Computer Talent Search

A project of the Institute of IT Professionals South Africa

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ELITE

Grade 12+

NOT TO BE USED BEFORE 6 MARCH 2017

If you are NOT in grade 12 or above, please report that you have the wrong paper.

Only when the teacher says "START", may you begin.

1. Write your personal details and your answers on the answer sheet provided.
2. You will have 45 minutes to complete the 15 tasks.
3. You may answer the questions in any order, but it is important to place the answer in the correct line on the answer sheet.
4. Leave the tasks you find difficult for later.

The mark allocation is as follows:

A section: +6 marks for every correct answer.
B section: +7 marks for every correct answer.
C section: +7 marks for every correct answer.
If you do not answer a question or answer correctly, you get 0 (zero) for that task.
The maximum mark is 100.

Wait for the teacher to say "START".

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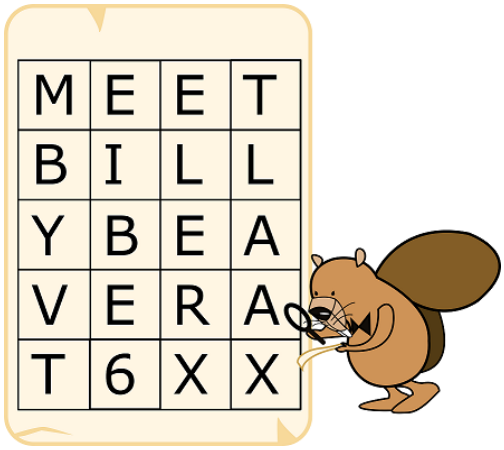
A1 Secret Messages

Agents Boris and Bertha communicate using secret messages.
Boris wants to send Bertha the secret message:

MEETBILLYBEAVERAT6

He writes each character in a 4 column grid from left to right and row by row starting from the top. He puts an X in any unused spaces. The result is shown below.



Then he creates the secret message by reading the characters from top to bottom and column by column starting from the left:

MBYVTEIBE6ELERXTLAAX

Bertha then uses the same method to reply to Boris. The secret message she sends him is:

OIERKLTEILH!WBEX

Question: What message does Bertha send back? Write the letter of your answer in the appropriate block on your answer sheet.

A: OKWHERETOMEET!

B: OKIWILLBETHERE!

C: WILLYOUBETHERETOO?

D: OKIWILLMEETHIM!

A2 Magic Potions

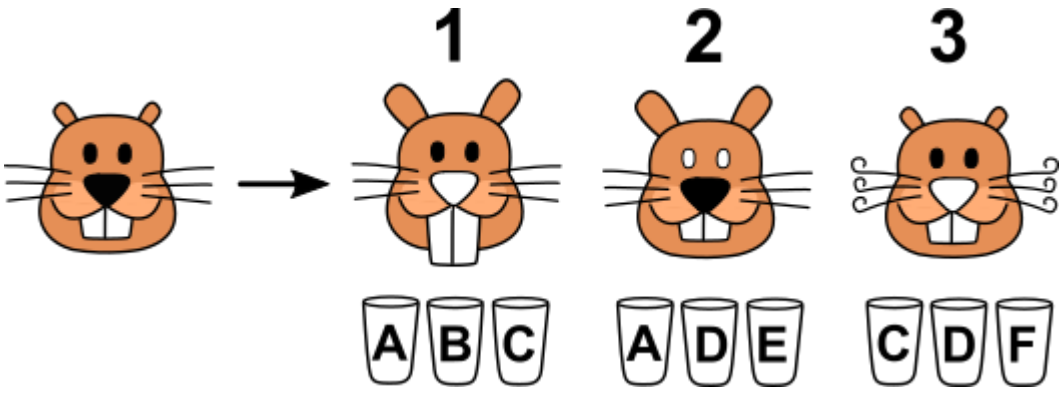
Betaro Beaver has discovered five new magic potions:

- one makes ears longer
- another makes teeth longer
- another makes whiskers curly
- another turns the nose white
- the last one turns eyes white.

Betaro put each magic potion into a separate beaker. He put pure water into another beaker, so there are six beakers in total. The beakers are labeled A to F. The problem is, he forgot to record which beaker contains which magic potion!

To find out which potion is in each beaker, Betaro set up the following experiments:

Experiment 1: A beaver drinks from beakers A, B and C together - the effects are shown in Figure 1.
Experiment 2: A beaver drinks from beakers A, D and E together - the effects are shown in Figure 2.
Experiment 3: A beaver drinks from beakers C, D and F together - the effects are shown in Figure 3.



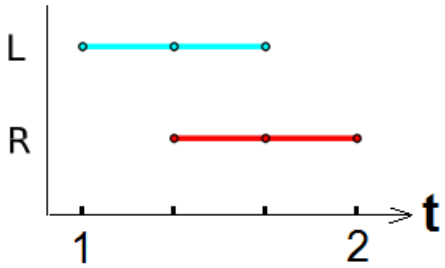
Question:
Which beaker contains pure water? Write down the letter of your answer in the appropriate block on your answer sheet.

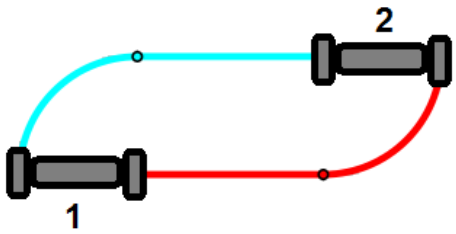
A3 Segway

Jan has a special vehicle that looks like a Segway. He moves it by pressing two buttons: a button on the left, and a button on the right.

When he presses a button, the wheel on that side of the vehicle rotates:
If both buttons are pushed at the same time, both wheels rotate and the vehicle moves forward.
If he pushes a single button, only one wheel rotates and the vehicle turns.

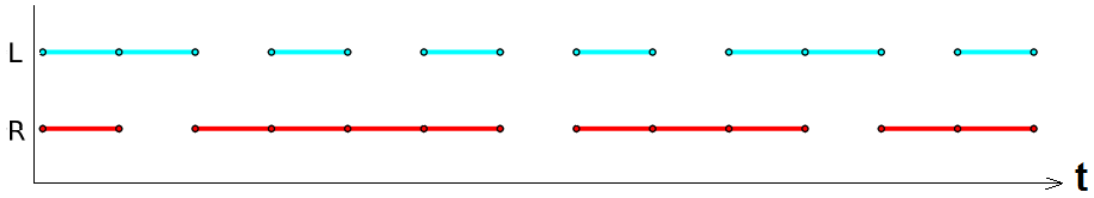
Example: The follow table shows which button was pushed when, and how the vehicle moved from location 1 to location 2.





First, the left button was pressed and the vehicle turned to the right. Then both buttons were pressed, and the vehicle moved forward. Finally the right button was pressed, and the vehicle turned left. The orientation of the vehicle is now the same as in the beginning: facing towards the upper wall.

Question: Here is a record of the button presses from a different journey:



The vehicle is in a large rectangular room. The vehicle kept going until it hit one of the walls. At the start the vehicle was facing towards the upper wall. Towards which wall was the vehicle facing at the end of the journey? Write down the letter of your answer in the appropriate block on your answer sheet.

A: upper wall

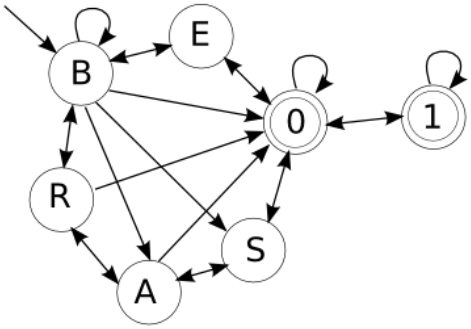
B: lower wall

C: left wall

D: right wall

A4 Rafting

Beavers build rafts. For river traffic control, all rafts should be registered.
This means that each raft should have a license plate with unique text.
The text is made up of letters and digits as shown in the illustration below.
The licence must start with the letter B and end with the digit 0 or 1.



Question:
Which **one** of the license plates **cannot** be registered? Write down the letter of your answer in the appropriate block on your answer sheet.

A: BB0001

B: BBB011

C: BB0100

D: BR00A0

E: BSA001

F: BE0S01

A5 Marbles

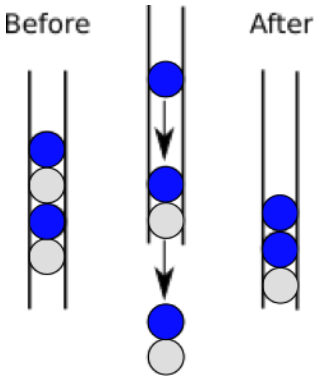
Beaver Emil is trying a new puzzle on his computer. He has to arrange a stack of marbles in a cylinder.

Rules: The marbles must be either white or blue. There must be at least three marbles in the cylinder at the start.

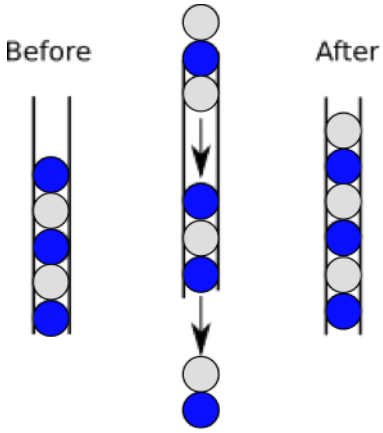
Aim: To produce a stack that never has less than 3 marbles in the cylinder when the GO button is repeatedly pressed.

What happens when GO button is pressed once: Each click of the GO button lets the two lowest marbles drop out. Then one of two things happen depending on the colour of the first marble to drop out:

If the first marble that drops is **white**: a new blue marble drops on the top of the cylinder.

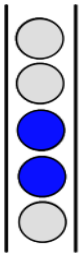


If the first marble that drops is **blue**: three new marbles drop on the top of the cylinder: one white, one blue, and one white.



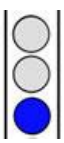
If at least three marbles remain in the cylinder after each press of the GO button, Emil will click the button again. The game ends if two marbles or less remain in the cylinder.

Example: The stack shown on the right produces a game that ends after five clicks. At this point only two blue marbles will remain in the cylinder.

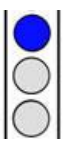


Question: Which of the following starting stacks that consist of only three marbles, will produce a never ending game. Write the letter of your answer in the appropriate block on your answer sheet.

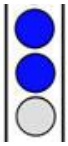
A



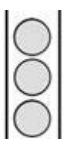
B



C



D

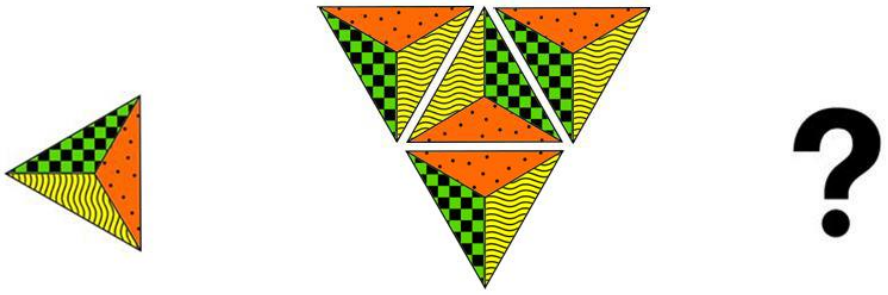


B1 Triangles

A Learner wants to create a mosaic with identical, triangle-shaped tiles.

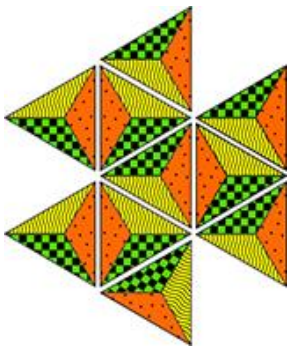
He starts with one tile. He rotates it 90 degrees clockwise and then adds tiles on each side of the triangle-shaped tile, as shown in the picture below.

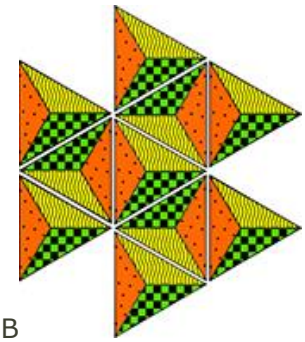
Then he rotates the whole shape 90 degrees clockwise again and adds tiles to the sides as before.

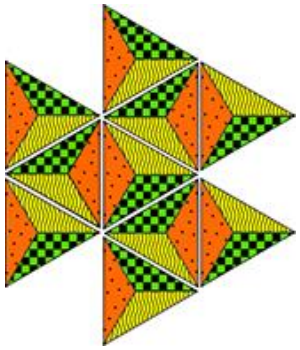


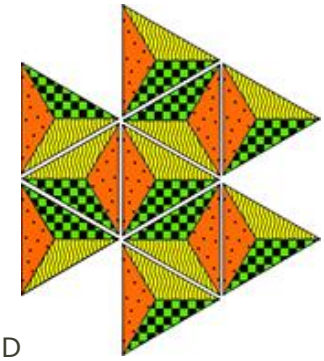
Step = 1 Step = 2 Step = 3

Question:
What will the final shape of the mosaics be after step 3? Write the letter of your answer in the appropriate block on your answer sheet.

A 

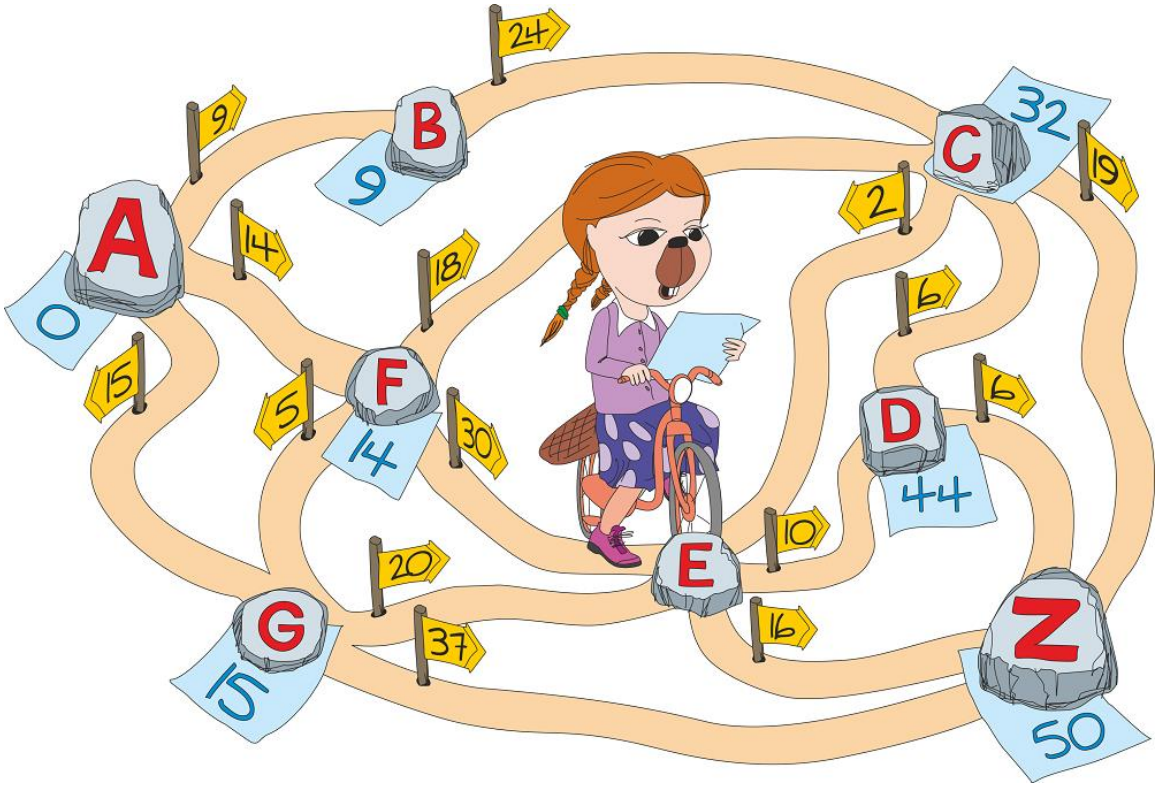
B 

C 

D 

B2 Bike Paths

Cleveria is a beaver biker. She explores the one-way paths that pass through the villages in her district. Each village has a village stone labelled with a single letter. All the paths have a distance and a direction. The distance and direction are given by the flags.



Over the course of many different trips Cleveria leaves notes that include a number under a stone in each village. The notes are about the distance from village A to the village with the note under the stone.

Question:
What is the meaning of the numbers she has left under the stones? Write down the letter of your answer in the appropriate block on your answer sheet.

A: The shortest distance going through the least number of villages

B: The shortest distance from village A to this village

C: The shortest distance to this village by taking a left turn at crossings if possible

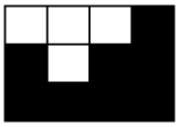
D: The shortest distance to this village by taking a right turn at crossings if possible

B3 Scanner Code

Two scanners encode an image by translating its pixels into a special code. The code lists the number of all consecutive pixels of the same colour (black or white), followed by the number of all consecutive pixels of the other colour, and so on. Both scanners start from the top left corner, and go from left to right, and row by row.

The two scanners use different methods at the end of a row:
Scanner A processes the pixels row by row and restarts the encoding on the next row.
Scanner B processes the pixels row by row but does not restart the encoding on the next row.

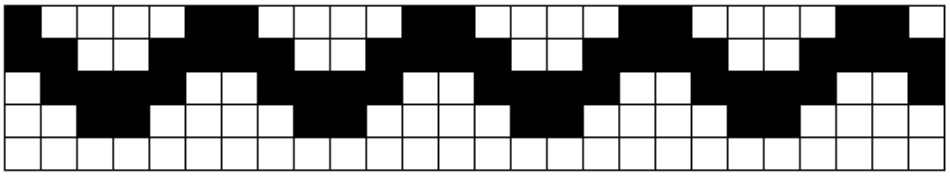
Example:
The image on the right would be represented by the following codes:



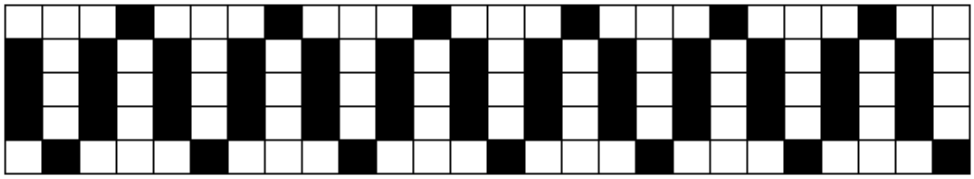
Scanner A: 3,1,1,1,2,4 (3 white, 1 black, 1 black; 1 white, 2 black, 4 black)
Scanner B: 3,2,1,6. (3 white, 2 black, 1 white, 6 black)

Question: Which of the following pictures will have the same code no matter which scanner is used? Write the letter of the correct answer in the appropriate block on your answer sheet.

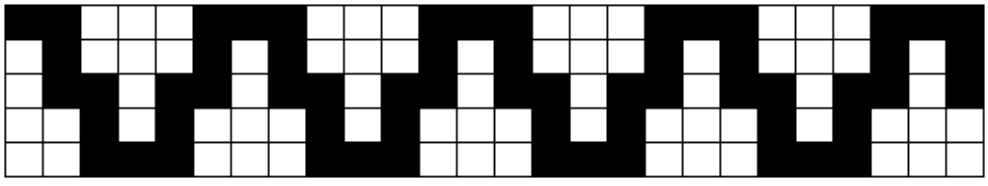
A



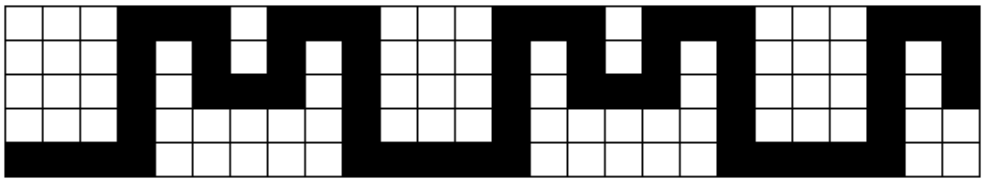
B



C



D



B4 Cards and Cones

Inés has a pack of cards, each card has a number written on it from 1 to 9. The pack contains many of the same cards.

She places three cones in front of her:

Inés intends to create stacks under the cones with the numbers facing up.
Each time she puts a new card on the stack it will cover the rest of the stack.

Her friend, Jules, takes notes as Inés puts cards, one at a time, under the cones.

Inés starts by placing a card with the number 5 on it under cone **X**. Jules writes: **X <-- 5**
Next Inés places another card with the number 3 under cone **X** on top of the previous one. Jules writes: **X <-- 3**
Then Inés peeps under cone **X** and finds a card from the pack with the same number as she sees.
She places the card from the pack under the cone **Y**. Jules writes **Y <-- X**

Jules' final notes look like this:

X <-- 5
X <-- 3
Y <-- X
Y <-- 3
X <-- Y
Y <-- 5
X <-- 6
Z <-- Y
X <-- Y
Y <-- 1

Question:
What cards are visible when the cones are lifted?
Write the letter of the correct answer in the appropriate block on your answer sheet.

A: **X = 5** **Y = 6** **Z = 3**

B: **X = 6** **Y = 3** **Z = 5**

C: **X = 5** **Y = 3** **Z = 3**

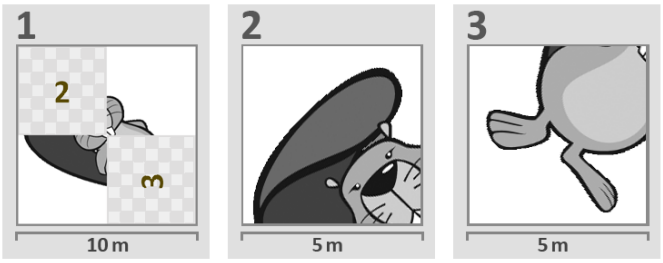
D: **X = 5** **Y = 1** **Z = 5**

B5 Recursive Painting

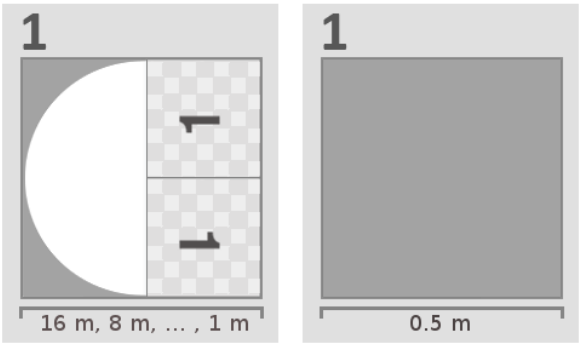
Ingrid and her friends have volunteered to help paint a floor that is 16m long by 16m wide.

The instructions are printed on numbered sheets that refer to the other sheets by their number. Each sheet has a scale printed at the bottom.

Here is an example floor plan from a previous project. It draws a beaver.



Ingrid is given the plan for the new project:



The planning sheet refers to itself and both sheets have the same number!

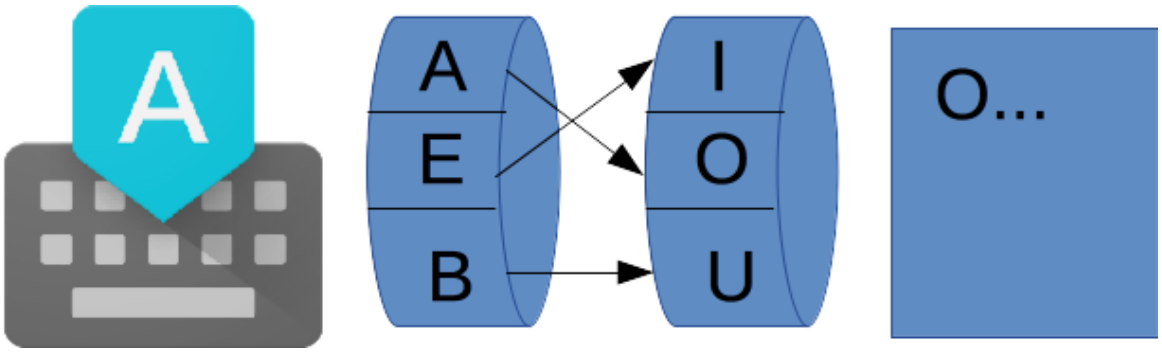
Ingrid's friend asks how this can be and she answers: "We can do it. The second sheet is important because it tells us when to stop."

Question:
What does the painted result look like? Write down the letter of your answer in the appropriate block on your answer sheet.

A B C D

C1 B-Enigma

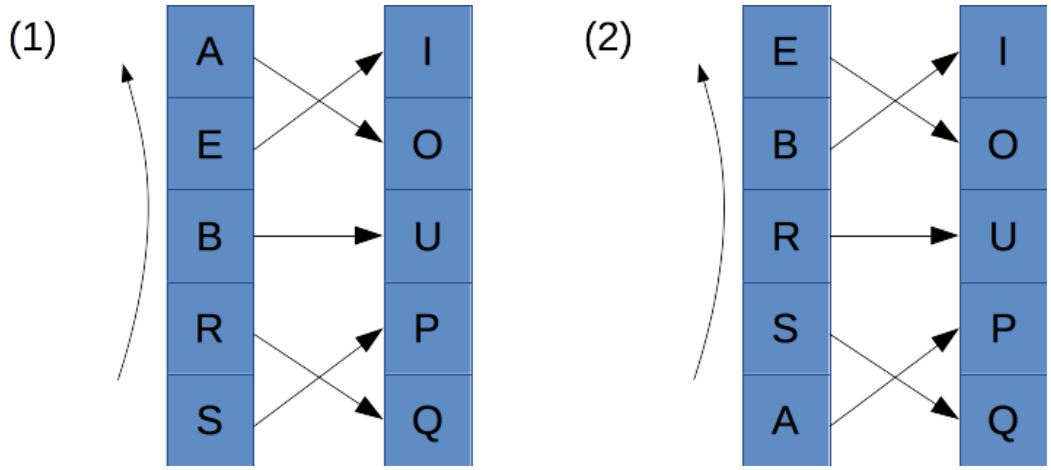
The Beavers need to communicate secretly. They decide to use a mechanism called the B-Enigma machine to hide (encrypt) their messages.



The B-Enigma works as shown above. Each time a letter is typed (e.g. "A"), the left rotor will find a letter on the right rotor according to the arrows (e.g. "O" for "A" in the first step). After typing a letter, the left rotor will move up one position.

This is shown in a different way in the diagram below. After rotating up one position the left rotor will then be in position (2). However, note that the rotor on the right never moves. The links between the two rotors (shown by the straight arrows) also remain the same.

In the diagram below, all the letters available are shown on both rotors.



Question:
The Beavers wish to send the message "BEBRAS". What will the encrypted message be if you start from position (1)? Write down the letter of your answer in the appropriate block on your answer sheet.

A: UOSAEB

B: UOUQOP

C: UOOOIP

D: UOOUPQ

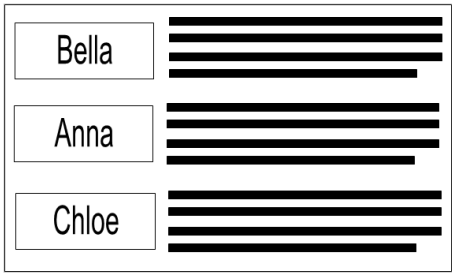
C2 E-Mail Software

Four friends, Anna, Bella, Chloe and Diane, send emails to each other using only T-Mail or B-Mail.
When forwarding an email to another person, T-Mail always adds the new email content to the top of the existing email thread, while B-Mail always adds to the bottom.

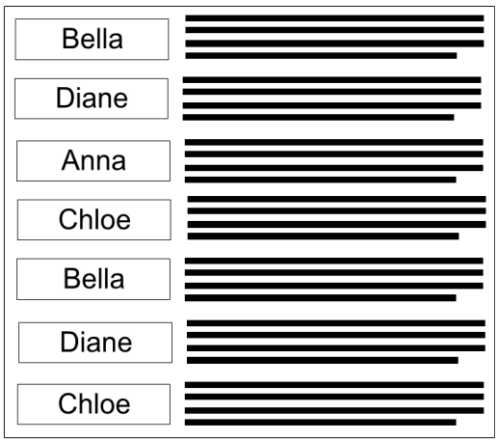
Example:
Anna and Bella only use T-Mail.

Chloe and Diane sometimes use T-mail, and sometimes use B-Mail.

Suppose that Anna sent the first email to Chloe in a new thread.
Chloe then used B-mail to forward the email to Bella adding her own message.
Finally, Bella forwards the email to Diane, again adding her own message.
The final email thread will then look like the image shown on the right.



Question:
The following image shows another email thread. It is not clear who sent the first email. The table on the right shows who used which email package.



User	Email package
Anna	T-mail
Bella	T-mail
Chloe	T-mail, B-mail
Diane	T-mail, B-mail

Who could **NOT** have been the sender of the first email? Write the letter of your answer in the appropriate block on your answer sheet.

A: Anna

B: Bella

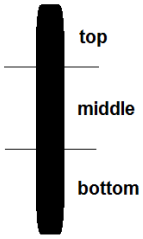
C: Chloe

D: Anybody could have sent the first email

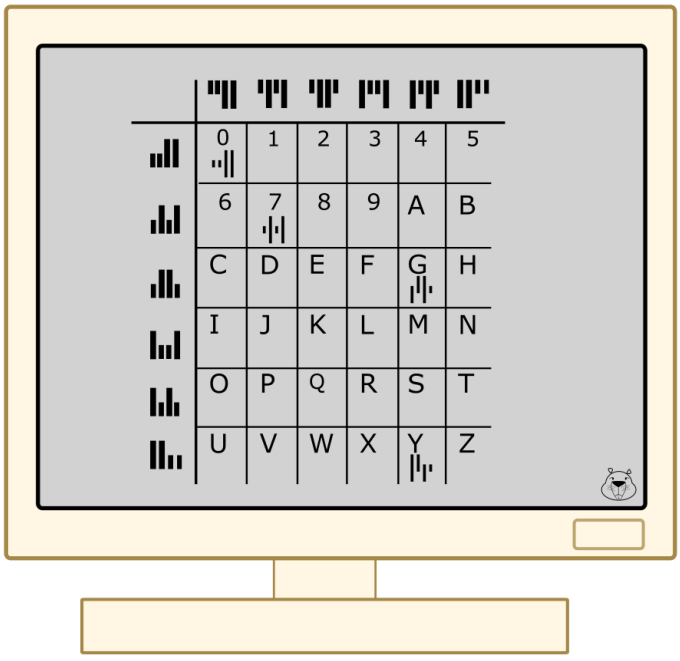
C3 Kix Code

The Bebras Post Office uses postal codes that contain four characters. Unlike in South Africa each character can be a number or letter.
To make the postal codes readable by machines, they convert the postal codes into Kix codes. In a Kix code, each character is represented by 4 vertical bars.

A code has 2 sections: upper and lower. The upper section contains only the middle and the top bars, while the lower section contains only the middle and the bottom bars.



This table shows the codes for several characters:



Example:
The Kix code for "G7Y0" is 

Question:
Another postal code has this Kix code. 

What is the postal code?

Write the postal code in the appropriate block on your answer sheet.

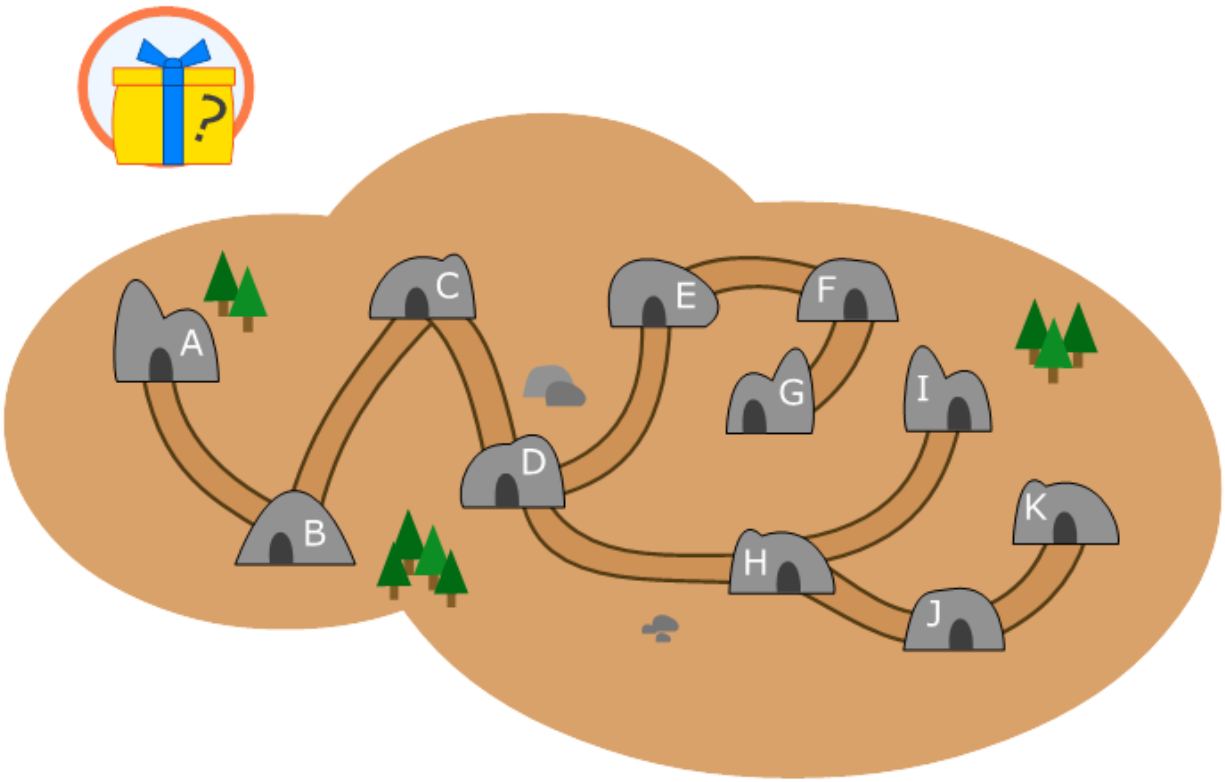
C4 Cave Game

Hale and Serge are playing a game:

Hale hides a present in one of several caves.
Serge has to find which cave it is in.

To do so, Serge has the map shown below and is only allowed to ask questions like: "Is the present in cave X?"
If Serge guesses correctly, Hale will answer "yes".
Otherwise, she will tell Serge which of the neighbouring caves leads to the hidden present.

When Serge knows for sure where the present is, the game is over and he will walk to the cave.



Question:
Serge wants to ask as few questions as possible to find the present.
In the worst case, how many questions does he have to ask to be sure to have found the present? Write down the number in the appropriate block on your answer sheet.

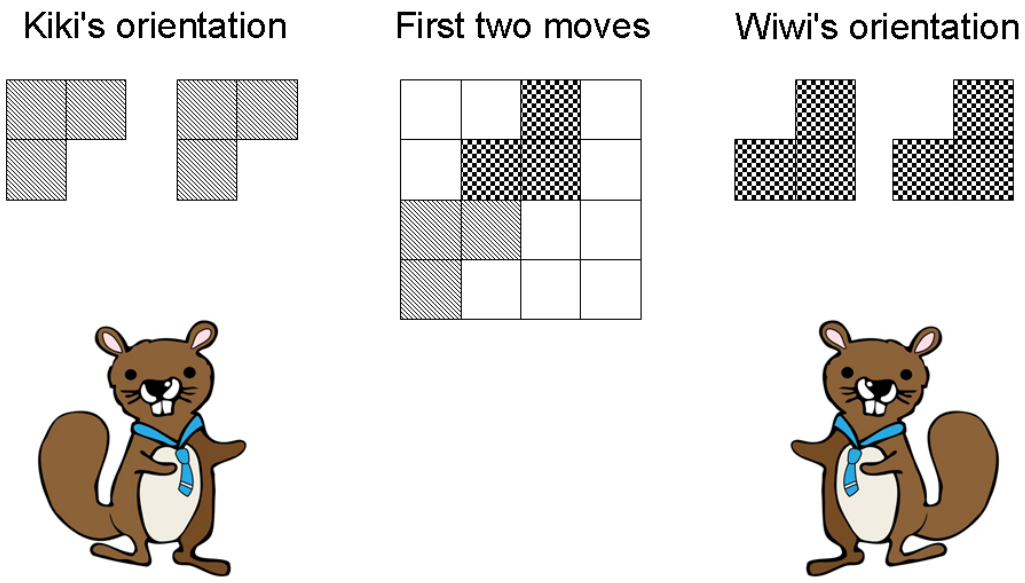
C5 L-Game

Kiki and Wiwi are playing L-Game on a 4x4 board. They take turns placing L-shaped pieces so that

- every piece placed by Kiki is oriented as shown below,
- every piece placed by Wiwi is oriented as shown below,
- every piece is placed entirely on the board, and
- no two pieces overlap.

Pieces cannot be moved after they are placed. A player loses the game when it is their turn but it is not possible to place a piece according to the rules above.

An example where Kiki goes first is shown below. In this example, Kiki can win the game by placing a piece in the bottom-right corner.



Question:
Kiki has nine possible first moves. In how many of them is she guaranteed to win no matter how pieces are placed in following turns? Write down the letter of your answer in the appropriate block on your answer sheet.

A: 0

B: 1

C: 2

D: 3