



UNIVERSITY OF  
**WATERLOO**



The CENTRE for EDUCATION in  
MATHEMATICS and COMPUTING



2017  
*Beaver*  
*Computing*  
*Challenge*  
*(Grade 7 & 8)*

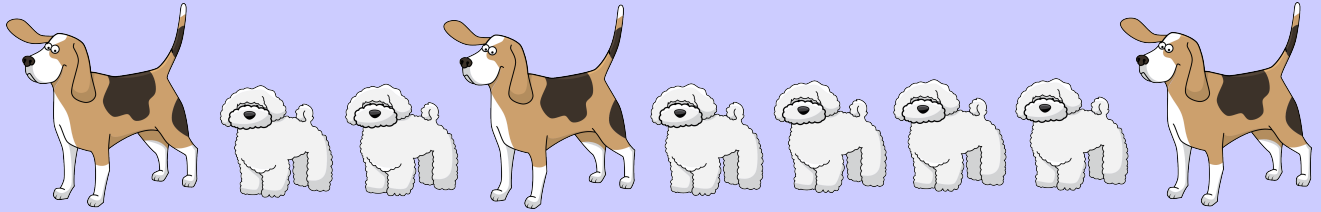
*Questions*

# Part A

## Swapping Dogs

### Story

Two types of dogs are standing as shown below.



A *swap* occurs when two dogs that are beside each other exchange positions. After some swaps, the three large dogs end up in three consecutive positions.

### Question

What is the fewest number of swaps that could have occurred?

- (A) 5
- (B) 6
- (C) 7
- (D) 8

# School Newspaper

## Story

Ten students work on a school newspaper using a lab of identical computers. All the work is done in one day. In the table below, cells with a check mark show when each student works.

Student	Time						
	8:00	9:00	10:00	11:00	12:00	1:00	2:00
1		✓	✓				
2			✓	✓	✓	✓	
3	✓	✓					
4					✓	✓	✓
5		✓	✓				
6				✓	✓		
7			✓	✓	✓	✓	✓
8		✓					
9	✓	✓	✓				
10						✓	✓

During any of the one-hour time slots, a computer can be used by only one student.

## Question

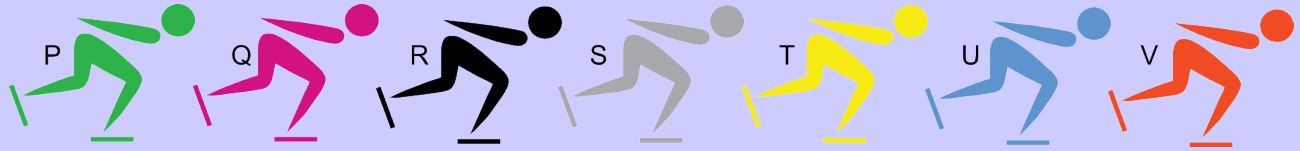
What is the minimum possible number of computers so that every student can get their work done?

- (A) 4
- (B) 5
- (C) 6
- (D) 10

# Skaters

## Story

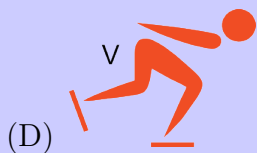
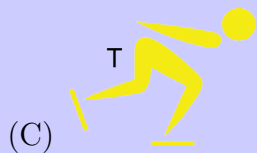
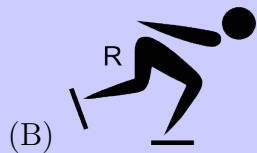
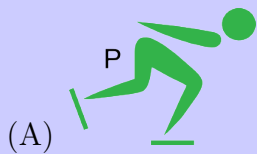
Seven people are skating in a line on a very long, frozen canal. They begin as shown below.



After every minute the person at the front of the line moves to the end of the line. For example, after one minute, U will be in front of the line, since V will move behind P.

## Question

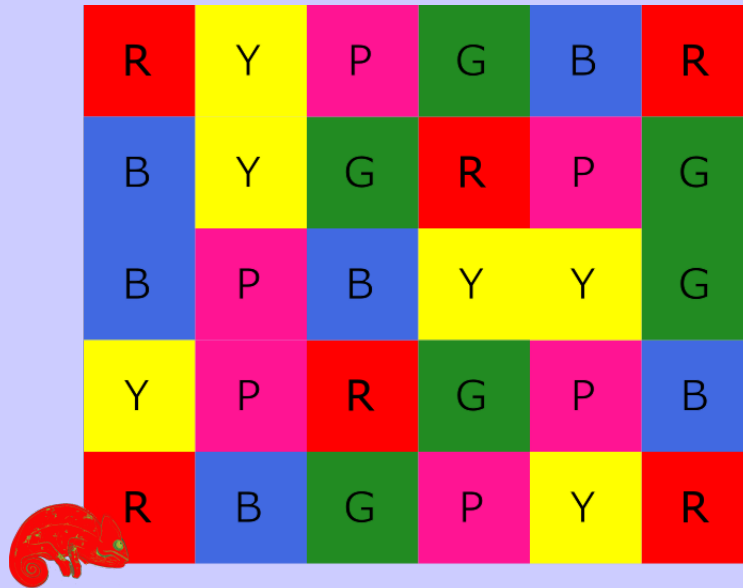
Which skater will be at the front of the line after 16 minutes?



## Chameleon

### Story

A chameleon travels on the grid below. It moves between adjacent cells either horizontally, vertically or diagonally. In a cell, a chameleon has the same colour as the colour of the cell.



### Question

What is the minimum number of different colours that the chameleon has when traveling from the lower left of the grid to the upper right?

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

## Risk

### Story

Darren's computer is connected to the Internet but does not have any antivirus or firewall software. None of the accounts on his computer are protected by a password.



### Question

Which computers are at risk because of this?

- (A) only Darren's own computer
- (B) only the computers in the same room as Darren's computer
- (C) only the computers in the same country as Darren
- (D) all computers in the world which are connected to the Internet and set up like Darren's

## Part B

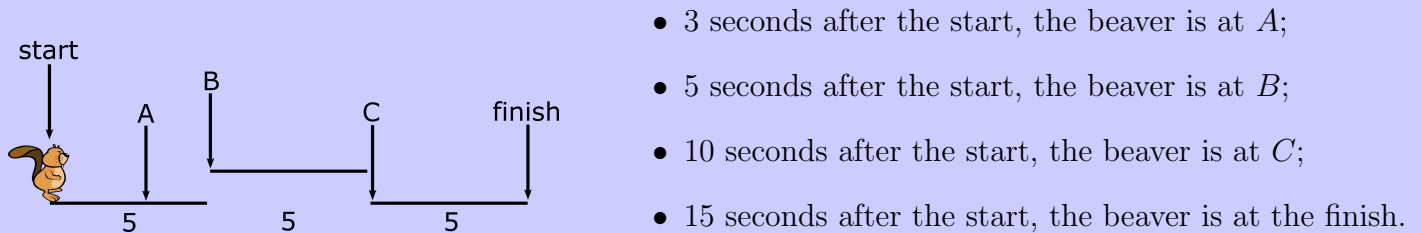


# Jumpers

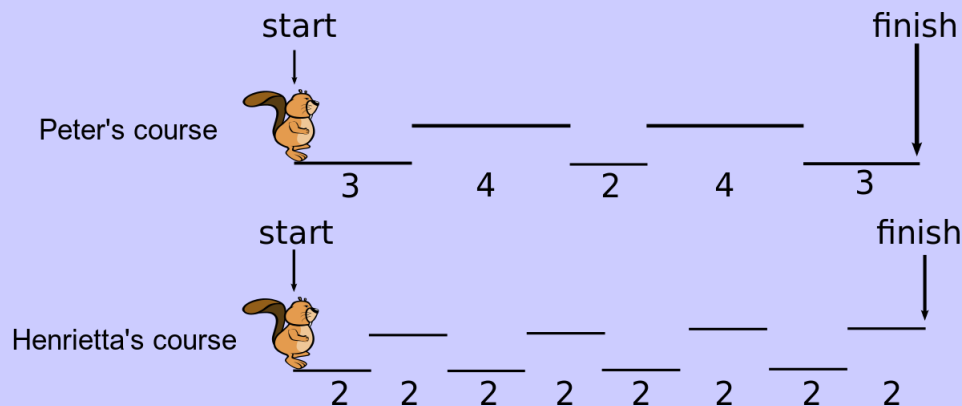
## Story

Peter and Henrietta are playing a video game. They move a beaver at a constant speed from the start of a course to the finish. The course consists of platforms on two levels. At the end of each platform before the finish, the beaver jumps instantaneously up or down to the next platform. The amount of time to move over each platform of the game is shown below each platform.

Here is an example course:



Peter and Henrietta start playing the following two different courses at exactly the same time.



## Question

For how long are both beavers moving along the top level at the same time?

- (A) 2 seconds
- (B) 4 seconds
- (C) 6 seconds
- (D) 8 seconds

## Bread

### Story

Alice, Bob, Charles, and Dorothy share two baguettes, two rolls, two croissants, and two slices of toast.



Each person has two different types of bread. Also:

- Alice and Bob do not have any type of bread in common.
- Charles has a baguette.
- Dorothy has a roll, but Alice does not have a roll.
- Bob has a croissant.

### Question

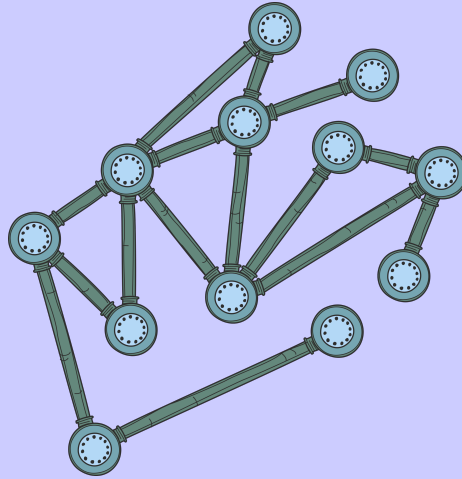
Which types of bread does Alice have?

- (A) A baguette and a croissant
- (B) A roll and a slice of toast
- (C) A baguette and a slice of toast
- (D) A roll and a croissant

## Pipe Network

### Story

A network of 12 nodes connected by pipes is shown below. Exactly one node is clogged. However, even with this clog, water can flow between any pair of connected unclogged nodes in the network.



### Question

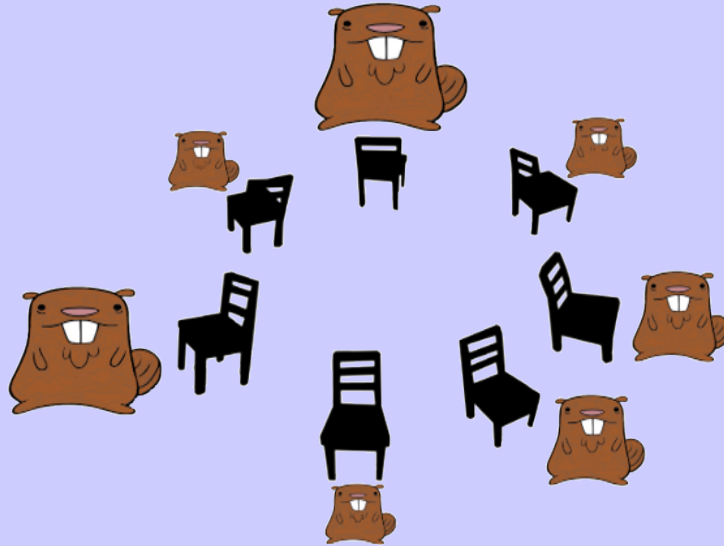
How many possibilities are there for the clogged node?

- (A) 5
- (B) 6
- (C) 7
- (D) 8

## Circle Chairs Game

### Story

Two large beavers, two medium beavers and three small beavers are playing a game around of circle of chairs. Seven chairs are placed at seven fixed positions. At the start of the game, each chair has one beaver in front of it, as shown below.



In one round of the game,

- each large beaver moves three positions counterclockwise,
- each medium-sized beaver moves two positions counterclockwise,
- and each small beaver moves one position clockwise.

### Question

After three rounds, how many chairs do not have a beaver in front of them?

- (A) 0
- (B) 1
- (C) 2
- (D) 3

## Beavers and Trees

### Story

Samantha is asked to record sequences of beavers and trees. Here is an example:



Samantha has a brilliant idea. For this example, she would only record this:







That is, she begins by recording the first image in the sequence (a beaver or a tree) and this is the only image she draws. After it, she writes down the number of times this image appears consecutively before the other image appears. Following this number, she writes down the number of times the other image appears consecutively, and so on. She continues writing down numbers in this way for the entire sequence.

Samantha looks back at her notes and finds this record of a sequence:



### Question

What was the original sequence of beavers and trees?

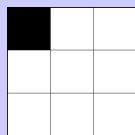
- (A) 
- (B) 
- (C) 
- (D) 

## Part C

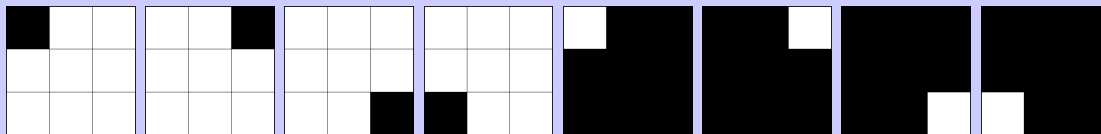
## What is THIS?

### Story

Beatrice Beaver is playing around with her simple 3-by-3 computer screen. She can paint some squares black. For example, if she painted only the top-left square, the screen would look like this:



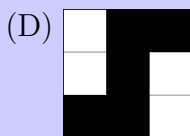
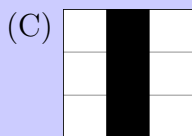
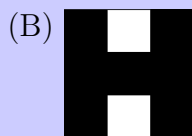
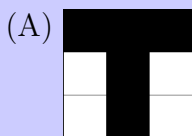
Her computer also has “rotate” and “invert” buttons. The “rotate” button rotates the screen clockwise by 90 degrees. The “invert” button changes all white squares to black and all black squares to white. For example, when Beatrice presses the “rotate” and “invert” buttons after painting only the top-left square, she can create a total of eight different patterns:



Beatrice begins with different images on the screen. She uses the two types of buttons any number of times and in any order trying to make different patterns.

### Question

Which of the following starting images allows Beatrice to make the largest number of different patterns?

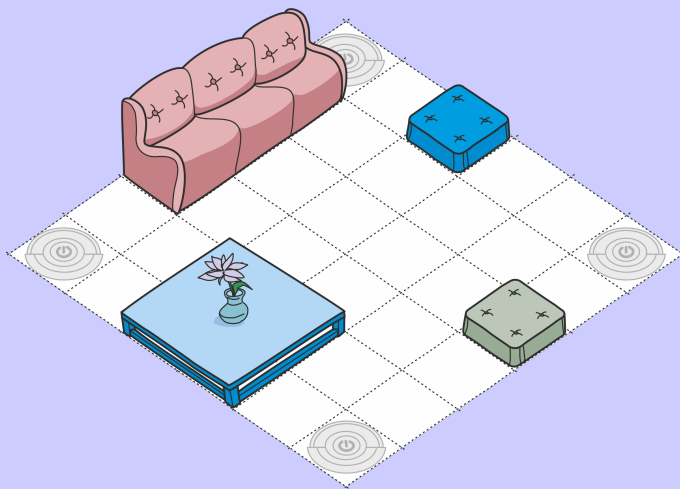


## Robot Cleaner

### Story

A robot washes the square tiled floor shown below by using the following commands:

- F – move forward one tile (which takes 1 minute)
- W – wash a tile (which takes 1 minute)
- R – turn  $90^\circ$  right (which is performed instantly)
- L – turn  $90^\circ$  left (which is performed instantly)



The robot can start at any corner facing any direction and can end at any corner. It never goes on a tile occupied by one of the four pieces of furniture and washes all the other tiles, including the 4 corner tiles, exactly once. The robot may travel over a tile more than once.

### Question

What is the minimum possible number of minutes the robot needs to wash the entire floor?

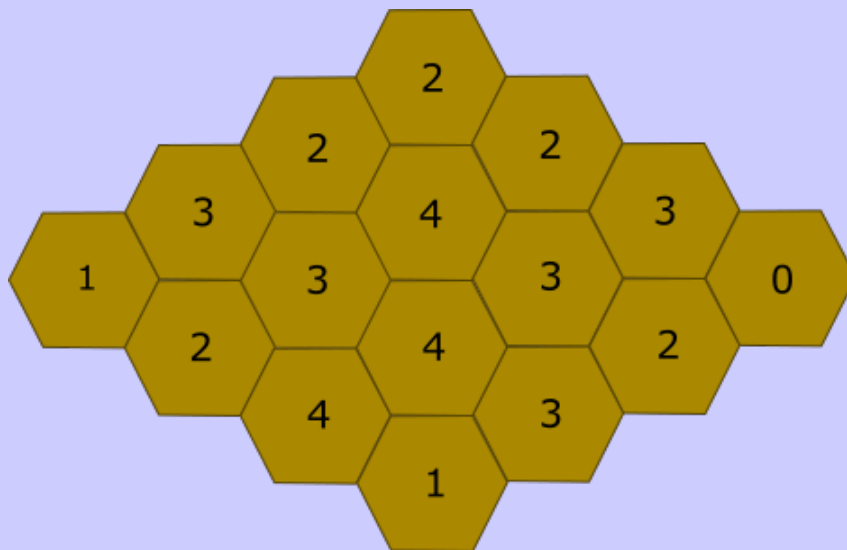
- (A) 53
- (B) 54
- (C) 55
- (D) 56



## Beehive

### Story

A bear studies how many hexagons in a honeycomb contain honey. For each hexagon, the bear records how many *other* hexagons touching this hexagon contain honey. So this number could be 0, 1, 2, 3, 4, 5 or 6. The results of the bear's study are below.



### Question

How many hexagons contain honey?

- (A) 7
- (B) 8
- (C) 9
- (D) 10

## Building a Dam

### Story

To build a dam, a beaver needs to cut 10 metre logs into smaller logs of lengths three and four. The table below shows how many of these smaller logs are needed.

<b>Length of Log</b>	<b>Number of Logs</b>
4 metre	7
3 metre	7

The beaver cannot combine together smaller logs to form larger logs.

### Question

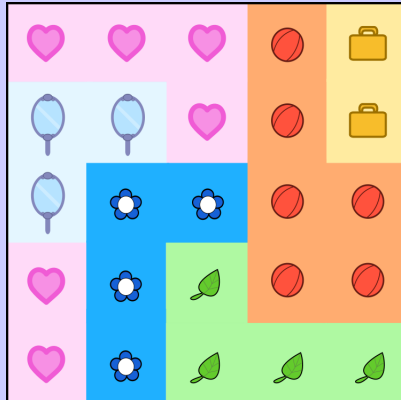
What is the least possible number of 10 metre logs that the beaver must cut?

- (A) 4
- (B) 5
- (C) 6
- (D) 7

# Wallpaper



















## Story

Robyn covers a wall with six overlapping rectangular sheets of wallpaper as shown. Each sheet of wallpaper is designed using a different image in a repeating pattern.



## Question

What is the order of the wallpaper pieces from the one placed first to the one placed last?

- (A)      
- (B)      
- (C)      
- (D) 