

CANADA JAY MATHEMATICAL COMPETITION

CJMC 2022

Official Exam Booklet

DO NOT OPEN THIS BOOKLET UNTIL YOUR PROCTOR OR TEACHER PERMITS

- 1) **Do not open the exam booklet** until instructed to do so by your proctor (supervising teacher).
- 2) **Only your Student Answer Sheet is marked** – all your answers and your identity must be recorded there. You can write in this booklet if you wish, but it has no value for marking.
- 3) **You should fill in the Student Identification first.** This is the top portion of the Student Answer Sheet. You don't need to rush. Be sure to fill in all required information fields and write legibly. **Make sure your pencil marks are dark enough** and your writing is neat.
- 4) Please **fill in the circles completely** on your answer sheet for the choice you make for each question. If you change your answer, erase your mark. Be sure it is very clear to the markers if you intend to leave a question unanswered (blank).
- 5) **Don't talk about it online or publicly:** The questions and solutions of the exam must not be publicly discussed or shared online **before Monday**. This is to make sure others across Canada or around the world don't get an advantage before they write the exam.
- 6) **Length:** You get a total of 1 hour and 30 minutes to complete this fifteen-question exam.
- 7) **Scores:**
 Questions you get *correct* get 4, 5 or 7 points for sections A, B, and C, respectively.
 Questions you answer *wrong* get zero points.
 Questions you leave *blank* get one point. So don't guess if you are really unsure.
- 8) **Diagrams** provided are *not* drawn to scale; they are intended as aids only.
- 9) **Scrap paper:** May be used, but only your answer sheet will be marked.



THIS BOOKLET IS NOT MARKED – WRITE YOUR ANSWERS ON THE ANSWER SHEET INSTEAD

Part A: Each correct answer is worth 4 points. Unanswered questions worth 1 point each.

1. Calculate

$$(1 + 2 + 3 + 4 + 5)^2 - 3^2$$

- (A) 26 (B) 46 (C) 144 (D) 216 (E) 49 284

2. Each symbol in the equations below represents a different whole number.

$$\begin{aligned} \spadesuit + \spadesuit &= \heartsuit \\ \spadesuit \times \clubsuit &= \heartsuit \\ \clubsuit + \clubsuit + \clubsuit &= \heartsuit \end{aligned}$$

What number does \heartsuit represent?

- (A) 6 (B) 10 (C) 2 (D) 20 (E) 8

3. Elizabeth walks at a constant speed. She walks $\frac{4}{5}$ of the way home in 40 minutes. How long will it take for her to walk the rest of the way?

- (A) 6 minutes (B) 8 minutes (C) 10 minutes
(D) 32 minutes (E) 50 minutes

4. In how many different ways can we pay \$28 using \$10 bills, \$5 bills and \$1 coins?

- (A) 8 (B) 9 (C) 10 (D) 12 (E) 14

5. Jordana comes across a strange text where the letters have been replaced by numbers. She replaces each number with its corresponding letter (for example $1 = A$, $2 = B$ and so on) but the message remains jumbled. Jordana suspects the numbers have been increased by some number n (the same for each letter). The original message is:

24 12 9 7 5 18 5 8 5 14 5 29 13 23 5 6 13 22 8
5 23 23 19 7 13 5 24 9 8 27 13 24 12 24 12 9 13 18 8 13 11 9 18 19 25 23
17 29 24 12 19 16 19 11 13 7 5 16 10 13 11 25 22 9
27 13 23 5 15 9 8 14 5 15

Using her assumption, Jordana decreases each number by some number n and gets the message:

The Canada Jay is a bird
associated with the Indigenous
mythological figure
Wisakedjak

What number n did Jordana use to decode the message?

- (A) 4 (B) 5 (C) 6 (D) 7 (E) 8

Part B: Each correct answer is worth 5 points. Unanswered questions worth 1 point each.

6. Hiroshi writes down a pattern of digits

123456789876543212345678987...

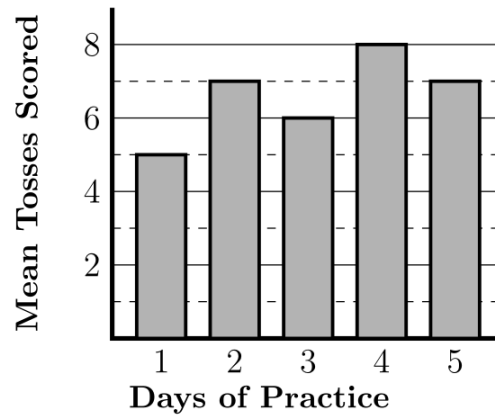
If he continues his pattern, what is the 2021st digit he writes down?

- (A) 1 (B) 3 (C) 5 (D) 7 (E) 9

7. Which is true about the number $2021 \times 2022 + 2022 \times 2023$?

- (A) It is odd.
(B) It is a perfect square.
(C) It can be divided by 2021 without remainder.
(D) It is a prime.
(E) It can be divided by 8 without remainder.

8. Zaria practiced ring toss by taking 15 tosses a day for 5 days. The graph below is her cumulative mean(average) number of tosses scored each day. That is, for example, the bar labelled 3 shows she had a mean of 6 tosses scored each day over the first 3 days.



Which day did Zaria score the fewest number of her tosses?

- (A) day 1 (B) day 2 (C) day 3 (D) day 4 (E) day 5
9. Numbers are *consecutive* when they follow their natural order. For example: 17, 18, 19 are consecutive *whole numbers*; 11, 13, 17 are consecutive *prime numbers* and 25, 36, 49 are consecutive *square numbers*. When two consecutive *odd numbers* are multiplied together their product is 1443. What is the sum of the two numbers?
- (A) 72 (B) 76 (C) 80 (D) 84 (E) 88

10. Hamza and his friends play in a one-on-one video game soccer tournament. Each plays one match against each other player. They agreed to award points as follows:

Result	Win	Tie with goals	Tie without goals	Loss
Points	3	2	1	0

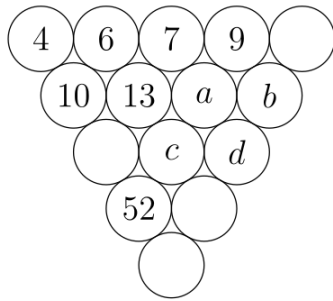
After all the matches ended, Hamza had 10 points without losing any matches.

Which one of the additional pieces of information is sufficient, by itself, to find with certainty the number of people participating in the tournament?

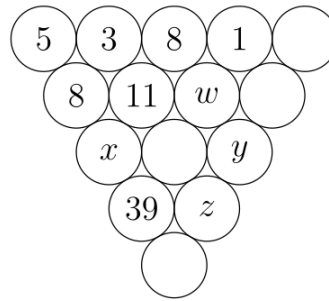
- (A) Hamza had at least one match in each of the other three categories.
- (B) More than half of Hamza's matches ended in ties with goals.
- (C) Four of Hamza's matches ended in either a win or a tie with goals.
- (D) Hamza had the same number of wins and ties without goals.
- (E) None of the above.

Part C: Each correct answer is worth 7 points. Unanswered questions worth 1 point each.

11. Sarah asked her friend Rina to solve the two similar puzzles shown below. The sum of any two circles that are beside each other is in the circle directly below both of them. For example, the first two circles in **Puzzle 1** are 4 and 6, which add to 10 which is in the circle below them. A puzzle is solved when all circles have been filled with the correct numbers.



Puzzle 1

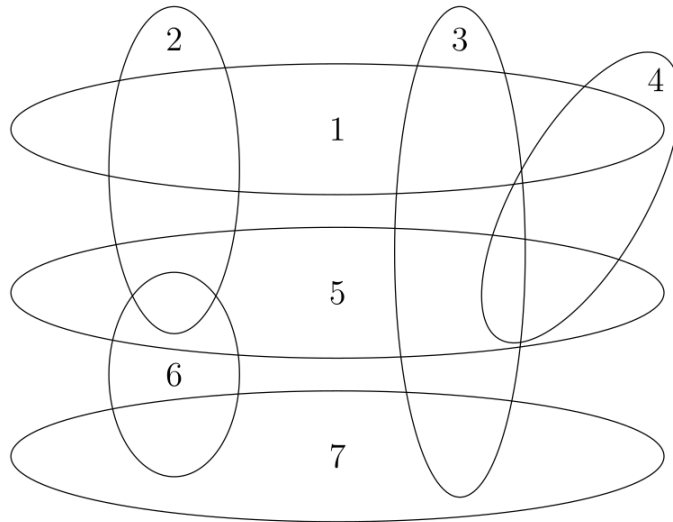


Puzzle 2

Which one of the following pieces of information, if given to Rina, would enable her to solve both puzzles?

- (A) The number in circles labelled a and y .
- (B) The number in circles labelled b and z .
- (C) The number in circles labelled c and w .
- (D) The number in circles labelled d and x .
- (E) None of the above.

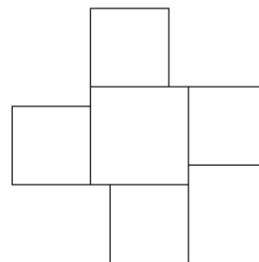
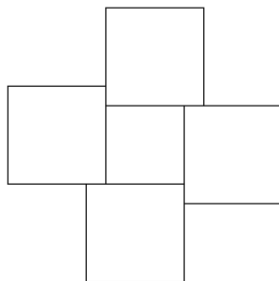
12. Jaytown has seven radio stations spread out throughout the town. If the regions covered by two radio stations overlap, they have to use a different frequency. But if the radio stations's regions don't overlap, they can use the same frequency. The picture below shows the regions covered each of the seven radio stations.



What's the smallest number of frequencies Jaytown can have so that no two overlapping radio stations share the same frequency?

- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

13. You have a collection of two types of squares, a smaller square and a larger square. When four of the larger squares are placed around a smaller square, as in the picture on the left, the total perimeter is 168 cm. When four of the smaller squares are placed around a larger square, as in the picture on the right, the total perimeter is 156 cm. What is the area of the smaller square?



- (A) 121 cm^2 (B) 144 cm^2 (C) 169 cm^2 (D) 196 cm^2 (E) 225 cm^2

14. James works for a courier company. He had to deliver 5 parcels. His motorcycle uses 3 litres of fuel to drive 45 km. The tank of the motorcycle holds 12 litres of fuel and was full when he started out.

The motorcycle used one quarter of the fuel for the delivery of the first parcel. For the second and third parcels together, the motorcycle used half of the remaining fuel.

James recognized that the fuel left in the tank after delivering the third parcel was only three fifths of what he needed to deliver the last two parcels. He filled up the tank of his motorcycle and then finished the deliveries.

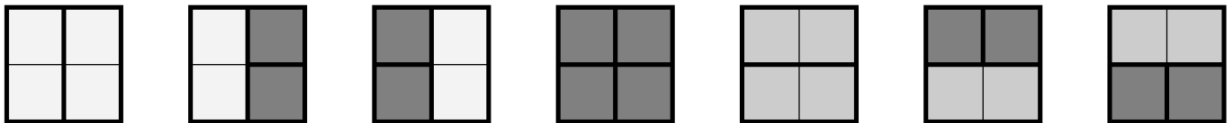
How far did James travel to deliver the 5 parcels?

- (A) 180 km (B) 210 km (C) 225 km (D) 240 km (E) 270 km

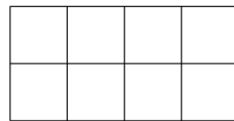
15. You have a number of 2×1 , 1×2 , and 1×1 tiles and want to tile a 2×2 square.



You notice that there are 7 different ways you could do the tiling as shown below.

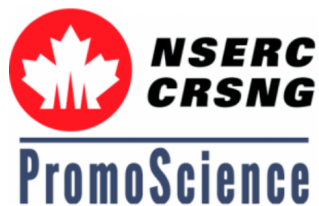


How many different ways could you tile the 2×4 rectangle, pictured below, using the tiles?



- (A) 49 (B) 55 (C) 63 (D) 71 (E) 81

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