Time Allowed: 120 minutes

Tasks T1 – T7 carry 3 points each

T1. Longest Sequence

Here is a sequence of length 16 made using three different shapes:

You may change the shape of exactly three items in the sequence.

Question / Challenge

What is the [length of the] longest unbroken chain of identical shapes possible?

A) 6   B) 7   C) 8   D) 9

T2. Lemonade

Anand and his sister Sarada run weekend lemonade stands in the front and back yards of their home. Anand sells lemonade in 150ml glasses whereas Sarada sells lemonade in 200ml glasses. Whenever they get an order, they run into the house to collect the lemonade required for the order, from a 2L jug kept in the fridge. To help out the children, their mother fills the jug to the brim at the end of every hour. That is, the jug has 2L lemonade in it at 10 AM, 11 AM, 12 PM, and so on.

If one of the siblings is already at the fridge, the other has to wait for their turn. However, if both of them get the orders at the same time, Anand lets his sister collect the lemonade first. Further, if the jug is empty, they have to wait for their mother to come and fill the jug at the end of the hour.

Irrespective of the number of glasses, it takes them exactly 1 minute to collect the lemonade. For example, Anand receives his first order of 3 glasses at 10:05 AM. So he collects 450 ml from the jug by 10:06 AM.

The following are the orders and the times of the orders Anand and Sarada received

Time	Anand's orders	Sarada's orders
10:05 AM	3 glasses	
10:20 AM	5 glasses	
10:53 AM		2 glasses
10.56 AM	2 glasses	5 glasses
11:07 AM	1 glass	4 glasses

Question / Challenge

How much water (in ml) is left in the jug at 11:01 AM?

A) 1200   B) 1400   C) 1450   D) 1510

T3. Secret message

Beavers Ben and Tom exchange messages consisting of 12 digits 0 and 1. Because Beaver Bonnie understands their messages they decided to encode them. In the first encoding step they replace a pair of consecutive digits by a character A, B, C or D:

00	01	10	11
A	B	C	D

In the second step they replace a pair of consecutive characters using the system below:

AA	AB	AC	AD	BA	BB	BC	BD	CA	CB	CC	CD	DA	DB	DC	DD
0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

yielding the final encoded message.

Question / Challenge

If the final message is C13, what was the initial message in digits 0 and 1?

A) 110000010011

B) 101010101111

C) 101010111011

D) 101011001001

T4. Upcycling

Beavers hate waste. They like to use old worn out things as materials to make new useful items. This is called upcycling. It is shown below what materials are required to make a wheel, a bicycle, a barrow, and a tricycle.

Doreen loves upcycling and likes to sell the items she is making. They can be sold at the market for these prices:

Wheel: £1

Bicycle: £10

Barrow: £5

Tricycle: £15

Question / Challenge

Doreen has these materials: 6 tyres, 6 iron bars and 2 wood pieces. What is the most money she can make by upcycling when she sells the items she makes?

A) 15   **B)** 20   **C)** 26   **D)** 30

T5. Still life

A painter has chosen one piece of fruit to paint from the fruits below.
You are trying to figure out which piece of fruit the painter chose by asking him yes or no questions.
You want to find out which fruit the painter picked in as few questions as possible.
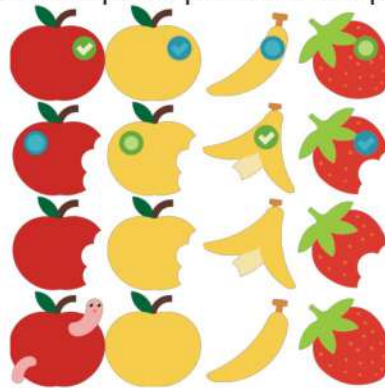
Question / Challenge

Which of the following questions is the most useful to start with?

A) is the fruit yellow?   **B)** is the fruit a banana?
C) does the fruit have a bite taken out?   **D)** is there a worm in the fruit?

T6. Species

A Venn-diagram is a diagram where you can show an overlap between different groups of objects. For instance, if you look at different species living on the planet Earth you will see that some of them can swim, some breathe air while some have legs. Also, some of them can swim and at the same time breathe air, or some of them can breathe air and have legs.
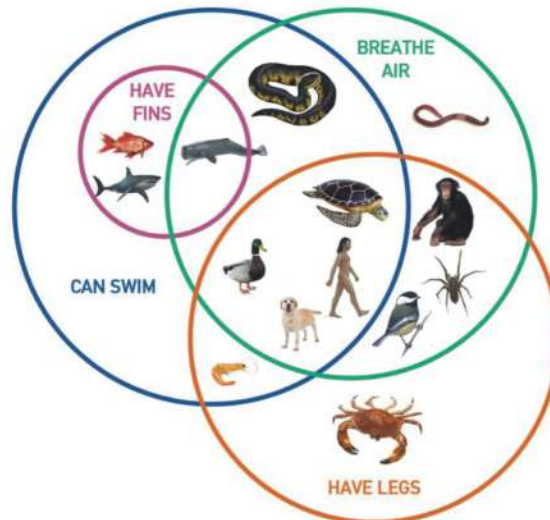
Question / Challenge

How many species can swim and breathe air according to the diagram?

A) 4 **B)** 6 **C)** 10 **D)** 14

T7. Mastermind

George is playing Mastermind on his computer: The computer makes up a password from 4 distinct digits. The player can submit several guesses of this password. Each time the computer responds with the number of *correct* digits, which appear both in the guess and in the password. Also it tells whether George placed these digits in the right positions.
George made some guesses (?). From the responses, he was able to discover the password.

?	?	?	?	Response
5	7	2	0	One of the digits is correct and in the proper position.
6	0	3	1	One of the digits is correct but not in the proper position.
1	4	8	5	Two digits are correct but they are not in the proper positions.
1	5	9	6	None of the digits is correct.
8	1	2	5	One of the digits is correct but not in the proper position.

Question / Challenge

What is the password?

A) 3641 **B)** 5632 **C)** 3748 **D)** 7624

Tasks T8 – T14 carry 4 points each

T8. Beavers market

Joe the beaver is in the Beavers market. He finds a seller with the following fruits:

$1.00 $0.70 $1.50 $1.00 $1.50

He wants to sort the fruits by price in ascending order by using a method that only implies counting and adding.

For counting he uses stones that he puts in jars. He noticed that the fruits have only three unique prices, so he needs three jars labeled with $0.70, $1.00 and $1.50 exactly in this order.

He puts one stone in the $0.70 jar, because only the orange costs $0.70. Then in the $1.00 jar he puts three stones, because there are two fruits that cost $1.00 each: the pear and the apple, and he also adds to the counting the number of stones in the previous jar: one, for the orange that costs $0.70.

In the $1.50 jar he puts five stones, because there are two fruits that cost $1.50 each: the bananas and the grapes, and he also adds to the counting the number of stones in the previous jar, three.


$0.70 $1.00 $1.50

Now Joe starts sorting the five fruits by price in five boxes. The first fruit is the pear, that costs $1.00. He checks the $1.00 jar and he finds that it has three stones in it. So he puts the pear in the third box and removes a stone from the $1.00 jar.

The jars are now the following:

$0.70 $1.00 $1.50
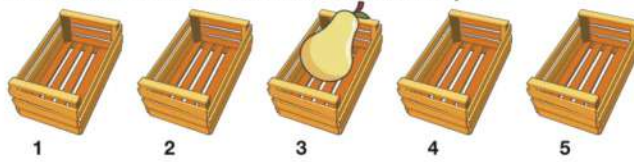
He applies the same steps on the orange, that costs $0.70. He sees in the $0.70 jar there is only one stone, so he puts the orange in the first box and removes the stone from the jar.
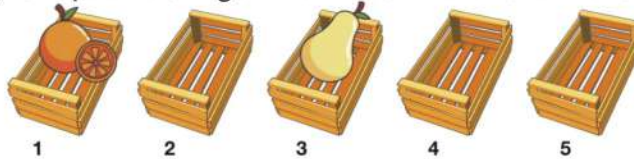
So the jars are now the following:

$0.70 $1.00 $1.50

Question / Challenge

Which is the content of the jars after all the fruits are sorted?

A) $0.70 $1.00 $1.50

B) $0.70 $1.00 $1.50

C) $0.70 $1.00 $1.50

D) $0.70 $1.00 $1.50
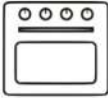
T9. Brownies Cake

Beaver Kay and Anny are planning to make *brownies*. To make brownies, they need the following ingredients: flour, sugar, cocoa powder, egg, and butter. They decide to share the work.

For example: When one of them is measuring and melting butter, the other will measure the other ingredients at the same time. By doing so, they can save time.

The order and time needed for processing each activity is shown below:

1. Measure butter (5 minutes) :

2. Melt butter (4 minutes):

3. Measure other ingredients (12 minutes):

4. Prepare baking pan (7 minutes):

5. Mix all ingredients, and pour the batter into the pan (10 minutes):

6. Bake the batter in the oven (30 minutes):

Question / Challenge

Which of the following order of process will take the shortest time to complete the task?
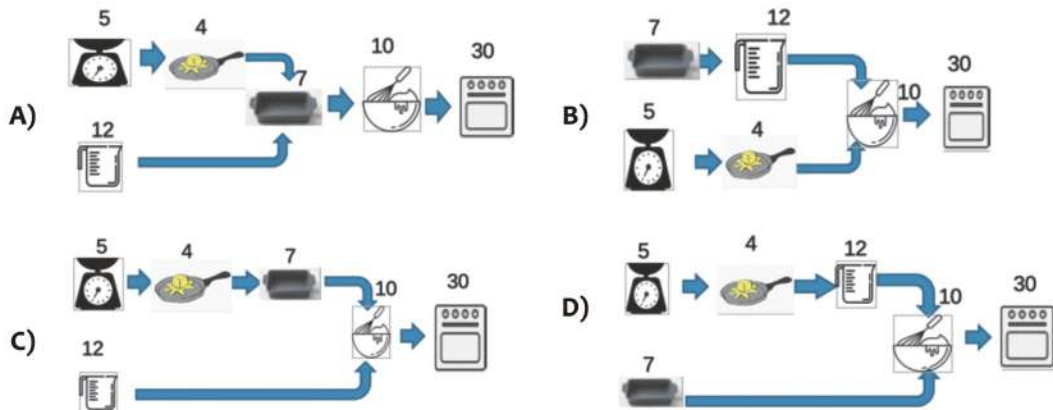
T10. Bench Workshop

Beaver Albert makes benches. Each bench must have four legs of equal length which we consider as "bench length". Since customer preferences can vary, each bench can have different "bench length".

Since Albert is looking for material for bench legs in the woods, he does not always manage to find the enough legs of the same length. However, Albert can shorten each leg to any length he wants (when shortening the leg, the remainder cannot be used).

Albert currently has the following 32 legs in stock:

Length	10	9	8	7	6	5	4	3	2
Count	3	6	3	3	5	3	3	2	4

Question / Challenge

Shortening the legs is a very hard process and needs too much effort. So, Albert wants your help to know: What is the minimum number of legs he needs to shorten in order to make eight(8) benches?

A) 2   **B)** 4   **C)** 6   **D)** 12

T11. Shop Counters

A shop has four billing counters numbered 1, 2, 3, 4. Each counter can have a queue of at most 4 customers, including the customer being served. Each counter can serve one customer at a time. It takes 2 minutes to serve a customer. Initially, only counter 1 is open.
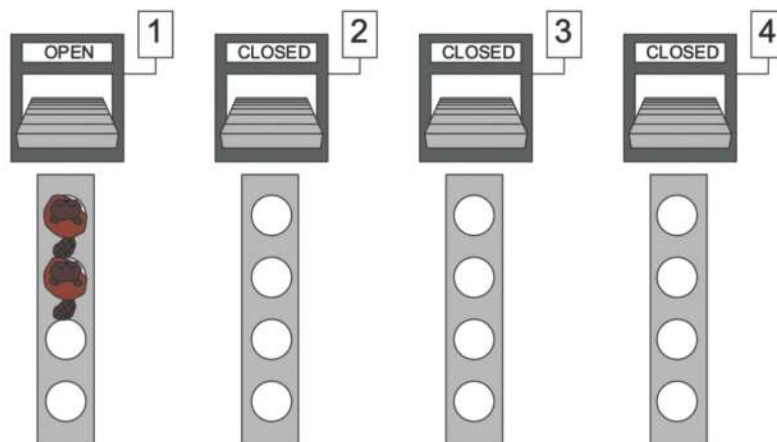
When a customer wants to pay the bill, he joins the end of the queue at the first counter where the queue is not full. He first tries counter 1, then counter 2, etc.

If there is no space available in any of the counters currently open, a new counter opens and the customer joins the queue there. However, it takes 1 minute to set up a counter, so it takes 3 minutes to serve the first customer at a newly opened counter. Each following customer will be served in 2 minutes as usual.

At a given time, if there are customers who leave their queue after being served and new customers who want to join a queue, you can assume that the served customers leave first and create an empty space in their queues where new customers can join.
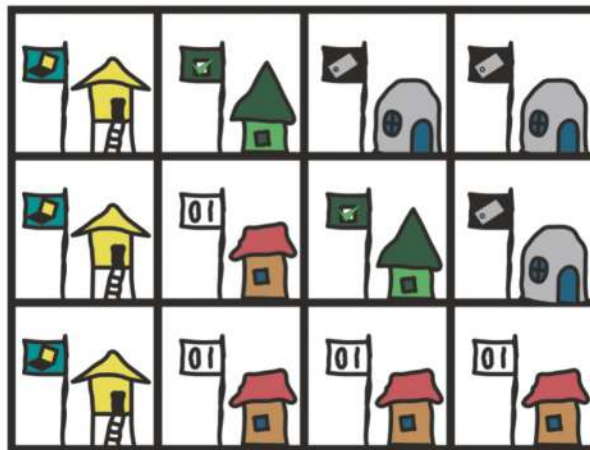
Question / Challenge

12 customers arrive at the counters, two at a time each minute (two customers arrive initially, another two after 1 minute etc.). How long does it take to serve them all?

A) 12 minutes   **B)** 11 minutes   **C)** 13 minutes   **D)** 8 minutes

T12. Great Wall of Beavaria

In the far land of Beavaria, there lived four tribes consisting of several villages, as shown in the picture: Binarians, Smatphonians, Checkboxians and Laptoppi. One day, they all decided to unify. However, in order not to cause chaos in the land of Beavaria, it was decided that only two tribes can be unifying at the same time. The time needed to unify two tribes in months is equal to the number of villages in these two tribes. After this, the two tribes become one single tribe, and the unification process is repeated until there is only one unified tribe remaining.


Question / Challenge

What is the minimal amount of months needed for the tribes to unify?

A) 23   **B)** 24   **C)** 25   **D)** 26

Time Allowed: 120 minutes

T13. #Book

Tim accompanies his older sister Sue to the Bebras Public Library. The library only has one huge shelf. They want to borrow the book "Constructing Dams for Beginners".

When they arrived Sue goes straight to the bookshelf and pulls out the correct book. *"How did you know where the book was"*, Tim asked surprised. Sue smiled and showed him two pieces of paper:
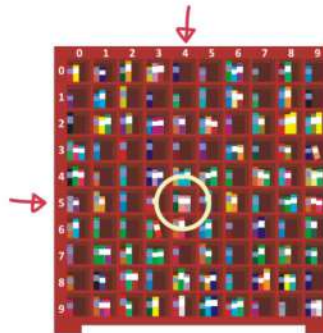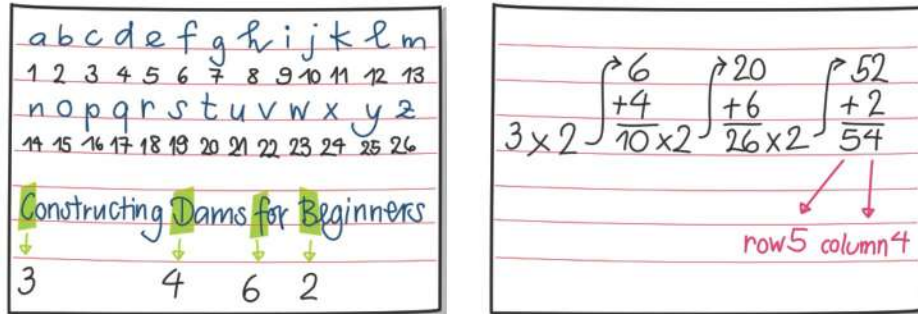
"I took the first letters of each word in the title and converted them into a number using the table. Then I multiplied the number of the first letter by 2 and added the number of the second letter. I then multiplied the result by 2 and added the number of the third letter. Finally I multiplied that result by 2 once more and added the number of the last letter. I looked in the row of the second-to-last digit and in the column of the last digit for the book. It was very easy to find the correct book from the three books that are there," explained Sue. *"But what about numbers greater than 99,"* asked Tim. Sue replied: *"I just ignore all digits except for the last two."*

Question / Challenge

In which bay can you find the book "How to Avoid Falling Trees"?

A) [row 0, column 0]

B) [row 1, column 3]

C) [row 1, column 9]

D) [row 2, column 4]

T14. Ada's Marble Machine

Ada the engineer is working with a set of marbles that have 4 properties but only certain combinations are permitted:


Size	Colour	Material	Design	Possible?
Small	Red	Stone	Glitter	No
Small	Red	Stone	Mosaic	No
Small	Red	Metal	Glitter	Yes
Small	Red	Metal	Mosaic	No
Small	Yellow	Stone	Glitter	Yes
Small	Yellow	Stone	Mosaic	Yes
Small	Yellow	Metal	Glitter	Yes
Small	Yellow	Metal	Mosaic	Yes
Large	Red	Stone	Glitter	No
Large	Red	Stone	Mosaic	No
Large	Red	Metal	Glitter	No
Large	Red	Metal	Mosaic	No
Large	Yellow	Stone	Glitter	No
Large	Yellow	Stone	Mosaic	Yes
Large	Yellow	Metal	Glitter	No
Large	Yellow	Metal	Mosaic	No

Ada also provides a flowchart, that can check whether the given marble belongs to the set. Ada didn't succeed the first time when she was preparing the flowchart.

Question / Challenge

Which of the following four flow charts correctly checks if a given marble belongs to the set described by the table?
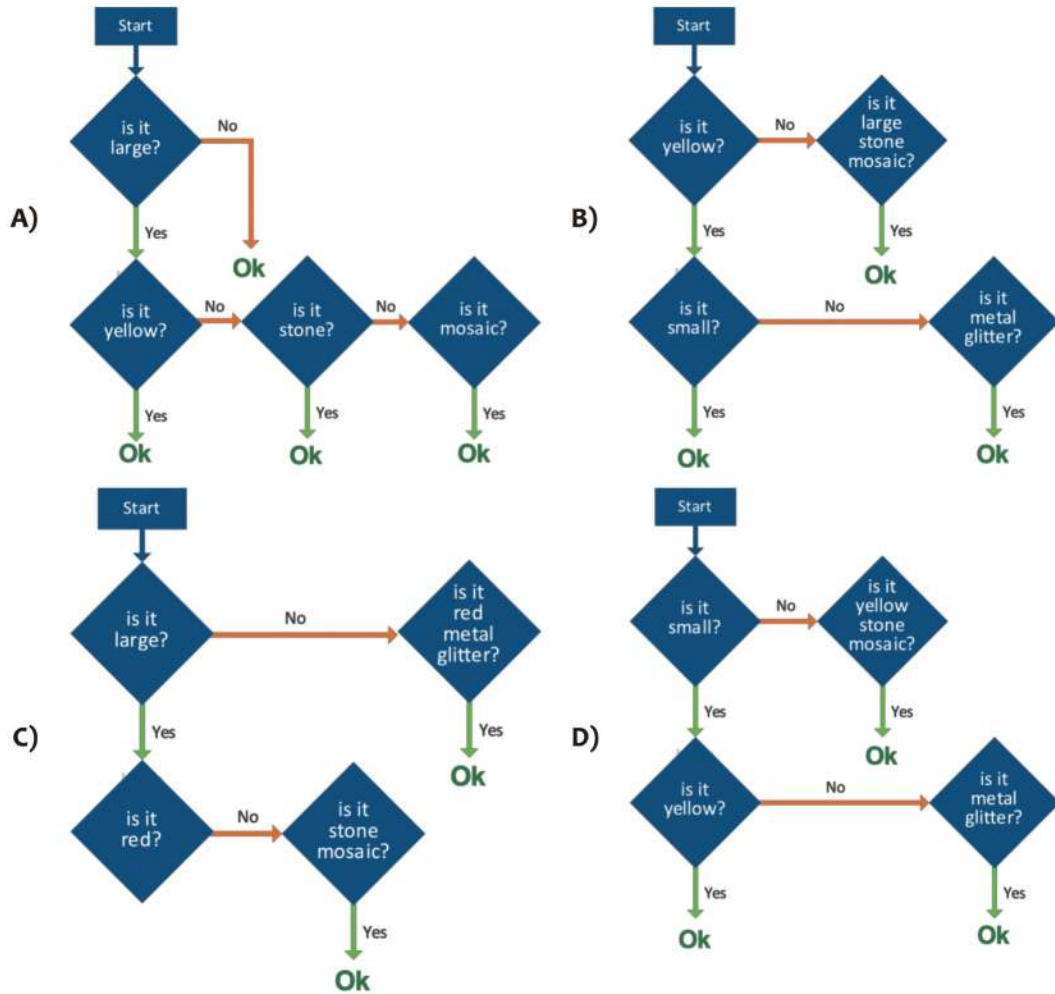
Tasks T15 – T21 carry 5 points each

T15. Snow White

Snow White and the seven dwarfs live in a house together. For easy reference, we address the dwarfs by numbers as shown in the picture below.

The seven dwarfs just had a quarrel. After that, 12 is friend with 1 and 2, 13 with 1 and 3, 23 with 2 and 3, and 123 is friend with all.

Trying to entertain the dwarfs, Snow white has proposed a game where she calls a number command and the dwarfs have to go in or out of the house based on the following rules:

- Calling "2" makes 2 and his friends (namely 12, 23, and 123) go into the house.
- Calling "3" makes 3 and his friends (namely 13, 23, and 123) go into the house.
- Calling "4" makes 1 and his friends change their individual positions.
- Calling "5" makes 2 and his friends change their individual positions.
- Calling "6" makes 3 and his friends change their individual positions.

For example, suppose 1, 2 and 12 are in the house while 3, 13, 23 and 123 are outside. If Snow White calls "5", then 2 and 12 go outside, while 23 and 123 go into the house, and the rest of the dwarfs stay where they are.

Question / Challenge

All the seven dwarfs are now in the house, but Snow White would like to stay alone with the Prince. What is the *shortest sequence* of number commands where she can send all the dwarfs outside? Example: 6512 for the sequence 6, 5, 1, 2.

A) 5423   **B)** 36452   **C)** 42536   **D)** 62435

T16. Save the trees!

On Planet Bebras there are many beautiful trees but no places for spaceships to land. A developer wants to cut down trees in order to build spaceship landing zones. A ranger wants to save the trees. They come to the following agreement:

- The ranger is allowed to mark three trees, which cannot be cut down, and
- A tree can only be cut down if needed to build a landing zone. That is, a tree cannot be cut down for no reason.

The trees are arranged in a 5-by-5 grid. Spaceships are rather large and they require the space occupied by two adjacent trees in order to land. The trees can be horizontally or vertically adjacent, but not diagonally.
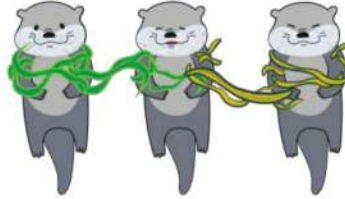
 and
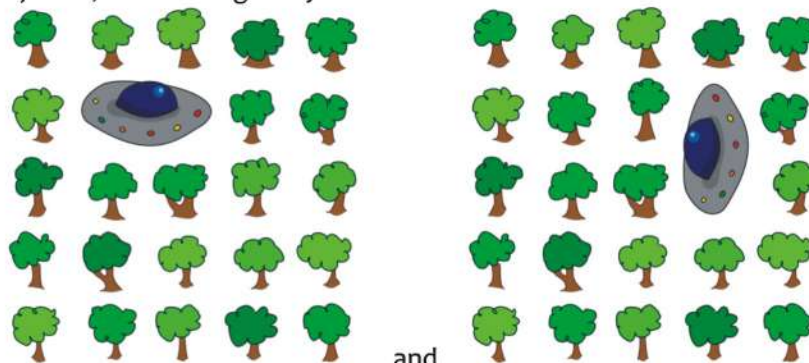
illustrate the two valid ways a spaceship could land.

Question / Challenge

Assuming the ranger marks three trees wisely in order to save the most trees, and assuming the developer cuts down trees wisely in order to build the most landing zones, how many landing zones will be built?

A) 11   **B)** 10   **C)** 9   **D)** 8

T17. Napping Together

When two otters in OtterKingdom meet each other, they will wrap a seaweed around themselves so that they can stay with each other in a group during nap time. However, the kingdom is suffering from a seaweed shortage. There are 7 otters in OtterKingdom, and they can only get 6 seaweeds. Luckily, two otters don't have to be connected directly. They just have to carefully choose whether to wrap a seaweed around or not. The decision has to be made immediately when they meet each other or they will drift apart, and there is no turning back.

Otters meet each other in the following order:
A-C, B-C, D-E, E-F, A-G, F-G, A-B, F-A, D-A, E-A

Question / Challenge
Which pair of otters will not be directly connected by any seaweed?

A) E - F   B) A - G   C) F - G   D) A - B

T18. Compact Representation

Beaver Xavier wants to represent some letters with binary digits 1 and 0. He notices that letters T and E are more frequent. He thus decides to give them a shorter representation and thus code the letters T, E, A, K, C, and R as follows:

Letter	T	E	A	K	C	R
Code	1	00	0010	0110	1010	1110

Xavier sent this coded message to Yvonne:
1 0 0 1 0 0 1 1 0 0 0 1 0 1 0 0 0 1 0 1 1 1 0 0 0
Yvonne has already found that this messages ends with the letter E.

Question / Challenge
In letters, what is the complete message written by Xavier?

A) RACKET   B) TRACKER   C) CRATE   D) TAKECARE

T19. Audit committee

The Bebras city council members may be related to other council members as colleagues from work, family, from the same political party or business partners.

The city council has 11 members. Any two members that have a relationship are connected by a line as shown in the diagram.

The city council audit committee comprises members of the council that are not related to other members.
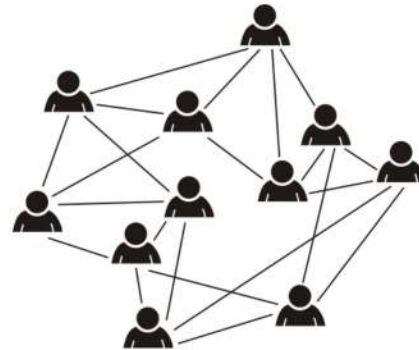
Question / Challenge

How many members can the audit committee have at most?

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

T20. Cupcakes

Bebras Bakery produces cupcakes for the hard-working hungry beavers in the town. Each cupcake is decorated with three sweet layers. Firstly, each cupcake gets an icing layer, then a toppings layer, and finally a fruit layer. The first example below has red icing, chocolate flakes topping, and a cherry fruit layer. The second example below has blue icing, toasted nuts topping, and a strawberry fruit layer.
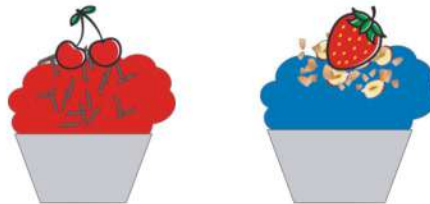
On the assembly line, each of the layers is changed from one cupcake to the next as follows:

- The icing layer changes with the following pattern:
  green ➜ white ➜ red ➜ blue ➜ [repeats again starting with green]
- The toppings layer changes with the following pattern:
  sprinkles ➜ chocolate flakes ➜ toasted nuts ➜ [repeats again starting with sprinkles]
- The fruit layer changes with the following pattern:
  cherry ➜ kiwi ➜ strawberry ➜ orange ➜ blueberry ➜ [repeats again starting with cherry]

Barry the Beaver plays a trick in the bakery. He changes the pattern of two of the layers:

- Barry changes the fruit pattern so that each time it skips the next two fruits in the pattern. For example, if an orange piece is placed on a cupcake the next cupcake would have a kiwi piece on top.
- Barry reverses the toppings pattern.

Question / Challenge

If the 1st cupcake has green icing, sprinkles, and a cherry on top, what will the 6th cupcake look like?
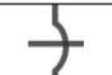
A)

Red, chocolate flakes, cherry

B)

White, toasted nuts, kiwi

C)

Blue, toasted nuts, strawberry

D)

White, chocolate flakes, cherry

T21. Ice cream machine

We have a special ice cream machine. It has two ingredients that we can put into the machine to give the ice cream flavor: Pistachio (green) and vanilla (yellow).

These ingredients flow through the tubes from left to right where the ice cream comes out.
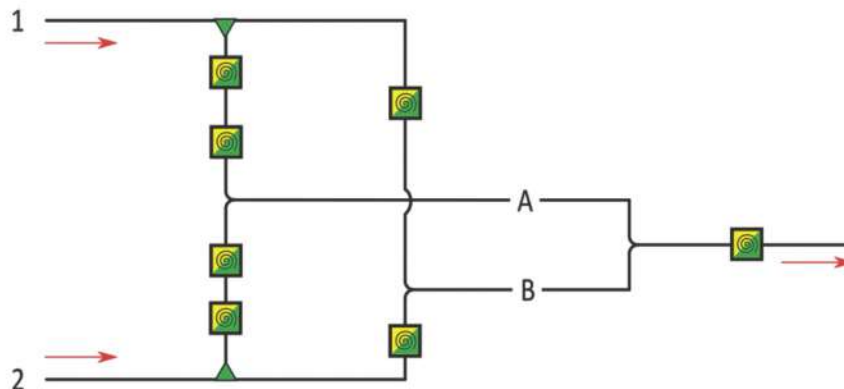
The machine is build up with the following devices:

	This device changes the flavor – vanilla to pistachio or pistachio to vanilla.
	If pistachio flavoring passes through this device, it will change its direction to the tube it is pointing at. Any other flavor than pistachio won't change direction.
	At this place, the tubes do not join but pass over each other.

Question / Challenge

Today, we can only pour one kind of ingredient into both inputs 1 and 2. Either we pour vanilla into both inputs, or pistachio into both inputs.

Where do we have to place another ![device] device to get <u>pistachio ice cream</u> as output no matter which flavoring we use as input?

A) A   **B)** B   **C)** A and B   **D)** Neither A or B