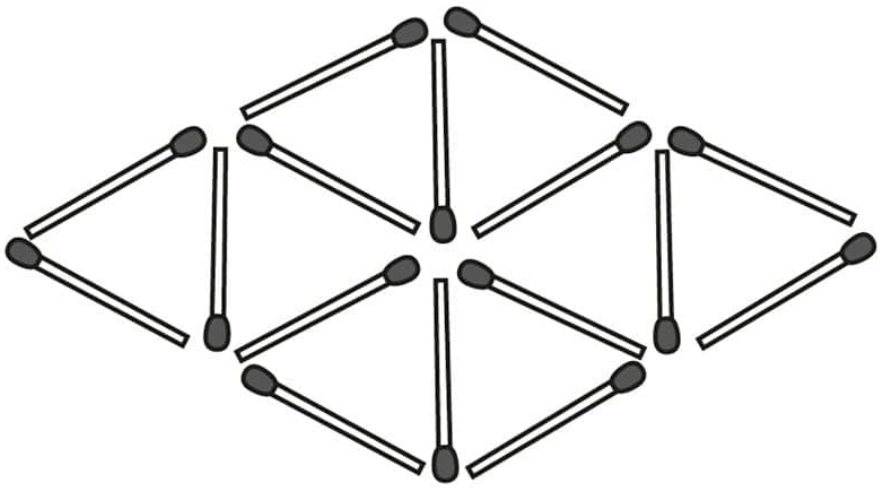
$200 Given the following equivalences, what's the missing number?

$$12 = 6$$

$$6 = 3$$

$$5 = \_\_\_\_\_$$

$300 The following 16 matches form 8 equilateral triangles. Remove **4** matches to leave exactly equilateral triangles, leaving no loose ends or unused matches.



$400 Mr. and Mrs. Tan have 4 children - 3 boys and 1 girl who each like one of the colours blue, red, green, yellow and the letters P, Q, R, S. Based on the following facts, which child is Darius?

- The oldest child likes the letter Q.
- The youngest child likes green.
- Alfred likes the letter S.
- Brenda has an older brother who likes R.
- The one who likes blue isn't the oldest.
- The one who likes red likes the letter P.
- Charles like yellow.

$500 Solve the following Sudoku puzzle. *Each row, column and* 3×3 *square can contain the numbers 1-9 only* ***once****.*

1	5			4	2	7		6
2	7	4	5	6			1	
		6			7	4		2
	1		9				4	
				5	1			7
5	6		4		3	1	9	
	2		6		5	9		
9	8	5		3			6	
	4		2	1	9	8	3	

Gauss Contest

$100 If x is a number between 0 and 1, which of the following represents the smallest value?
(Source: 2011 Gauss (Grade 8), #17)

(A) x (B) x^2 (C) $2x$ (D) $\sqrt{x}$ (E) $\frac{1}{x}$

$200 A fraction is equivalent to $\frac{5}{8}$. Its denominator and numerator add up to 91. What is the difference between the denominator and numerator of this fraction?
(Source: 2006 Gauss (Grade 7), #16)

$300 If each of the fours numbers 3, 4, 6, and 7 replaces a $\square$, what is the largest possible sum of the fractions shown? $\frac{\square}{\square} + \frac{\square}{\square}$
(Source: 2010 Gauss (Grade 7), #19)

$400 Lorri took a 240 km trip to Waterloo. On her way there, her average speed was 120 km/h. She was stopped for speeding, so on her way home her average speed was 80 km/h. What was her average speed, in km/h, for the entire round-trip?
(Source: 2007 Gauss (Grade 8), #20)

$500 Five students wrote a quiz with a maximum score of 50. The scores of four of the students were 42, 43, 46 and 49. The score of the fifth student was N. The average (mean) of the five students' scores was the same as the median of the five students' scores. The number of values of N which are possible is?
(Source: 2006 Gauss (Grade 7), #25)

Final Jeopardy

How many different pairs (m, n) can be formed using numbers from the list of integers {1, 2, 3, ..., 20} such that $m < n$ and $m + n$ is even?