Time Allowed: **150 minutes**

Tasks T1 – T10 carry 3 points each

T1. Rainfall distribution

The beavers are planning to build a new dam. Based on the mean annual rainfall distribution (in the figure below) they want to find the best month to build it. They agree on the following:

- They want to test the maximum dam capacity in the most rainy month of the year.
- The dam should be built one or two months earlier than testing it, and in the driest possible month.
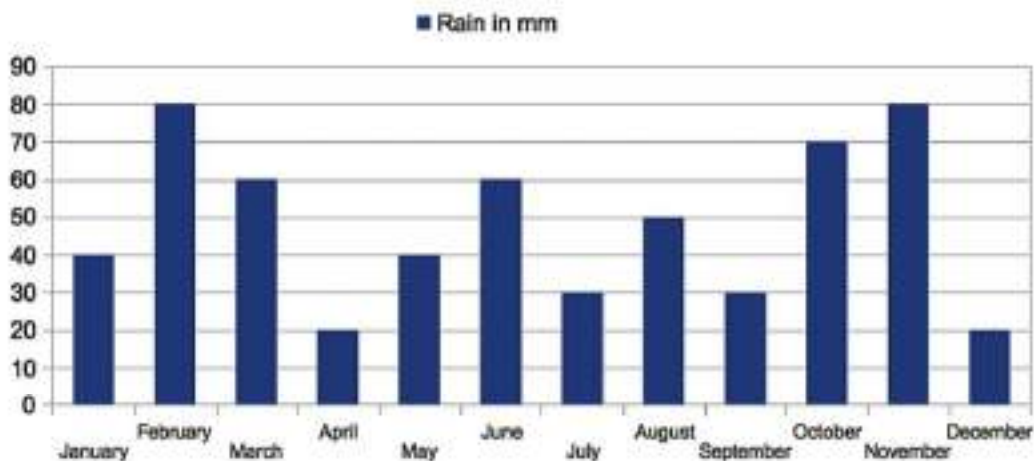
Question / Challenge

Which month should the beavers build the dam?

A) January   B) April
C) September   D) December

T2. 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.

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)

T3. Bowling

Little Beaver saw a new game in school fair: with different numbers of balls and different combinations, Little Beaver can get different letters on a screen by rolling balls in different tracks.

Time Allowed: **150 minutes**

The following table shows in which tracks the balls must be rolled to get different letters.

Letter	Balls Rolled		Letter	Balls Rolled		Letter	Balls Rolled
A	0100 0001		J	0100 1010		S	0101 0011
B	0100 0010		K	0100 1011		T	0101 0100
C	0100 0011		L	0100 1100		U	0101 0101
D	0100 0100		M	0100 1101		V	0101 0110
E	0100 0101		N	0100 1110		W	0101 0111
F	0100 0110		O	0100 1111		X	0101 1000
G	0100 0111		P	0101 0000		Y	0101 1001
H	0100 1000		Q	0101 0001		Z	0101 1010
I	0100 1001		R	0101 0010			

Balls are rolled successively by decreasing track number. When a ball is rolled in a track with a larger number than the one of the previous roll, it means the combination for the letter is done, and it gets shown on the screen.

For example, if Little Beaver wants to get the letter "A", Little Beaver needs to first roll one ball in "*track 7*", and then one ball in "*track 1*".

Question / Challenge

How many balls does Little Beaver need to spell "BEBRAS"?

A) 13 balls　　　　B) 14 balls　　　　C) 15 balls　　　　D) 16 balls

T4. Irrigation

Beaver has a flower bed and a vegetable garden. For watering he has built 2 identical irrigation systems, one of them is pictured below.

It is connected to a power source and consist of:

- a long cable
- a short cable
- the pump
- the pump contains a fuse (the pump will not work if the fuse is blown)

Time Allowed: **150 minutes**
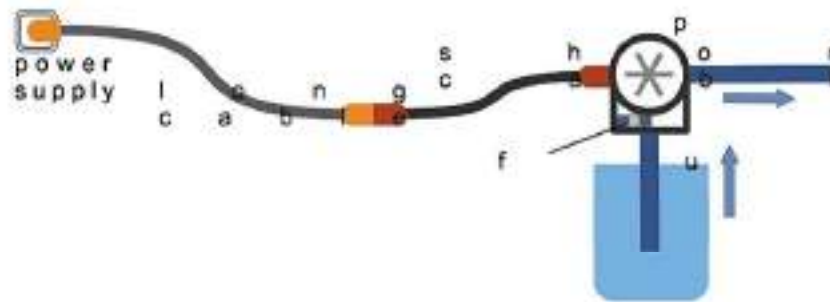
One day the irrigation system of the flower bed stopped working. Beaver confirmed that the water pipes and the water tank are not the problem. However, all the parts of the irrigation system in the vegetable garden are working properly and could be used for testing.

Question / Challenge

There is only one faulty part and Beaver wants to find the failure. There is no obvious sign which part is at fault. Beaver starts testing. Which of the following statements are true?

1. When testing one must start with the pump, because it is the most important part.
2. Replacing one part at a time helps to identify the faulty part. When the system starts working the last replaced part was faulty.
3. When testing one could start at the power source and move further step by step away from the power source.
4. When testing, one should replace two parts at a time to find the fault, because this approach always results in fewer trials than replacing one part at a time.

A) 1 and 4.   B) Only 2.

C) Only 3.   D) 2 and 3.

T5. Chameleon

A chameleon wants to travel through a colorful grid. It can move between adjacent cells either horizontally, vertically or diagonally. It needs to travel from the lower left of the grid to the upper right. In a cell, the chameleon takes the same colour as the colour of the cell.

Time Allowed: **150 minutes**

Question / Challenge

What is the minimum number of colors that the chameleon needs to take?

A) 3: red, green, yellow   B) 4: red, green, yellow, blue
C) 2: red, blue   D) 2: red, green

T6. New house numbers

An apartment building has ten floors. Each floor has seven apartments. Each apartment has its own house number which is shown in the table below.

10th floor	64	65	66	67	68	69	70
9th floor	57	58	59	60	61	62	63
8th floor	50	51	52	53	54	55	56
7th floor	43	44	45	46	47	48	49
6th floor	36	37	38	39	40	41	42
5th floor	29	30	31	32	33	34	35
4th floor	22	23	24	25	26	27	28
3rd floor	15	16	17	18	19	20	21
2nd floor	8	9	10	11	12	13	14
1st floor	1	2	3	4	5	6	7

The local authority has decided to renumber the apartments. The new numbers of the apartments on the first floor are 1, 2, 3 ..., 7; on the second floor 11, 12, 13, ..., 17; on the third floor 21, 22, 23, ..., 27, et cetera. In some cases the new number of an apartment is equal to its old number or equal to the old number of an apartment on the same floor.

Question / Challenge

On how many floors is this the case?

A) 3   B) 10
C) 1   D) 4

T7. What time is it?

Busy beavers have invented a way to know the time without looking at the clock. They use the bell in city square tower.

- When it is a quarter past of any hour, the bell rings once.
- When it is the half of an hour, the bell rings twice.
- When it is three quarters of any hour, the bell rings three times.
- At every hour on the dot, the bell rings four times plus as many times as the time it is.

For example, at five o'clock, the bell rings nine times.

Less than one hour ago, beavers heard thirteen rings one after the other.

Now the bell is ringing three times.

Question / Challenge

What time it is it?

13:00	9:45	3:00	13:45
A)	B)	C)	D)

T8. Office lights

Eight beavers have their own office at work. When they are in their office, they turn on the light. When they leave, they turn the light off. Their boss checks who is working by checking which lights are on. As you can see in the picture below, not all beavers are working today.

Time Allowed: **150 minutes**

The boss makes notes about who is working and who is not, but she uses symbols and we do not know where she has begun and which direction she uses to write down the notes.

Question / Challenge

Which of the notes correspond to the picture above?

A) # & & & # # & #   B) & & # & & # # &

C) & # & & & # & #   D) # & # # & & & &

T9. Hats and bicycles

A beaver class is lined up in a row. Only the beavers between [Hat on] and [Hat off] wear a hat. Only the beavers between [Get on] and [Get off] sit on a bicycle.

Question / Challenge

How many Beavers are either wearing a hat or sitting on a bicycle but not both?

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

T10. Charts

Beaver Bruno has drawn charts using some values.

Question / Challenge

Which of the following charts is NOT consistent with the other charts?

Time Allowed: **150 minutes**
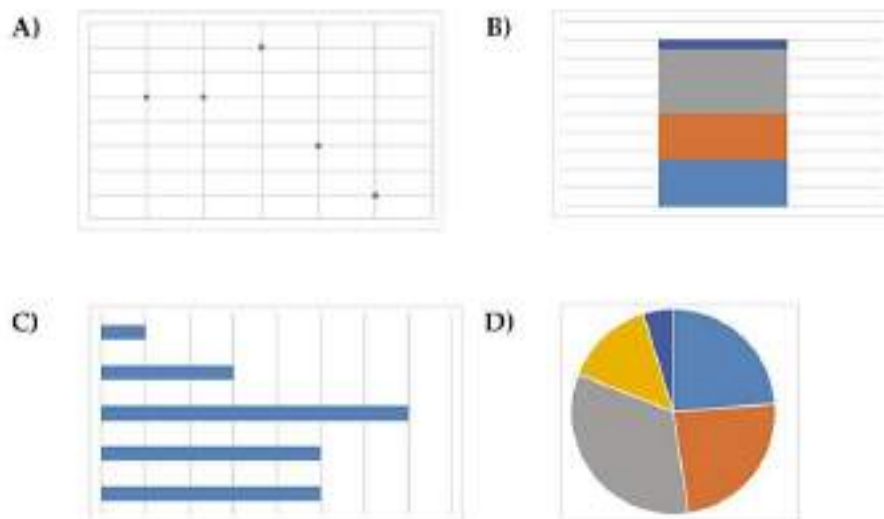
Tasks T11 – T20 carry 4 points each

T11. Dam Support

In modern Beaver communities, several lodges get together and share the support of one or two Dam Building Consultants (DBCs). These wise old Beavers go and help the lodges in their community solve problems with their dams.

Here is a map of such a community with the times it takes to swim between each lodge shown in minutes:
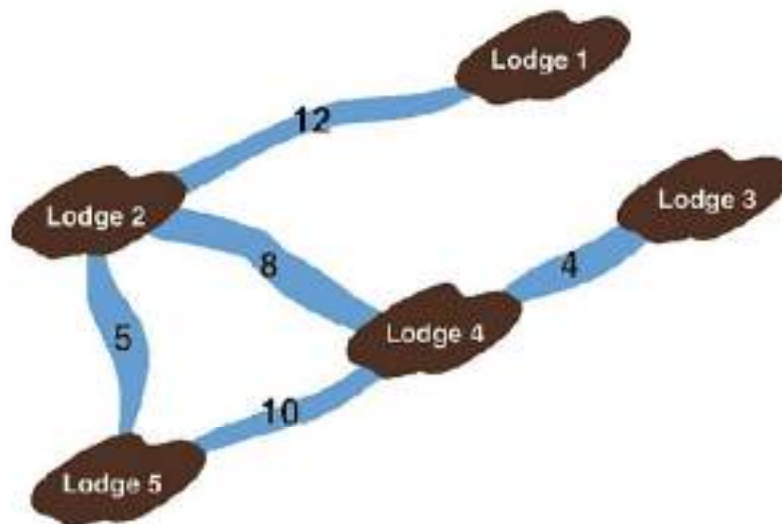
This community employs the services of two DBCs, Smith and Patel, but where should they live to provide the best service?

All lodges will call a DBC once a day but they are not allowed to call more than once a day. It is not known where the calls will come from. After completing each visit, the DBC must return immediately to their base to do the paperwork.

Question / Challenge

Where should Smith and Patel be based so that the total swimming time to answer all the calls is the lowest?

A) Lodges 2 and 4 or lodges 1 and 2
B) Lodges 2 and 4 or lodges 2 and 3
C) Lodges 2 and 4 or lodges 3 and 4
D) Lodges 2 and 4 or lodges 1 and 5

T12. Pigpen Cipher

Beaver Benjamin and his neighbor Kathy secretly communicate with each other by sliding messages underneath the garden fence. They made their own keys to make sure nobody else understands the message.

They use the following key:

For example, the word BEAVER is written as follows:

Benjamin received the following message from Kathy:

Question / Challenge

What did Kathy want to communicate to Benjamin?

A) At dinner she will eat apple.

C) Apples are better than oranges.

B) We will meet at the apple tree.

D) At dinner she will eat orange.

T13. Travelling

John wants to take a trip to visit nine cities of his country: Onecity, Twocity, Threecity, Fourcity, Fivecity, Sixcity, Sevencity, Eightcity and Ninecity. There are bus lines connecting some of these cities. The buses make the following routes in both directions:

- Threecity - Onecity
- Ninecity - Twocity
- Threecity - Ninecity
- Ninecity - Onecity
- Onecity - Twocity
- Sevencity - Eightcity
- Eightcity - Sixcity
- Sixcity - Fivecity
- Fivecity - Fourcity
- Fourcity – Sevencity

Question / Challenge

If John starts his trip at Threecity, which city will he NOT be able to visit?

A) Onecity

B) Twocity

C) Fourcity

D) Ninecity

T14. Skaters

Seven people are skating in a line along a very long, frozen canal. They begin as shown below.

To save energy, every minute the person at the front of the line moves to the end of the line.

Question / Challenge

Which skater will be at the front of the line after one hour?

A)

B)

C)

D)

T15. Balls

Numbered balls roll down ramps. The order of the balls changes as they fall into holes. When a ball comes to a hole, if there is enough space, the ball falls in. Otherwise, the ball rolls past the hole. A pin at the bottom of each hole can be pulled which ejects the balls. Here is an example:

before five balls
start rolling

after balls have
stopped rolling

final result after
pulling the pin
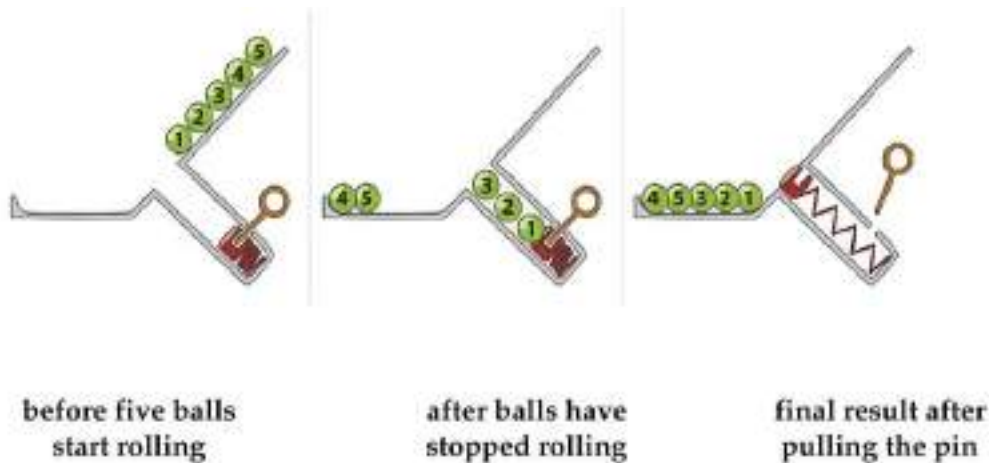
Time Allowed: **150 minutes**

Ten balls roll down the ramp below. Three holes A, B and C have space for 3, 2 and 1 balls as shown. Pins are pulled in the order A, B, C but each time, only after all balls have stopped rolling.
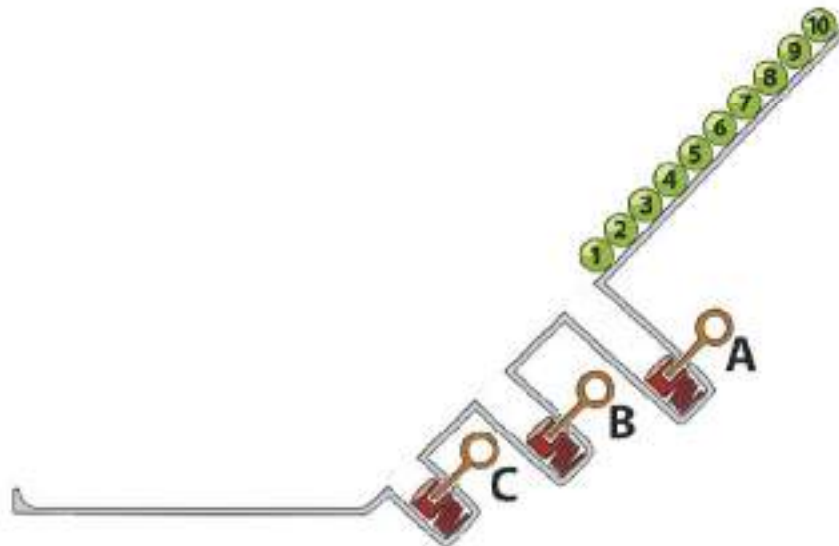
Question / Challenge

Which of the following is the final result?

A) 7 8 9 10 1 2 3 4 5 6

B) 7 8 9 10 1 2 3 5 4 6

C) 10 9 8 7 6 5 4 3 2 1

D) 7 8 9 10 3 2 1 5 4 6

T16. Commuting

Beaver Martina needs to go to work using public transportation every day. There is no direct line, so Martina has to switch between several lines. The map hereafter shows the six existing lines with the travel time between any two stations (Martina's home is marked with "H", her workplace is marked with "W", and stations, where it is possible to change line, are marked with "S").
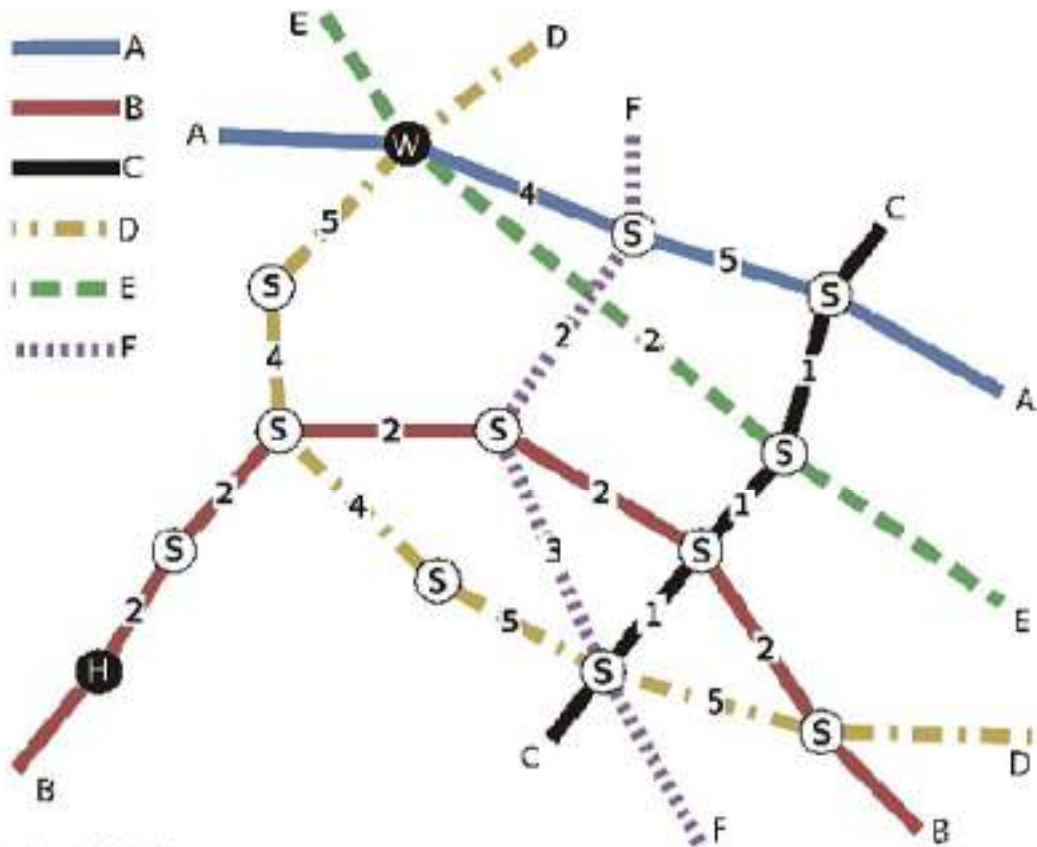
Question / Challenge

Assuming that changing line takes no time, which lines should Martina take in order to arrive at work as fast as possible?

A)

B)

C)

D)

T17. Space Odyssey

Clarke is the captain of Earth II, a spaceship whose mission is to explore the planets of the solar system. Earth II spaceship has Jupiter as its destination. It uses two types of fuel: solar battery and solid fuel. Only one type of fuel can be used at any time. Earth II also has two operational modes: "accelerating", which means the spaceship is using some fuel to gain speed and "inertial", which means the spaceship is not using any fuel, thus only keeping its current speed.

Its computer system has a program called "Jupiter Arrival", which once triggered executes the following steps:

Put Earth II in accelerating mode.
While Earth II is not in inertial mode, do:
> While the solar battery charge is greater than 35 units, use only the solar battery
> If the solar battery charge is equal to or less than 35 units and the amount of solid fuel is greater than 20 units
> > Send a message to Earth: "Recharging solar battery"
> > Use 10 units of the available solid fuel
> > Wait and recharge the solar battery to 50 units
> If the amount of solid fuel is less than or equal to 20 units
> > Send a message to Earth: "Entering inertial mode"
> > Put Earth II in inertial mode

Question / Challenge

When captain Clarke activates the "Jupiter Arrival" program, the energy stats are 100 units of solar battery charge and 40 units of solid fuel. What messages will Earth II have sent once the "Jupiter Arrival" program has executed?

A) Recharging solar battery, Recharging solar battery, Recharging solar battery, Entering inertial mode
B) Recharging solar battery, Recharging solar battery, Entering inertial mode
C) Recharging solar battery, Entering inertial mode
D) Entering inertial mode, Recharging solar battery, Recharging solar battery

T18. What's for lunch?

Bibo and Biba love to create encrypted messages using a Cipher Disk. The Cipher Disk has an inner disc and an outer disc. Everyday, Bibo sends Biba an encrypted message on what he likes to have for lunch. The message is encrypted in the following way.

1. Bibo writes down the food name, for example "PIZZA".
2. Under each letter he writes a number between 1 and 9 and turns the inner disc to the left that many times from the initially aligned position. The figure on the right shows the inner disc turned 3 times to the left.
3. Bibo then writes down the corresponding letter on the inner disc. The figure on the right shows that "P" is encrypted as "S".

4. Bibo sends the encrypted message to Biba. Biba then decrypts the message to get the lunch choice.
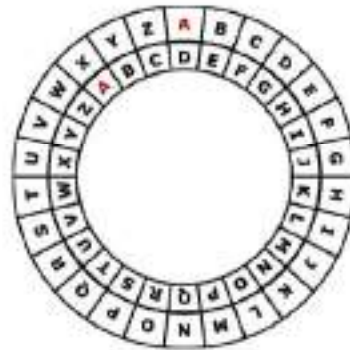
For example: Bibo wants to have PIZZA for lunch, so he writes:

Message	P	I	Z	Z	A
Turn to the left	3	1	4	3	1
Encrypted Message	S	J	D	C	B

Question / Challenge

What does Bibo suggest for lunch if the following encrypted message is received by Biba?

Message	?	?	?	?	?	?	?
Turn to the left	3	5	1	7	2	4	8
Encrypted Message	O	F	T	H	I	R	I

A) LASAGNA

B) APRICOT

C) AVOCADO

D) SPINACH

T19. Honomakato MC

The Honomakato archipelago consists of the five beautiful islands Ho, No, Ma, Ka, and To. The big island Ho is connected to the internet by a big cable. In addition, small cables connect Ho and No, Ho and Ka, Ka and Ma, and Ka and To. Via these cables, all islands are connected to Ho and, therefore, the internet.
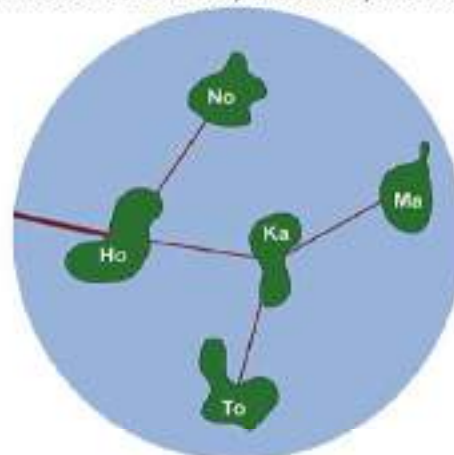
The Honomakato people want the network to be resilient: If one of the small cables breaks, no matter which one, every island shall still be connected to the internet.

Question / Challenge

If two more cables are laid to make the network resilient, which of the following is correct?

A) Between Ho and To, and between No and Ma.
B) Between Ho and To, and between Ma and To.
C) Between Ka and No, and between No and Ma.
D) Two further cables are not enough to make the network resilient.

T20. Beaverhotel

The beaverhotel has 5 floors with 8 rooms each. The robot that cleans them follows the instructions below:

- letter C: look for any uncleaned room on your floor and clean it,
- letter U: go up one floor,
- letter D: go down one floor,
- A number n followed by round brackets () means you should repeat everything between the brackets n times.

For example, if you want the robot to clean two uncleaned rooms on the same floor, then type 2(C). If you want the robot to go down one floor afterwards, type 2(C) D.

Question / Challenge

In order to clean all the rooms the robot starts on the ground floor and after it is finished it must return to the ground floor.

Which of the following instructions is the correct one to clean all the rooms and during the work never leave the five mentioned floors?

A) 4(8(C) U) 8(C) 4(D) B) 4(8(C) U) 8(C D)
C) 5(8(C) U) 4(D) D) 5(C) U 4(D)

Time Allowed: **150 minutes**

Tasks T21 – T30 carry 5 points each

T21. Pizzeria Biberia

In Pizzeria Biberia, there is a small pizza oven so the chef can only bake a few things at once. The two tables below show the only possible combinations and the baking times.

Possible Combinations

three ciabatta breads	one ciabatta bread and one large pizza	one small pizza and two ciabatta breads

Baking Times

small pizza	10 minutes
large pizza	15 minutes
ciabatta bread	20 minutes

In the pizzeria there are many orders. The pizza chef has to plan the baking times cleverly so that the guests can eat as quickly as possible. The breads and pizza can be put into the oven in any order but each item must stay in the oven until it is ready.

Question / Challenge

An order is placed for one small pizza, two large pizzas and four ciabatta breads. What is the minimum amount of time until the entire order is baked?

A) 20   B) 40   C) 50   D) 60

Time Allowed: **150 minutes**

T22. A Stray Baby Beaver

A baby beaver has lost his mom in a forest. The forest consists of 6 by 6 blocks, with two trees and one rock as shown below.
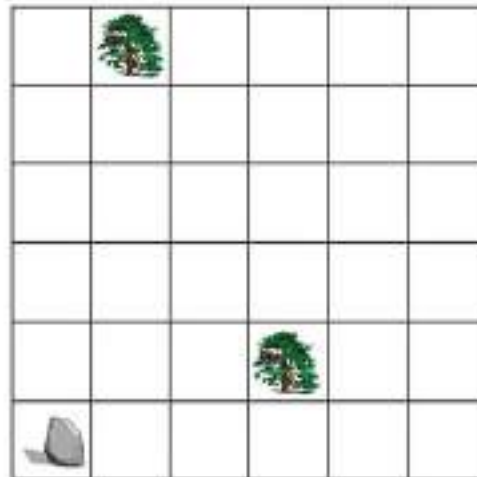
A beaver cannot pass the blocks diagonally. The distance between blocks is defined as the number of blocks that must pass through for the shortest path. For example, the distance from the rock to the closest tree is 4.

The baby beaver is able to see all the objects within the distance of 4 from his location.

Mom Beaver: "How many rocks and trees do you see?"

Baby Beaver: "I only see two trees, no rocks"

Mom Beaver: "How far are you from each tree?"

Baby Beaver: "I'm 2 away from one tree, and 4 for the other one."

Question / Challenge

How many blocks are possible locations of the stray baby beaver?

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

T23. Railroad

8 trains (named a through h) enter the switch X1 from the left on the figure below. Train *a* needs to go to station A, train *b* to station B, train *c* to station C, etc. Each of the switches X1 to X7 are initially set to directing trains to the left. After a train has passed a switch, the switch reverts to the other direction.

Time Allowed: **150 minutes**

Railroad director needs to order the trains so that they end up in the correct stations.
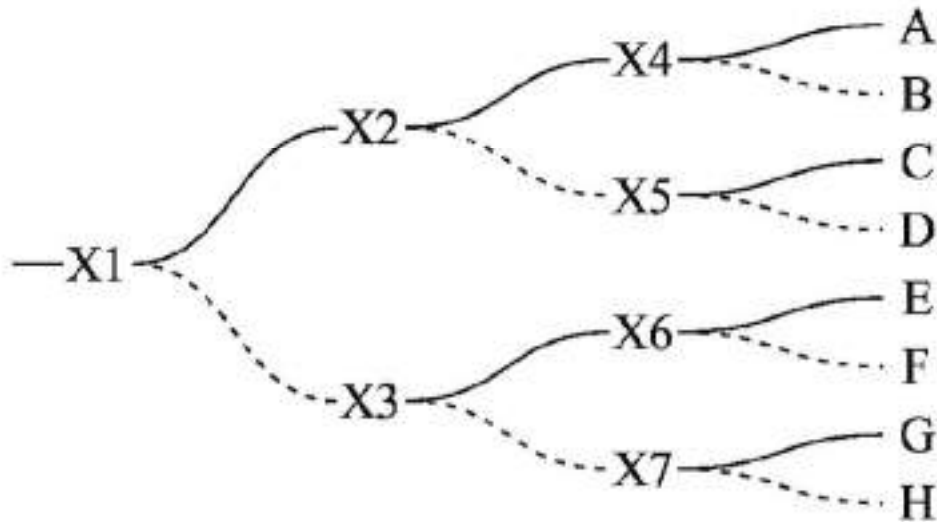
Question / Challenge

What is the correct order for the trains to pass through switch X1?

A)	B)	C)	D)
a	a	a	a
e	d	g	c
c	c	c	e
g	g	d	d
b	b	b	f
f	f	f	g
d	e	e	h
h	h	h	b

T24. Naughtingham School

The Naughtingham school has one corridor with five doors. The pupils are misbehaving, terribly: when a pupil enters the corridor, s/he passes by the classrooms, slamming theirs open doors shut, until s/he encounters the first closed door. S/he opens this door, enters that classroom and leaves the door open.

If all doors are opened in the corridor when a pupil arrives, then the pupil congratulates themselves (after slamming all the doors) and skips school for the day.

Question / Challenge

We all know that this is absolutely not the way to behave in the school. But in the hypothetical case that you wanted to skip school for the day: if all doors are closed in the beginning and pupils are entering one by one, which position in the row would you want to be?

A) 8   **B)** 32   **C)** 16   **D)** 64

T25. Super Hero

A super hero watches over Beaver City from a straight path across a river. From every point along the path, the super hero needs to be able to see the point in the city directly across the river. Unfortunately, 16 walls of varying lengths stand between the river and the city.

Fortunately, the super hero has X-ray vision and can see through a wall. Unfortunately, the super hero can only see through one wall at a time. Fortunately, the super hero is strong enough to destroy walls. Unfortunately, destroying a wall makes the super hero very tired.

Question/Challenge

What is the fewest number of walls that the super hero needs to destroy?

A) 9   **B)** 10   **C)** 11   **D)** 12

T26. Shaker Machines

In computer science class, students are writing a small function to handle a list of numbers. A list of numbers holds five numbers, in a certain order. Such a list of numbers is written down as [a, b, c, d, e]. Each function will be called with a

list of numbers and outputs a list of the same five numbers, but possibly in a different order.

Anna writes a function `anna([a, b, c, d, e])` that returns `[e, b, c, d, a]`.
Bob writes a function `bob([a, b, c, d, e])` that returns `[e, d, c, b, a]`.

The teacher checks and finds their functions work as expected.

She now writes a new function `shaker([a, b, c, d, e])` that returns `anna(bob(anna([a, b, c, d, e])))`.

She shows the class how to apply this function shaker:

```
anna(bob(anna([a, b, c, d, e])))    First apply the inner function
anna(bob([e, b, c, d, a]))          Then apply the now inner function
anna([a, d, c, b, e])               Now apply the function anna
[e, d, c, b, a]
```

Question / Challenge

Now the teacher creates another function to test her class.

She defines `test([a, b, c, d, e])` returns `bob(shaker(anna([a,b,c,d,e])))`
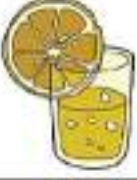
What list of numbers will this function return?

A) [a, b, c, d, e]   B) [e, b, c, d, a]
C) [e, d, c, b, a]   D) [a, d, c, b, e]

T27. Soda Shoppe

Four friends are on a road trip and decide to stop to get a drink at a nearby soda shoppe. Each of the four has a preference for which beverage they want as denoted in the table below. The soda shoppe offers four beverages, however they are running out of stock and only have one of each drink.

The drink each person prefers most is listed below with a number of hearts in the column heading to show how much they like the drink.

Time Allowed: **150 minutes**

	♥♥♥♥	♥♥♥	♥♥	♥
Anna	soda can	lemon juice	coffee	milk bottle
Bernard	soda can	coffee	lemon juice	milk bottle
Christine	soda can	coffee	lemon juice	milk bottle
Daniel	milk bottle	soda can	coffee	lemon juice

For example, Anna prefers the [soda can] with happiness [♥♥♥♥], [lemon juice] with happiness [♥♥♥] and so on.

Question / Challenge

What is the maximum total number of hearts the group can get?

A) 4   B) 10   C) 14   D) 16

Time Allowed: **150 minutes**

T28. A Bug

A young beaver found an interesting spinning game wheel and decided to play with it. He noticed that the wheel is programmed to spin according to an algorithm containing the following steps:

1st step – skip one box,
2nd step – skip two boxes,
3rd step – skip three boxes etc.
The beaver is trying to make up a word which starts with the letter "P".

Question / Challenge

The beaver read the resulting word and found a mistake. In which step did the mistake happen?

A) 3   B) 6   C) 7   D) 9

T29. Computing center

In the Bebras computing center, there are 5 available computers that are stacked together as in the image. The Bebras organization wants to choose some of the computers to be actively running, however they can't choose 2 computers that stand next to each other, otherwise they will overheat and break down. So, for example, they can choose computer 1 and 3, but not 1 and 2. The organization wants to know how many different ways are there to choose any set of computers (including the empty set) so that no two computers stand next to each other.

If there were only two computers, then only 3 possible sets exist, one formed by computer 1, another formed by computer 2 and another with no computers. If there were only three computers, then 5 possible sets exist: 3 sets formed by a single computer, one set formed by computers 1 and 3, and one set with no computers.
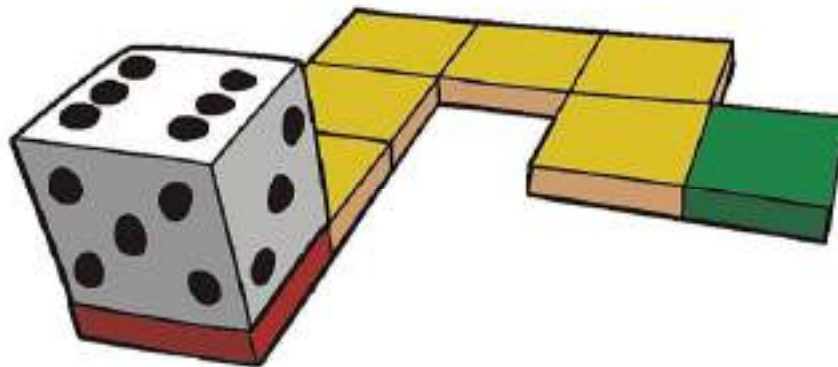
Question / Challenge

How many different sets can be formed from the 5 computers?

A) 5   B) 8   C) 11   D) 13

T30. Moving Die

Beaver Jack moves a die along the path of squares. To move the die from one square to the next, Jack rotates the die over the edge that lies between both squares. He does it 7 times until the die lands on the green square on the right.

Note that the total number of dots on opposite faces of a die is always 7 (1 dot opposite to 6, 2 opposite to 5 and 3 opposite to 4). Initially the face with 1 dot (opposite to the one with 6) is at the bottom, as in the figure. After rotating the die once onto the second square, the face with 2 dots (opposite to 5) will be at the bottom.

Question / Challenge

What will be the number of dots at the bottom when the die has reached the green square?

A) 2 dots   B) 4 dots   C) 5 dots   D) 6 dots

Well done!