



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

# *Fryer Contest*

(Grade 9)

**Thursday, April 12, 2018**  
(in North America and South America)

**Friday, April 13, 2018**  
(outside of North America and South America)



UNIVERSITY OF  
**WATERLOO**

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**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) previously stored information 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 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 answers as simplified exact numbers except where otherwise indicated. For example,  $\pi + 1$  and  $1 - \sqrt{2}$  are simplified exact numbers.



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

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*The name, grade, school and location of some top-scoring students will be published on our website, [cemc.uwaterloo.ca](http://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:

- Please read the instructions on the front cover of this booklet.
- Write all answers in the answer booklet provided.
- For questions marked , place your answer in the appropriate box in the answer booklet and **show your work**.
- 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.
- Diagrams are *not* drawn to scale. They are intended as aids only.
- 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.
- No student may write more than one of the Fryer, Galois and Hypatia Contests in the same year.

1. Sandy's Fruit Market sells cherries, plums and blueberries. For each type of fruit, the price of one box is shown in the table.

Fruit	cherries	plums	blueberries
Price	\$2.00	\$3.00	\$4.50



- (a) On Monday, Shane visited Sandy's Fruit Market. He bought 4 boxes of cherries, 3 boxes of plums, and 2 boxes of blueberries. How much did Shane pay in total?



- (b) On Wednesday, Shane bought 2 boxes of plums. He bought some boxes of cherries, no blueberries, and spent \$22.00 in total. How many boxes of cherries did he buy?



- (c) On Saturday, Shane bought twice as many boxes of plums as boxes of cherries. He also bought 3 boxes of blueberries. How many boxes of cherries did Shane buy if he gave the cashier \$100.00 and received \$14.50 in change?

2. In the diagrams shown,  $ABCD$  represents a rectangular field. There are three flagpoles:  $M$  on  $BC$ ,  $P$  on  $AD$ , and  $Q$  on  $CD$ . Paul runs along the path  $A \rightarrow D \rightarrow C \rightarrow M \rightarrow A$ . Tyler runs along the path  $A \rightarrow P \rightarrow Q \rightarrow C \rightarrow B \rightarrow A$ .



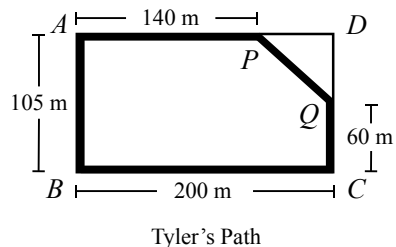
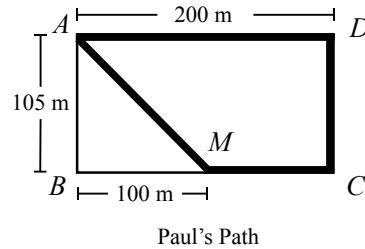
- (a) What is the length of  $MA$ ?











- (b) What is the total distance that Tyler runs?



- (c) Paul and Tyler start running at the same time. Tyler runs at a speed of 145 m/min. Paul runs at a constant speed and finishes 1 minute after Tyler. Determine Paul's speed, in m/min.



3.  (a) A line has equation  $y = 2x - 6$ . What is its  $x$ -intercept and what is its  $y$ -intercept?
-  (b) A line has equation  $y = kx - 6$ , where  $k \neq 0$ . What is its  $x$ -intercept? Express your answer in terms of  $k$ .
-  (c) A triangle is formed by the positive  $x$ -axis, the negative  $y$ -axis, and the line with equation  $y = kx - 6$ , where  $k > 0$ . The area of this triangle is 6. What is the value of  $k$ ?
-  (d) A triangle is formed by the positive  $x$ -axis, the line with equation  $y = mx - m^2$ , and the line with equation  $y = 2mx - m^2$ . Determine all values of  $m > 0$  for which the area of the triangle is  $\frac{54}{125}$ .
4. A *Bauman number* is a positive integer each of whose digits is 1 or 2. Each Bauman number consists of *blocks* of digits. Each block contains at least one digit and includes all of the consecutive equal digits. For example, 222111112111 is a 13-digit Bauman number consisting of four blocks: a block of four 2s, then a block of five 1s, then a block of one 2, then a block of three 1s; 2222222 is a 7-digit Bauman number consisting of a single block of seven 2s.
-  (a) How many 3-digit Bauman numbers are there?
-  (b) How many 10-digit Bauman numbers consist of fewer than three blocks?
-  (c) Determine the number of Bauman numbers that consist of at most three blocks and have the property that the sum of the digits is 7.
-  (d) Some Bauman numbers include a block of exactly 2018 2s. Determine the number of 4037-digit Bauman numbers that include at least one block of exactly 2018 2s.



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**For students...**

Thank you for writing the 2018 Fryer Contest! Each year, more than 240 000 students from more than 75 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 2018.

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**For teachers...**

Visit our website [cemc.uwaterloo.ca](http://cemc.uwaterloo.ca) to

- Obtain information about our 2018/2019 contests
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- Find your school's contest results