

*The Faculty of Mathematics at the University of Waterloo  
in association with  
The Centre for Education in Mathematics and Computing  
presents*

# The Fourteenth Annual Small c Competition

for First and Second Year Students

Friday 19 September 2014

**Time:** 1 hour

**Calculators are permitted.**

**Instructions:**

1. Do not open this booklet until you are told to do so.
10. You may use slide rules, abaci, rulers, compasses and paper for rough work. You may also use log tables; log cabins are not permitted. Protractors are also permitted, though contractors are not.
11. By Faculty policy, only fourth-year students are allowed to use scissors. (Of course, they can't run with them.) Thus, there are no scissors allowed on the Small c.
100. Any contestant carrying an Elongated Pentagonal Orthocupolarotunda must register it with a proctor.
101. On your response form, print your name, plan, and ID number.
110. This is a multiple choice test. Each question is followed by five possible answers marked **A**, **B**, **C**, **D**, and **E**. Only one of these is correct. When you have decided on your choice, fill in the appropriate bubble on the response form.
111. In the past, your response form was read only by a *dumb human*, who had undergone rigorous training in order to be able to recognize the letters **A** through **E**. Due to labour unrest, this year, the dumb humans have been replaced by even dumber machines.
1000. Scoring: Each correct answer is worth 5 in Part A, 6 in Part B, and 8 in Part C.  
There is *no penalty* for an incorrect answer.  
Each unanswered question is worth 2, to a maximum of 20.
1001. Diagrams are *not* drawn to scale. They are intended as aids only.
1010. Als u dit kunt lezen, spreekt u het Nederlands.
1011. When your supervisor instructs you to begin, you will have *sixty* minutes of working time.
1100. Unfortunately, there is little room in this question booklet for you to sketch a new logo for the university.
1001. Anyone overheard making a joke about the Toronto Maple Leafs will be immediately removed from the premises.
1110. The only website you may use during the contest is [www.theonion.com](http://www.theonion.com).
1111. Data was scrambled during construction in the MC building. Try and find the flipped bit above.
10000. Turn off and put away your cell phones, tablets, laptops, desktops, satellites and quantum computers.

## Part A

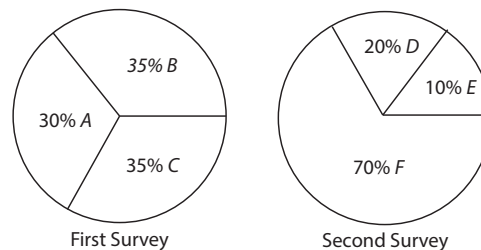
- What is the value of  $(9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1) + (1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9)$ ?  
 (A) 45            (B) 55            (C) 90            (D) 100            (E) 110
- A tiny piece of a bacon-wrapped chocolate bar dipped in peanut butter contains 13 grams of fat which makes up 20% of your recommended daily intake. What is your total recommended daily intake of fat?  
 (A) 2.6 g            (B) 15.6 g            (C) 16.25 g            (D) 26 g            (E) 65 g
- Answer ONE of the following two parts. They have the same numerical answer.
  - What is the maximum value of  $3\varepsilon + 2\nu$  subject to the following constraints?

$$\begin{aligned} 2\varepsilon + \nu &\leq 18 \\ 2\varepsilon + 3\nu &\leq 42 \\ 3\varepsilon + \nu &\leq 24 \\ \varepsilon &\geq 0 \\ \nu &\geq 0 \end{aligned}$$

- What is the largest multiple of 11 less than 37?  
 (A) 11            (B) 22            (C) 33            (D) 44            (E) 55
- Rocket was very excited about the new coffee shops on campus. He had 3 cups of coffee on Monday and 4 cups of coffee on Tuesday. How many cups of coffee did he drink on Wednesday if the average over the three days is exactly 3 cups per day?  
 (A) 5            (B) 4            (C) 3            (D) 2            (E) 1
  - For which of the following values of  $a$  is  $a^2 - a^3$  the greatest? (Calculus is not recommended.)  
 (A)  $\frac{1}{8}$             (B)  $\frac{1}{4}$             (C)  $\frac{1}{2}$             (D)  $\frac{3}{4}$             (E) 1

- The results of two surveys are shown on the right. The number of people that answered the first survey is twice the number of people that answered the second survey. What is the ratio of the the number of people that answered  $A$  on the first survey to the number of people that answered  $E$  or  $F$  on the second survey?

- (A) 1:2            (B) 1:3            (C) 3:4  
 (D) 1:4            (E) 2:3



- Gamora defines a sequence of numbers recursively by  $t_1 = 5$  and  $t_n = 3t_{n-1} - n$  for all natural numbers  $n \geq 2$ . The value of  $t_5$  is  
 (A) 307            (B) 80            (C) 405            (D) 205            (E) 325
- Nebula has 200 Canadian dollars (CAD). She converts some of that money to American dollars (USD) so that she has  $x$  CAD and  $x$  USD. If  $1 \text{ USD} = 1.05128 \text{ CAD}$ , what is the value of  $x$  to the nearest cent?  
 (A) \$95.12            (B) \$97.50            (C) \$100.00            (D) \$102.50            (E) \$105.13
- The number of real solutions to  $\ln(x^2) = \pi$  is  
 (A)  $-1$             (B)  $0$             (C)  $2$             (D)  $4$             (E)  $\infty$



