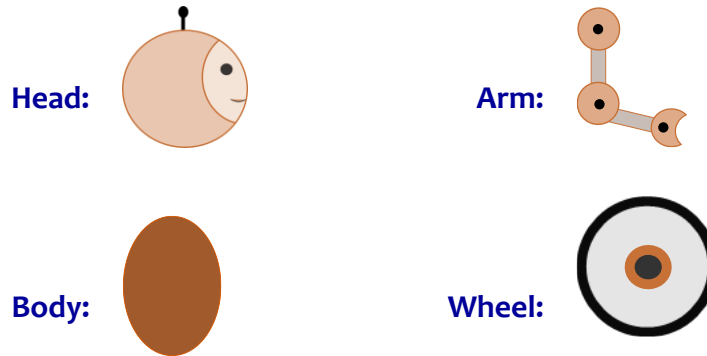### Tasks T1 – T7 carry 3 points each

T1. Drawing a robot

Jelena loves to draw on the computer. Today she is drawing a robot.
First, she drew the following parts of the robot:

Head: **Arm:**

Body: **Wheel:**

After that, she merged them into the image shown below:

Question / Challenge

If you know that each new robot part in the picture goes above the previous one (if they overlap), what is the order in which Jelena stacked the parts?

A) head, wheel, body, arm   **B)** wheel, body, head, arm
C) body, wheel, arm, head   **D)** wheel, head, arm, body

T2. Tile laying

Beaver Bitaro is laying down eight types of tiles, as shown on the right. He must put them down in a sequence from left to right according to certain rules:
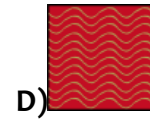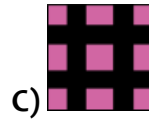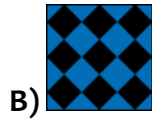
- The first tile is always type 1; the second tile is always type 2.
- The next tile is determined by adding the number of the two previous tiles. If that sum exceeds 7, then a grey tile with number –2 is used instead.

For example, the third position will be a red tile with number 3 because 3 is the addition of 1 (tile in first position) and 2 (tile in second position):
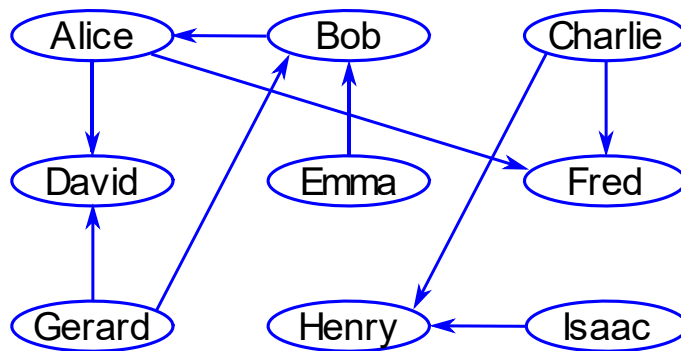
	1
	2
	3
	4
	5
	6
	7
	–2

Question / Challenge

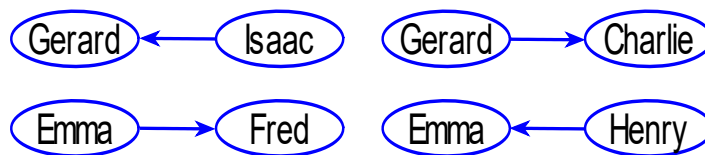Which tile will Bitaro lay down in the eighth position?

A)   B)   C)   D)

T3. Winner and Loser

Beavers are having a chess tournament. They have already played some games. In the picture below, every arrow is drawn from the winner to the loser. For example: Bob won against Alice and Alice won against David.

Because they did not have enough time to play all the games, they decided to use a new rule to decide the final winner. The rule is: if Bob won against Alice and Alice won against David, that would mean Bob won against David. The winner of the whole tournament is the person who won against every other beaver according to this rule.

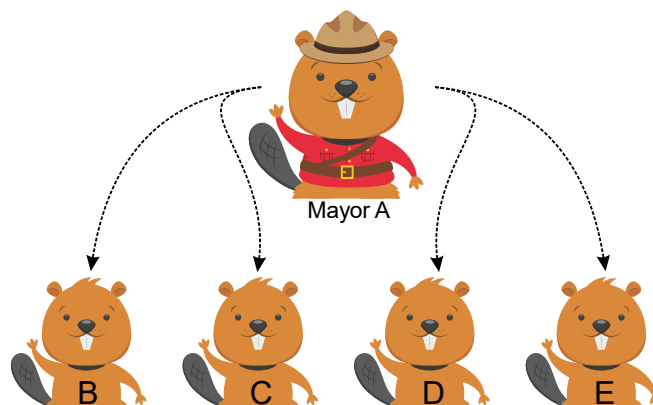But the results they had were not enough to decide the winner, so they played four more games. The results where:

Question / Challenge

Who will win the tournament?

A) Gerard   **B)** Isaac   **C)** Charlie   **D)** Emma

T4. Whispering

New information about wood prices got into Beaver's town and only the beaver mayor A knows it at the moment. He needs to share it with his four counselors, but, because of strict safety reasons and ranks involved, there are certain rules:

- Beaver C has to find out BEFORE beaver D.
- Beaver B has to find out AFTER beaver C.
- Beaver D has to find out AFTER beaver B.
- Beaver E has to find out AFTER beaver D.

Before means **anytime** before, doesn't have to be exactly the beaver that found out before him.
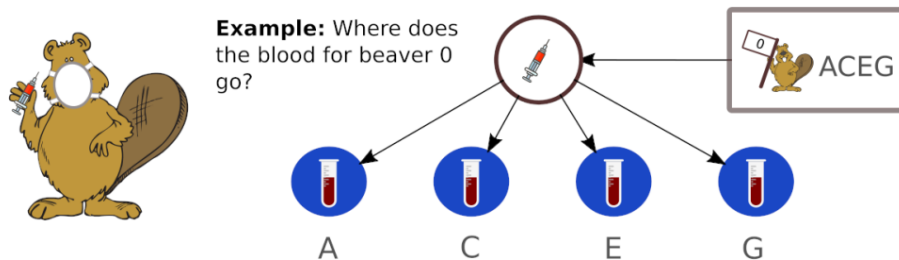
Question / Challenge

What is the correct order in which the information passes to all the counselors, without breaking the rules?

A) B, C, D, E   **B)** C, D, B, E   **C)** C, B, D, E   **D)** C, D, E, B

T5. Mixed results

Dr Beverley knows one of her 16 beaver patients is ill. She only has 8 test-tubes A, B, C, D, E, F, G, and H.

To find the ill beaver, she needs to get a blood sample which is infected. She takes samples from each beaver and mixes part of the sample into a labeled test tube, along with samples from other beavers. She carefully follows the Test Tube Distribution plan. For example beaver number 0 has had their blood distributed into test tubes A,C,E and G.

Test Tube Distribution:

#	Tubes
0	ACEG
1	ACEH
2	ACFG
3	ACFH
4	ADEG
5	ADEH
6	ADFG
7	ADFH
8	BCEG
9	BCEH
10	BCFG
11	BCFH
12	BDEG
13	BDEH
14	BDFG
15	BDFH

Example: Where does the blood for beaver 0 go?

0 → ACEG → A C E G

So far, Beverley has tested tubes A (infected), C (healthy) and E (healthy). She has only one test left.

Test results so far:
- Test tube A - infected
- Test tube C - healthy
- Test tube E - healthy

Question / Challenge

Which of these 4 test tubes can Dr Beverley finally use to identify the ill beaver?

A) Test tube B   **B)** Test tube D
C) Test tube F   **D)** Test tube G

T6. Chairs

The beavers are siting on 6 chairs kept in a row and are given numbers from 1 to 6 and want to play a game. Before starting the game, a number between 1 and 4 is chosen. With every clap, all the beavers would go to the chair on their right as many positions as was the number chosen and beavers at the end will move to the front.

After the movement, the rightmost beaver is out of the game and last chair is removed. The beaver left in the end is the winner. So, if number 2 is drawn, beaver 6 is the winner as you can see below:

Start:

After 1st Clap:
(Beaver 4 out)
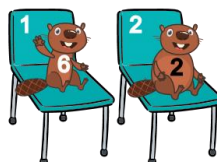
After 2nd Clap:
(Beaver 1 out)

After 3rd Clap:
(Beaver 3 out)

After 4th Clap:
(Beaver 5 out)

After 5th Clap:
(Beaver 2 out)

Question / Challenge

Who will be the winner if number 3 is drawn?

A) 2   **B)** 3   **C)** 5   **D)** 6

T7. Glowing Panels

The king of Kingdom Bebras decided to make a giant art using glowing panels and display it in the square to celebrate the National Anniversary. The art is created using a total of 36 panels as shown below in Figure 1. Each panel switches between on and off when stepped on. The king starts from the "IN" panel in the figure, step on adjacent panels up, down, left or right (not diagonally), and proceed to the "OUT" panel to create various glowing patterns. He can step on the same panel more than once.
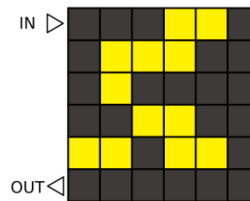
Panel switched off

Figure 1

Panel switched on

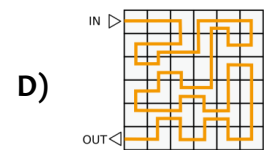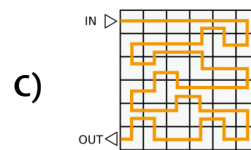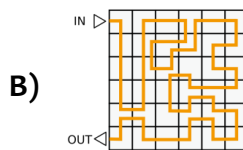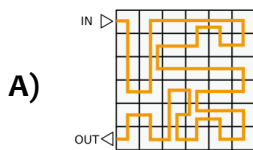### Question / Challenge

The king made the pattern shown above, but he didn't like it, so he wanted to turn on all the panels to start over.
Which of the following routes to light up everything?

A)   B)   C)   D)

Tasks T8 – T14 carry 4 points each

T8. MathMachine

The beavers created a MathMachine. It takes a number as input and returns another number as output.
Inside, the MathMachine uses components. All components work in the same way.
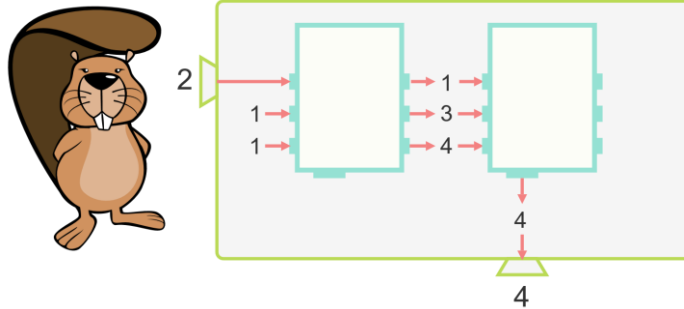Each component takes three numbers as input, and processes them as follows:

- If the first number is 1, return the third number to the MathMachine as output.
- Else:
  o Decrease the first number by 1. The result is the new first number.
  o Increase the second number by 2. The result is the new second number.
  o Add the new second number and the third number. The result is the new third number.
  o Pass the new numbers to the next component, in the same order.
- Repeat until the machine provides an output.

When the MathMachine receives an input, it passes this number as the first input to a component.
The other two inputs for this component are 1.
As soon as the MathMachine receives the output of any component, it returns this number as result.
The image shows how the MathMachine processes the input 2, using two components in this case.
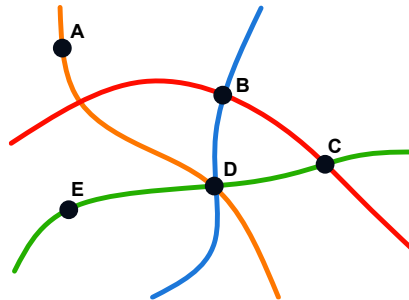
Question / Challenge

The MathMachine processes the input 4.
Which number does the MathMachine return as output?

A) 7   **B)** 10   **C)** 16   **D)** 64

T9. Towns and highways

This is a map of 5 towns and 4 highways. The black dots are the towns. The coloured lines are the highways.

We want to represent this map with a diagram in which:
- towns are represented by circles
- two towns are connected with a line, when they lie on the same highway.
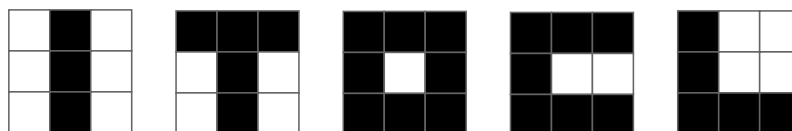
Question / Challenge

Which diagram represents the map correctly?

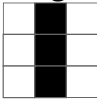**A)**

B)

C)

D)

T10. Heat Map

The letter machine can recognize these five images representing the letters I, T, O, C and L.
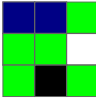
The letter machine uses heat maps for the recognizing process. In the heat map of an image the color of a square indicates the uniqueness of the pixel color at this position. The lighter the color the more unique is the pixel.

Unique. None of the other images has the same pixel color at this position.

Rather unique. Only one of the other images has the same pixel color at this position.

Not unique: Two of the other images have the same pixel color at this position.

Rather common: Three of the other images have the same pixel color at this position.

Common: All other images have the same pixel color at this position.

For example, the image ⬜⬛⬜ has the heat map .

Question / Challenge

Which image has the heat map ?

A)   B)   C)   D)

T11. Electric cars

A blue car can travel 4 km before it needs charging and needs 3 minutes to charge. A green car can travel 5 km before it needs charging and needs 4 minutes to charge. A red car can travel 6 km before it needs charging and needs
5 minutes to charge.

A car does not need to stop at every charging station, but once a car stops to charge, it spends the full amount of charging time, no matter how much charge the car has left. All cars travel at the same speed (1 km/min) and are fully charged at node A.

The map above shows all the roads and the charging station between A and B. The numbers indicates the distance (in km) between each charging station.

Question / Challenge

Based on the map, which car can travel from A to B in the fastest time?

A) Blue **B)** Green
C) Red **D)** Both Blue and Red

T12. Game of Whispers

Five friends sit in a sequence: Anjali, Bernard, Chandra, Damini, and then Eshwar. Anjali whispers the spelling of a ten letter word to Bernard (eg. V-I-S-I-B-I-L-I-T-Y). Bernard then whispers the spelling of the word to Chandra, but with one error. The error could be a replacement of a letter with a new letter (eg. V-I-Q-I-B-I-L-I-T-Y) or the deletion of a letter (eg. V-I-S-I-B-I-L-I-Y). Chandra, in turn, whispers the spelling with one error to Damini and Damini whispers to Eshwar with one more error.

In each whisper, there is exactly one error; no more, no less, and the same letter or position could be involved in more than one error.

Question / Challenge

If the spelling whispered by Anjali to Bernard is A-D-V-E-N-T-U-R-E-S, which of these spellings could be whispered to Eshwar?

A) A-D-E-N-U-R   **B)** A-V-E-N-G-E-R-S
C) V-E-N-T-U-R   **D)** D-E-N-T-U-R-E

T13. Party messages

Three friends have a secret language for sending hidden messages among them. Each of them has written down what they will bring to the weekend party on a piece of paper using their secret language. Emily and Olivia's messages have already been revealed as shown in the picture below:

Emily's message

```
1:32131221
1:1311111111111
1:3111111111111
1:1311111111111
1:14131221
```

1	1	1	0	0	1	0	0	0	1	0	0	1	1	0
1	0	0	0	1	0	1	0	1	0	1	0	1	0	1
1	1	1	0	1	0	1	0	1	0	1	0	1	0	1
1	0	0	0	1	0	1	0	1	0	1	0	1	0	1
1	0	0	0	0	1	0	0	0	1	0	0	1	1	0

Olivia's message

```
0:14111313
1:15111411
1:1221113211
1:1311111411
0:141111411
```

Question / Challenge

Jack's secret message is shown on the picture below. What will Jack bring to the party?

Jack's message
```
0:122123121
1:1311111111111
1:133122111
1:1311111111111
0:121111111121
```
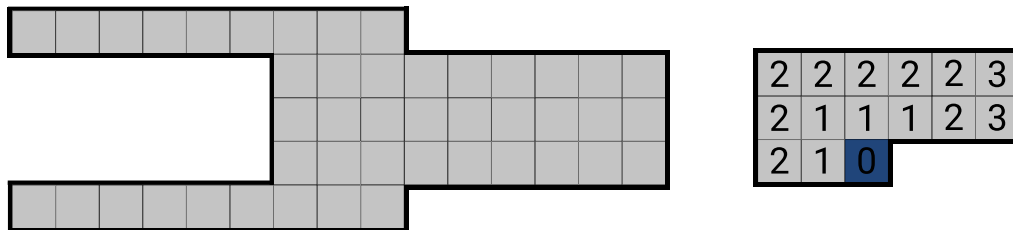
A) GAME   **B)** COLA   **C)** CARD   **D)** CAKE

T14. Heating

A group of beavers want to heat their cold house using 4 heating units. Their house is shown in the left image. The house is formed of multiple cells. A heating unit occupies one cell, heating the cell instantly. The hot air from a cell takes 1 minute to propagate to all its neighboring cells (cells that share vertices and/or edges). The right image exemplifies how many minutes it takes to warm an entire small room if one heating unit is placed on the blue cell.

2	2	2	2	2	3
2	1	1	1	2	3
2	1	0			

Question / Challenge

Your task is to help the beavers place 4 heater units in the house, such that the entire house is heated in as little time as possible. How long will it take to heat the entire house?
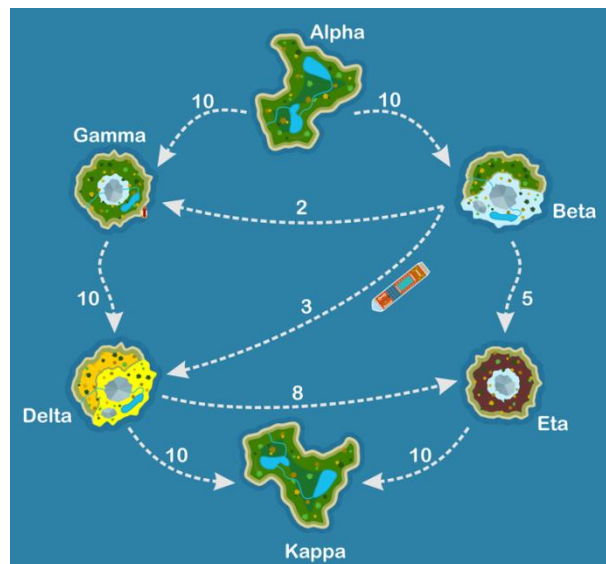
A) 1 min   **B)** 2 min   **C)** 3 min   **D)** 4 min

Tasks T15 – T21 carry 5 points each

T15. Dangerous Virus

Alpha island is the capital of a nation consisting of six islands. The names of the other islands are Gamma, Beta, Delta, Eta, and Kappa. A dangerous virus is spreading on Kappa island so it needs medical supplies, but they are only produced on Alpha island.

To prevent the virus from spreading, the government limits all existing transportation routes to those shown below. The number on each route is the maximum weight of medical supplies (in kg) that can be sent on the route in one day.

Each route can only be used once per day butthere are no restrictions on the order in which the routes are used.

For example, from Beta island, 2 kg can be sent to Gamma island, 3 kg to Delta island, and 5 kg to Eta island.
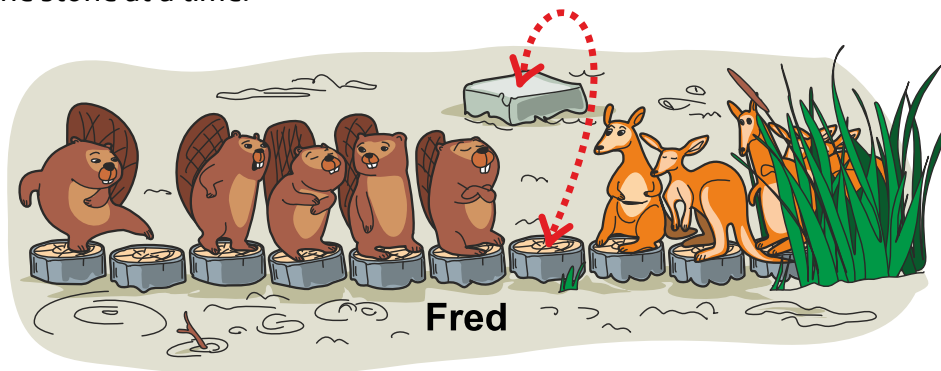
Question / Challenge

What is the maximum weight of medical supplies that can be obtained by Kappa island per day?

A) 20   **B)** 18   **C)** 15   **D)** 12

T16. Beavers vs. Kangaroos

While crossing a swamp by using a log path, five beavers meet a group of kangaroos going into the opposite direction. Nobody wants to become wet or dirty so they stay on the path. The Kangaroos found out that from one specific log it is possible to jump onto a stone next to the log path and jump back to that one log. However, only one kangaroo can stand on the stone at a time.

Fred

The kangaroos and beavers don't mind going all the way back, except for Fred, the leading beaver, who is the first to meet the kangaroos. Fred can move back and forward, but is only willing to take at most 10 steps back in total.
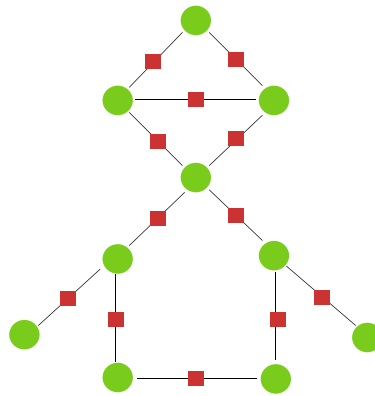
Question / Challenge

With Fred's behaviour, how many kangaroos can pass him without taking a step back?

A) More than 10 kangaroos can pass Fred.   **B)** Exactly 10 kangaroos can pass Fred.
C) Exactly 6 kangaroos can pass Fred.   **D)** It is not possible to determine.

T17. Grocery Stores

Due to a virus outbreak, many grocery stores have to close to minimize health risks. However, every village needs to have at least one grocery store near it to ensure food supply. A grocery store is near a village, if no other village has to be passed on the way to the store.

The green dots represent villages, the red squares represent grocery stores. The linesconnecting them represent streets.
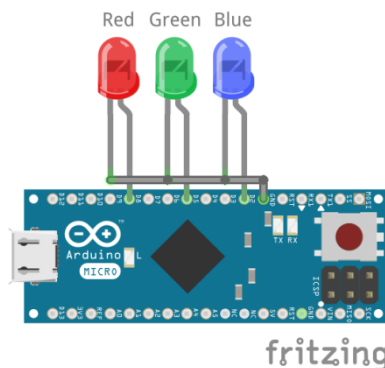
Question / Challenge

What is the minimum number of grocery stores shown in the map above that must stay open to ensure food supply?

A) 1   **B)** 3   **C)** 5   **D)** 10

T18. Blinking LEDs

You received a *programmable electronic board* and started to play with it. On this board, there are three LEDs (one red, one green and one blue), a particular kind of light device, which you can control with a program by turning them on or off (they are all off before the program starts).

Here is an example of such a small program:

```
REPEAT:
|   turn_on (RED_LED);
|   wait (1s);
|   turn_off (RED_LED);
|   wait (2s);
```

The actions performed by this program are as follows:
1. turn on the red LED,
2. wait and do nothing during 1 second,
3. turn off the red LED,
4. wait and do nothing during 2 seconds,
5. and start again with step 1.

The red LED will blink forever, alternating between being on for 1 second and being off for 2 seconds.

Question / Challenge

You found the following program on internet and want to try it on your board:
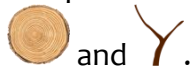
```
REPEAT:
|    turn_on (BLUE_LED);
|    wait  (2s);
|    turn_on (RED_LED);
|    turn_on (GREEN_LED);
|    wait  (2s);
|    turn_off (GREEN_LED);
|    turn_off (BLUE_LED);
|    wait  (2s);
|    turn_on (GREEN_LED);
|    wait  (2s);
|    turn_off (RED_LED);
|    turn_off (GREEN_LED);
```

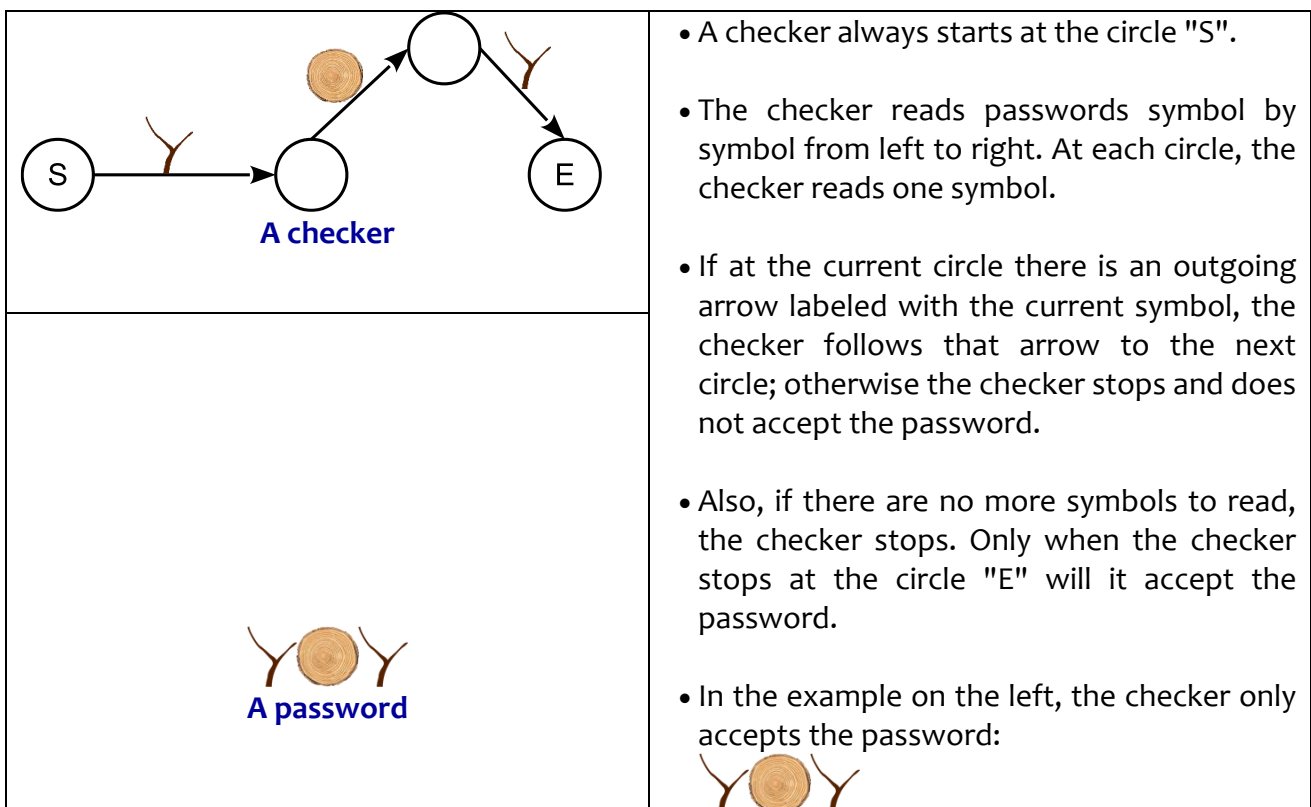How many LEDs are on **13 seconds** after the program has been started?

A) 0   **B)** 1   **C)** 2   **D)** 3
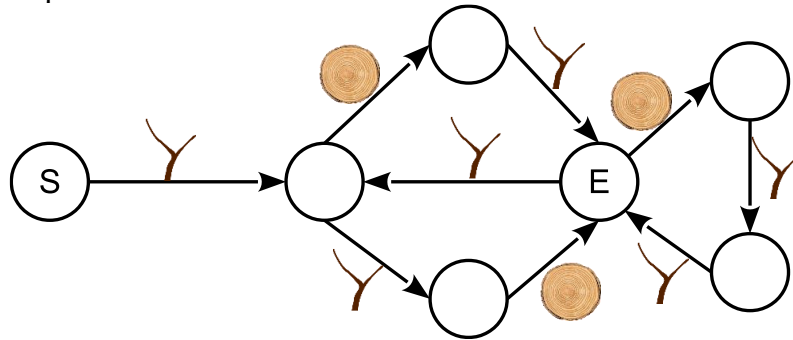
T19. Password Security

The beavers make up a set of passwords for securing their lodge. The passwords consist of only these two beaver symbols:

 and .

A password checker makes sure a given password is acceptable. The beavers use circles and arrows to describe how the checker works:

A checker

A password

- A checker always starts at the circle "S".

- The checker reads passwords symbol by symbol from left to right. At each circle, the checker reads one symbol.

- If at the current circle there is an outgoing arrow labeled with the current symbol, the checker follows that arrow to the next circle; otherwise the checker stops and does not accept the password.

- Also, if there are no more symbols to read, the checker stops. Only when the checker stops at the circle "E" will it accept the password.

- In the example on the left, the checker only accepts the password:

They invent a new password checker:

Question / Challenge

Which of the following passwords does the new password checker accept?

A)

B)

C)

D)

T20. Beavers Pets

Anna, Ben and Lisa live in Beaver Village. Each of them lives in a house of a different color. Each of the kids has a different pet. It is known that:

- one of the houses is blue;
- Anna lives in the yellow house;
- Ben lives in the house besides Lisa;
- a cat lives in the red house;
- Lisa has a parrot.

Question / Challenge

Who owns the dog?
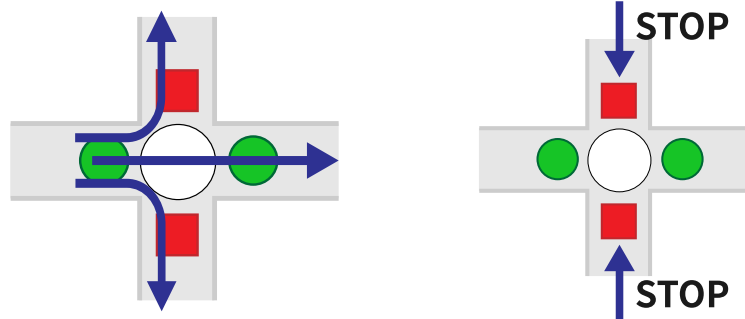The table below can help you find the answer:

House	1	2	3
Color			
Name			
Pet			

Yellow — Red — Blue

Anna — Ben — Lisa

Cat — Dog — Parrot

A) Anna   **B)** Ben   **C)** Lisa   **D)** We cannot determine
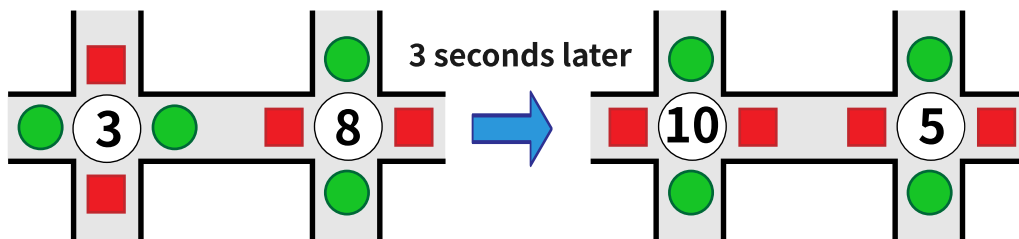
T21. Traffic Light

There are traffic lights in every intersection in Beaver City. The following are two important details of the traffic regulations:
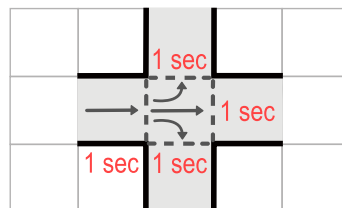
When the light is green, beavers can either go forward or make a right turn or left turn, and when the light turns red, beavers should stop and wait for the light to turn green again.
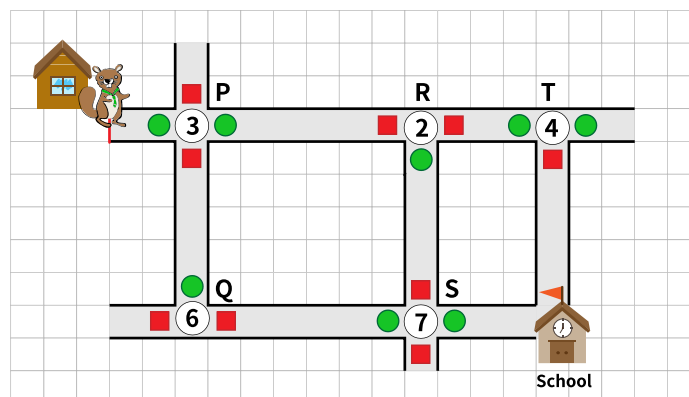

As shown in the following picture, the lights alternate between green and red every 10 seconds. Each set of traffic lights at a intersection has its own timer which keeps counting down from 10 to 0. Beavers can see the timer, and the lights will switch color when the timer hits 0.

When Little Beaver walks, it takes a second to advance one square; it also takes him one second to either cross the road or make a turn at an intersection.

The map below shows the roads connecting Little Beaver's home and school. Right when Little Beaver starts walking from his house behind the red line, the status of the timers are also shown in the map.

Question / Challenge

Based on the timer, if Little Beaver wants walk to school without stopping for any red lights and without crossing the same intersection twice, which route should he take?

A) P→R→T→SCHOOL   **B)** P→Q→S→SCHOOL

C) P→R→S→SCHOOL   **D)** P→Q→S→R→T→SCHOOL

Good Luck!