



UNIVERSITY OF
WATERLOO



The CENTRE for EDUCATION in
MATHEMATICS and COMPUTING



2023
Beaver
Computing
Challenge
(Grades 9 & 10)

Questions

Part A

Photo

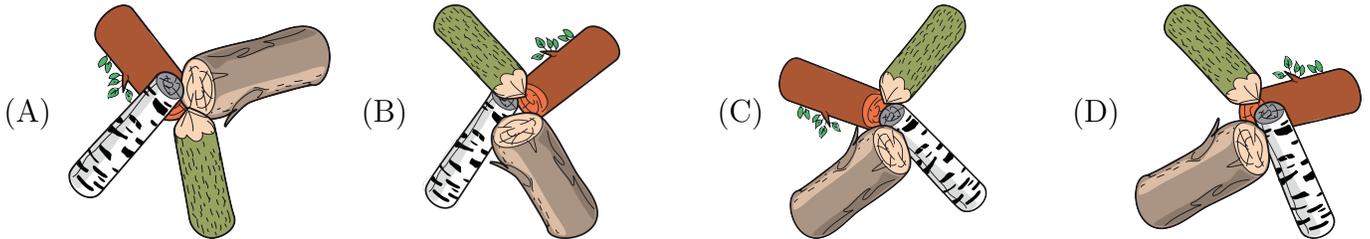
Story

A beaver took a photo looking directly down the centre of an arrangement of four logs assembled as shown.



Question

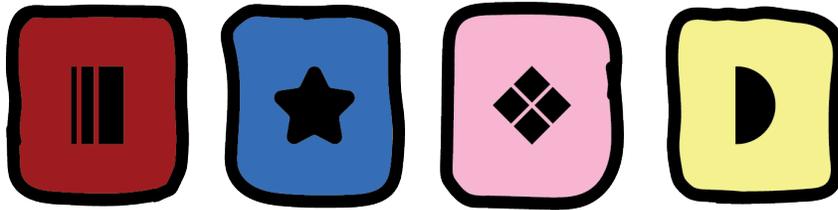
Which of the following could be the beaver's photo?



Cards

Story

A card game has four types of cards:



The symbol on each card indicates the number of points the card is worth, as shown.

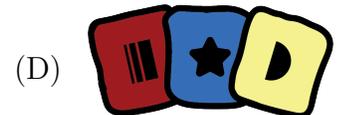
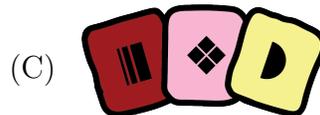
Symbol				
Number of Points	8	4	2	1

A player's score is the total number of points of the cards they have in their hand.

For example, Zita has the cards  and her score is $4 + 2 = 6$.

Question

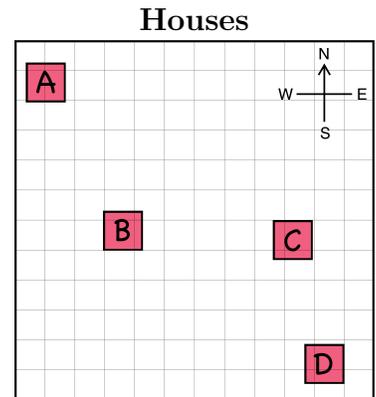
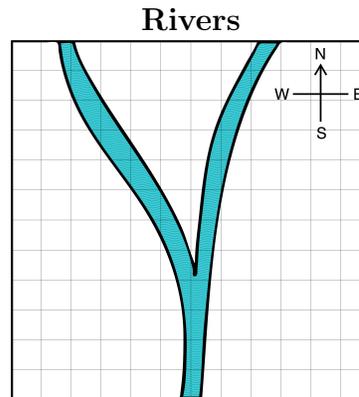
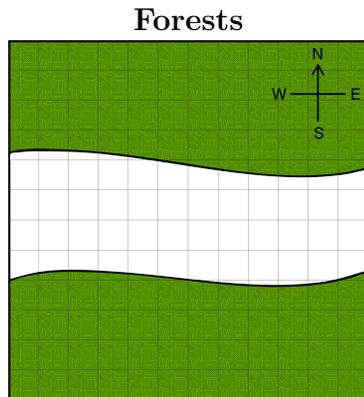
If Silat's score is 9, what cards could he have in his hand?



Karla's House

Story

Karla has three maps that all show exactly the same region. One map shows the forests , one shows the rivers , and one shows the houses . Karla's house is in the forest, touches the bank of the river, and is House A, B, C, or D.



Question

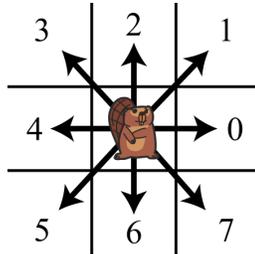
Which house is Karla's house?

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

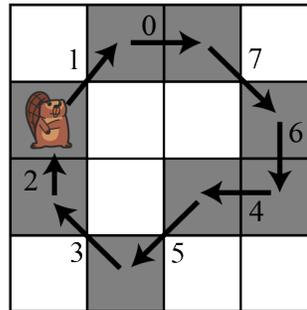
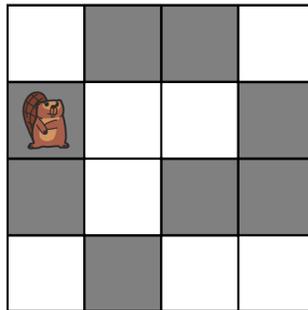
Video Game

Story

Sasha uses the numbers from 0 to 7 to move her character different directions in a video game, as shown.

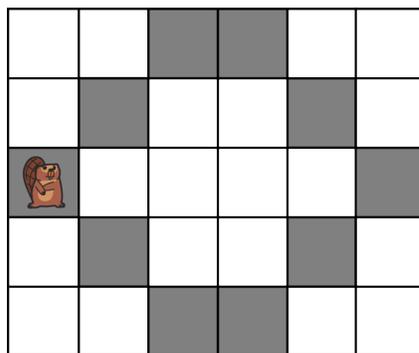


For example, to move her character clockwise along the grey path below and back to its original position, she types the sequence 1, 0, 7, 6, 4, 5, 3, 2.



Question

Which of the following sequences will move Sasha's character clockwise along the grey path and back to its original position?



(A) 1, 1, 7, 7, 5, 5, 3, 3

(C) 1, 1, 0, 7, 7, 5, 5, 4, 3, 3

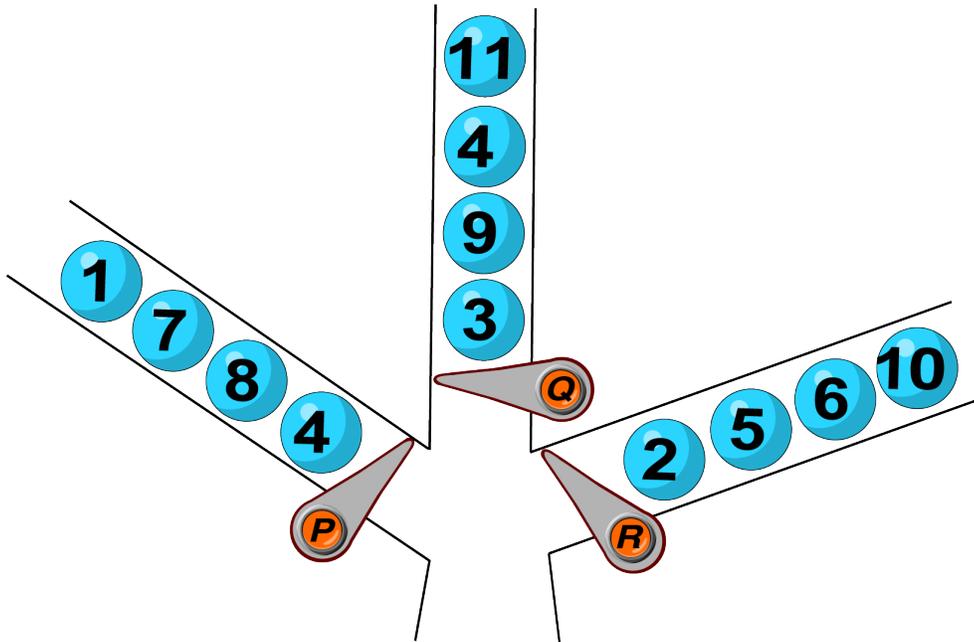
(B) 1, 1, 4, 7, 7, 5, 5, 0, 3, 3

(D) 7, 7, 0, 1, 1, 5, 5, 4, 3, 3

Push the Button

Story

Numbered balls are stored in the device shown below. Pushing one of the buttons P , Q or R causes its gate to open and the first ball behind that gate to drop.



Question

What is the maximum number of button pushes that result in balls being dropped in increasing (but not necessarily consecutive) order?

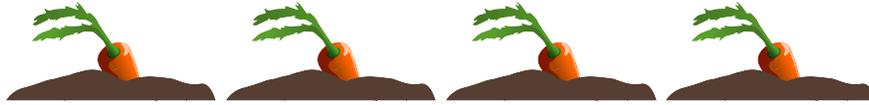
- (A) 6
- (B) 7
- (C) 8
- (D) 9

Part B

Eating Carrots

Story

Four carrots are growing in four soil patches as shown.



Rabbits are capable of the following three actions:



Hop to the soil patch immediately to the left of the current soil patch.



Hop to the soil patch immediately to the right of the current soil patch.



Eat the carrot growing in the current soil patch.

Earl the rabbit started in one of the four soil patches, but we do not know which one. We do know that Earl never jumped left of the leftmost soil patch nor right of the rightmost soil patch.

In addition, we know that Earl's sequence of actions was:



Question

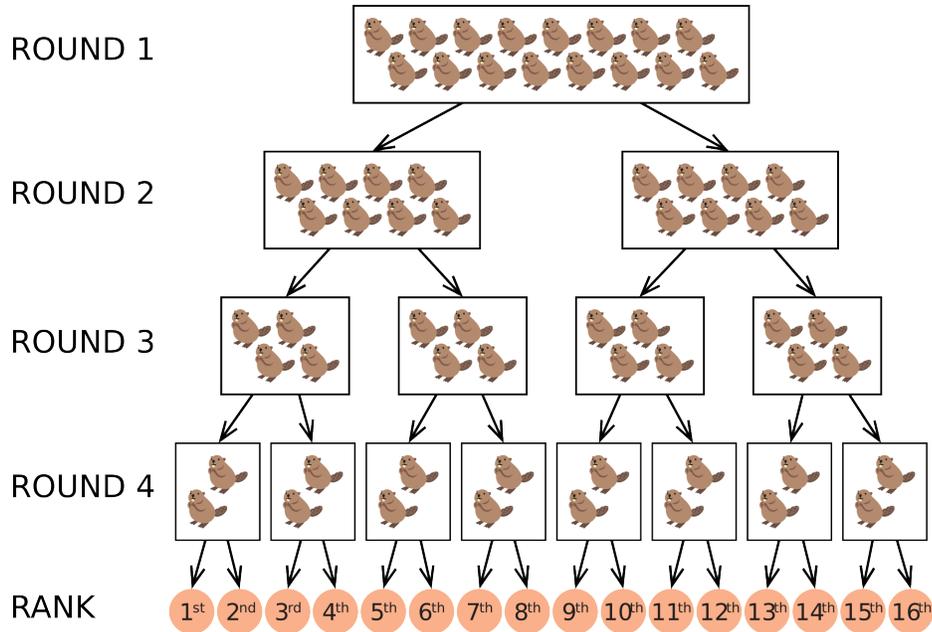
Which image below shows the soil patches and the one uneaten carrot after Earl finished his sequence of actions?

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

Bebras Ball

Story

Players are ranked from 1st place to 16th place based on their performance in a Bebras Ball tournament. The tournament consists of four rounds. All the players are grouped together for the first round, and divided into smaller groups after each round as shown. Winning players follow the left arrow to their group in the next round (or final rank). Losing players follow the right arrow to their group in the next round (or final rank).



For example, a player who wins during rounds 1 and 2, but loses during rounds 3 and 4, will receive a rank of 4th place.

Question

If Noro played in the tournament and lost during exactly one round, which of the following ranks could he **not** receive?

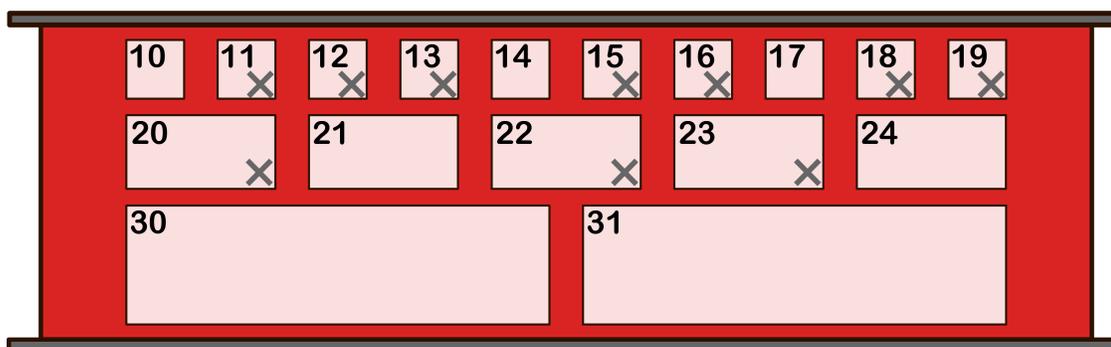
- (A) 2nd
- (B) 3rd
- (C) 5th
- (D) 7th

Lockers

Story

When packages arrive at the post office they are placed in lockers to await pick up. The top row of lockers can only hold small packages. The middle row of lockers can hold small or medium packages. The bottom row of lockers can hold packages of any size. Each locker can only hold one package at a time.

The following image shows what the lockers at the post office currently look like. Lockers marked with an X are holding a package.



When a new package arrives, it is placed in the lowest-numbered available locker in which it can fit. When a customer arrives to pick up a package from a locker, the locker becomes available again.

The post office has opened for the day and the following five events occur in this order:

- Four small packages arrive.
- The packages in lockers 11 and 19 are picked up.
- Two medium packages arrive.
- The packages in lockers 20 and 21 are picked up.
- Two small packages arrive.

Question

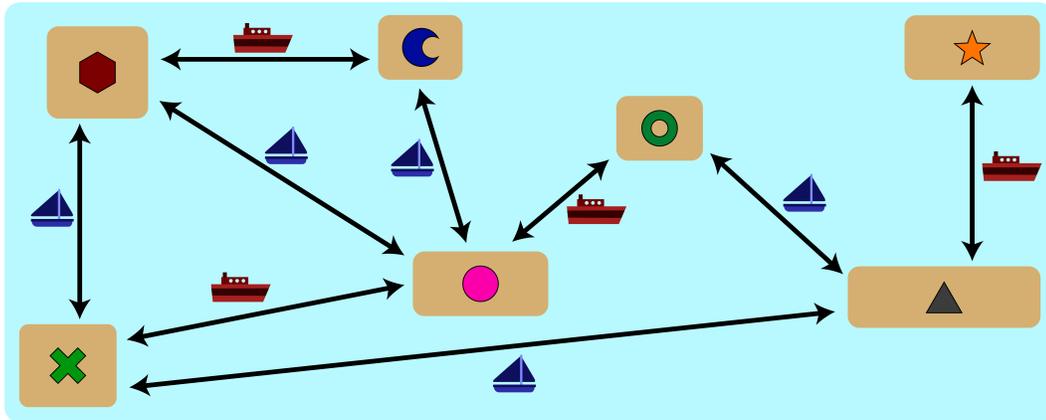
Then one more small package arrives. In which locker is it placed?

- (A) 20
- (B) 19
- (C) 24
- (D) 17

Island Vacation

Story

Ravi is on vacation in the Island Kingdom. On the map, each island is marked with a different shape, and the routes between islands are marked with the type of boat used on the route. There are two types of boats:  and .



Ravi started at the island marked with  and traveled to the island marked with , possibly visiting some islands more than once.

Question

Which of the following sequences of boats could Ravi **not** have taken?

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

Moving Documents

Story

Every day, employees of Beaver Logistics must move documents in boxes from one site to another. It takes 1 minute per box to load the truck, 1 minute per box to unload the truck, and it is a 50 minute round trip between the two sites. The truck can hold at most 20 boxes and so moving more than 20 boxes requires more than one trip back and forth.



At the start of each day, there are 36 boxes of documents to be moved. However, it is possible to spend some time reorganizing to reduce the total number of boxes that then need to be moved.

- On Monday, Alia did a lot of reorganizing before moving the documents on Monday. It took her 2 minutes per original box to reorganize, but when she was done she had eliminated half the boxes.
- On Tuesday, Bala did some reorganizing before moving the documents. It took him 1 minute per original box to reorganize, and when he was done he had eliminated a third of the boxes.
- On Wednesday, Yoko did no reorganizing at all before moving the documents. She had to move all the original boxes.

Question

Who was able to move all the documents (including any time spent reorganizing), and return to the starting site in less than 3 hours?

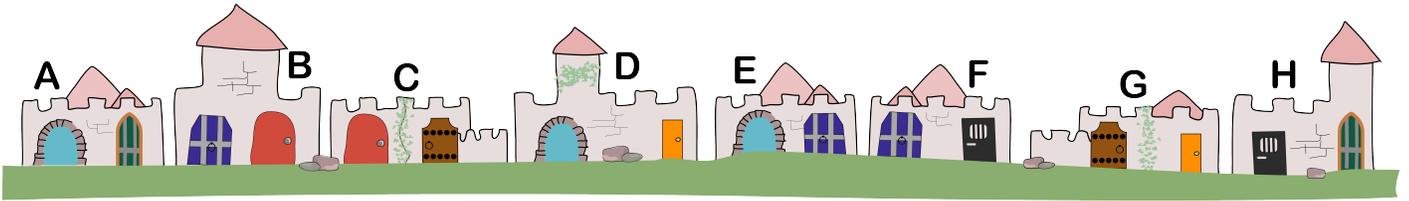
- (A) Alia and Yoko
- (B) Alia and Bala
- (C) Bala and Yoko
- (D) Alia, Bala and Yoko

Part C

Magical Doors

Story

There are eight buildings, labelled A through H, along a road as shown below.



The only way to travel between the buildings is by using magical doors. There are seven different types of doors:



Each building has two different doors. When you exit a building through one of its doors, you can then enter any of the other buildings that have a door of the same type.

For example, if you exit building A via the leftmost door , then you can enter either building D or building E, and if you exit building A via the rightmost door , then you will enter building H.

Question

If you passed through the fewest buildings possible starting in building A and ending in building C, how many **types of doors** did you travel through?

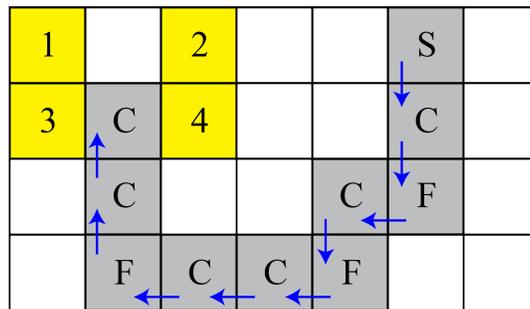
- (A) 2
- (B) 3
- (C) 4
- (D) 5

Closer or Farther

Story

Daniel is playing a game to find treasure buried in a grid of squares. Starting from the square labelled “S”, he can only move one step at a time to a neighbouring square. After each step, Daniel receives a signal indicating whether he is now closer to (C) or farther away from (F) the treasure, where the distance is the minimum number of steps it would take Daniel to reach the treasure from his current location.

Daniel plays this game on the following 4-by-7 grid. His path and the signals he receives after each step are shown.



You might notice that Daniel does not always make the best decisions.

Question

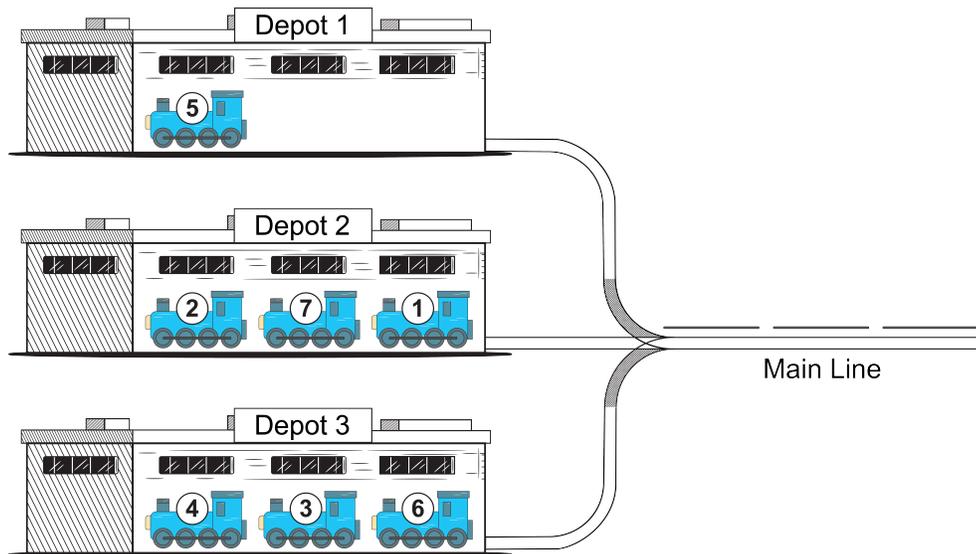
In which numbered square is the treasure buried?

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

Trains

Story

A train station is shown. It currently contains seven numbered trains in three numbered depots. The main line is connected to these depots. The main line and each depot can each hold up to three trains.



Two types of commands result in trains moving between the depots and the main line:

- **OUT(X)**: the rightmost train in Depot X becomes the leftmost train on the main line
- **IN(X)**: the leftmost train on the main line becomes the rightmost train in Depot X

For example, the sequence of commands **OUT(3)** - **OUT(1)** - **IN(3)** - **IN(1)** will result in trains 5 and 6 exchanging positions.

Question

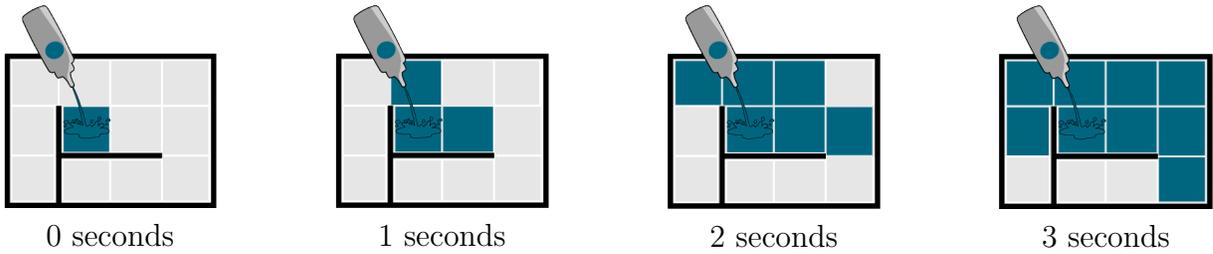
Which of the following sequences of commands will result in Depot 1 containing trains 1, 2, and 3?

- (A) **OUT(1)** - **OUT(2)** - **IN(1)** - **OUT(2)** - **OUT(2)** - **IN(1)** - **OUT(3)**
- (B) **OUT(1)** - **OUT(2)** - **IN(1)** - **OUT(2)** - **OUT(2)** - **IN(1)** - **OUT(3)** - **IN(2)** - **OUT(3)** - **IN(1)**
- (C) **OUT(1)** - **OUT(2)** - **IN(1)** - **OUT(2)** - **IN(1)** - **OUT(3)** - **IN(2)** - **OUT(3)** - **IN(1)**
- (D) **OUT(1)** - **OUT(2)** - **IN(1)** - **OUT(2)** - **OUT(2)** - **IN(1)** - **OUT(3)** - **OUT(3)** - **IN(1)**

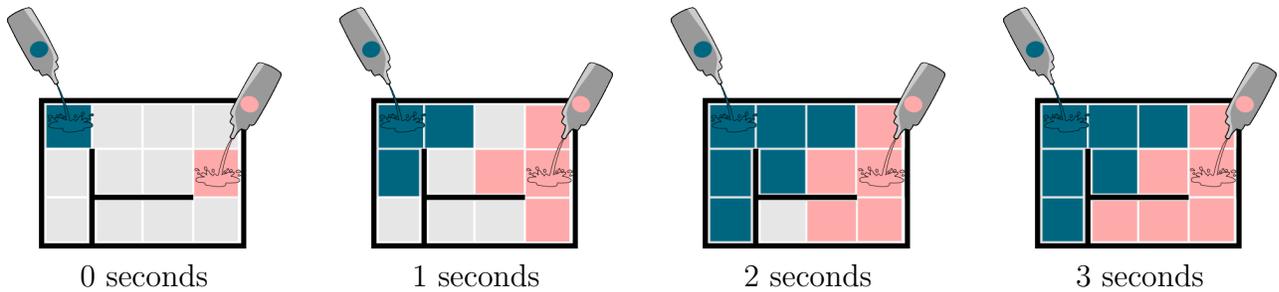
Watercolour

Story

A beaver designs mazes on rectangular grids of squares. To make the mazes more interesting, it can pour watercolour on a square. The colour then spreads. Every second, colour reaches each uncoloured square that shares an edge with a coloured square. However, colour does not spread through walls. Here is an example:

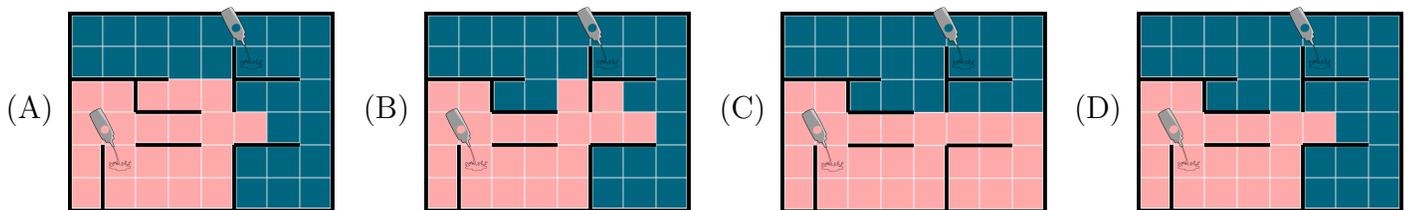
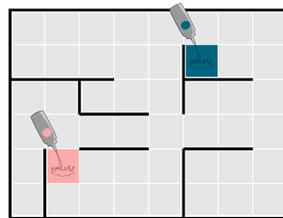


If different colours are used and poured into two different squares, then the first colour that spreads to an uncoloured square will fill it completely and no new colour will be added. If two colours reach a square at the same time, the square takes the darker colour.



Question

If different colours are poured as shown, what will the maze look like when the maze is filled with colour?



Companion Planting

Story

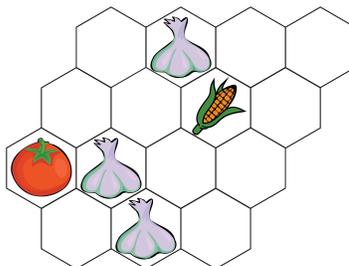
Thalia is planting a garden with garlic , tomatoes , sunflowers , corn , and beans . She wants the plants to help each other grow and knows that some pairs of plants are good companions and some pairs of plants are bad companions:

Good Companions				
				 
			 	 

Bad Companions	
 	 

All other pairs of plants do not affect each other's growth.

There are 15 sections in Thalia's garden bed. She wants to place three of each type of plant in her garden. She has already placed three garlic plants, one corn plant, and one tomato plant as shown.



Question

In how many different ways can Thalia place the remaining plants so that each plant is next to at least one of its good companions, and no plant is next to any of its bad companions?

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