



The CENTRE for EDUCATION
in MATHEMATICS and COMPUTING
cemc.uwaterloo.ca

Galois Contest

(Grade 10)

Thursday, April 3, 2025
(in North America and South America)

Friday, April 4, 2025
(outside of North America and South America)



UNIVERSITY OF
WATERLOO

Time: 75 minutes

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Do not open this booklet until instructed to do so.

Number of questions: 4

Each question is worth 10 marks

Calculating devices are allowed, provided that they do not have any of the following features: (i) internet access, (ii) the ability to communicate with other devices, (iii) information previously stored by students (such as formulas, programs, notes, etc.), (iv) a computer algebra system, (v) dynamic geometry software.

Parts of each question can be of two types:

1. **SHORT ANSWER** parts indicated by



- worth 2 or 3 marks each
- full marks given for a correct answer which is placed in the box
- **part marks awarded only if relevant work** is shown in the space provided

2. **FULL SOLUTION** parts indicated by



- worth the remainder of the 10 marks for the question
- **must be written in the appropriate location** in the answer booklet
- marks awarded for completeness, clarity, and style of presentation
- a correct solution poorly presented will not earn full marks



WRITE ALL ANSWERS IN THE ANSWER BOOKLET PROVIDED.

- Extra paper for your finished solutions must be supplied by your supervising teacher and inserted into your answer booklet. Write your name, school name, and question number on any inserted pages.
- Express answers as simplified exact numbers except where otherwise indicated. For example, $\pi + 1$ and $1 - \sqrt{2}$ are simplified exact numbers.

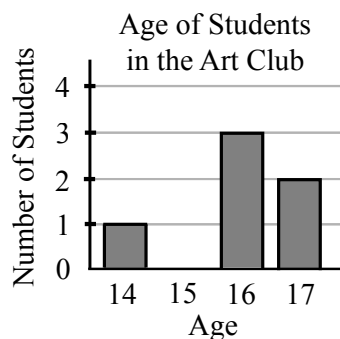
Do not discuss the problems or solutions from this contest online for the next 48 hours.




The name, grade, school and location of some top-scoring students will be published on our website, cemc.uwaterloo.ca. In addition, the name, grade, school and location, and score of some top-scoring students may be shared with other mathematical organizations for other recognition opportunities.

NOTE:

1. Please read the instructions on the front cover of this booklet.
2. Write all answers in the answer booklet provided.
3. For questions marked , place your answer in the appropriate box in the answer booklet and **show your work**.
4. For questions marked , provide a well-organized solution in the answer booklet. Use mathematical statements and words to explain all of the steps of your solution. Work out some details in rough on a separate piece of paper before writing your finished solution.
5. Diagrams are *not* drawn to scale. They are intended as aids only.
6. While calculators may be used for numerical calculations, other mathematical steps must be shown and justified in your written solutions, and specific marks may be allocated for these steps. For example, while your calculator might be able to find the x -intercepts of the graph of an equation like $y = x^3 - x$, you should show the algebraic steps that you used to find these numbers, rather than simply writing these numbers down.
7. No student may write more than one of the Fryer, Galois and Hypatia Contests in the same year.

1. Members of the Art Club are between 14 and 17 years old, inclusive. The graph shows the number of students of each age in the club.



-  (a) What is the total number of students in the Art Club?
-  (b) Determine the mean (average) age of the students in the Art Club.
-  (c) Determine the number of 15-year old students that must join the Art Club so that the mean age of all the students in the club is exactly 15.5.

2. In a *magic square*, the numbers in each of the three rows, each of the three columns, and each of the two diagonals have the same sum. This sum is called the *magic constant*. Each of the four figures shown below is a magic square.



(a) In Figure 1, the magic constant is 18. What is the value of n ?



(b) In Figure 2, what is the value of p ?



(c) In Figure 3, what is the value of r ?



(d) In Figure 4, determine the value of u .

7	2	
	n	
3		

Figure 1

8	p	
9		5
4		

Figure 2

13		r
7		17
	$r+1$	$r+3$

Figure 3

	$u+3$	
		12
$u+2$	$u-5$	u

Figure 4

3. Point A has coordinates $(10, 15)$ and C has coordinates $(20, 27)$. Rectangle $ABCD$ has side AD parallel to the y -axis and side AB parallel to the x -axis.



(a) What is the area of rectangle $ABCD$?



(b) The line with equation $y = -\frac{3}{2}x + 39$ intersects side AD at E and side AB at F . Determine the area of the pentagon $BCDEF$.



(c) The line with equation $y = mx + b$, with $m < 0$, intersects side AD at G and side AB at H . Determine all ordered pairs of integers (m, b) with $b < 50$ for which the area of $\triangle GAH$ is equal to $-\frac{8}{m}$.

4. To determine the number of positive divisors of N , we take the exponents on the prime powers in the prime factorization of N , add 1 to each of the exponents, and multiply the resulting numbers together. For example, the prime factorization of 280 is $2^3 5^1 7^1$, and so 280 has $(3 + 1)(1 + 1)(1 + 1) = 16$ positive divisors.



(a) How many ordered pairs of positive integers (a, b) are there for which $ab = 400$ and $1 < a \leq b$?



(b) Determine the number of ordered triples of positive integers (p, q, r) for which $pqr = 270\,000$.



(c) Determine the number of ordered triples of positive integers (x, y, z) for which $xyz = 270\,000$ and $1 < x \leq y \leq z$.



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For students...

Thank you for writing the 2025 Galois Contest! Each year, more than 260 000 students from more than 80 countries register to write the CEMC's Contests.

Encourage your teacher to register you for the Canadian Intermediate Mathematics Contest or the Canadian Senior Mathematics Contest, which will be written in November 2025.

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For teachers...

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