UNIVERSITY OF
WATERLOO

The CENTRE for EDUCATION in
MATHEMATICS and COMPUTING

2023
Beaver
Computing
Challenge
(Grades 7 & 8)

Questions

Part A

Lakes

Story

Six lakes are connected by rivers. Water always flows from a lake with a greater height above sea level to a lake with a lesser height above sea level.

An online search provides the following information about these lakes:

Lake	pH Level	Height Above Sea Level (m)	Estimated Fish Population
Atlyn	6.5	320	32000
Clare	7.1	740	1500
Doffin	6.8	490	65000
Kazba	7.2	673	4200
Mus	6.5	973	22100
Soul	6.2	382	43000

Question

In what order does water flow between these six lakes?

(A) Atlyn, Clare, Doffin, Kazba, Mus, Soul

(B) Mus, Clare, Soul, Atlyn, Doffin, Kazba

(C) Kazba, Clare, Doffin, Mus, Atlyn, Soul

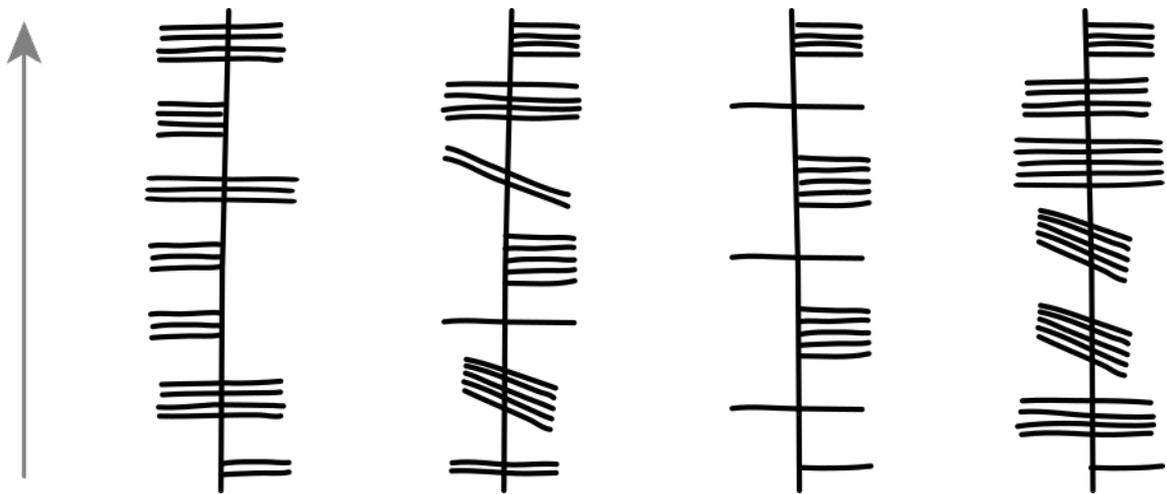(D) Mus, Clare, Kazba, Doffin, Soul, Atlyn

Ogham Code

Story

Ogham is a medieval alphabet used to write words vertically along a pillar.

Each letter is represented by a group of lines that always touches or crosses the pillar in the same way. Groups (letters) are separated by big gaps and arranged upwards from the bottom of the pillar to the top of the pillar.

Eabha writes four words using the Ogham alphabet as shown. The words are BANANAS, BERRIES, LETTUCE, and ORANGES, but we do not know which word corresponds to which image.

Question

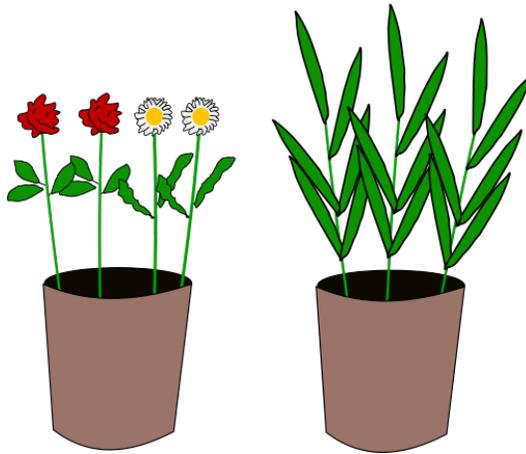From left to right, what is the order in which Eabha has written these words?

(A) LETTUCE, ORANGES, BANANAS, BERRIES

(B) ORANGES, LETTUCE, BANANAS, BERRIES

(C) BERRIES, BANANAS, LETTUCE, ORANGES

(D) LETTUCE, ORANGES, BERRIES, BANANAS
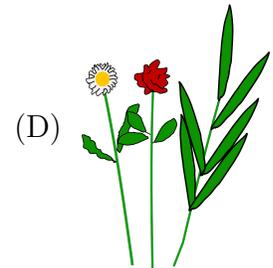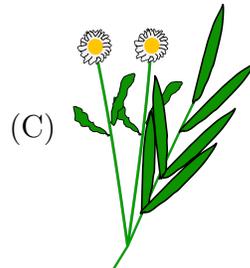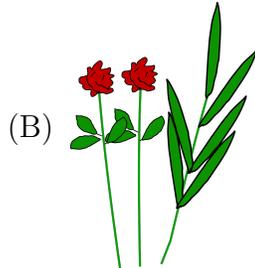
Flower Shop

Story

A florist makes bouquets by following these three steps in order:

1. Pick one flower from the bucket shown on the left to start the bouquet.

2. If the flower picked is a daisy , add a second daisy to the bouquet.

3. Complete the bouquet by adding at least one branch of leaves from the bucket shown on the right.

Question

Which bouquet might the florist make?

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

Magic Tree

Story

Bain the Beaver has a magical tree growing near their home.

Whenever a bird 🐦 lands on it, the tree sprouts 2 apples.

Whenever a squirrel 🐿 climbs up it, the tree drops 1 apple (if it has any).

Bain has also noticed that whenever a snake 🐍 visits the tree, all of the apples instantly disappear!

One morning Bain notes that the magical tree contains 25 apples. Bain then spends the rest of the day drawing pictures of all the animals that come to the tree. The drawings, in order, are:

🐦 🐦 🐿 🐦 🐍 🐿 🐿 🐦 🐦 🐦 🐿 🐦 🐍 🐦 🐦 🐦 🐿

Question

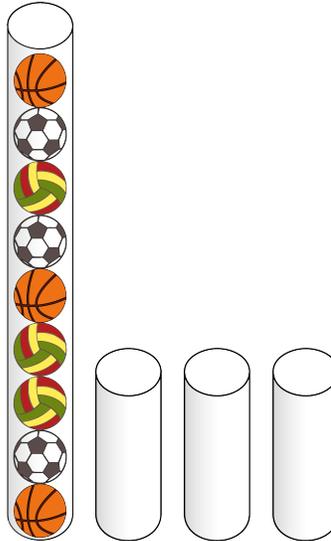How many apples are on the tree at the end of the day?

(A) 3

(B) 7

(C) 17

(D) 31

Equipment Sorting

Story

An equipment tube contains basketballs 🏀, soccer balls ⚽, and volleyballs 🏐.

Sarah reorganizes the equipment by moving the balls one by one. That is, Sarah takes each ball out of the top of the equipment tube and then drops it into the top of one of the smaller tubes. After moving each ball once, each type of ball is stored together in a smaller tube.

All the balls are the same size and each smaller tube holds three balls.

Question

Which of the following statements is **true**?

(A) Sarah fills the tube of soccer balls first.

(B) Sarah fills the tube of volleyballs last.

(C) Sarah fills the tube of soccer balls after filling the tube of basketballs.

(D) Sarah fills the tube of volleyballs before filling the tube of basketballs.
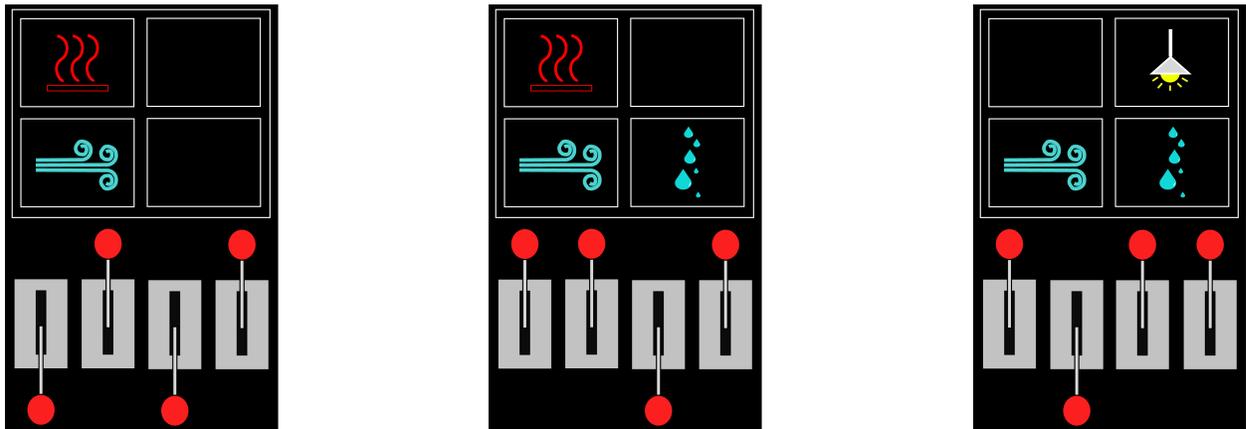
Part B

Levers

Story

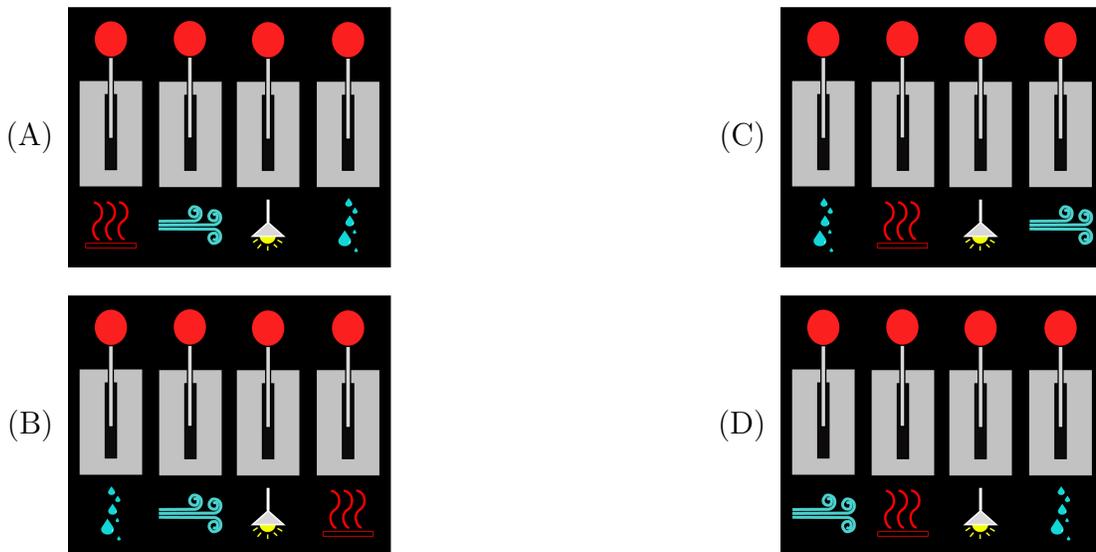Jacinta's new helicopter has a control panel with four levers that each control a different system.

The labels on the levers are missing, and Jacinta was told that the system was wired in a confusing way so she doesn't know which lever controls which system. All she knows is that putting a lever up turns one system and its indicator light on, and putting a lever down turns one system and its indicator light off.

The image shows which indicator lights are on for three different configurations of the levers.
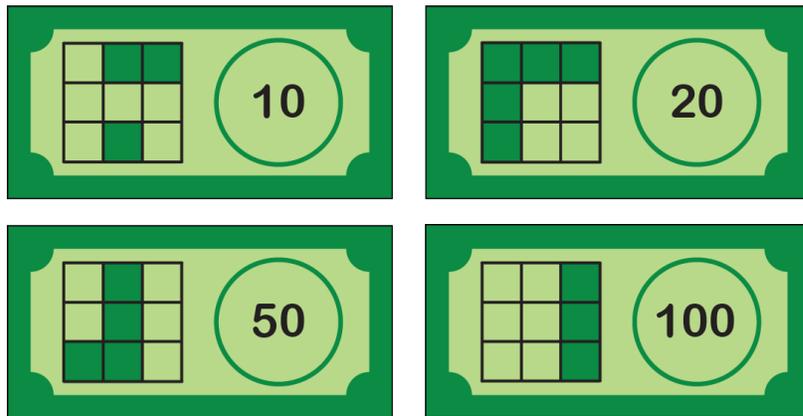

Question

Which of the following correctly matches each lever to the system that it controls?

Vending Machine

In Beaverland, paper money comes in four different values: 10, 20, 50, and 100. These values are written on the paper money and they are also encoded using a grid of nine squares that are either blank or filled in, as shown.
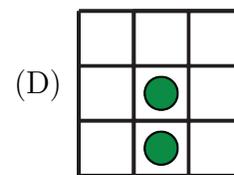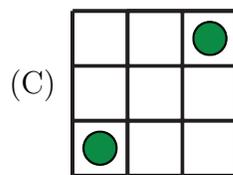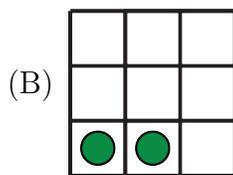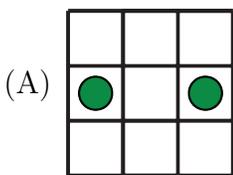

When paper money is inserted into a vending machine, the machine scans all nine grid squares and determines whether each square is blank or filled in. This is how the vending machine identifies the value of the paper money. For example, if the vending machine determines that only the squares in the rightmost column are filled in, it identifies the paper money as having a value of 100.

Sylvia has noticed that the vending machine doesn't need to scan all nine squares. It could correctly identify the value of the paper money by scanning only two squares.
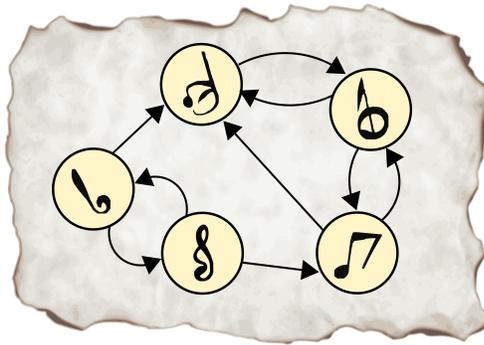
Question

Which two squares could Sylvia reprogram the vending machine to scan (ignoring all others) in order to identify the value of the paper money?

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

Restoring Music

Juno has found an ancient diagram that describes how to compose pieces of music using just five types of notes. Any note can be selected as the first note, but a note can only be selected next if there is an arrow pointing to it from the previous note.

Juno has also found the sheet containing a piece of music which was composed using the diagram above. Two notes are missing due to a hole torn in the sheet as shown below.

Question

Juno would like to restore this sheet of music. Which two notes must be missing?
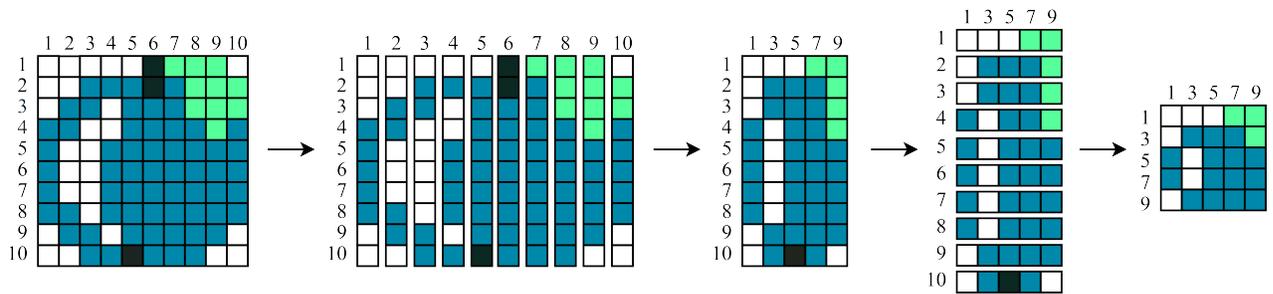
(A)

(B)

(C)

(D)

Snail Compress

A beaver has a special technique to shrink images.

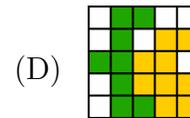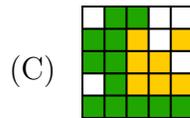First, they cut the original image into 10 equally-sized vertical strips. Then, they remove the even-numbered strips and assemble the odd-numbered strips to create a new image.
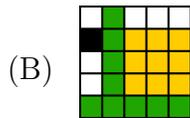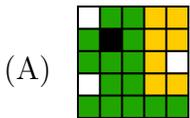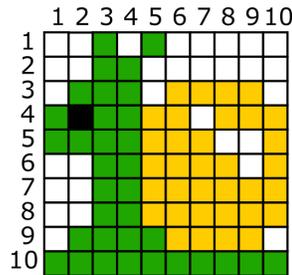
Next, they cut the new image into 10 equally-sized horizontal strips. Then, they remove the even-numbered strips and assemble the odd-numbered strips to create a complete shrunken image. Here is an example:

Question

If the beaver uses this technique to shrink the image below, what is the complete shrunken image?
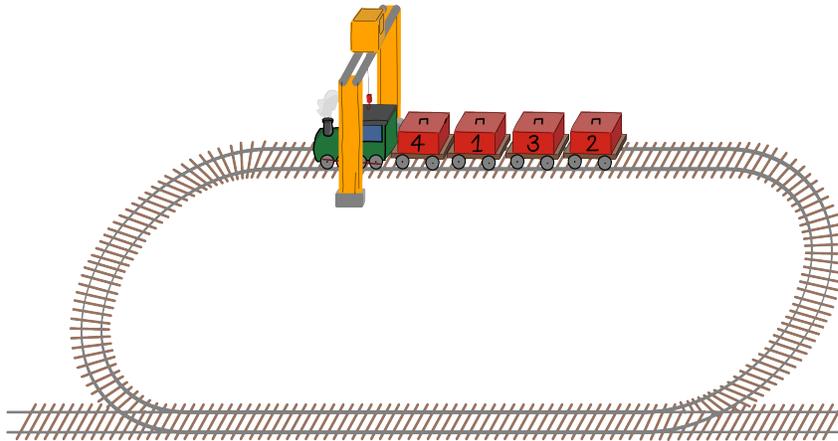

(A)   (B)   (C)   (D)

Unloading

Story

Freight trains consist of an engine followed by wagons, each holding a numbered box. The boxes must be unloaded in increasing order, starting from box 1. To unload a box, its wagon must be positioned directly below the crane.

The crane is in a fixed position and trains can only move forward on a loop. Usually, this means that several rounds are needed to unload all the boxes. Each round begins with the engine directly under the crane.

In the example shown, the boxes have to be unloaded in the order 1, 2, 3, 4 and three rounds are needed to do this. In the first round of unloading, the train moves forward to skip box 4, unload box 1, skip box 3, and unload box 2. The train then goes around the track until the engine is under the crane again. In the second round of unloading, the train moves forward to skip box 4, skip the empty wagon, and unload box 3. The train then has to come back for a third round in order to unload box 4.

Question

How many rounds will be needed to unload all the boxes from the following train?

(A) 5

(B) 6

(C) 7

(D) 8

Part C

Story

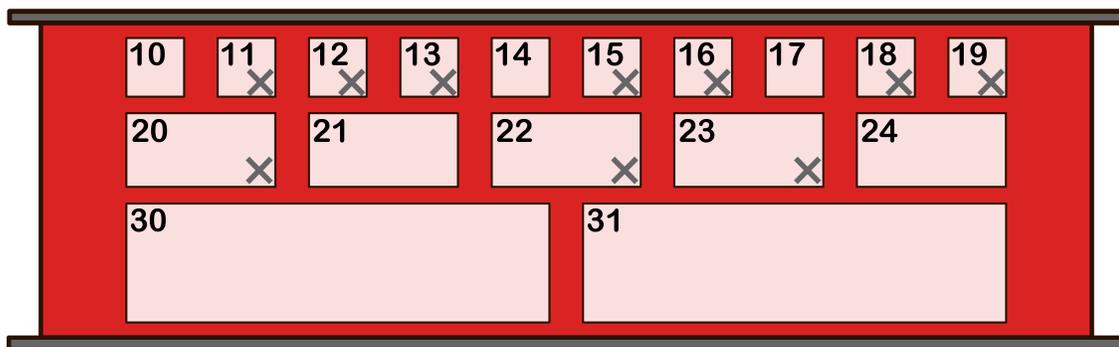When packages arrive at the post office they are placed in lockers to await pick up. The top row of lockers can only hold small packages. The middle row of lockers can hold small or medium packages. The bottom row of lockers can hold packages of any size. Each locker can only hold one package at a time.

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?
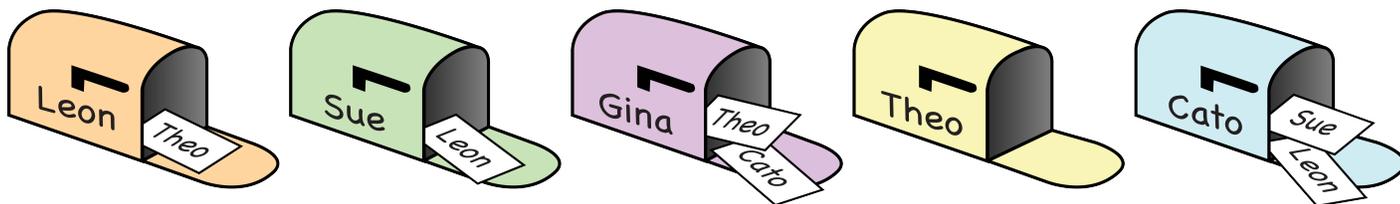
(A) 20

(B) 19

(C) 24

(D) 17

Delivering Mail

Story

When beavers want to send mail to each other they leave the mail in their own mailbox. Percy, the mail-delivery beaver, then does two things at each mailbox:

- He collects any mail in the mailbox and puts it in his bag.

- He delivers all the mail for that beaver from his bag by putting it in their mailbox.

At the start of Percy's shift, his bag is empty and the beavers' mailboxes contain the following mail:

At the end of Percy's shift, all the mail has been delivered. Percy also notes that he only had to visit each mailbox exactly once (which is unusual for Percy).

Question

In which of the following orders must Percy have visited the mailboxes?

(A) Gina $\longrightarrow$ Cato $\longrightarrow$ Leon $\longrightarrow$ Sue $\longrightarrow$ Theo

(B) Gina $\longrightarrow$ Sue $\longrightarrow$ Cato $\longrightarrow$ Theo $\longrightarrow$ Leon

(C) Gina $\longrightarrow$ Cato $\longrightarrow$ Sue $\longrightarrow$ Leon $\longrightarrow$ Theo

(D) Cato $\longrightarrow$ Gina $\longrightarrow$ Sue $\longrightarrow$ Leon $\longrightarrow$ Theo

Logic Treasure

Story

An island contains three treasure chests: one by the mountains, one under the palm tree, and one on the beach. At the start of the day all three treasure chests were empty. Then, at some point during the day, Pirate Beaverbeard filled one of the chests with gold.

Three treasure hunters explored the island. One of them did all of their exploring *before* Beaverbeard filled a chest with gold. The other two treasure hunters did all of their exploring *after* Beaverbeard filled a chest with gold. None of the treasure hunters ever found the gold; they only discovered empty chests, as shown below.

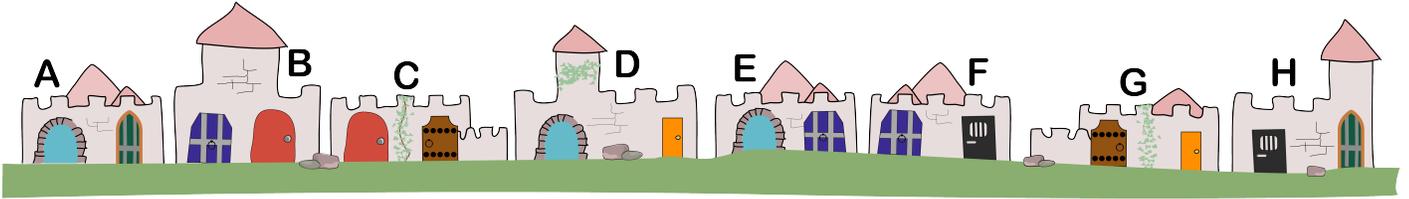| Treasure Hunter	Empty Chest(s) Discovered
Alice	on the beach
Bob	on the beach / under the palm tree
Clark	by the mountains / under the palm tree

Question

Which treasure chest was the gold in?

(A) The chest under the palm tree

(B) The chest on the beach

(C) The chest by the mountains

(D) The chest cannot be determined

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?
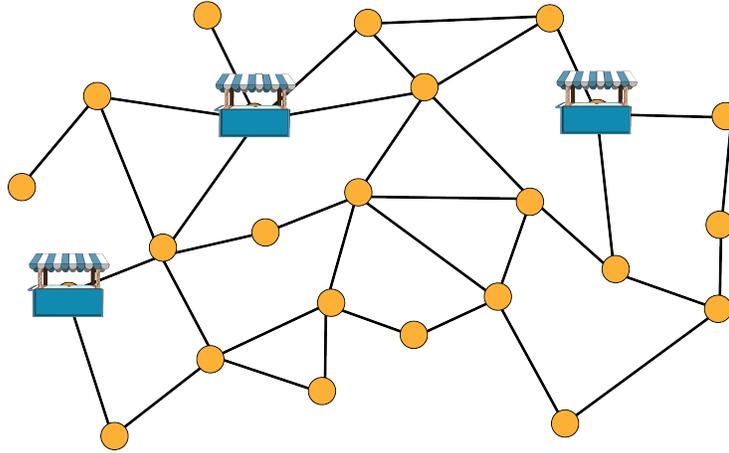
(A) 2

(B) 3

(C) 4

(D) 5

18

Juice Carts

To celebrate National Juice Day, three juice carts have been placed in a huge park. The juice carts will distribute free juice.

The image below shows a map of the park. The juice cart icons represent points of interest where a juice cart has been placed, circles represent other points of interest, and the lines represent paths.

It takes 5 minutes to walk between any two points of interest which are directly connected by a path. There are some points of interest from which you have to walk more than ten minutes in order to reach a juice cart. This is considered too far to walk for free juice. Therefore, a point of interest must be chosen for another juice cart. After this fourth juice cart is placed, it must be possible to reach a juice cart from any point of interest in at most 10 minutes.

Question

How many different points of interest can be chosen for the location of the fourth juice cart?

(A) 1

(B) 2

(C) 3

(D) 4