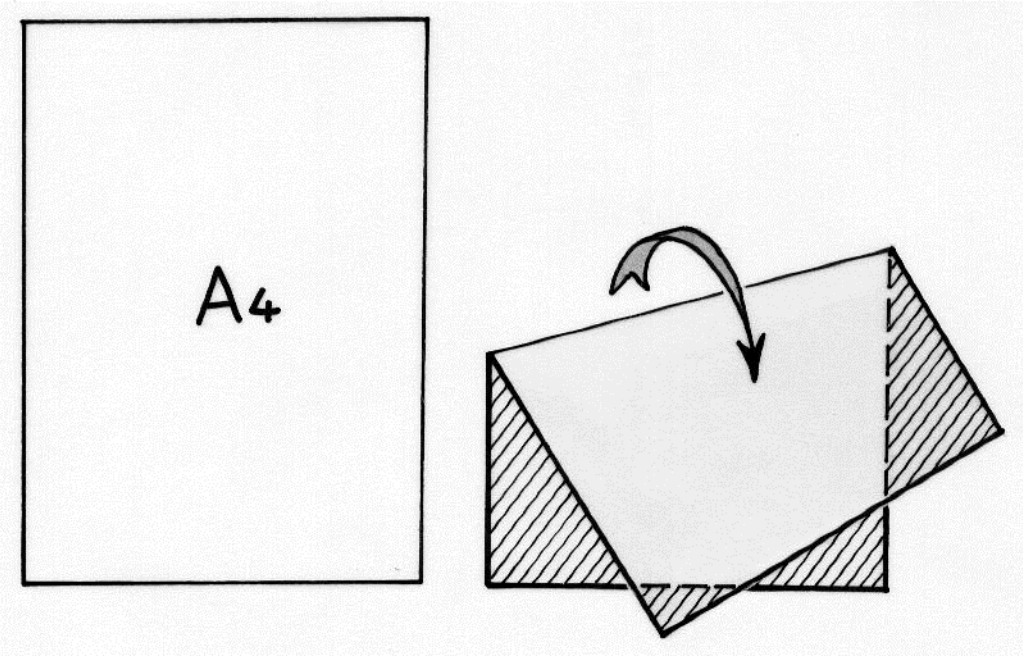
Question 2 Secret message 5 marks

During the maths class Eloi is writing her friend a note on an A4 sheet, 21 cm by 29.7 cm. Her teacher is about to catch her out. Eloi does not want the teacher to see what she has just written. She folds the paper quickly and says: “Wait a minute! Here’s a puzzle for the class! What is the sum of the perimeters of the four shaded triangles?”

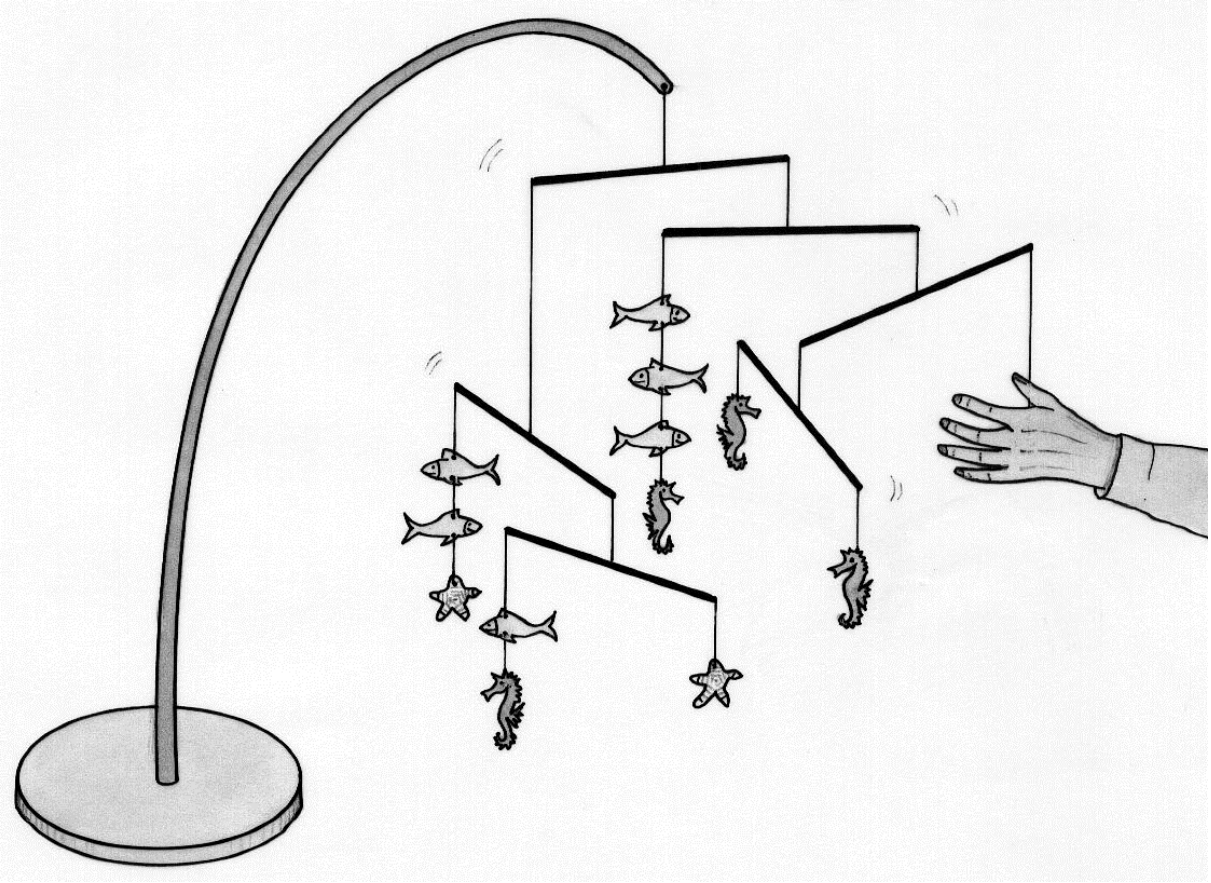
Solve the puzzle justifying your answer.



Question 3 Balanced diet 7 marks

Here is a mobile made up of three types of object : fish, sea-horse and star fish. The rods of the mobile are all the same length and weight. The rods are suspended at their mid-point by a thin wire whose weight is negligible. All the objects of the same type are identical and the rods are horizontal. The mobile is balanced.

What object is hidden behind the hand? Justify your answer.



Ex 4 – 5 pts

Question 4 Where has the time gone? 5 marks

The same film seen in a cinema or put out on the MsF-TV channel does not last the same length of time.

In the cinema the film runs at 24 images per second. On MsF-TV film would run at 25 images a second.

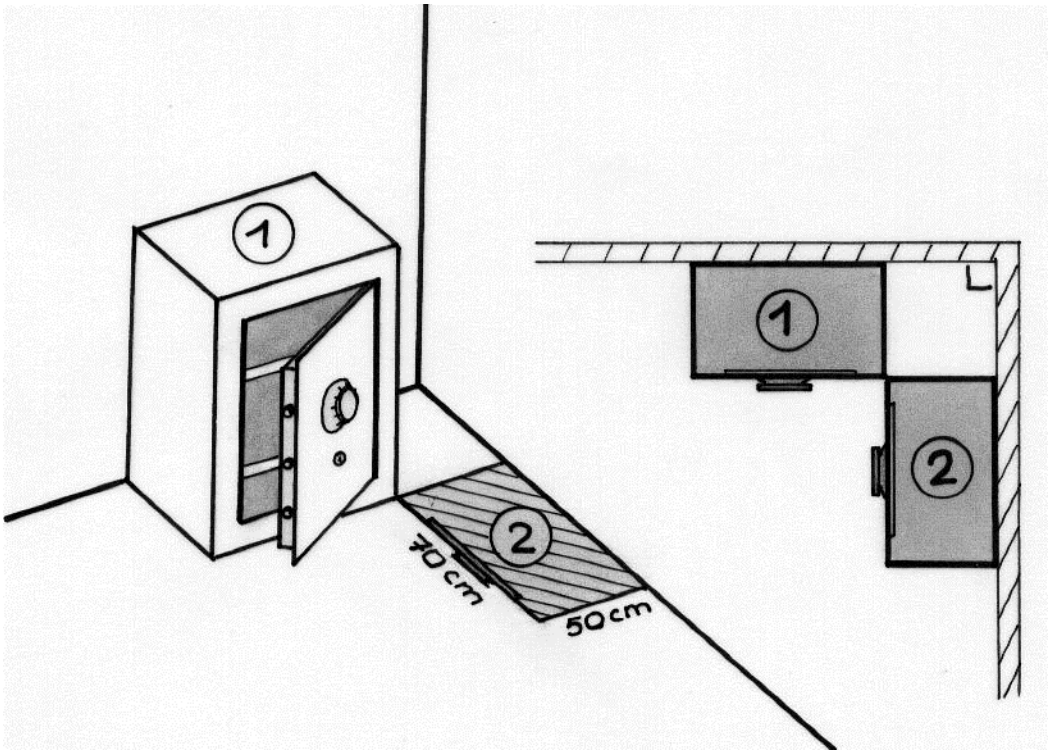
For the film classic, *Gone with the wind*, the difference in running time between the cinema version and the TV version is 9 minutes and 30 seconds.

What are the running times of the cinema and TV versions? Justify your answer.

Question 5 Heavy work 7 marks

In my office I have a safe which is 70 cm by 50 cm as shown.
The safe is in position ① as seen in the picture.
I want to move it to position ②. Obviously after it has been moved I still want to be able to open it!
It is so heavy that the only way to move it is to pivot it round one of its corners.

How can I change the safe's position using as few movements as possible ?
Show clearly the different positions of the safe on a diagram with scale 1/10.

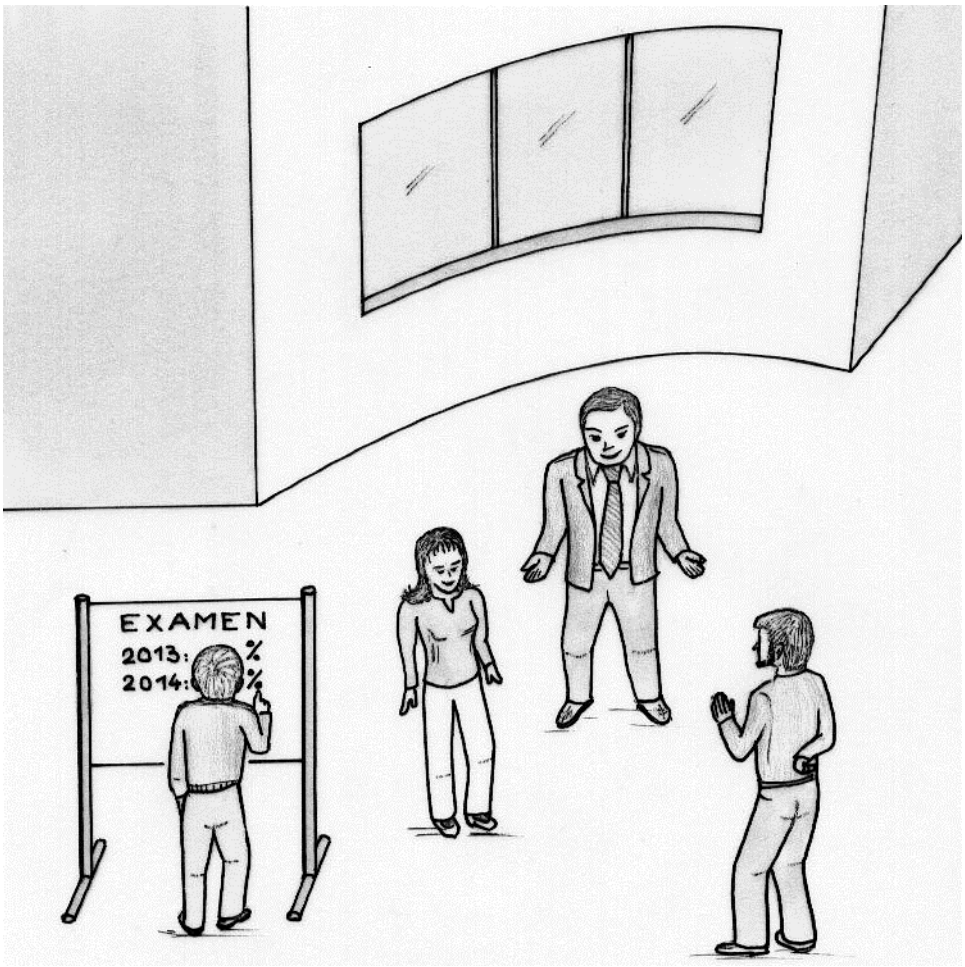


Question 6 Rates increase 5 marks

When the exam results are published the headteacher puts up a notice saying : “The pass rate for 2014 has gone up by 20% compared to 2013.”

When she reads this one girl does a subtraction in her head and says: “What puzzles me is the difference between the two pass rates in 12%!”
A maths teacher overhears her and says: “You are both right!”

Work out the pass rate in 2014.



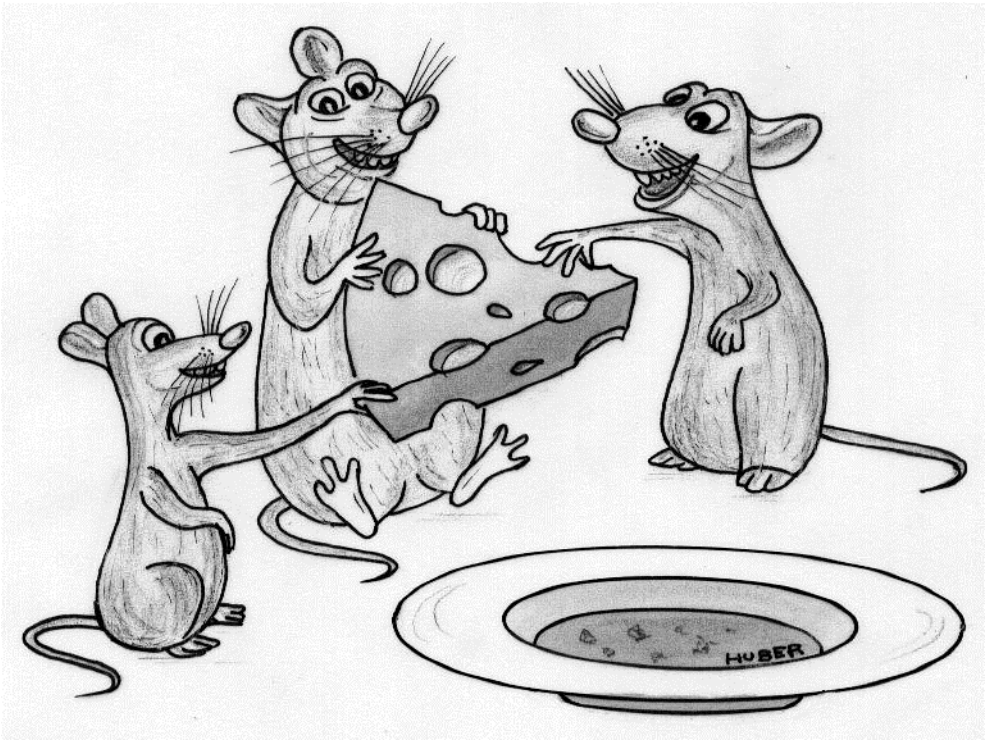
Question 7 *Cheesed off 7 marks*

On a shelf in the larder there are identical pieces of Gruyere cheese.
Three mice, one small, one medium-sized and one big, visit the larder regularly to eat the cheese.

- The small mouse eats a piece in 15 minutes.
- The medium-sized one takes 7 min 30 sec.
- The big mouse, the greedy one, eats a piece in 5 min.

Sadly, one day there is just one piece of cheese there, still identical to all the pieces before. The three mice rush all at once to eat the cheese. They all eat at their normal pace.

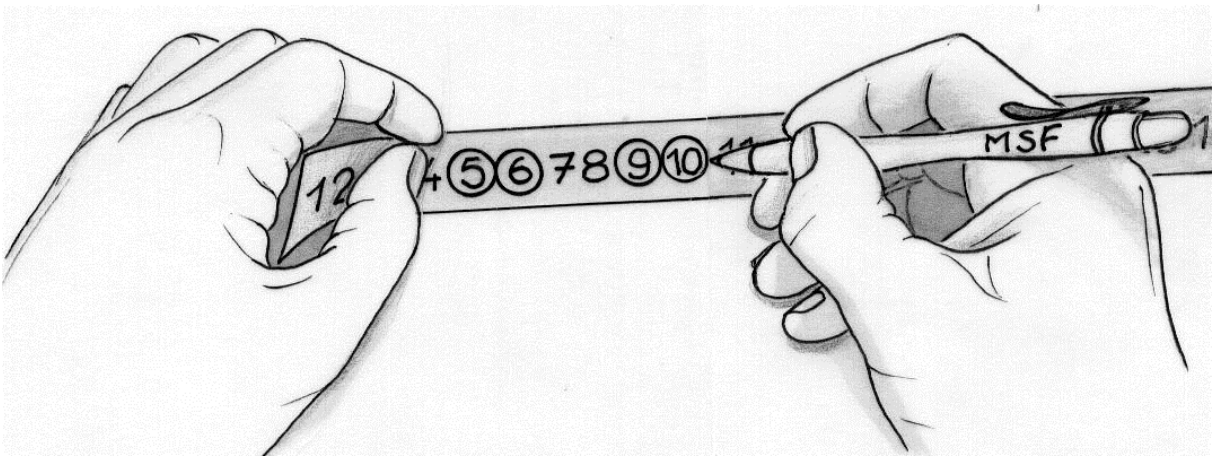
How long will the three mice need to eat this piece of Gruyere? Justify your answer.



Question 8 Circle game 5 marks

A mathematician writes out all the whole numbers between 1 and 2014. Then he goes through his list putting a circle round the multiples of 3 and the multiples of 5.

How many whole numbers in the list have not been circled? Justify your answer.

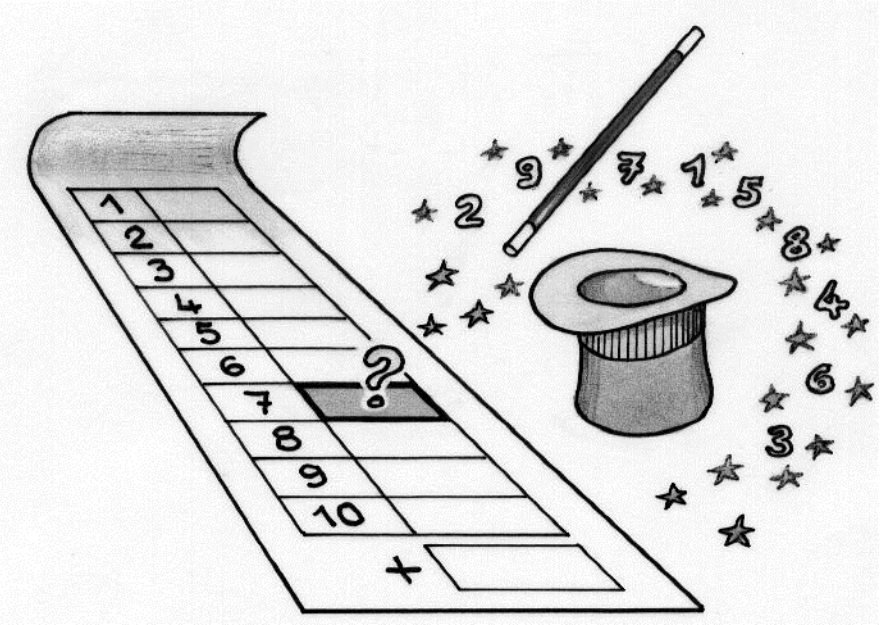


Question 9 Open the box *7 marks*

Paul found this trick in a book of magic :

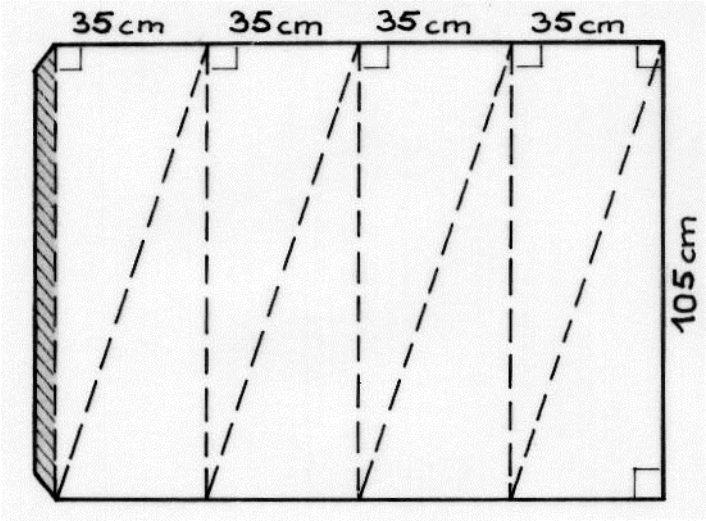
"Ask a member of your audience to fill in this grid. You are not to see it. The rules for filling it in are:
write two whole numbers of your own choice in the first two boxes;
then for the other eight boxes write in the sum of the two numbers above the box;
then add up the total of the ten boxes.
Ask your volunteer for the number in box number seven.
Astonish your audience when you quickly tell them the total of the ten numbers."

Find out how the trick is done and explain it fully.

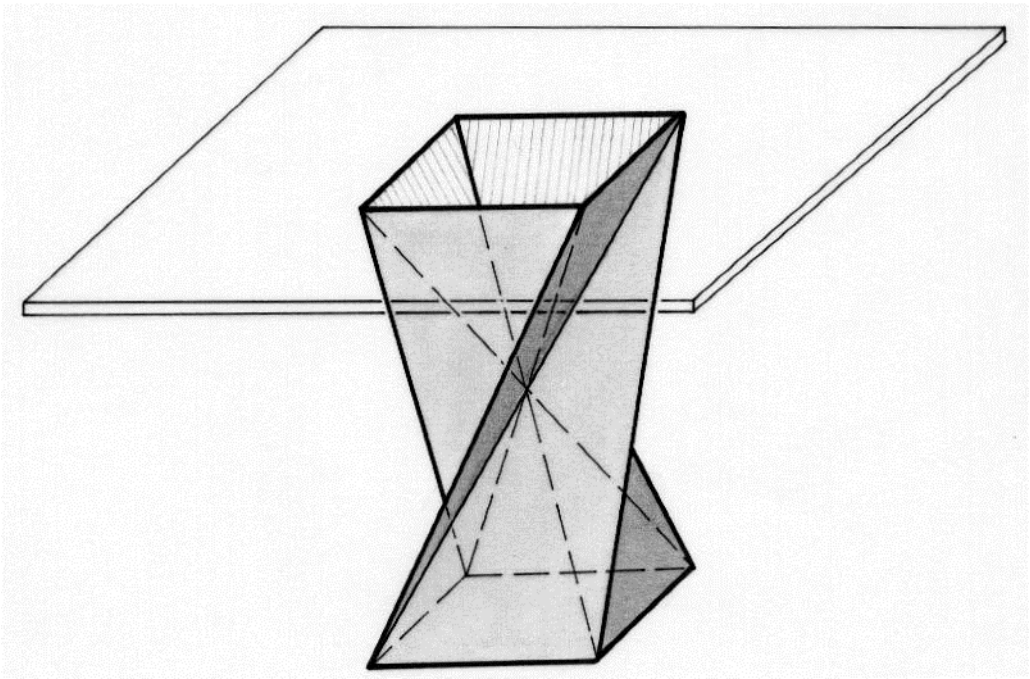


Question 10 Twist 10 marks

For receptions and banquets the city of Hagenau has ordered an interesting base for their tables. A model of the base can be made by folding along the dotted lines.



Draw the diagram above to a scale of 1/5.
Cut it out, fold it along the dotted lines and glue the shaded lip to make the model of the base.
Show your model to your teacher.

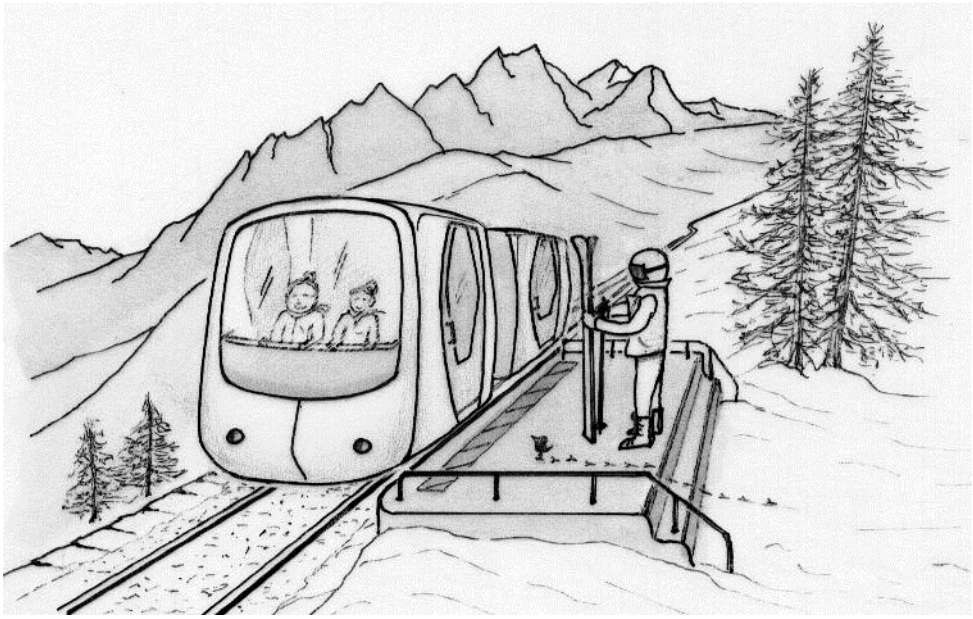


Caculate the height of the actual base.

Question 11 *In training* *5 marks*
Senior classes only

Five passengers are going up in the Mont Noir funicular railway. The funicular has two carriages. The five passengers do not know each other. Each one chooses a carriage entirely at random.
We are interested in three ways the passengers can be allocated: all the passengers are in one carriage and the other is empty; four passengers are in one and the other has just one passenger; and three passengers are in one and two in the other.

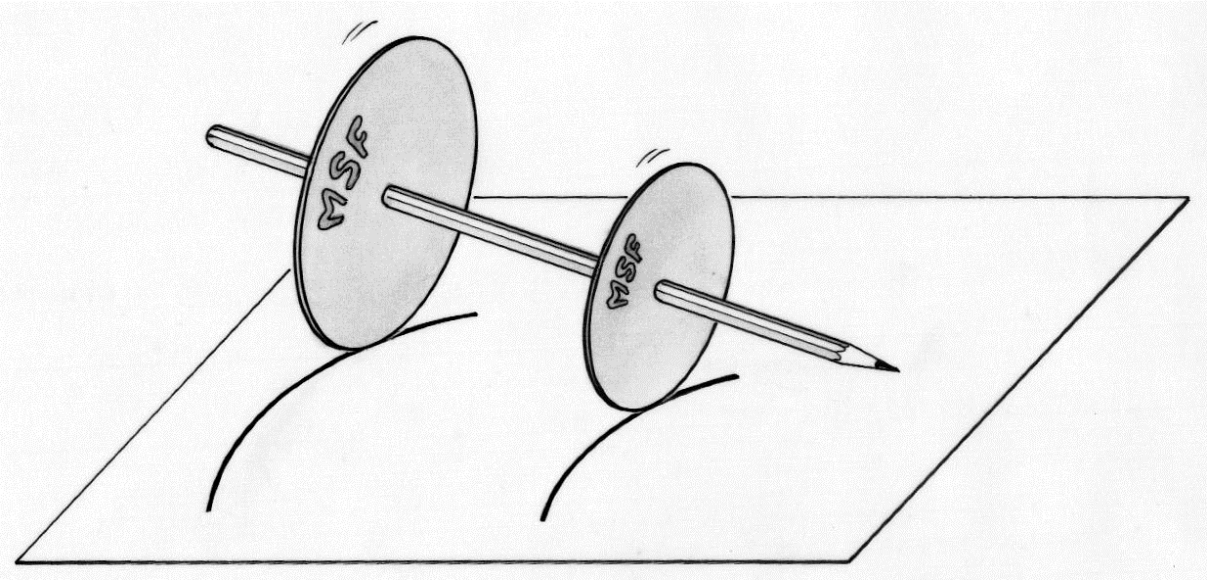
Work out the probability of each allocation and justify your answer.



Question 12 *Moving in th right circles 7 marks*
Senior classes only

Michel cuts two discs of radii 5 cm and 7 cm from a piece of cardboard. He makes a hole in the centre of each and puts a pencil through the holes as shown. The two discs are perpendicular to the pencil and they are 8 cm apart.
He notices that he can make the assembly roll on the table. The big disc and the small one trace out circles of different radii on the table.

Work out the radii of these two circles.

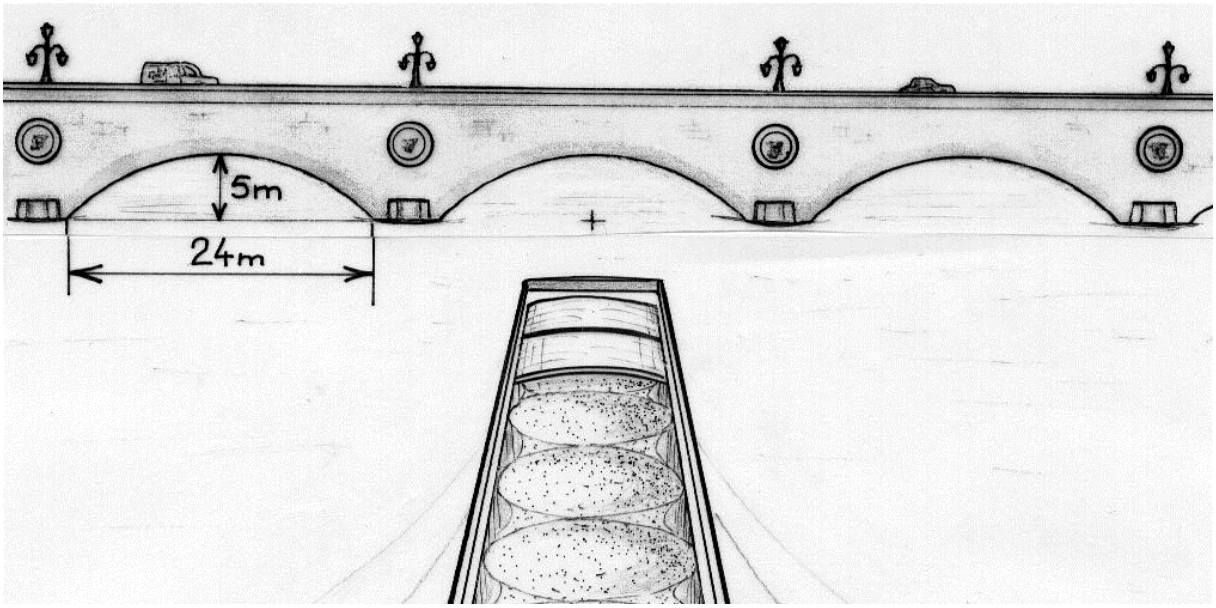


Question 13 A bridge too far? Senior classes only 10 marks

At the high point of a flood the water reaches the arch of a bridge. The arch is the arc of a circle. The maximum height from the water to the top of the arch is 5 metres. The distance between the two supports is 24 metres. The diagram below shows the situation.
The barge *Marie-Pierre* is approaching. The barge's profile above the water is a rectangle 4 metres high by 12 metres wide.

Work out the radius of the arch.

Can the barge get under the arch without any damage? Justify your response.



Note : It is normally forbidden to attempt to pass under a bridge in times of flood.