UNIVERSITY OF
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FACULTY OF MATHEMATICS
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CENTRE FOR EDUCATION IN
MATHEMATICS AND COMPUTING

Grade 7/8 Math Circles
November 28/29/30, 2017
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!
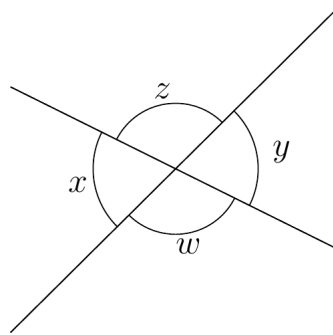
Angles and Light

$100 What term describes the bending of light as it crosses the boundary separating 2 media?

$200 What are the angle theorems we learned that you can use when you have parallel lines?
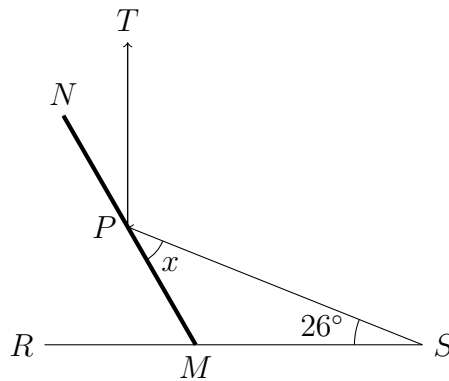
$300 Find the missing angle:
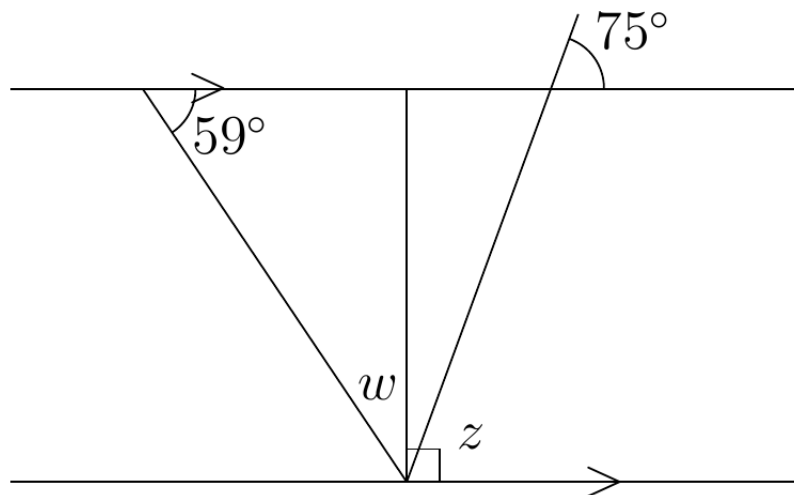
$400 Prove the Opposite angle theorem.

$500 A beam of light shines from point S, reflects off a mirror MN at point P, and reaches point T so that PT is perpendicular to RS. What is the measure of $\angle SPM$? *(Problems, Problems, Problems, Volume 7: page 37, question 10)* **Hint:** Think about the Law of Reflection

Matrices

$100 What is the transpose of this matrix:

$$A = \begin{bmatrix} 13 & 2 & 1 \\ 5 & 3 & 4 \end{bmatrix}$$

$200 Do the following matrix addition:

$$\begin{bmatrix} 4 & -2 \\ 24 & 0 \\ 7 & 30 \end{bmatrix} + \begin{bmatrix} 9 & 11 \\ 5 & 16 \\ 8 & -4 \end{bmatrix}$$

$300 Do the following matrix subtraction:

$$3 \begin{bmatrix} 2 & 4 & 1 \\ 12 & 0 & 5 \\ 20 & 3 & 4 \end{bmatrix} - \begin{bmatrix} 3 & 6 & 1 \\ 17 & 4 & 8 \\ 53 & 5 & 10 \end{bmatrix}$$

$400 Which of these matrices could you multiply, and what would be the dimension of the final matrix?

  (a) $(n \times n) \times (m \times m)$

  (b) $(n \times m) \times (m \times t)$

  (c) $(n \times m) \times (t \times m)$

$500 Do this matrix multiplication:

$$\begin{bmatrix} 3 & 2 & 1 \\ 5 & 3 & 4 \end{bmatrix} \begin{bmatrix} 7 & 1 \\ 2 & 5 \\ 10 & 4 \end{bmatrix}$$

Boolean Logic

$100 Name these logical operators:

$$\neg, \vee, \wedge, \uparrow, \downarrow$$

$200 What operator this truth table for?

A	B	
True	True	True
True	False	False
False	True	False
False	False	True

$300 Convert the binary number 100101 to decimal form

$400 Why are truth table useful?

$500 Evaluate this logical statement:

$$(\neg(True \wedge \neg False) \vee False) XNOR((True \downarrow \neg False) \wedge \neg False)$$

Physics and Special Relativity

$100 What are the two Newtons Laws of Motion that we talked about?

$200 What kinds of frames does Special Relativity deal with? What does that mean?

$300 What is the total force on an object if it has mass 5 kg and is moving with velocity 2 m/s [Up]?

$400 Explain the classical Principle of Relativity, and how Einstein changed it for Special Relativity.

$500 How much time does Alice observe passes for Bob if 10 seconds pass for Alice, and Bob flies by Alice at a constant velocity, with a speed of 0.6c

Miscellaneous

$100 What room are you taught in?

$200 How did George Boole die?

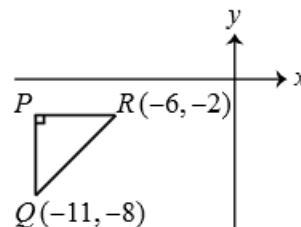**$300** How old are your Math Circles teachers?

$400 How much wood would a woodchuck chuck if a woodchuck could chuck wood?

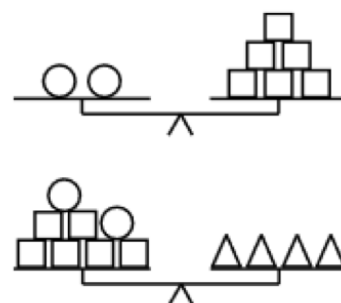**$500** What is the capital of Bulgaria?

Gauss Contest

$100   In $\triangle PQR$ shown, side PR is horizontal and side PQ is vertical. The coordinates of P are

(A) $(-8, -2)$ (B) $(-6, -8)$ (C) $(-11, -6)$

(D) $(-11, -2)$ (E) $(-8, -6)$

$200   The two scales shown are balanced. Which of the following is not true?

(A) $\bigcirc = \triangle$

(B) $\triangle\triangle = \bigcirc\square\square$

(C) $\bigcirc = \square\square\square$

(D) $\bigcirc\triangle = \square\square\square\square$

(E) $\triangle = \square\square\square$

$300   The value of $\dfrac{1}{1+\dfrac{1}{1+\dfrac{1}{2}}}$ is
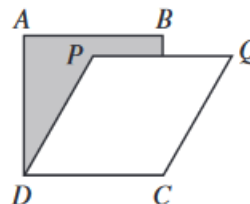
(A) $\frac{3}{5}$ (B) $\frac{5}{3}$ (C) $\frac{1}{3}$ (D) 3   (E) $\frac{3}{2}$

$400   How many numbers from the set $\{-5, -4, -3, -2, -1, 0, 1, 2, 3\}$ satisfy the inequality $-3x^2 < -14$?

(A) 1   (B) 2   (C) 3   (D) 4   (E) 5

$500   In the diagram, $ABCD$ is a square with area 25 cm^2. If $PQCD$ is a rhombus with area 20 cm^2, the area of the shaded region, in cm^2, is

(A) 12   (B) 10   (C) 11

(D) 12.5   (E) 9

Final Jeopardy

How many pairs of positive integers (x, y) have the property that the ratio $x : 4$ equals the ratio $9 : y$?

(A) 6   (B) 7   (C) 8   (D) 9   (E) 10