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

Time: 75 minutes   ©2018 University of Waterloo

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.

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.

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 $A \rightarrow P \rightarrow Q \rightarrow C \rightarrow B \rightarrow A$.

Paul's Path

Tyler's Path

(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.
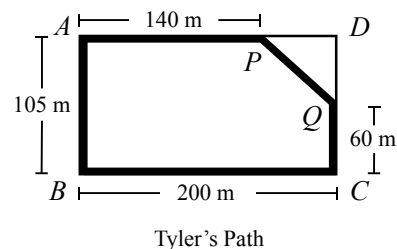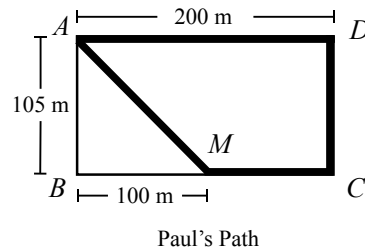
3.   (a) A line has equation $y = 2x - 6$. What is its x-intercept and what is its y-intercept?

   (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, 2222111112111 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.

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 2018/2019 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
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