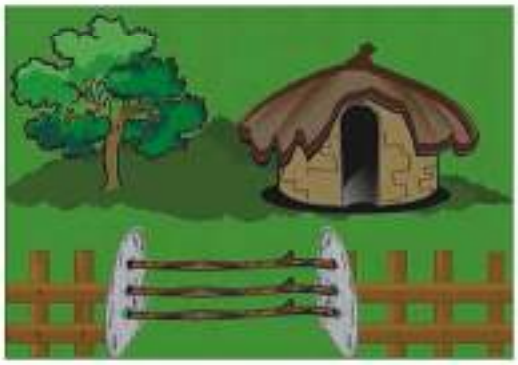
Time Allowed: **150 minutes**

Tasks T1 – T10 carry 3 points each

T1. Binary Gate

The beavers are hospitable and they like visit each other. However, sometimes they are not at home. Therefore, they need to leave a message for their guests using an informational gate.



The beavers have come up with 4 different messages, as follows:

We are at home. Please come in.	We will come back at noon.	We will come back in the evening.	We will be back at midnight.
			

However, Little Beaver Cheolsoo thinks it is possible to make up more than 4 messages by changing the place of these logs.

He knows that the logs must meet the following conditions:

- The logs can only either be attached horizontally, or be removed completely.
- The shape and orientation of the logs are not important.

But he does not know exactly how many messages are possible.

Question / Challenge

What is the maximum number of messages that are possible, including the 4 original messages?

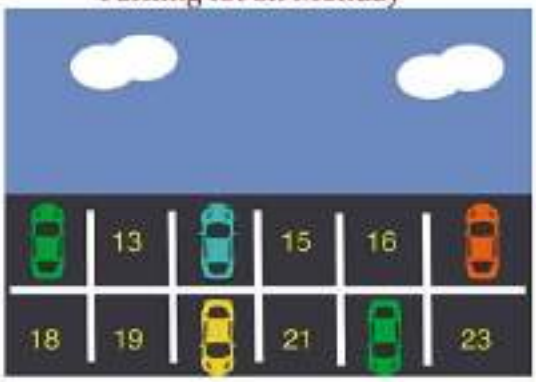
A) 8 **B)** 10 **C)** 6 **D)** 4

T2. Parking Lot

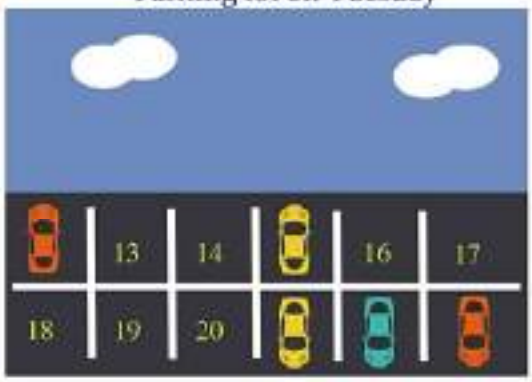
There are 12 spaces for cars in a parking lot. Each space is labelled with a number. The pictures below show which spaces were used on Monday and which spaces were used on Tuesday.

Time Allowed: **150 minutes**

Parking lot on Monday



Parking lot on Tuesday



Question / Challenge

How many parking spaces were empty on Monday and empty on Tuesday?

A) 3
B) 4
C) 5
D) 6

T3. Music with repeats

When beavers are performing music, such as their specialty, teeth-clapping, they are actually using almost the same notation as we humans do. In particular, they use repeat signs for indicating that a certain portion of the music should be played twice:

|: A B :|

Here, the letters A and B indicate different types of teeth-clapping sounds. Between each pair of repeat signs there can be one or several letters. For example, the piece above should be played

A B A B

Question / Challenge

How should the following piece of music be played? In other words, how should it be written out fully, without repeat signs?

B |: A B :| B |: A :| |: A C :| A

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

T4. Counting Game

Beavers Alex, Ben, Clover and Diana are playing a counting game. Each beaver draws a task card which has instructions written on both sides of the card as follows.

Beaver Alex:

Front of the card: "Count from 1 to 10 then follow the instruction on the back of the card."

Back of the card: "Count from 1 to 5 then follow the instruction on the front of the card."

Time Allowed: **150 minutes**

Beaver Ben:

Front of the card: "Count from 1 to 20 then follow the instruction on the front of the card."
Back of the card: "Count from 1 to 20 then follow the instruction on the back of the card."

Beaver Clover:

Front of the card: "Count all the even numbers from 2 to 1,000,000."
Back of the card: "Count all the even numbers from 2 to 1,000,000."

Beaver Diana:

Front of the card: "Count odd numbers from 1 to 1,000 then follow the instruction on the front of the card."
Back of the card: "Count odd numbers from 1 to 1,000 then follow the instruction on the back of the card."

Each beaver starts by following the instruction on the front of the card.

Question / Challenge

Which beaver will finish the task first?

A) Beaver Alex
B) Beaver Ben
C) Beaver Clover
D) Beaver Diana

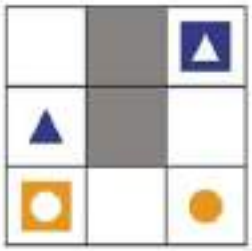
T5. All home

A board game is played on a board of white and gray squares. White squares are free, gray squares are walls.Some of the white squares contain:

- colored **shapes** - circle, triangle or diamond.
- **home** places for each shape - a colored square with white shape in its middle.

Each shape can be moved by commands: U - up, D - down, L - left, R - right. Each command moves the shape to an adjacent square, but only if that square is empty (white and no other shape or home is on it) or if it contains the home for the shape being moved. In the latter case the shape and its home disappear from the board after the move.

The player's task is to command each shape so that all of them reach they homes (and disappear). For this board



the correct sequence of commands can be: circle: L L, triangle: D R R U U

Time Allowed: **150 minutes**

Question / Challenge

What is the correct sequence of commands for this board?

A) circle: R R, diamond: L D R R, circle: U U, triangle: D D R R U U
B) diamond: L D L L, circle: R R U U, triangle: D D R R U U
C) circle: R R, diamond: L L D L, circle: U U, triangle: D D R R U U
D) circle: R R, diamond: L D L L, circle: U U, triangle: D D R R U U

T6. Shortening the Messages

You are searching for objects in a field and each object is labeled with a capital letter of the alphabet (A , B , C , ... , Z). Now you want to send a short message to a friend describing all these objects.

You figured out a way to make messages shorter by grouping similar objects: to count the number of occurrences of each object and to place the number in front of the object label.

For example, instead of sending the message AAAAAABBBCCCCC you can send the compressed message 6A3B5C.

Question / Challenge

If each one letter or one digit equals to one character, how many characters will be needed after the compression of the following message:

DDDDDDDEEEEEEAAAAAABBBBBFFFFFFFFFCCCCCCCCCGGGGGGGGGHH HH

A) 15
B) 16
C) 17
D) 18

T7. Swapping Dogs

Two types of dogs are standing as shown below.

A *swap* occurs when two dogs that are beside each other exchange positions.

After some swaps, the three large dogs end up in three consecutive positions.

Question / Challenge

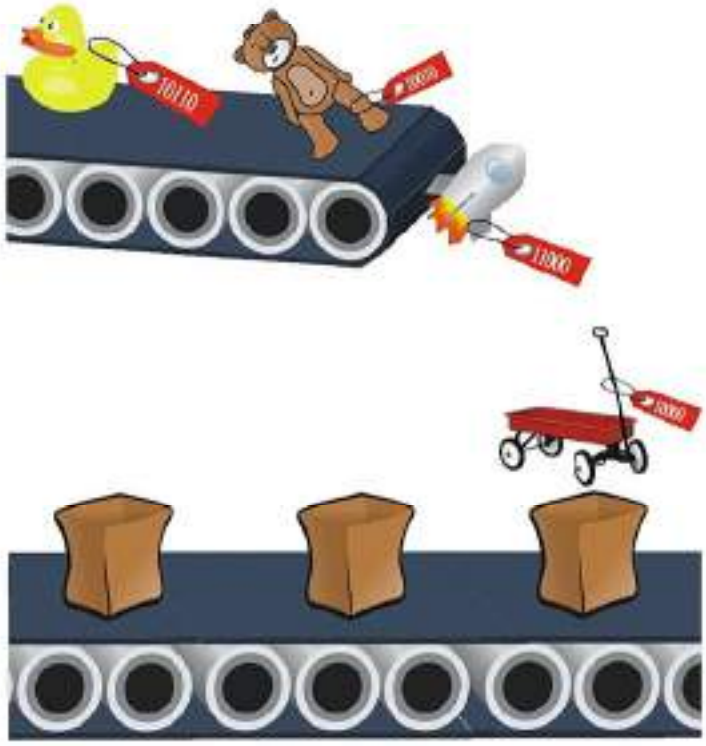
What is the fewest number of swaps that occurred?

A) 5
B) 6
C) 7
D) 8

Time Allowed: **150 minutes**

T8. Toy factory

Toys are produced by a special machine that attaches an integer code to the toys as they are released. Toys must come out of the machine in increasing order or else when they go to be shipped, they will go to the incorrect location. The toys fall from the conveyor belt into a bag as shown below.



Question / Challenge

Which toy above needs to be removed so that the remaining are in increasing order?

A)

B)

C)

D)

Time Allowed: **150 minutes**

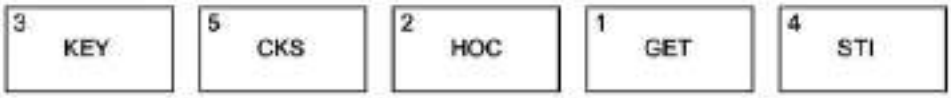
T9. Message Service

Violet wants to send a long message to Leo with a help of some beavers. She breaks the message into groups of at most 3 letters in each card, and gives each beaver one card with these letters.

Violet knows that sometimes the beavers get distracted while they transport their card, and they arrive at different times. Therefore, Violet numbers the cards in order before giving them to the beavers. Leo must then order the cards to determine the message.

For example, to send the message DANCETIME, Violet creates 3 cards as:

When Leo received the following sequence of cards from the beavers:



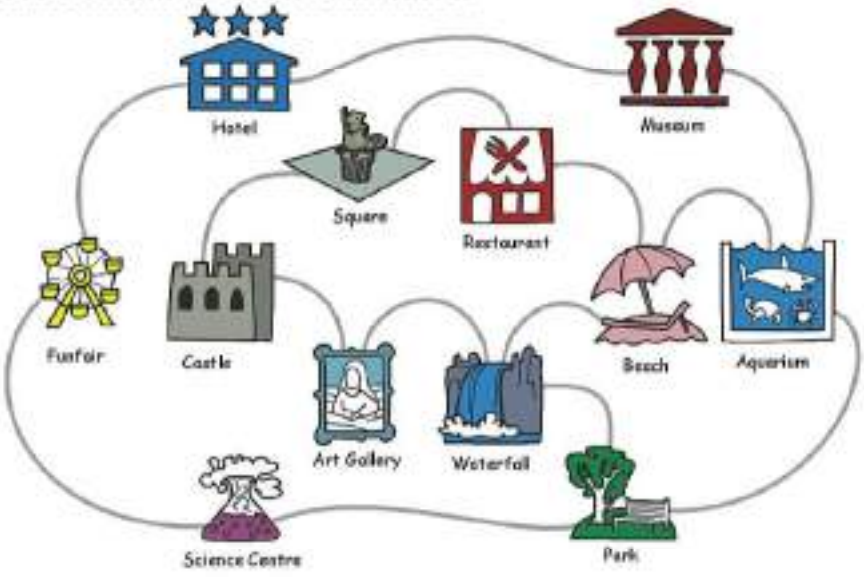
Question / Challenge

What was the original message?

A) GETSTICKYSHOCKS
B) STICKYGETHOOKS
C) GETHOCKEYSTICKS
D) KEYCKSHOCGETSTI

T10. Tour Guide

Peanut is a tour guide, who knows all the Beaver City's attractions. She works out a tour for tourists at the Hotel to visit several attractions in one day. She plans to take public buses to go from one attraction to the next. The Beaver City Map shows all possible bus-connections between attractions.



Time Allowed: **150 minutes**

Question / Challenge

Which of the following paths can be done with exactly four bus rides, without visiting the same attraction more than once?

A) From the **Park** to the **Science Center**
B) From the **Waterfall** to the **Science Center**
C) From the **Aquarium** to the **Waterfall**
D) From the **Restaurant** to the **Art Gallery**

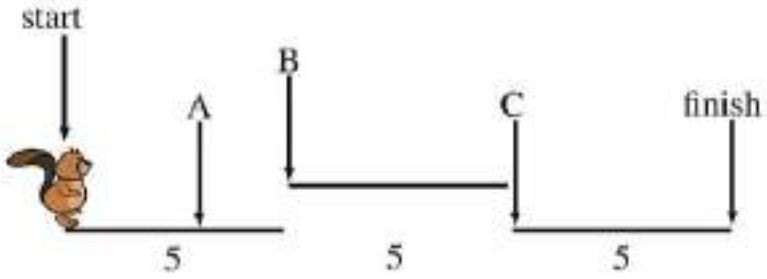
Tasks T11 – T20 carry 4 points each

T11. Jumpers

Peter and Henrietta are playing a simple video game together. The point of the video game is to move the Beaver from the start to the finish, jumping between platforms. The platforms are on two levels: the "bottom", where the Beaver always starts, and the "top". The amount of time to move over each platform of the game is shown below each platform.

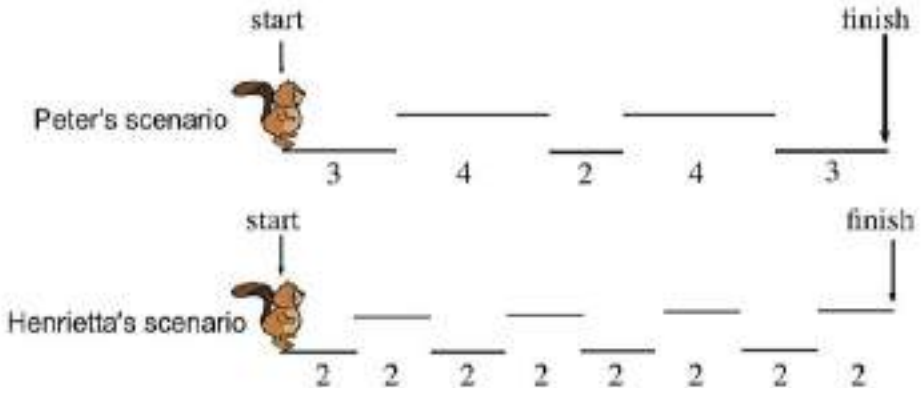
For example:

- the Beaver is at point A 3 seconds after the start;
- the Beaver is at point B 5 seconds after the start;
- the Beaver is at point C 10 seconds after the start;
- the Beaver is at finish 15 seconds after the start.



Notice that the Beaver can instantly jump up or jump down between platforms.

Peter and Henrietta start playing the game on their own video game console at exactly the same time. However, they are playing different scenarios within the game. The two scenarios are shown below:



Time Allowed: **150 minutes**

Question / Challenge

For how many seconds are *both* Peter's and Henrietta's Beaver moved along the top level *at the same time*?

A) 2 **B)** 4 **C)** 6 **D)** 8

T12. LeftRight

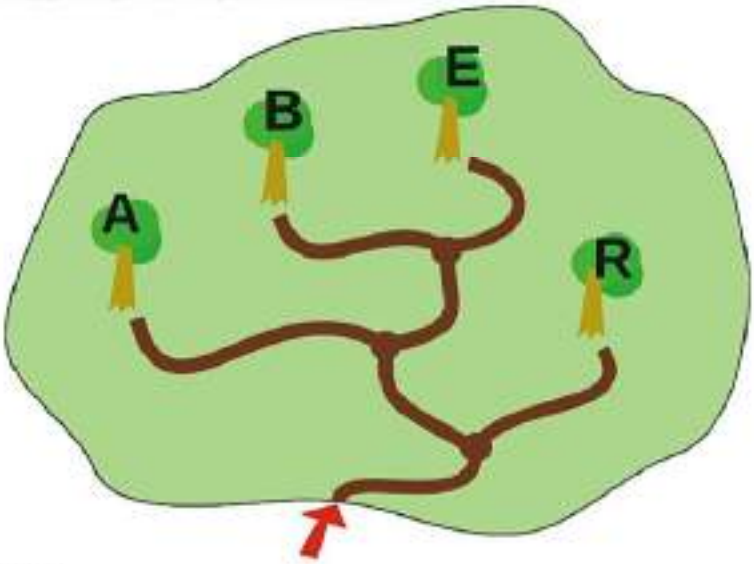
The beavers have made a code that uses this map:

- Every tree in the park is named with a letter.
- The code for each letter is found by how to get to its tree by turning left and right.
- The code for each letter always starts from the park entrance.

Examples

Example 1: The code for **A** is LL because to get to tree A from the park entrance you must turn left twice.

Example 2: The code for the word **BAR** is LRLLLR.



Question / Challenge

How many letters are there in the beaver's code for the word BEAR?

A) 6 **B)** 7
C) 11 **D)** 9

T13. Red Light, Blue Light

Betty Beaver sends messages to her friend using 7 lights, each of which can be red or blue.Betty uses the first 5 lights to indicate the letter to send.

To show that the message is valid, Betty uses the last 2 lights in the following way:

- the 6th light is blue if there is an even number of blue lights amongst the first 5 lights; otherwise, the 6th light is red;
- the 7th light is red if there is an even number of red lights amongst the first 6 lights; otherwise, the 7th light is blue.

Time Allowed: **150 minutes**

Remember that 0 is an even number. For example, if Betty has set the first 5 lights as:

then the 6th light should be blue (since there are 2 blue lights in the first 5 lights), and the 7th light should be blue (since there are 3 red lights in the first 6 lights). So, she should use the following pattern:

Question / Challenge

Which of the following patterns is a valid message?

A) 

B) 

C) 

D) 

T14. Run Encoding

In the Samantha's class the data is written down as a sequence of pictures of beavers and trees like this

Samantha has a brilliant idea to write down this data in a shorter way.
For example, instead of writing down the above sequence Samantha will write down the sequence

Time Allowed: **150 minutes**

That is, first she will write down the initial picture, which is either a beaver or a tree; then she will write the number of appearances of that picture in a row. Then she will look for the next different picture and write down the number of its appearances in a row, then she will look for the next one and so on...

Samantha looks back at her notes and finds the sequence:

421132

Question / Challenge

What was the original sequence of beavers and trees?

A)

B)

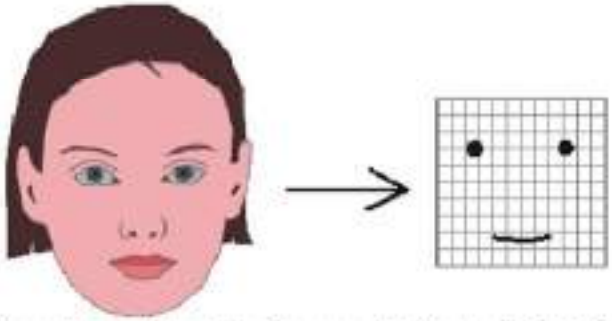
C)

D)

T15. Give Me a Smile

The beavers have developed a system detecting smiling human faces on a camera image. It works in two steps:

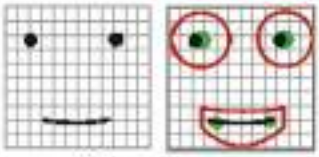
1) Pre-processing: The image of a face is transformed to a smiley-like face model consisting of two spots and a line indicating the positions of eyes and the mouth.



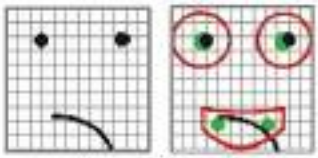
2) Smile-detection: The smiley-like face model is checked with a pattern consisting of red lines and four green spots.

Time Allowed: **150 minutes**

The face model is accepted as a smiling face, if and only if it touches all green spots and does not touch a red line.



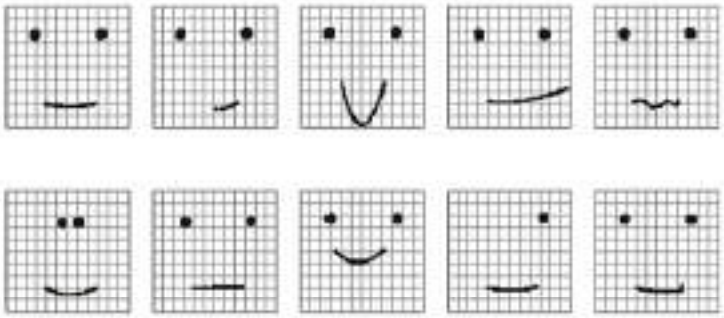
smiling face



not a smiling face

Question / Challenge

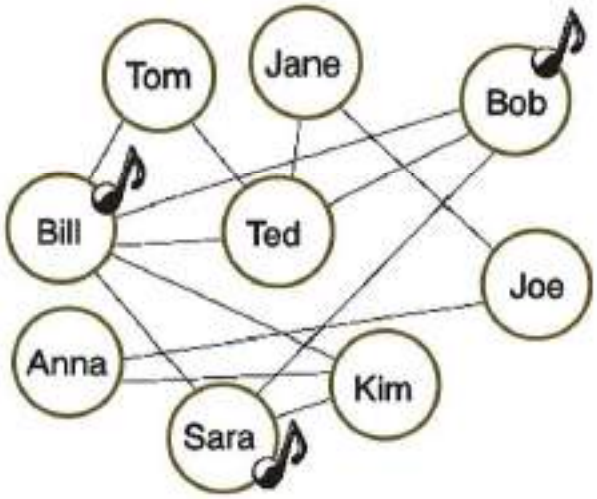
How many smiling faces are detected on this image, which already has been pre-processed?



A) 6 **B)** 4 **C)** 5 **D)** 8

T16. Bebragram

The lines in the diagram show exactly which pairs of students in a class are friends. A popular artist releases a new song on Monday and there is a musical note beside each student that buys the song that day.



Every day after that, if a student has not bought the song yet but at least half or more of their friends have (on a previous day), he or she will also buy the song. Otherwise they do not buy the song yet.

Time Allowed: **150 minutes**

Question / Challenge

On what day will all the students own the song?

A) Saturday
B) Thursday
C) Wednesday
D) Sunday

T17. Flags

Flags, as other pictures, are represented in computers by matrices (rectangular arrays of numbers). The simplest way is to represent "black and white" versions and to put 1 for white and 0 for black. The matrix in Fig. 1 represents one possible flag.

```
101111
010110
111111
010110
101111
```

Fig. 1

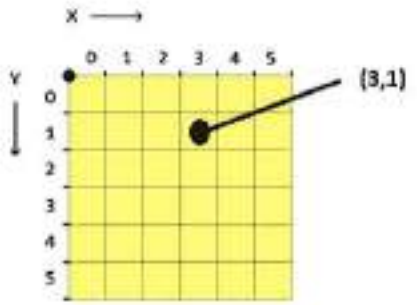


Fig. 2

```
101010
010101
101010
010101
101010
010101
```

Fig. 3

```
111111
111110
111100
111000
110000
100000
```

Fig. 4

The position of every element (0 or 1) in the matrix is represented by its coordinates, as shown in Fig. 2.
Let's assume that there are 2 different types of flags represented with matrices of 6 rows and 6 columns (**Chess flag**, shown in Fig. 3, and **Triangle flag**, in Fig. 4).

Question / Challenge

Your friend picks one of the two flags. If he tells you only that the element in the position (1, 4) is 1, can you guess which flag he has picked?

A) Chess flag
B) Triangle flag
C) It can be either Chess flag or Triangle flag
D) Neither Chess flag nor Triangle flag have 1 in that position

T18. Five sticks

Adam has five sticks. He puts them on the table and creates this shape:

Time Allowed: **150 minutes**

Nola comes to the table. She takes one stick and puts it in a different place:

Then Bob comes to the table, He also takes one stick and puts it in a different place.

Question / Challenge

Which shape is Bob **not able** to make?

T19. Files

Tom, Peter, Anne, Mark, Jenny, Joanne are friends.

Tom stores text files containing stories about his adventures with his friends in a folder called "Our-Stories". He wants to collect all the files mentioning "Anne".

For that, he runs a program that copies all files containing either "Anne" or "anne" into a newly created folder called "Anne-Stories". But Tom realizes that the new folder might contain files that contain "Joanne", but not only "Anne".

He then runs a second program that deletes all files from "Anne-Stories" that contain "Joanne".

Question / Challenge

Tom has made a mistake. Which one?

A) With this approach some text files mentioning Joanne might remain in "Anne-Stories"

B) Tom will be deleting all files in the folder "Anne-Stories".

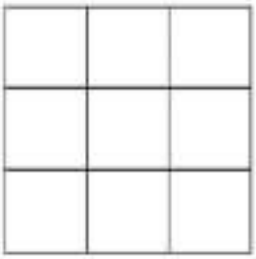
C) Some files containing "Anne" may be missing from the folder "Anne-Stories".

D) Tom has to take into consideration whether Anne or Joanne are mentioned first in the text.

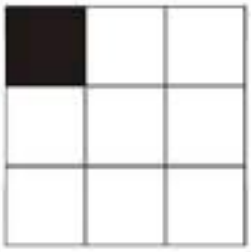
Time Allowed: **150 minutes**

T20. What is THIS?

Beatrice Beaver is playing around with her new computer screen. It is very simple: it has only 9 squares on it, arranged in 3 rows of 3 columns, as shown here:

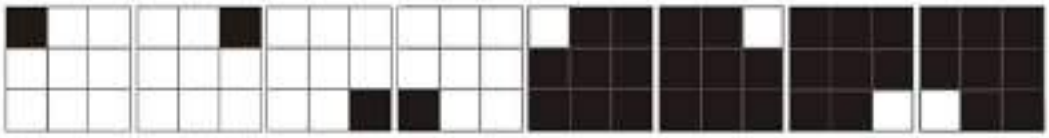


She can paint some squares black. For example, if she painted only the top-left square, the image on the screen would look like:



Her computer also has "rotate" and "invert" buttons. The "rotate" button will rotate the image clockwise by 90 degrees. The "invert" button will change all white squares to black and all black squares to white.

For example, when Beatrice presses the "rotate" and "invert" buttons after painting the top-left square, she can create a total of 8 different patterns:

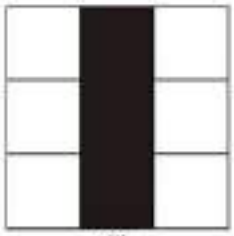


Question

Starting from the images of the letters T, H, I and S, from which of them can Beatrice make the largest number of different patterns using the "rotate" and "invert" buttons?

A)

B)



C)

D)

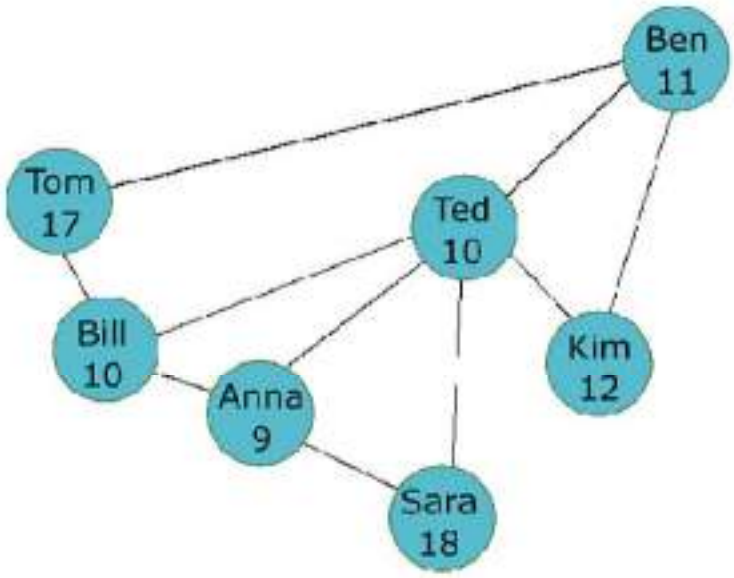
Time Allowed: **150 minutes**

Tasks T21 – T30 carry 5 points each

T21. Book-sharing Club

This diagram shows the relationship between 7 students in a book-sharing club. Their names and ages are also shown.The club has some regulations for members: When you receive an unread book, you read it, then pass it to the youngest friend who has not read it yet. If all your friends have read the book, you should pass it to the friend who gave it to you.

Now Ben has read a new book and wants to share it with his friends.



Question / Challenge

Who will be the last reader of the book?

A) Tom **B)** Sara **C)** Bill **D)** Kim

T22. Library

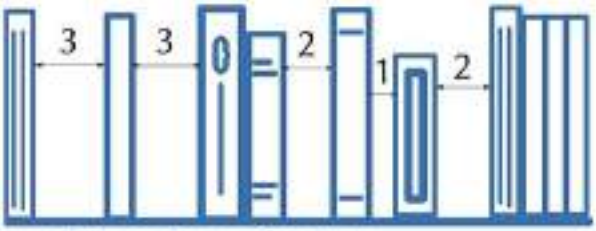
Jack and Sue work in the school library. Books are arranged on a one meter-long shelf. When a book is borrowed, they pick it up from the shelf, leaving an empty space as thick as the book.

Each day, all returned books are stacked on a table. Before closing the library, Jack and Sue put the books back on the shelf. However, they each use a different approach:

- Jack takes the first book in the stack, scans the shelf from left to right and places the book in the first empty space large enough to store it. He does the same until he places all the books or finds a book which he is not able to place.
- Sue places each book in the biggest empty space that can store the book or the leftmost largest available space if there is a tie, and stops when either all books have been placed or when she finds a book which she is not able to place.

Time Allowed: **150 minutes**

At the end of a day the shelf is organized as follows, with free spaces denoted in centimeters.



Books on the stack are of three sizes as given by

Thickness (in cm)	1	2	3
Book Type			

Consider the following stacks of returned books (the first is on the top of the stack). The books are taken from this stack, rotated vertically and then placed back on the shelf.

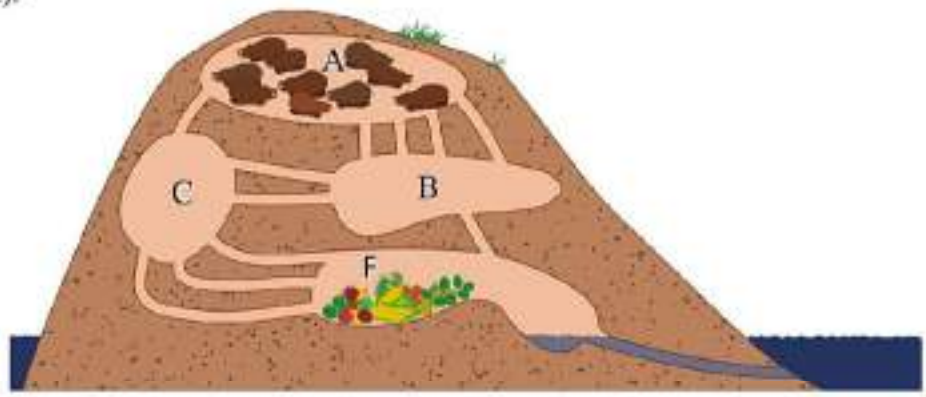
Question / Challenge

Which of the stacks below lets Jack place more books on the shelf than Sue?

A) B) C) D)

T23. Tunnels of the Homestead Dam

"Homestead Dam" has tunnels that connect four rooms (A, B, C, F). The first three rooms (A, B, and C) are living rooms, the fourth room (F) is where food is stored (see figure).



Time Allowed: **150 minutes**

10 beavers are staying in room A, they are becoming hungry and they want to go to room F to eat. Since all beavers are very hungry, they all want to arrive in the food storage as soon as possible.
It takes 1 Minute to traverse a tunnel and only one beaver may traverse a tunnel at the same time (not several beavers following each other).

The connections between the rooms are composed by a certain number of tunnels:

- Between A and B: 4 tunnels.
- Between A and C: 1 tunnel.
- Between B and C: 2 tunnels.
- Between B and F: 1 tunnel.
- Between C and F: 3 tunnels.

The rooms have no capacity limits, that is in all rooms there can be as many beavers as want to be there.

Question / Challenge

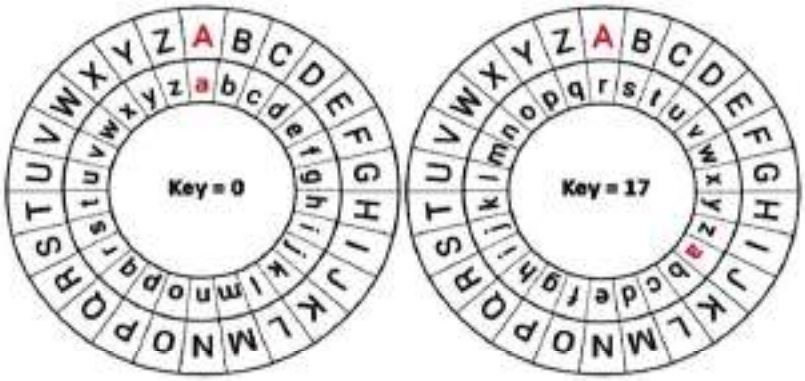
What is the *maximal number* of beavers that can arrive in the food storage *in exactly 2 Minutes*?

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

T24. Cipher Wheel

A beaver left a secret message on his tombstone by using the 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'. As shown in the second image, when the key is 17 (because the inner wheel has been rotated by 17 positions counter-clockwise), 'A' is encoded as 'r'.



Time Allowed: **150 minutes**

With the key equal to 17, we will encode the message "WHO ARE YOU" to "nyf riv pfl".

Question / Challenge

What does the message (**j cp fjgcma**) mean if we know that the beaver used such a coding process that for the first letter the key is 1, while the key for the second letter is 2, the key for the third letter is 3, etc.?

A)

I	D	O	C	O	O	K	I	E

B)

U	D	O	B	E	A	V	E	R

C)

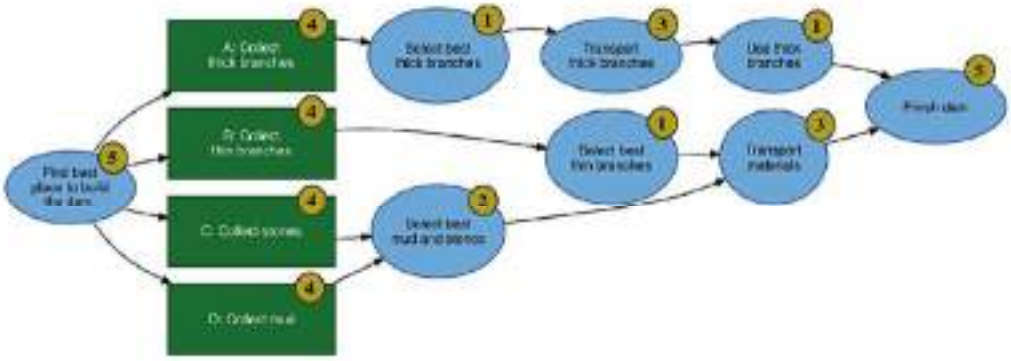
I	A	M	B	E	A	V	E	R

D)

I	A	M	C	A	S	T	O	R

T25. Dam construction

Four beavers are building a dam. They use a plan as drawn below. The tasks have to be done in the order indicated by the arrows. The numbers in the yellow circles indicate how many hours each task takes. Every task is always performed by a single beaver.



After the beavers found the best place to build the dam, one beaver decided to take a four hour nap, so his task will be delayed by four hours.

Question/Challenge

Which of the four tasks should be postponed in order to minimize the delay in finishing the dam?

A) Collect thick branches
B) Collect thin branches
C) Collect stones
D) Collect mud

Time Allowed: **150 minutes**

T26. One Too Many

I recently discovered a stupid mistake I made in a long long text I have written. All 1's should be 11's and all 11's should be 1's. Luckily, I have an editor in which I can 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.

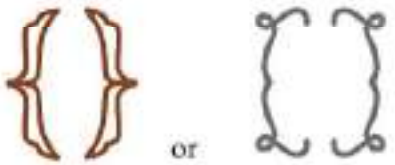
Question / Challenge

What did I do to fix my text?
Hint: ($ is a character not used in the text!)

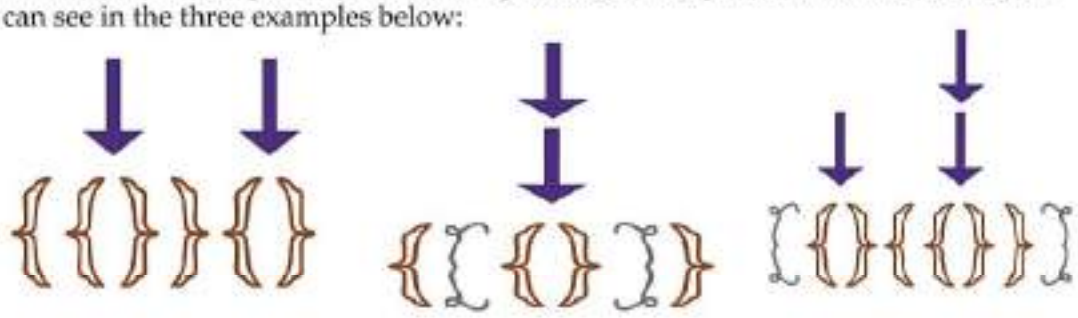
A) I replaced all 11's with 1's and then all 1's with 11's.
B) I replaced all 1's with 11's and then all 11's with 1's.
C) I replaced all 1's with $'s and then all $'s with 11's and then all 11's with 1's.
D) I replaced all 11's with $'s and then all 1's with 11's and then all $'s with 1's.

T27. Brackets

A jewellery shop produces bracelets. They use bracket-shaped ornaments that come in pairs. To make a bracelet you start with one of those pairs:



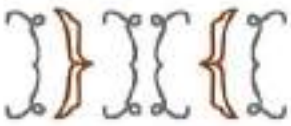
Additional bracket pairs are inserted repeatedly at any place of the bracelet, as you can see in the three examples below:



Question / Challenge

Which of the following bracelets is made with the method described?

A)


B)


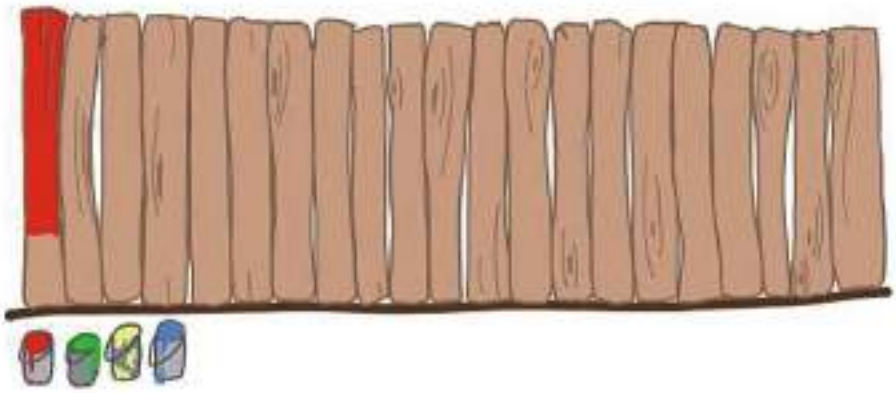
C)


D)


Time Allowed: **150 minutes**

T28. Board Fence

A painting robot has a row of colour buckets. Not every bucket is full of colour. The robot is painting the boards in a fence. He is painting every board with one colour. Then he continues painting the next board with the colour in the next bucket in the row. When he reaches the last bucket in a row he starts again from the first bucket. Once a bucket is empty the robot withdraws it from the row. The robot continues painting until all buckets are empty or until he would have to paint the next board with the same colour as the previous board.



At the beginning he has buckets with these amounts of color:

- red colour for 5 boards
- green colour for 3 boards
- yellow colour for 7 boards
- blue colour for 2 boards

Question / Challenge

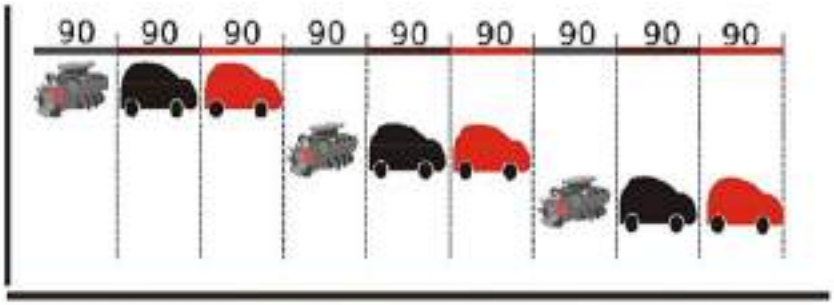
After how many painted boards he will finish?

A) 5 **B)** 8 **C)** 17 **D)** 15

T29. The assembly line

Michelle has a car-building factory with three teams in charge of three different tasks: one team builds the engine, another team builds the car body, and another team paints the car. To produce an individual car one must first build its engine, after that complete its body, and finally paint it.

Each task takes 90 minutes. Therefore, working on one task after another, Michelle thought they would need 90 x 3 = 270 minutes per car. The figure shows Michelle's idea.



Time Allowed: **150 minutes**

However, one of the workers suggested a faster way to build cars by making different teams work simultaneously. For example, one team can paint one car while another team is building the engine of a different car.

Question / Challenge

Working in the fastest possible way, how many minutes are between producing consecutive cars?

A) 150 minutes
B) 30 minutes
C) 120 minutes
D) 90 minutes

T30. Washing machine

A washing machine has five different commands: wash, rinse, spin, fill (with clean water) and drain.

For the washing machine to work correctly:

- every rinse must be immediately followed by a drain and
- every drain must be immediately followed by a spin and
- every fill must be immediately followed by a rinse.

The expression 3 (...) means that commands in brackets are repeated 3 times.

We want the machine to wash once and rinse three times in clean water.

Question / Challenge

Which of these sequences of commands makes the machine wash once and rinse three times in clean water?

A) wash drain 3(spin fill rinse) drain spin
B) wash drain 3(fill rinse drain spin)
C) wash 3(drain spin fill rinse) drain spin
D) wash rinse drain 3(spin fill drain) spin