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:

\[
\begin{align*}
63 & \equiv \underline{\quad} \mod 9 \\
42 & \equiv \underline{\quad} \mod 5 \\
765 & \equiv \underline{\quad} \mod 4
\end{align*}
\]

$300$ 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?

\[ 38 \quad 4 \quad 13 \quad 72 \quad 96 \]

$500$ Reduce the following:

\[
\begin{align*}
2^{82} & \mod 3 \\
5^{46} & \mod 3 \\
2^{164} \times 5^{138} & \mod 3
\end{align*}
\]
$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?

\[
\begin{align*}
12 &= 6 \\
6 &= 3 \\
5 &= \_\_\_ 
\end{align*}
\]

$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 $3 \times 3$ square can contain the numbers 1-9 only once.*

$$
\begin{array}{ccc}
1 & 5 & \Box \\
2 & 7 & 4 \\
\Box & 6 & \Box \\
\end{array}
\begin{array}{ccc}
4 & 2 & 7 \\
5 & 6 & 1 \\
\Box & 7 & \Box \\
\end{array}
\begin{array}{ccc}
\Box & 1 & \Box \\
\Box & 9 & \Box \\
\Box & 4 & \Box \\
\end{array}
\begin{array}{ccc}
5 & 6 & 4 \\
\Box & 3 & 1 \\
9 & \Box & \Box \\
\end{array}
\begin{array}{ccc}
2 & 6 & 5 \\
\Box & \Box & 9 \\
9 & 8 & 5 \\
\end{array}
\begin{array}{ccc}
4 & 2 & 1 \\
\Box & \Box & \Box \\
\Box & \Box & \Box \\
\end{array}
$$
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 four numbers 3, 4, 6, and 7 replaces a □, what is the largest possible sum of the fractions shown? $\frac{□}{□} + \frac{□}{□}$
(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?