One Too Many

BEBRAS Australia

I recently discovered a silly mistake I made in a long piece of alphanumeric text.

All 1s should be 11s and all 11s should be 1s. Luckily, I can be rather smart and I have an editor which enables me to replace a sequence of characters with another sequence.

See what happops in a soptopce in which I replace all occuropces (except the last one) of ‘en’ with ‘op’!
Of, wofse, feplacing all occuffences of ‘r’ (except the last one) with ‘f’.

Question

What should I do to fix my text?

- A Replace all 11s with 1s and then all 1s with 11s.
- B Replace all 1s with 11s and then all 11s with 1s.
- C Replace all 1s with $s and then all $s with 11s and then all 11s with 1s.
- D Replace all 11s with $s and then all 1s with 11s and then all $s with 1s.

This question comes from Slovenia

Answer

Replace all 11s with $s
and then all 1s with 11s
and then all $s with 1s

Explanation

In A, after we replace 11s with 1s, we can no longer distinguish between the original 1s which now have to be replaced with 11s, and those 1s that we just made from 11s. In the end, we would have just 11s.

In B, we don't only change 1s into 11s, but also 11s into 1111's and then back, so we end up where we started.

C will let us end up with only 1s.

D works.

Computational Thinking: Decomposition

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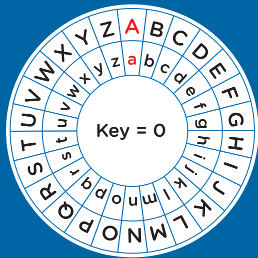
Cipher Wheel

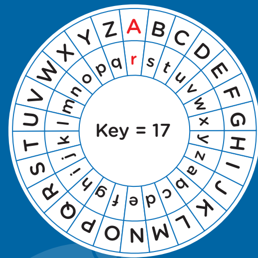
BEBRAS Australia

A beaver left a secret message on his tombstone by using a cipher wheel and we want to figure out what it means.

The wheel works such that only the inner wheel (with small letters) can be rotated. The outer wheel is for the actual message.

As you can see in the first image, when the key is 0 ‘A’ is encoded as ‘a’.
The second image shows that when the key is 17 ‘A’ is encoded as ‘r’.





With the key equal to 17, we can encode the message ‘WHO ARE YOU’ as ‘nyf riv pfl’

You receive the following message: **j cp fjgcma**. We know that this was encrypted in a clever way: for the first letter the key was 1, for the second letter the key was 2, the key for the third letter was 3 and so on.

Question

What does the message on the tombstone read?

This question comes from Malaysia

Answer

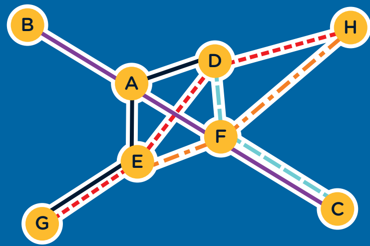
I AM BEAVER

Explanation

You need to pay attention to the change of the key for every letter. The key actually means how many steps you need to go through the alphabet for encoding. Also note that by deciphering you need to go the other way so for ‘j’ you get ‘I’ because you take 1 step backwards.

Cost Reduction

Beaverland has eight railway stations and five railway lines. The lines are shown in the diagram below, each with a different colour. Note that it is possible to travel from any station to any other station using at most one train transfer. For example, to get from B to H one could follow the purple line from B to F, transfer to the orange line and go to H.



The railway company wants to reduce costs by shutting down one or more rail lines. They must do this in such a way that all stations stay connected to the railway network and that travelling from any station to any other station can still be done using at most one train transfer.

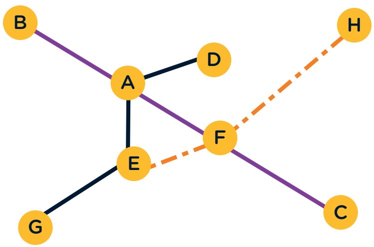
Question

What is the maximum number of lines that can be shut down?

This question comes from the Netherlands

Answer

Two lines can be removed (leaving 3 lines).



Explanation

If you remove the red line (GEDH) and the light blue line (DFC) all conditions are still satisfied. Indeed the lines that remain (BAFC, GEAD and EFH) clearly serve all eight stations and have the additional property that each pair of them has (at least) one station in common. Therefore, you can go from any station to any other with at most one transfer.

Removing other lines would either remove service to stations or introduce more transfers.

Computational Thinking: Abstraction

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Cave Game

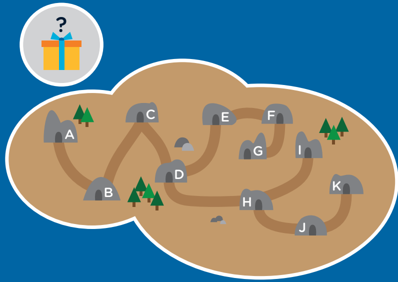
BEBRAS Australia

Hale and Serge are playing a game.

Hale hides a present in one of several caves and Serge must 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?

This question comes from the Netherlands

Answer

3 questions

Explanation

This problem can be solved by finding the centre most cave in the network and starting by asking questions from there. This gives the shortest number of questions to the farthest possible cave on either side. This central cave can be found by counting the longest chain of connected caves and starting in the middle.

Starting at A you can find that the longest chain of connected caves is 7 (both A to K and A to G are 7). This means that the middle cave in this sequence is D. From cave D you can find the present in 3 or less questions, giving you the best chance of finding the present quickly.

Cards and Cones

BEBRAS Australia

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 coloured 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 the red cone.
Jules writes: A <-- 5. Next Inés places another card under the red cone on top of the previous one.
Jules writes: A <-- 3. Then Inés peeps under the red cone and finds a card from the pack with the same number as she sees. She places it under the blue cone. Jules writes B <-- A.

Jules' final notes look like this:
A <-- 5, A <-- 3, B <-- A, B <-- 3, A <-- B, B <-- 5, A <-- 6, C <-- B, A <-- B, B <-- 1

Question

What cards are visible when the cones are lifted?

This question comes from France

Answer

5 1 5

Explanation

Below is shown the top card in the stacks under the three cones after each of the instructions recorded by Jules.

Notes	A	B	C
A <-- 5	5		
A <-- 3	3		
B <-- A		3	
B <-- 3		3	
A <-- B	3		
B <-- 5		5	
A <-- 6	6		
C <-- B			5
A <-- B	5		
B <-- 1		1	

Computational Thinking: Abstraction

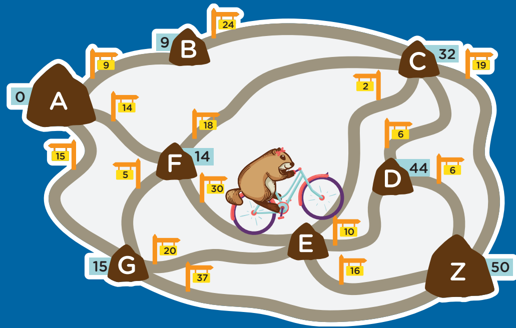
CSIRO digital careers

Bike Paths

BEBRAS Australia

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 labeled with a single letter. All the paths have a distance and a direction. The distance and direction are given by the yellow flags.

Over the course of many different trips Cleveria leaves blue notes with a number on it under a stone in each village. The notes are about the distance from village A to the village stone where the note has been placed.



Question

What is the meaning of the numbers she has left under the stones?

- (A) The shortest distance going through the least number of villages
- (B) The shortest distance 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

This question comes from Lithuania

Answer

B

The shortest distance to this village.

Explanation

In order to find the correct answer, we use the process of elimination to check if each answer is correct.

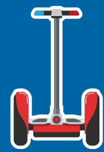
A is wrong because otherwise D = 45, Z = 52;

C is wrong because otherwise C = 33, D = 45, Z = 52;

D is wrong because otherwise C = 51, D = 45, Z = 52.

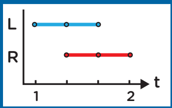
Segway

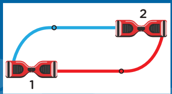
Jan has a special vehicle that looks like a Segway. He moves it by pressing two buttons: a blue (light) button on the left, and a red (dark) button on the right.



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.

The diagram below shows which button was pushed when, and how the vehicle moved from location 1 to location 2.

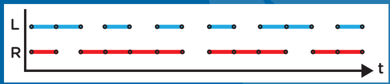




First, the blue button was pressed and the vehicle turned to the right.
Then both buttons were pressed, and the vehicle moved forward. Finally the red button was pressed, and the vehicle turned left. The orientation of the vehicle is now the same as in the beginning: facing towards the upper wall.
Here is a record of the button presses from a different journey:

The vehicle kept going until it hit one of the walls. At the start the vehicle was facing towards the upper wall.

Question



Towards which wall was the vehicle facing in the end?
Upper, lower, left or right?

This question comes from the Czech Republic

Answer

Lower

Explanation

The left button was pressed 8 times during the ride, while the right button was pressed 10 times. That means the right button was pressed two times more and the vehicle turned left twice, so will face the opposite direction from where it started – it must hit the lower wall.

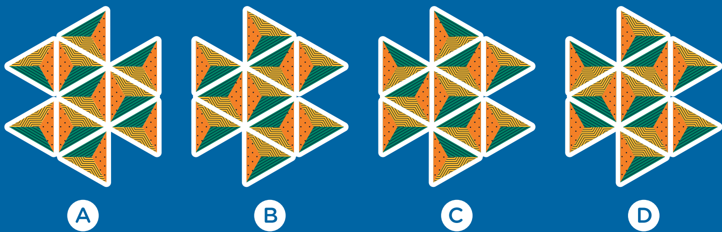
Triangles

A beaver 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.

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

Question

Which of the following shapes will be the triangles after step 3?



This question comes from Turkey

Answer

B

Explanation

Answer A is incorrect because the tiles are not rotated 90 degrees clockwise.

Answers C and D are incorrect because the tiles do not match on their adjacent sides.

Passcode

Beaver Daniel received a chest of gold that is locked with an electronic lock. The lock can be opened by entering a code of 9 digits. Daniel has received the following hints about the code:

- The only digits in the code are 2, 6, 7 and 9.
- The digit with the highest value is used the lowest number of times in the code.
- The digit with the lowest value is used the highest number of times in the code.
- The code looks the same in reverse.
- All consecutive digits are different.
- The last digit entered is odd.

Question

With the information given above, what is his passcode?

This question comes from Malaysia

Answer

7 2 6 2 9 2 6 2 7

Explanation

From the given information we know that 9 appears once, number 6 and 7 appears twice and number 2 appears 4 times.

If the code looks the same in reverse, the number 9 can only be the middle digit and as 7 appears twice and the last digit is odd, it must be at the beginning and the end

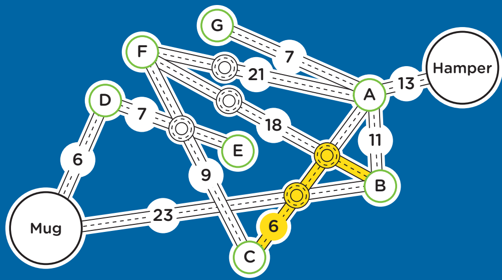
Hint 5 tells us that the number 2 must be at places 2, 4, 6, 8. The 6s fill the remaining spaces.

Toll Roads

Bob decided to drive from Hamper to Mug.

In the map, circles with letters are cities and lines are two-way roads. Roads also have roundabouts where they intersect. The number beside a road is the toll that cars must pay every time they enter the road.

Cars can change their route at roundabouts, but they need to pay the full toll for the road they enter. For example, to drive from city B to city C you can take road 18 and road 6 thus the toll fee is 24 dollars.



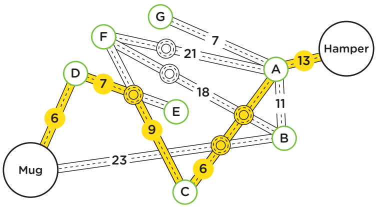
Question

What is the minimum toll fee Bob should pay to drive from Hamper to Mug?

This question comes from Iran

Answer

41 dollars



Explanation

The optimal path can be found by working backwards from Hamper to Mug adding the toll values for each route to find the lowest value. Bob has to travel the road A to Hamper so a value of 13 dollars must be paid. There are 3 possible roads from A in the direction of Mug that go to F, C or B with the toll values of 21, 6 and 11 respectively.

Working backwards from F and C towards Mug you must use the same roads and tolls so will cost 9+7+6 = 22. Working backwards from B to Mug you must use the toll with a value of 23.

By adding these tolls together you have three options of 56, 41 or 47. 41 is the optimal total toll for this journey from Mug to Hamper.

Computational Thinking: Evaluation

Sign Up Debug

BEBRAS Australia

Sara is developing a website for her friends to share their art projects.

She designed a sign-up process so a user can first create an account with a unique STUDENT ID as a username and then enter a valid email address for further communication.

The diagram to the right shows the steps of her design.

1. Ask the user for STUDENT ID
2. Check if the STUDENT ID was not used before
3. Create an account with the STUDENT ID
4. Ask the user for email address
5. Send a confirmation link to the email
6. Detect a click on the confirmation link
7. Finished! Proceed to the sign-in page

During testing she found a critical design bug. If a user mistypes their email address, they do not receive the email with a confirmation link and consequently they cannot sign-in. On the other hand, they cannot start the process all over again as their STUDENT ID has already been submitted and it is not available any longer.

Question

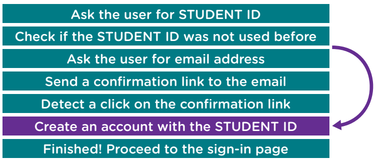
Which step should be moved to remove the critical error?

This question comes from Iran

Answer

'Create an account with the student ID'

Moved from 3rd position to 6th position (second last position).



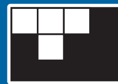
Explanation

In the initial system design, when the STUDENT ID is chosen it locks that particular STUDENT ID. The second phase, the lock release, happens when the confirmation is received by the system. Unfortunately, according to the initial design, this can never happen. The updated design avoids this problem, as the lock phase does not happen before the e-mail is confirmed.

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 the 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.

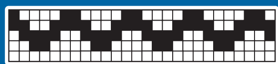
The two scanners use different methods at the end of a row. Scanner A processes the pixels row by row and restarts the encoding on the next row. Scanner B processes the pixels row by row but does not restart the encoding on the next row.

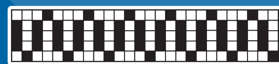


Example: The image on the above would be represented by the following codes:
Scanner A: 3,1,1,1,2,4 (3 white, 1 black, 1 black; 1 white, 2 black, 4 black).
Scanner B: 3,2,1,6. (3 white, 2 black, 1 white, 6 black)

Question

Which of the following pictures will have the same code no matter which scanner is used?

A 

B 

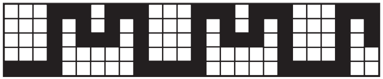
C 

D 

This question comes from Malaysia

Answer

D



Explanation

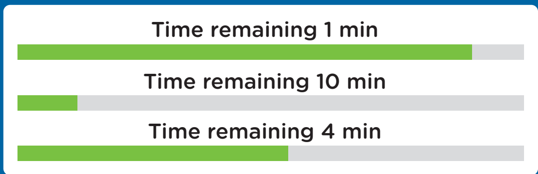
The difference in the two methods is in whether the last pixel(s) in a row and the first pixel(s) in the next row are combined or not. Scanner A does not combine them. Scanner B combines them only if they are of the same colour. If they are not the same colour, the resulting code from the two scanners will be the same. We only need to compare the 4 pixels at the end of each row and the corresponding 4 pixels starting each row, in each of the four supplied images, to make sure that they are of the opposite colours.

Downloads

When downloading files from a server, the download speed is limited. For example, when 10 files are downloaded simultaneously, the download speed for each file is 10 times slower than it would be for only one file.

A user simultaneously downloads three files from a server. The picture below shows the current download state.

Note that the time remaining for each file is computed based only on the current speed and does not depend on any history.



Question

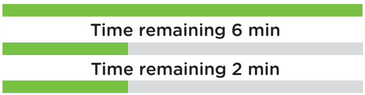
How many minutes will it take to download all the files?

This question comes from Russia

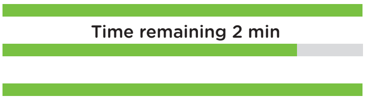
Answer

5 minutes

A



B



Explanation

After one minute the first file will be downloaded, so the speed will increase by a factor of 3/2 (that is, the 3 downloading files became 2 downloading files). The progress will look like image A.

After a further two minutes the third file will be downloaded, and the progress will look like image B.

There are two more minutes needed to download the last file. So, after 1 + 2 + 2 = 5 minutes all the files will be downloaded.

Computational Thinking: Decomposition

CSIRO digital careers

Theatre

BEBRAS Australia

Three spotlights are used to light the theatre stage in the beavers' forest – a red one, a green one and a blue one.

The colour of the stage depends on which of the three spotlights are turned on.

This table shows the possible combinations of colours.

From the beginning of the show, the lights will be switched on and off in this pattern:

- The red light repeats the sequence: two minutes off, two minutes on.
- The green light repeats the sequence: one minute off, one minute on.
- The blue light repeats the sequence: four minutes on, four minutes off.

Red Light	Green Light	Blue Light	Stage Colour
OFF	OFF	OFF	Black
OFF	OFF	ON	Blue
OFF	ON	OFF	Green
OFF	ON	ON	Cyan
ON	OFF	OFF	Red
ON	OFF	ON	Magenta
ON	ON	OFF	Yellow
ON	ON	ON	White

Question

What will the colour of the stage be in the first 4 minutes of the show?

This question comes from Slovakia

Answer

Blue, cyan, magenta and white

Explanation

By creating a table or list that showed all light patterns for the first four minutes, we can see the light combinations created.

Time (mins)	1	2	3	4
Red Light				
Green Light				
Blue Light				
Stage Colour	Blue	Cyan	Magenta	White

Computational Thinking: Decomposition

CSIRO digital careers

Popularity

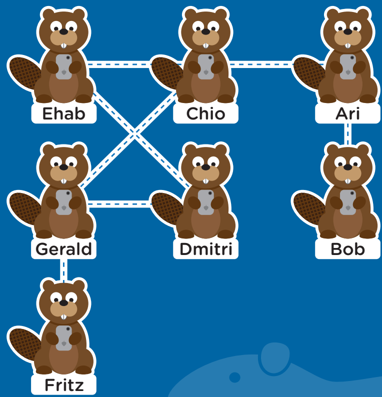
BEBRAS Australia

Seven beavers are in an online social network called Instadam.

Instadam only allows them to see the photos on their own and their friends' pages.

In this diagram, if two beavers are friends they are joined by a line.

After the summer holidays everybody posts a picture of themselves on all of their friends' pages.



Question

Which beavers' picture will be seen the most?

This question comes from Canada

Answer

Chio

Explanation

The following table summarises the information and helps us to see whose picture will be seen the most.

Beaver	Direct friends	Friends' friends	Total
Ari	Bob, Chio	Ehab, Gerald	4
Bob	Ari	Chio	2
Chio	Ari, Ehab, Gerald	Bob, Dmitri, Fritz	6
Dmitri	Ehab, Gerald	Chio, Fritz	4
Ehab	Chio, Dmitri	Ari, Gerald, Fritz	5
Fritz	Gerald	Chio, Dmitri	3
Gerald	Chio, Dmitri, Fritz	Ari, Ehab	5

Computational Thinking: Decomposition

Fireworks

Two beavers live in lodges separated by a large forest. They decide to send messages to each other by shooting fireworks into the sky above the trees.

Each message is a sequence of words, though the beavers only know five different words.
The beavers can shoot two types of fireworks, one after the other, and know the following codes:

Word	Code
Log	
Tree	
Rock	
River	
Food	

For example the message “food, log, food”, for a beaver would be seen as:

Question

How many different meanings can the following sequence of fireworks have?

0 1 2 3 4

This question comes from Canada

Answer

4

Explanation

The message could mean any of the following:

log, rock, food, river

log, log, log, river

rock, tree, river

rock, food, log, river

Animal Competition

The beavers and dogs had a competition. In total nine animals took part.

The nine participants had the following scores: 1, 2, 2, 3, 4, 5, 5, 6, 7.

No dog scored more than any beaver.

One dog tied with a beaver.

There were also two other dogs that tied with each other.

Question

How many dogs took part in the competition?

(2) (3) (5) (6) (7)

This question comes from the Czech Republic

Answer

6 dogs

Explanation

First we arrange the scores in numerical order.
Then we look for ties, there are two of these.

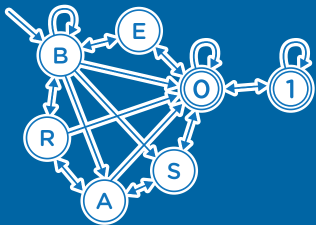
One must be between two dogs and the other between a dog and beaver. If the two animals that score 2 points are the beaver and dog then the two animals scoring 5 points must be the tied dogs. This cannot be the case though because that would mean two dogs at least scored more points than a beaver. We can now see the boundary between beavers and dogs:

Dogs 1, 2, 2, 3, 4, 5, Beavers 5, 6, 7

Therefore, 6 dogs took part in the competition.

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 diagram below. The licence must start with the letter B and end with the digit 0 or 1.



Question

Which two of these license plates cannot be registered?

BB0001 BBB100 BBB011 BB0100 BR00A0 BSA001 BE0S01

This question comes from Lithuania

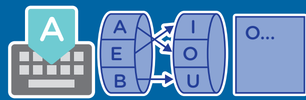
Answer

BBB100 and BR00A0

Explanation

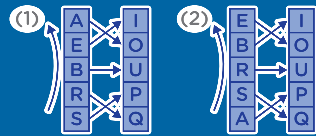
BBB100 cannot be registered, because the digit part starts with 1 (you can't get from the B to the 1) and BR00A0 can't be registered because you can't get from 0 to A as it is a one-way arrow.

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, all the letters available are shown on both rotors.

Question

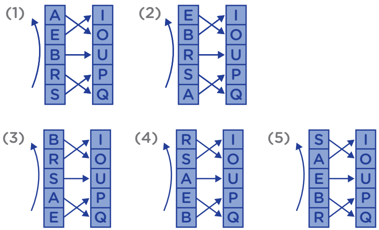
The Beavers wish to send the message “BEBRAS”.
What will the encrypted message be if we start from position (1)?

A UOSAEB **B** UOUQOP **C** UOOOIP **D** UOOUPQ

This question comes from Pakistan

Answer

UOOOIP



Explanation

At position (1) letter B is encrypted to U and at position (2) E is encrypted to O as shown in the image. The other transformations for the letters 3-5 are shown below. For the last letter we use position (1).

At position (3) letter B is encrypted to O, so answers A and B are incorrect.

At position (4) letter R is encrypted to O, so answer D is incorrect.

Computational Thinking: Decomposition

CSIRO digital careers

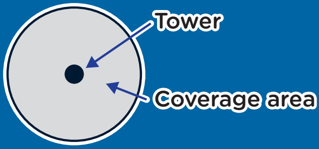
Storm Proof Network

BEBRAS Australia

On a small green island a network of mobile phone towers is setup. Every tower covers a circular area of the island.

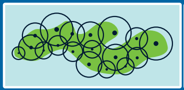
When the coverage area of two towers overlaps the towers are said to be directly connected. Towers can also be indirectly connected if there is a chain of directly connected towers between the two towers.

The operators want to make the network of towers storm-proof. This means that even if one tower breaks down all other towers must still be connected, either directly or indirectly.

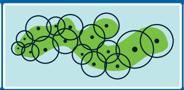


Question

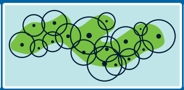
Which is a way to create a storm proof network on the island?



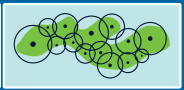
A



B



C



D

This question comes from Hungary

Answer

D

Explanation

In the other cases, there exists a tower that, if broken, will mean a signal cannot be sent between some pair of towers. One example in each case is highlighted in the pictures below.

Computational Thinking: Algorithms

digital careers