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

Fryer Contest

(Grade 9)

Wednesday, April 13, 2016
(in North America and South America)

Thursday, April 14, 2016
(outside of North America and South America)

UNIVERSITY OF WATERLOO

Time: 75 minutes

Do not open this booklet until instructed to do so.

Number of questions: 4 **Each question is worth 10 marks**

Calculators are allowed, with the following restriction: you may not use a device that has internet access, that can communicate with other devices, or that contains previously stored information. For example, you may not use a smartphone or a tablet.

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 supplied by your supervising teacher must be inserted into your answer booklet. Write your name, school name, and question number on any inserted pages.
- Express calculations and answers as exact numbers such as $\pi + 1$ and $\sqrt{2}$, etc., rather than as $4.14\ldots$ or $1.41\ldots$, except where otherwise indicated.

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. Three schools each sent four students to a competition. The scores earned by nine of the students are given in the table below. The scores of the remaining three students are represented by x, y and z. The total score for any school is determined by adding the scores of the four students competing from the school.

	Student 1	Student 2	Student 3	Student 4
School A	12	8	10	6
School B	17	5	7	x
School C	9	15	y	z


(a) What is the total score for School A?


(b) The total scores for Schools A and B are the same. What is the value of x, the score for Student 4 at School B?


(c) The total scores for Schools A and C are the same. If the score for Student 4 at School C is twice that of Student 3 at School C, determine these two scores.

2. When Esther and her older brother Paul race, Esther takes 5 steps every 2 seconds, and each of her steps is 0.4 m long. Paul also takes 5 steps every 2 seconds, but each of his steps is 1.2 m long.

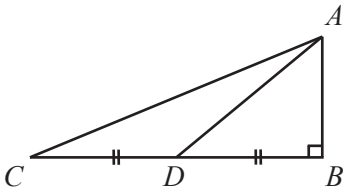

(a) In metres, how far does Esther travel in 2 seconds?


(b) In metres per second, what is Paul's speed?

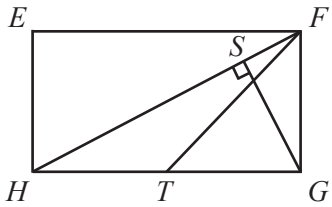

(c) If they both start a race at the same time, what distance ahead will Paul be after 2 minutes?


(d) If Esther begins a race 3 minutes before Paul, how much time does it take Paul to catch Esther?

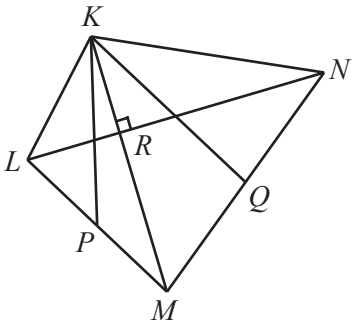
3. A *median* is a line segment drawn from a vertex of a triangle to the midpoint of the opposite side of the triangle.



(a) In the diagram, $\triangle ABC$ is right-angled and has side lengths $AB = 4$ and $BC = 12$. If AD is a median of $\triangle ABC$, what is the area of $\triangle ACD$?



(b) In rectangle $EFGH$, point S is on FH with SG perpendicular to FH. In $\triangle FGH$, median FT is drawn as shown. If $FS = 18$, $SG = 24$ and $SH = 32$, determine the area of $\triangle FHT$.



(c) In quadrilateral $KLMN$, KM is perpendicular to LN at R. Medians KP and KQ are drawn in $\triangle KLM$ and $\triangle KMN$ respectively, as shown. If $LR = 6$, $RN = 12$, $KR = x$, $RM = 2x + 2$, and the area of $KPMQ$ is 63, determine the value of x.

4. A BINGO card has twenty-five different integers arranged into five rows and five columns labeled B, I, N, G, and O such that:

- The middle integer is always 0.
- Integers in column B are between 1 and 15 inclusive.
- Integers in column I are between 16 and 30 inclusive.
- Integers in column N are between 31 and 45 inclusive (other than the middle integer being 0).
- Integers in column G are between 46 and 60 inclusive.
- Integers in column O are between 61 and 75 inclusive.

Here is an example of a BINGO card.

B	I	N	G	O
5	24	36	48	61
2	29	31	53	64
11	18	0	60	68
15	20	44	51	69
3	26	42	47	70

(a) What is the smallest possible sum of the numbers in a row on a BINGO card?

(b) Carrie's BINGO card has a row and a diagonal each with the same sum. What is the smallest possible such sum? Show that there is a BINGO card with this sum and explain why there is no BINGO card with a smaller such sum.

(c) In the BINGO card shown, numbers in a diagonal and in the 3^{rd} row are missing. Determine with justification the number of ways to complete this BINGO card so that the sum of the numbers in this diagonal is equal to 177 and the sum of the numbers in the 3^{rd} row is also equal to 177.

B	I	N	G	O
	23	35	47	65
5		31	52	63
		0		
11	20	40		69
9	18	38	48	

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

For students...

Thank you for writing the 2016 Fryer Contest! Each year, more than 220 000 students from more than 60 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 2016.

Visit our website `cemc.uwaterloo.ca` to find

- Free copies of past contests
- Math Circles videos and handouts that will help you learn more mathematics and prepare for future contests
- Information about careers in and applications of mathematics and computer science

For teachers...

Visit our website `cemc.uwaterloo.ca` to

- Obtain information about our 2016/2017 contests
- Register your students for the Canadian Senior and Intermediate Mathematics Contests which will be written in November
- Look at our free online courseware for senior high school students
- Learn about our face-to-face workshops and our web resources
- Subscribe to our free Problem of the Week
- Investigate our online Master of Mathematics for Teachers
- Find your school's contest results