Tasks T1 – T7 carry 3 points each

T1. Bus schedule

The following tables show when buses will stop at each bus stop.

Bus stop	Route 1	Route 1	Route 1
Stop A	10:00	11:00	12:00
Stop B	10:20	11:20	12:20
Stop C	10:40	11:40	12:40
Stop D	11:00	12:00	13:00
Stop E	11:20	12:20	13:20

Bus stop	Route 2	Route 2
Stop A	10:10	11:10
Stop F	10:20	11:20
Stop C	10:30	11:30

Question / Challenge

If beaver James is at stop A at 11:05, what is the earliest time that he can reach stop D?

A) 13:00 **B)** 11:00 **C)** 12:00 **D)** 11:30

T2. Sawmill

To build a log house you need logs of the right length. Logs arrive with various lengths, and the factory below puts each log with a length between 60 cm and 160 cm on a truck.

The logs arrive at the left of the factory. The different parts of the factory are:

- **Switch S** automatically prioritises logs from two streams into one stream.

- **Switch A** allows logs of length >= 60 cm to pass and sends away shorter logs.

- **Switch B** allows logs of length > 160 cm to pass and sends the rest to the truck.

- **Switch C** activates a saw to saw the log in two. The first one will be 160 cm long and immediately send it to the truck. The remaining log passes on for more processing.

- **Probe A** and **Probe B** are used to count the number of logs sent to the truck.
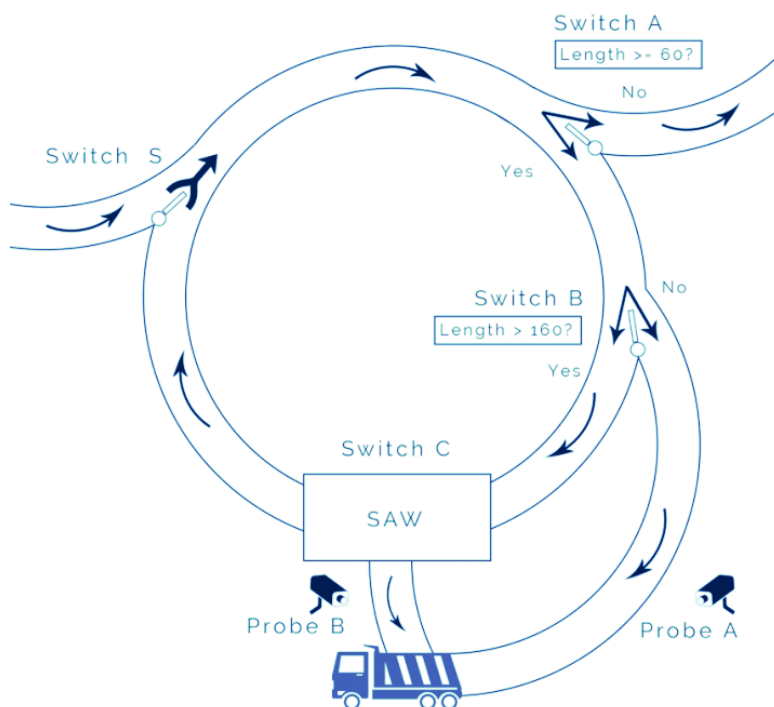
Question / Challenge

Three logs of different sizes (60 cm, 140 cm and 360 cm) are sent to the factory. When all of the logs have been completely processed, what are the values counted by the probes?

A) Probe A: 1 log, Probe B: 3 logs   **B)** Probe A: 3 logs, Probe B: 1 log
C) Probe A: 2 logs, Probe B: 2 logs   **D)** Probe A: 0 logs, Probe B: 4 logs

T3. Drawing triplets

A robot draws a line creating a picture while it moves on a square grid. Each picture is represented by a sequence of three numbers.

For example, the sequence 3,1,5 represents Fig. 4 because it means:
- move forward 3 squares, then turn right (Fig. 1)
- move forward 1 square, then turn right (Fig. 2), and
- move forward 5 squares, then turn right (Fig. 3).
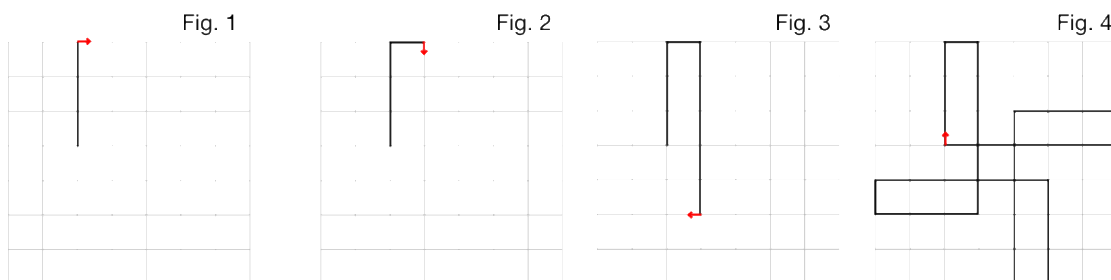
It repeats all of this forever.

Time Allowed: 150 minutes

Question / Challenge

Which sequence of pictures has the correct representation above it?

	1,4,1	2,2,3	4,2,4	3,3,3
A)				

	3,3,3	2,2,3	4,2,4	1,4,1
B)				

	3,3,3	1,4,1	2,2,3	4,2,4
C)				

	4,2,4	2,2,3	1,4,1	3,3,3
D)				

T4. Colorful Chinese character

The Chinese character deeply attracts the attention of the little Beaver who intends to study its structure. A beaver creates a Color and Pattern-filled Structure Board, which is shown as follows:

According to this board the following Chinese characters can be expressed as:

川"
as left-middle-right structure

"儿"
as left-right structure

"吕"
as upper-lower structure

Question / Challenge

Which option represents the characters "三", "二", "八" all in the right way?

A)

B)

C)

D)

T5. Breaking into the school library

A thief (or thieves) stole a large amount of IT books from the school library and drove away with them.

The police identified three well-known IT "specialists". They were asked to come to the police station and were questioned. The following information was revealed during the questioning.

1. No one apart from **Adam, Bob** or **Claire** could have taken part in the theft.
2. **Claire** never participates in any activity unless **Adam** does also.
3. **Bob** cannot drive.

Question / Challenge

Must **Adam** be guilty?

A) Yes   B) No   C) It is impossible to determine

T6. Superstar

In the social network "TeeniGram", members may "follow" other members.

Time Allowed: 150 minutes

TeeniGram "groups" are collections of members. Within a group, a member can be a "celebrity".
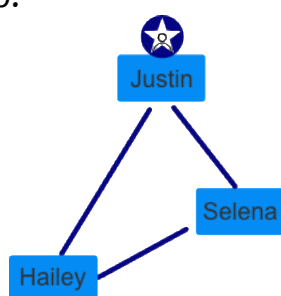A "celebrity" is someone who:
- is followed by everyone in the group
- does not follow anyone in the group

One TeeniGram group has these members: Hailey, Selena and Justin.
- Hailey follows Justin and Selena
- Selena follows Justin
- Justin doesn't follow anyone

Justin is a celebrity in this group.

Another TeeniGram group has these members: Alan, Don, Frances, Grace and Robin.
- Alan follows Don and Grace.
- Don follows Grace and Robin.
- Frances follows Alan, Grace, and Robin.
- Robin follows Alan and Grace.

Question / Challenge

Is there a celebrity in this group?

A) Yes, Alan is a celebrity in this group.
B) Yes, Frances and Robin are celebrity in this group.
C) Yes, Grace is a celebrity in this group.
D) No, there is no celebrity in this group.

T7. Bridges and Islands

The map below shows islands represented by each circle. To travel between them, beaver needs to build some bridges. The numbers indicated in each island tell how many bridges must connect to that island. The bridges can only be built horizontally or vertically. Once all the bridges are built, the bridges system must make it possible to travel from any island to any other island.

For example, a certain group of islands has a map shown on the left. Once all the bridges are built, its bridges system would be as shown on the right.

Question / Challenge

How many bridges does one need to build in the map below?
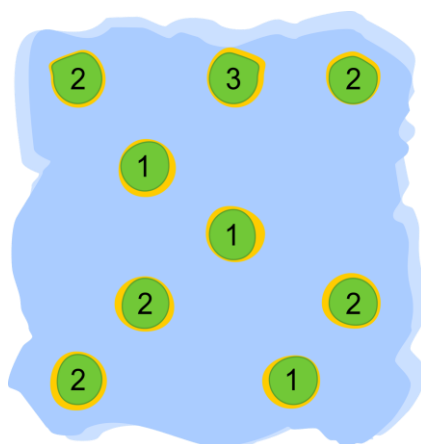
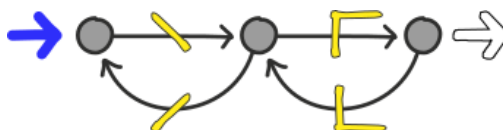**A)** 7   **B)** 8   **C)** 9   **D)** 10

Tasks T8 – T14 carry 4 points each

T8. Making Stitches

A sewing machine can make 4 different types of stitches. The rules that the machine follows to select the next stitch to make is shown in the following diagram:


The machine starts a new line of stitches by following the thick blue arrow on the left. It moves from circle to circle along the arrows and makes the stitch that is shown on that arrow. If a circle has more than one arrow leading away from it, the machine can select either one of those arrows to follow. The machine finishes the line of stitches it is making by following the outlined arrow on the right.

Question / Challenge

Which line of stitches cannot be made using the above rules?

A)

B)

C)

D)

T9. Trap Island

An autonomous boat goes from the southern bank of the river to the northern bank. It has to go around the islands in the river.

The boat navigates along the squares of its digital map, from one square to the next. The boat can only go to a square when this square is free and not partly blocked by an island.

The autonomous boat navigates according to these instructions:

Pirates install an artificial island, which can be a trap for the autonomous boat. That is: If the autonomous boat comes close to the island, it might happen that the boat halts before reaching the northern bank.

Question / Challenge

Which of these islands can be a trap for the autonomous boat?

A)   B)   C)   D)
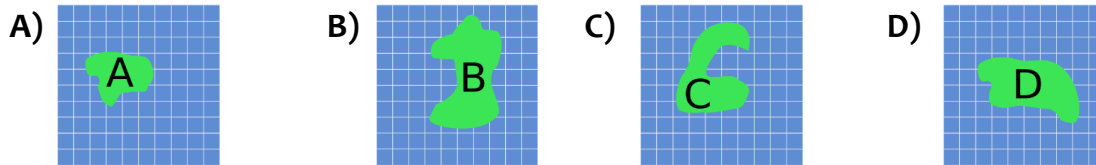
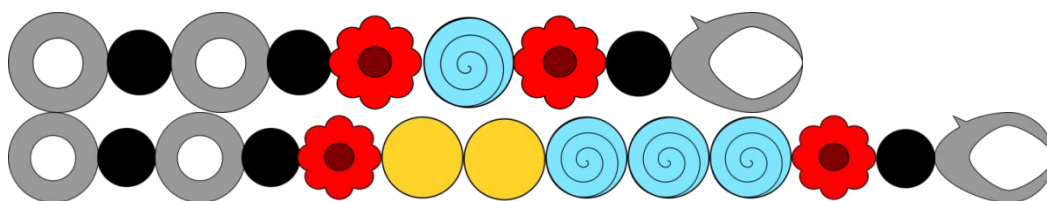## T10. Friendship Bracelets

Stephen makes bracelets starting with
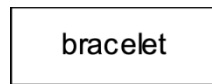
And using the rules below.
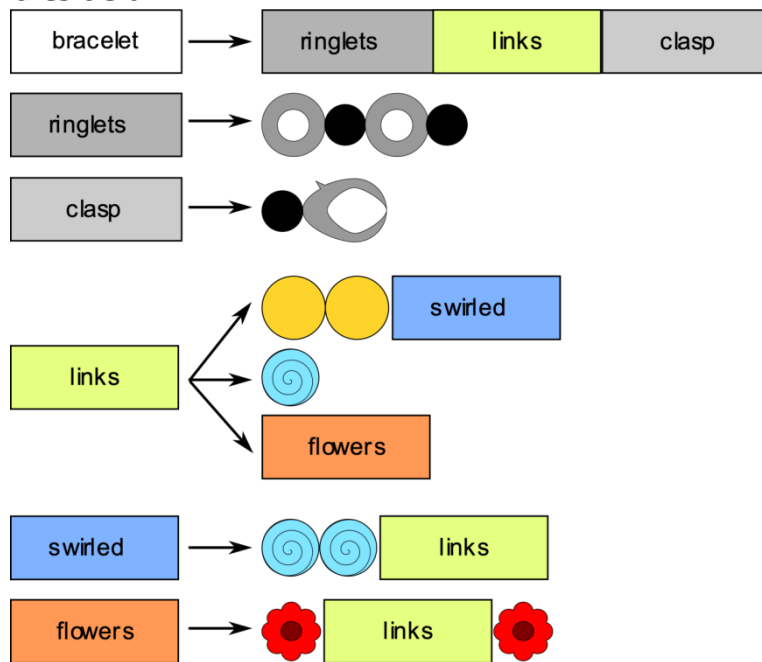
That is, every symbol on the left is replaced with one of the sequences of symbols it points to.

For example, using these rules several times, Stephen can make these two bracelets.

Stephen made four bracelets for four of his friends, using the same rules. One of the friends broke the bracelet and made a mistake trying to fix it.

Question / Challenge

Which of the four bracelets below is the one with the mistake?

A)

B)

C)

D)
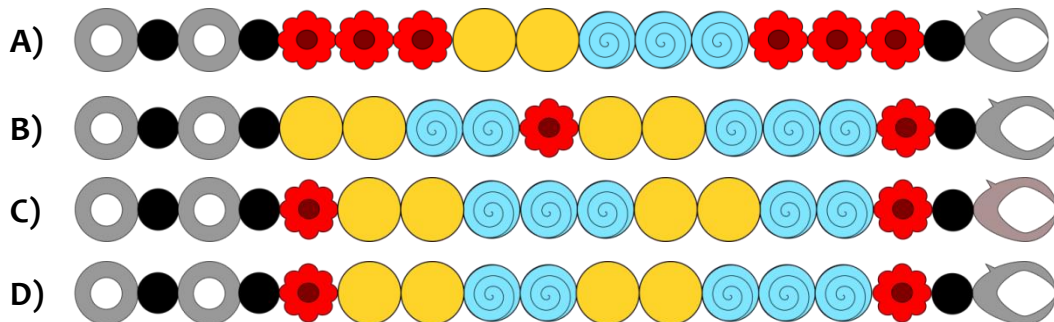
T11. Binary bulbs

Beavers use Binary bulbs to send a message remotely. To send a message they are using the following table and the following rule:

|							
A	01000001	J	01001010	S	01010011
B	01000010	K	01001011	T	01010100
C	01000011	L	01001100	U	01010101
D	01000100	M	01001101	V	01010110
E	01000101	N	01001110	W	01010111
F	01000110	O	01001111	X	01011000
G	01000111	P	01010000	Y	01011001
H	01001000	Q	01010001	Z	01011010
I	01001001	R	01010010		

0

1

Question / Challenge

By using the table and the specified rule, the beavers sent the following message:
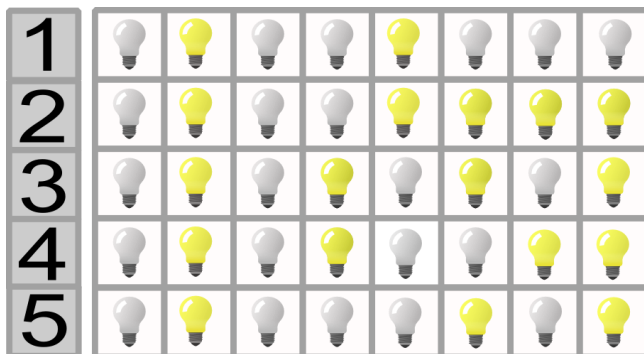
Which message they sent?

A) HOUSE   **B)** HAPPY   **C)** HORSE   **D)** HONEY

T12. Recover my robot

Natasha lost her robot in a park. The park is a square composed of 3×3 smaller squares. The robot could have been lost in any of the nine squares.

Natasha can manually send a sequence of commands to the robot. She can command it to move either one square UP, LEFT, RIGHT or DOWN. If the robot is moving towards a wall, it won't be able to go further and stands still. The walls are drawn on the picture by a thick (green) line.
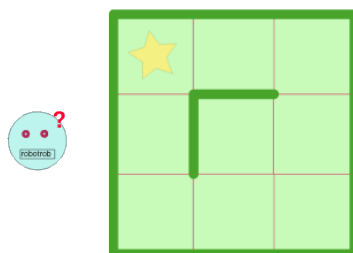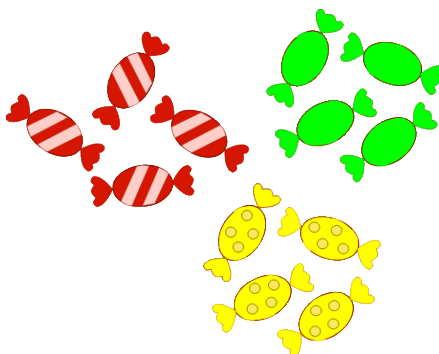

Question / Challenge

Natasha doesn't know where the robot is. What is the shortest sequence of commands that she can send to the robot, so that it reaches the square with a star?

A) DOWN - LEFT - DOWN - LEFT - UP - UP
B) RIGHT - UP - UP - LEFT - LEFT
C) RIGHT - UP - RIGHT - UP - LEFT - LEFT
D) UP - RIGHT - UP - LEFT – LEFT

T13. A bag of candies

Peti has a bag of candies. There are 4 green, 4 yellow and 4 red candies in the bag. Peti plays with his friend and they have some rules: the friend has three turns to take out a candy from the bag and he has to collect them in a bowl.

- Each time he takes out a green candy, he has to put it in the bowl and he takes out one more candy from the bag (though it is still considered as the same turn)
- If he takes out a yellow candy, he eats it right away without putting it in the bowl.
- If he takes out a red one, he has to put it in the bowl immediately.

Question / Challenge

What is the maximum number of candies that can be in the bowl after the third turn?

A) 5 **B)** 6 **C)** 7 **D)** 9

T14. Beaver Network

There is network of passages that beavers enter and exit. There are six entrances and six exits. Exactly one beaver enters at each entrance. There are two types of beavers, grey and brown. If two beavers meet at a junction and they are of two different colors, the brown beaver will go to the right while the grey one will go to the left. Six beavers enter the network of passages at the same time.
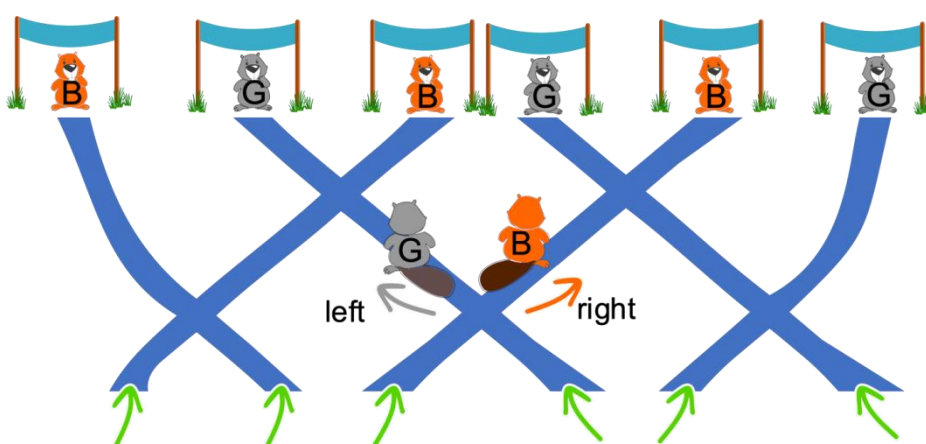
Question / Challenge

For the following order of beavers exiting the network: BGBGBG what is the order they entered the network?

A) BBBBGG **B)** BBBBGG or GGGBBB
C) BBGBGG or BBBGGG **D)** GBGBGB

Tasks T15 – T21 carry 5 points each

T15. Buying Shoes

Beaver went to the shoe store to buy a pair of shoes. He saw several shoes on display arranged as shown in the picture. The shoes were arranged in increasing order of size as well as width. The shoes varied in size and width, with the smallest and the narrowest shoes kept in left bottom and the biggest and the widest shoe at the top right. All shoes have different size and width.

Being a forgetful beaver, he did not remember his shoe size and will have to try on shoes till he finds the right fit. A right fit is one that is the right size and the right width. Each time Beaver tries a shoe, he is able to tell if the size should be increased, decreased or it is just perfect, and he is also able to tell if the width should be increased, decreased or it fits him perfectly.
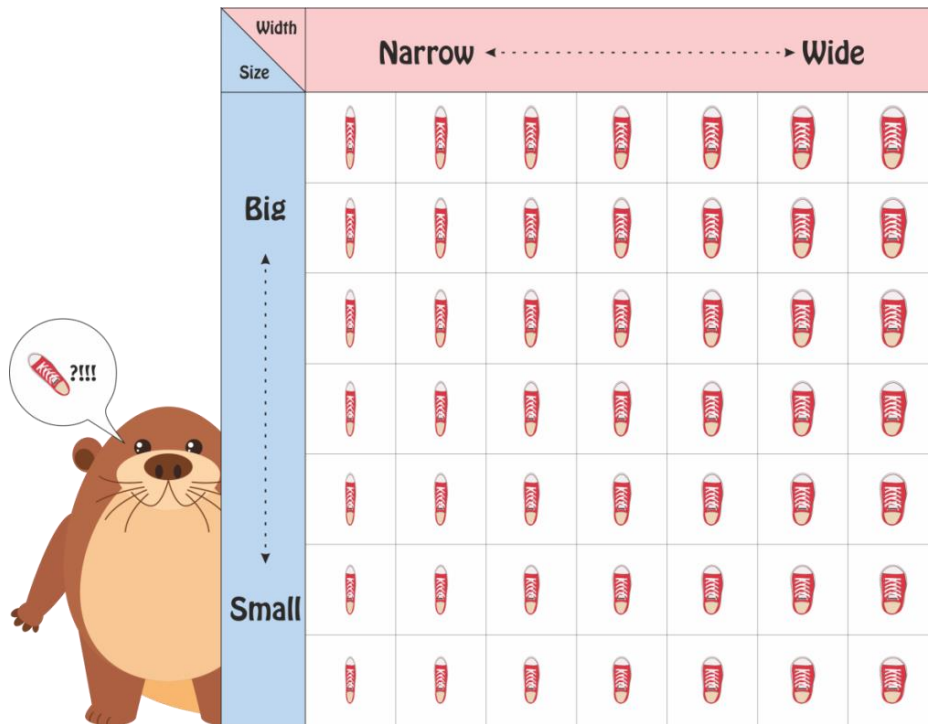
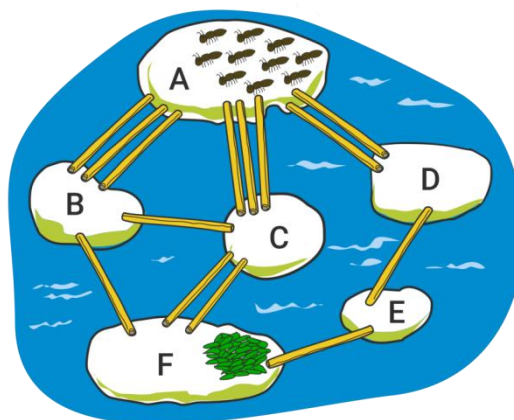Beaver uses a method that guarantees that he can find the shoe that fits him in 'n' tries.

Question / Challenge

What is the least possible value of 'n'?

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

T16. Ants in Swamp

Ten ants are located on Stone A and seek to reach the food on Stone F. Only one ant at a time can walk on a single straw, and it takes 1 minute for an ant to walk from one stone to another.

Question / Challenge

What is the maximum number of ants that can reach the food on Stone F after 3 minutes?

A) 2   B) 3   C) 5   D) 7

T17. Classification Yard

A train has to drop off individual railroad cars along the main line. It is currently parked at a classification yard and, before leaving, the railroad cars have to be sorted so that the leftmost car has the number 1.

The classification yard offers a hump where all railroad cars are pushed over from right to left and the railroad cars can be rolled into one of the two sidings. After all railroad cars are pushed over the hump they're collected by the locomotive in any order. This whole procedure is considered as **one** operation.

For instance if you have 4 railroad cars it is sufficient to push them over the hump twice (step ① + ②) to sort them:
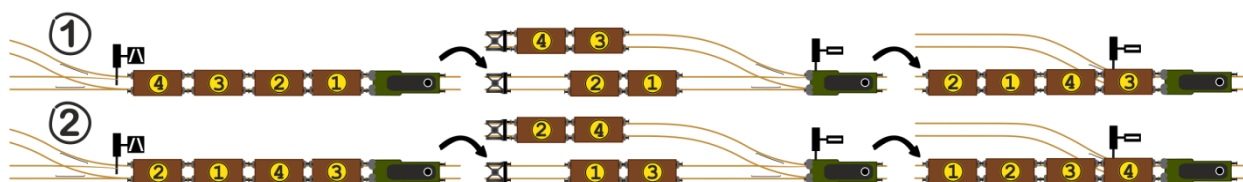
It is not possible to sort them in only one operation over the hump.

Question / Challenge

If the railroad cars are in the order 2 – 8 – 3 – 1 – 5 – 7 – 6 – 4, what is the minimum number of times the railroad cars have to be pushed over the hump to sort them to 1-2-3-4-5-6-7-8?

A) Once **B)** Three times **C)** Six times **D)** Eight times

T18. Machine Embroidery

A beaver tries to make an embroidery pattern by using an embroidery program and a machine.

The embroidery program uses the command OUT(cc)-IN(dd), where cc and dd indicate the position of the needle in the grid. For example, OUT(B2)-IN(A3) is a command to move the needle to the B2 position and pull it out from back to front and then move the needle to the A3 position and pierce it in, from front to back.

The following two commands create a pattern like below.

OUT(E6)-IN(G8);OUT(E2)-IN(E4)

Question / Challenge

Which commands could be used to create a ribbon pattern like the one in the image?

A) OUT(H2)-IN(C2);OUT(H9)-IN(C9);OUT(C9)-IN(C2);OUT(H9)-IN(C2)

B) OUT(C2)-IN(H9);OUT(H2)-IN(C9);OUT(C2)-IN(H2);OUT(C9)-IN(H9)

C) OUT(H9)-IN(C9);OUT(H9)-IN(H2);OUT(C2)-IN(H2);OUT(C9)-IN(H2)

D) OUT(C2)-IN(C9);OUT(H2)-IN(H9);OUT(C2)-IN(H2);OUT(C9)-IN(H9)

T19. Quipu

A queen uses knots on hanging ropes (called quipu) to announce news to her kingdom. For example, the following quipu might be the announcement "let's celebrate".
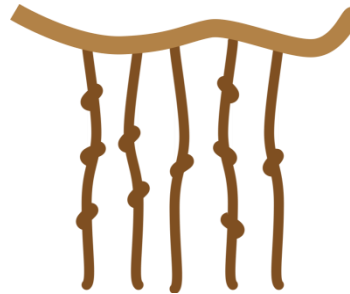
All that matters is the order of the ropes and the number of knots on each rope. Each rope has 0, 1, 2 or 3 knots.

There are only 50 different possible announcements made by the queen.

Question / Challenge

What is the minimum number of ropes that the queen needs?

A) 2   **B)** 3   **C)** 4   **D)** 5

T20. Rescue Mission

After a snow storm, three people want their igloos connected to the main road system again. A robotic snowplow is given the task to clear a path to do this. The robot then needs to return to its starting position.
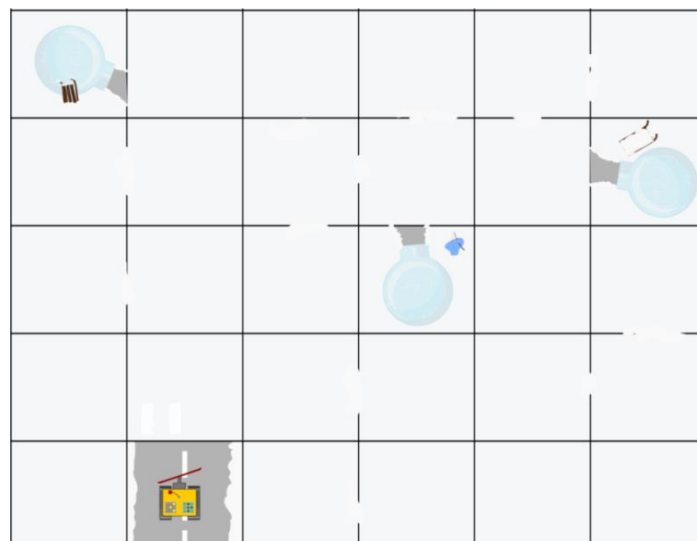
Notes:

It takes 1 hour to move from one square to another if there is no snow in either square.

It takes 2 hours to move from one square to another if snow needs to be cleared.

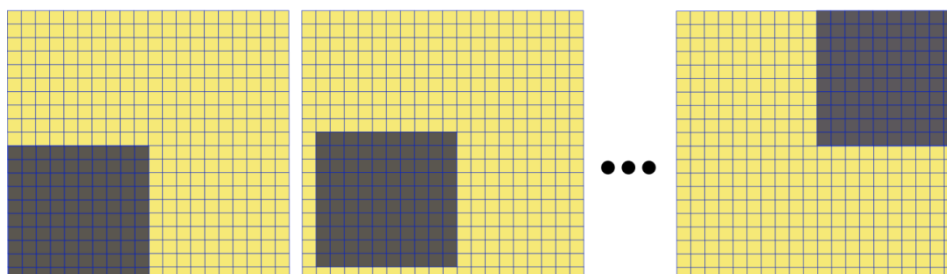It takes no time for the robot to turn around in a cleared square.

The robot does not need to go to an igloo, just clear the square in front of it's entrance so the people can walk out.

Question / Challenge

What is the minimum time the robot needs to accomplish the task?

A) 21 hours   **B)** 13 hours   **C)** 5 hours   **D)** 3 hours

T21. Video Compression

A computer image is a rectangular grid of coloured squares, called *pixels*. A video is a sequence of images, called *frames*, each slightly different from the previous one.

The simplest way to store a video is to store all the pixels in each frame. A more efficient way is to store the entire first frame and then only store those pixels that change from the current frame to the next one. In the picture above, the 10×10 dark coloured square moves from the lower left corner to the upper right corner of the light coloured 20×20 field, moving one pixel horizontally and vertically in each frame. This takes 11 frames. If we store this video in the simple format, this will require (20×20)×11 = 4400 pixels.

Question / Challenge

If we store this video in our more efficient format, how many pixels do we require?

A) 200   **B)** 400   **C)** 560   **D)** 780

Good Luck!