

Competition Highlights Canadian Mathematical Olympiad and Junior Olympiad (CMO/CJMO)

Paweł Prałat* James Rickards†

October 2026

The Canadian Mathematical Olympiad (CMO) is an annual, invitational, proof-based competition for Canadian students. It is Canada's premier national advanced mathematics competition. Students attempt to solve 5 problems in three hours, with each problem graded on a scale from 0 to 7. In 2020, the CMS introduced the Canadian Junior Mathematical Olympiad (CJMO), also by invitation only, a variant specifically for students in grade at most 10. These 3-hour competitions are held each March at a selected time and date (by default, the second Thursday of March). All official participants write at the same time and are proctored by their local school faculty or staff. For more information visit <https://cms.math.ca/competitions/cmo/>.

The CMO is an important contest for students with international aspirations, as a good performance leads to the Canadian Team Selection Test, and then onto the International Mathematical Olympiad (IMO) itself. Qualification for the C(J)MO is primarily via the Canadian Open Mathematics Challenge (COMC), an open contest written in late October.

The 2026 CMO was written by 95 students, and the CJMO was written by 18 students. Four Canadian provinces were represented, with the number of contestants as follows:

CMO: AB (11), BC (21), ON (44), QC (8)

CJMO: AB (3), BC (1), ON (10), QC (2)

(note that Canadian citizens residing outside of Canada can also officially write the C(J)MO, accounting for the discrepancy in numbers).

*Department of Mathematics, Toronto Metropolitan University, Toronto, ON, Canada; e-mail: pralat@torontomu.ca

†Department of Mathematics and Computing Science, Saint Mary's University, Halifax, NS, Canada; e-mail: james.rickards@smu.ca

Grading for both contests went relatively smoothly, with a team of 15 mathematicians, including professors, students, and former contestants, contributing their time. The top score on the CMO was 31, achieved by Ansh Agarwal, and the mean score was 11.1. The Matthew Brennan Award for best solution went to Perry Dai for his solutions to both Problem 2 and Problem 5. In Problem 2, he proved a bound better than anticipated, and on Problem 5, he incorporated ideas from algebraic number theory as part of his solution. The top score on the CJMO was 30, achieved by Haruka Kimura, and the mean score was 17.2. A full breakdown of the marks assigned problem by problem is in Table 1.

Score	P1	P2	P3	P4	P5	Score	P1	P2	P3	P4	P5
7	60	9	22	8	0	7	7	15	7	1	0
6	12	2	3	3	0	6	2	0	3	0	0
5	0	0	4	0	1	5	0	0	0	0	1
4	0	0	7	0	0	4	7	1	1	0	2
3	1	1	1	0	1	3	0	0	1	0	0
2	0	15	40	22	0	2	0	0	0	0	7
1	4	14	5	4	0	1	0	0	1	0	2
0	18	54	13	58	93	0	2	2	5	17	6
Avg	5.25	1.28	3.24	1.28	0.08	Avg	4.94	6.06	4.17	0.39	1.61

(a) CMO

(b) CJMO

Table 1: C(J)MO score breakdown by problem.

Problem 2 on the CMO (which doubled as problem 4 on the CJMO) turned out to be unexpectedly tricky. It has a straightforward solution, that was likely overlooked by most students searching for more clever ideas!

Problem 2. *There are n types of coins in Wario's gold mine. Each coin of the i th type is worth d_i cents, where $d_1, \dots, d_n$ are distinct positive integers. A positive integer D is denoted lucky if the following holds: For each positive integer k , any collection of coins (containing any number of coins of each type) with a total value of exactly kD cents can be split into k groups, each worth D cents. Does a lucky number necessarily exist?*

For a basic example, imagine $n = 3$, $(d_1, d_2, d_3) = (4, 5, 6)$, and $D = 20$. If $k = 3$, the problem is asking if any combination of 4, 5, 6 cent coins making 60¢ can be split into 3 piles each totalling 20¢.

Playing around further, imagine that we had 4 of each coin. This can be solved by splitting into

$$2 \cdot 4\text{¢} + 2 \cdot 6\text{¢}, \quad 2 \cdot 4\text{¢} + 2 \cdot 6\text{¢}, \quad 4 \cdot 5\text{¢}.$$

However, we can soon realize that we were pretty tightly constrained. In fact, the only way to make out 20¢ using at least one 6¢ coin is to make $2 \cdot 4\text{¢} + 2 \cdot 6\text{¢}$.

So, for example, if we had a collection of ten 6¢ coins, we immediately see that we cannot split this collection into 20¢ piles, as each pile will necessarily be a multiple of 6¢, hence 20 is not lucky in this example.

We can see an immediate generalization: if any d_i does not divide D , then D is not lucky. The proof is simple: take $k = d_i$, and consider a collection of D coins each worth d_i ¢. Any sub-collection has value being a multiple of d_i , and thus cannot have value D , contradiction.

The above observation rules out many numbers D , but not everything! In particular, it tells us that in searching for a lucky number D , we require $\text{lcm}(d_1, d_2, \dots, d_n) \mid D$. If this holds, then our special case of having only one type of coin in the collection now works: we can indeed always split this into equal piles of value D , since each d_i divides D evenly.

Considering the case where there are coins of multiple types seems trickier, as we may potentially have to combine different values in non-trivial ways. A natural line of thought is to consider the famous Frobenius coin problem: given a collection of infinitely many coins of values $a_1, a_2, \dots, a_n$ where $\text{gcd}(a_1, \dots, a_n) = 1$, what is the largest value that you cannot make exactly using these coins? For example, in the $n = 2$ case, the answer is $a_1 a_2 - a_1 - a_2$. With this intuition, it feels like if D is large enough, then this should help us find the combinations. In essence, we should have enough “room” to play around with combining coins to always make multiples of D . The $\text{gcd}(a_1, \dots, a_n) = 1$ condition is a small issue, but that is taken care of our divisibility condition that $d_i \mid D$ for all i .

While the intuition is reasonable and it does lead to the correct answer, it does not seem to lead to an actual *solution*. One of the main issues is that we do not have control over how many of each coin there is: we allow the pile to contain *any* collection of the coins totalling kD ¢. Back to the drawing board!

A key to breaking this barrier is going back to the simplest case of having all coins of the same type. While this does not always need to be true, what if it is close? For example, if you had at least D/d_1 of the coin worth d_1 ¢, then you could make a group of d_1 ¢ coins worth D ¢, and remove those from the collection. You could then repeat this process: as long as there was some i for which you had at least D/d_i coins of value d_i ¢, then you could make a pile worth D ¢, and induct backwards. At the final step (that would eventually correspond to the base case of a proof by induction) you would be left with some assortment of the leftover coins, but they would necessarily be worth D ¢, and the problem would be solved.

If we cannot do the above, then we have less than D/d_i coins worth d_i ¢, hence their total value is less than D ¢, and thus the total collection is worth less than nD ¢. This provides us a solution when $k \geq n$, but does not help us with $2 \leq k \leq n - 1$. The final clever idea is realizing that, since we have full control over D , why don't we just make D larger, and repeat this idea? For example, if D was replaced by nD , then we could repeat this idea n times, making n piles worth D ¢ (each comprised of only a single type of coin), and combine those into our group.

Indeed, this idea does work, and leads to lucky numbers. Formally, consider

$d = \text{lcm}(d_1, d_2, \dots, d_n)$ and $D = nd$. We claim (by induction) that any collection worth $kD\text{¢}$ can be split as desired. The base case of $k = 1$ is trivial, so assume that $k \geq 2$. Assume that there are n_i coins worth $d_i\text{¢}$, so that $kD = \sum_{i=1}^n n_i d_i$. Using only coins worth $d_i\text{¢}$ to make piles of value $d\text{¢}$, we form

$$\left\lfloor \frac{n_i}{d/d_i} \right\rfloor \geq \frac{n_i d_i}{d} - 1$$

piles. Thus, the total number of piles (across all i) that are worth exactly $d\text{¢}$ is at least

$$\sum_{i=1}^n \left(\frac{n_i d_i}{d} - 1 \right) = \frac{kD}{d} - n \geq 2n - n = n,$$

so we can form n of them, combine these piles into one group worth $nd = D$ cents, and remove this from the collection. By induction, we can repeat, proving that D is lucky.

While we have classified some lucky numbers, one can do better! In Perry Dai's solution, he was able to prove that $D = d_1 d_2 \cdots d_n$ is lucky. If our values d_i are pairwise co-prime, this value is significantly smaller than the one we used in the above proof. For that solution, see the official CMO solutions on the CMS website.

Finally, it is natural to ask for the smallest lucky number given each input: call this L . In our above commentary we have noted that

$$\text{lcm}(d_1, d_2, \dots, d_n) \leq L \leq d_1 d_2 \cdots d_n,$$

which does fully solve the problem when the d_i 's are pairwise co-prime. We leave the remaining cases as an open problem for the reader!