The Canadian Mathematical Society presents

2026 Canadian Open Mathematics Challenge



Canadian Mathematical Society
Société mathématique du Canada

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Official Competition Question Booklet

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Section A *questions are worth a maximum of 4 points. Correct answers that are clearly indicated receive full marks, regardless of work shown. Partial marks may be awarded if some correct work is shown.*

Question A1 (4 points)

A single square table can seat exactly four people, with one person on each side. If 2026 of these tables are pushed together in a single straight row, how many people can be seated at this combined, long rectangular table?

Question A2 (4 points)

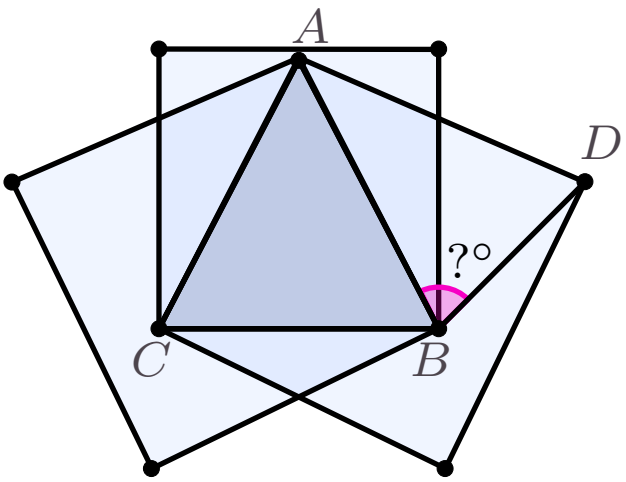
For a positive integer $n \geq 2$ we will define $n\dagger$ recursively as follows:

- $2\dagger = 2$,
- $(n+1)\dagger = (n+1) \times (n\dagger \div p)$, where p is the smallest prime that divides $n\dagger$.

For example, $3\dagger = 3 \times (2\dagger \div 2) = 3$.
Determine the value of $8\dagger$.

Question A3 (4 points)

The diagram shows an equilateral triangle ABC with squares drawn on every one of its sides. Find the measure of angle ABD in degrees.



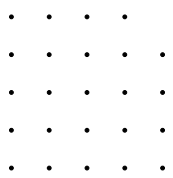
Question A4 (4 points)

Alice, Barb, and Cate let fate decide whether to buy ice cream. Each flips a fair coin and writes 0 for Heads, 1 for Tails. Let a, b, c be the values that Alice, Barb, and Cate obtain, respectively. They then calculate $1 - a - b - c + ab + ac + bc - abc$. If the answer is zero, the girls buy ice cream. What is the likelihood that on this toss the girls will buy ice cream?

Section B *questions are worth a maximum of 6 points. Correct answers that are clearly indicated receive full marks, regardless of work shown. Partial marks may be awarded if some correct work is shown.*

Question B1 (6 points)

A 5×5 rectangular grid of dots is placed so that adjacent dots are 1 unit apart. The dot in the top right corner is removed as in the diagram below.



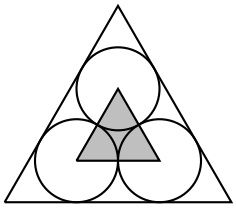
A square is drawn whose vertices are grid points in the diagram, and the area of the square is A square units. What is the **sum** of all possible values of A?
(Note: congruent squares in different locations or with different orientations have the same area A. This number should be counted in the sum only once regardless of the number of congruent squares that have this area.)

Question B2 (6 points)

Waldo has solved several quadratic equations of the form $x^2 - ax + b = 0$, where $0 < b < 20$. He observed that each of the equations had two distinct positive integer roots. If no two equations shared a root, what is the maximal possible number of equations that Waldo solved?

Question B3 (6 points)

Three identical mutually tangent circles are drawn inside an equilateral triangle of area 10 square units and are each tangent to two of the sides of the triangle. A new triangle is formed with the centres of the circles as vertices. Determine the area (in square units) of the new triangle.



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Question B4 (6 points)

An *N-fold set* is a collection of $N+1$ distinct positive integers such that if any one of the elements is removed, the sum of the remaining elements is not divisible by N. For example, $\{2,3,5,6\}$ is a 3-*fold set* because none of the sums $2+3+5$, $2+3+6$, $2+5+6$, $3+5+6$ is divisible by 3.

What is the smallest possible sum of the elements of a 110-*fold set*?

Section C** questions are worth a maximum of 10 points. **All work must be shown and must be legible.

Question C1 (10 points)

Let $T_n = 1+2+3+...+n$ be the n^{th} triangular number for $n \geq 1$. For example, $T_1 = 1$, $T_2 = 1+2 = 3$, $T_3 = 1+2+3 = 6$.

(a) Prove that $T_n = \frac{n(n+1)}{2}$ for all $n \geq 1$.

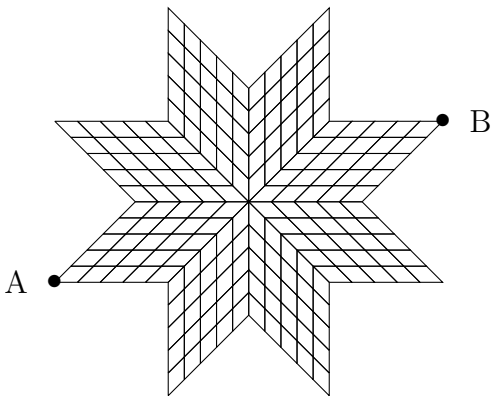
(b) Show that the expression $2T_nT_{n-1}$ is a triangular number T_k and find k in terms of n.

(c) Find the sum $\sum_{n=1}^{2026} \frac{1}{T_n}$.

(d) Suppose there exist positive reals a, b, c, d such that $\sqrt{aT_n + b} = cn + d$ for all positive integers n. Express a, b, c in terms of d.

Question C2 (10 points)

The Atrium of the First Nations University of Canada is tiled with the following design, called a star-blanket design. It is made up of small rhombi, with all sides exactly 10 cm long.
There are two points labeled A and B in two corners of the design.



Assume that a *path* on the design from a grid point to another grid point travels only along the edges.

(a) How long is the shortest path from A to B?

(b) How many different shortest paths are from A to B?

(c) For how many pairs of grid points P and Q of the star-blanket design, does there exist a shortest path between P and Q that goes through the center of the design?

Question C3 (10 points)

Consider a square $ABCD$ with center K. A point P lies in the interior of the segment KB, and let Q be a point on the circumcircle of $\triangle APC$, distinct from A such that $AC = QC$.

(a) Let $\angle ACP = \theta$. Express $\angle QAP$ in terms of θ.

(b) Suppose that $QP = 4$ cm and $AC = 3$ cm, determine the length AP (in cm).

(c) Now suppose that P varies arbitrarily across the interior of segment KB. Let QP intersect AC at point X. Determine the locus of X as P varies.

Question C4 (10 points)

Given any set D and a function $f : D \to D$, call f an *involution* if $f(f(x)) = x$ for all $x \in D$.

(a) Prove that if a function $g : D \to D$ is given such that f and $f \circ g$ are involutions, then so is $g \circ f$.

(b) Let $D = \{1, 2, \ldots, 2025\}$, and let $g : D \to D$ be defined via

$$g(x) = \begin{cases} 1 & \text{if } x = 2025, \\ x + 1 & \text{else.} \end{cases}$$

How many involutions f on D are there for which $f \circ g$ is also an involution?

(c) Let $D = \{1, 2, \ldots, 2025\}$, and let g be a function from D to itself such that there are exactly 2025 involutions f for which $f \circ g$ is also an involution. What is the maximum number of fixed points of g: that is, values $x \in D$ such that $g(x) = x$?

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