Front cover

Training test December 2002-11-06

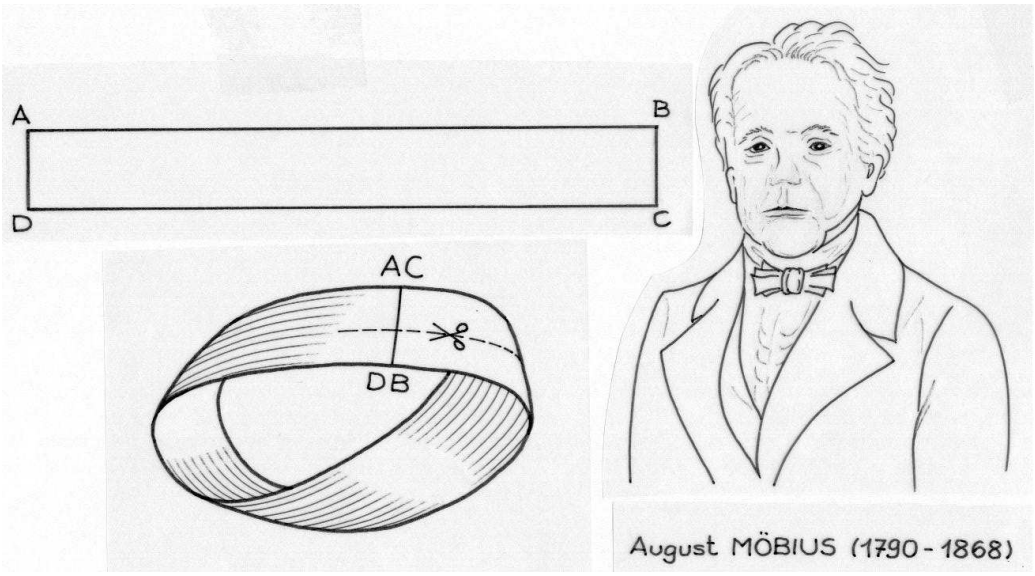
For questions 3,6,10,11,12 and 13 you need to explain or justify your answer.
Incomplete answers will still get some marks.
Careful work can gain marks.
Only one answer should be handed in for each question.

Question 1 Möbius strip 7 marks

Die Abbildung zeigt ein Möbiusband. Seine geometrischen Eigenschaften überraschen.

Um ein Möbiusband aus einem rechteckigen Papierstreifen ABCD herzustellen, musst du die Seite AD an die Seite BC kleben. Aber Achtung : A muss mit C und B mit D zusammenfallen.

Stelle ein solches Band her und male eine Seite farbig an. **Was hast du bemerkt ?**
Zeichne nun die Mittellinie des Bandes ein und schneide das Band entlang dieser Linie. **Was stellst du fest ?**



Il nastro di Möbius è rappresentato in figura : possiede delle proprietà geometriche sorprendenti.

Per costruire un nastro di questo tipo con una striscia di carta rettangolare ABCD, si deve raccordare il lato AD con il lato BC…ma attenzione perché A deve coincidere con C e B con D.

Costruite un tale nastro. Coloratene una faccia. ***Che cosa notate ?***
Tracciate la mediana del nastro. Tagliate il nastro secondo questa linea. ***Che cosa osservate ?***

El dibujo nos muestra la cinta de Möbius. Esta cinta tiene propiedades geométricas sorprendentes.

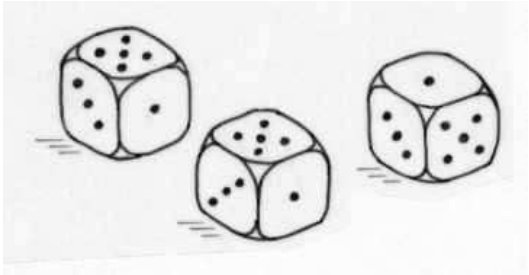
Para fabricar una cinta de Möbius con una tira de papel rectangular ABCD, hay que unir el lado AD con el lado BC… pero cuidado A debe coincidir con C y B con D.

Construya una cinta así. Coloree una cara. ***¿ Qué observas ?***

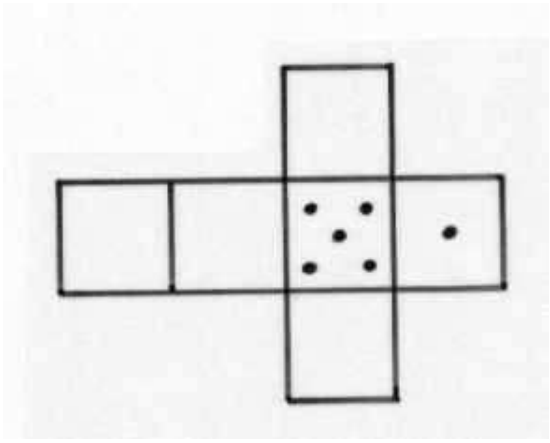
Trace la línea mediana de la cinta. Corte la cinta siguiendo esta línea. ***¿ Qué constatas ?***

Question 2 No mistake 5 marks

For a standard dice, the numbers on opposite faces always add up to 7. In spite of this rule, you can still get different examples of a dice, for example:



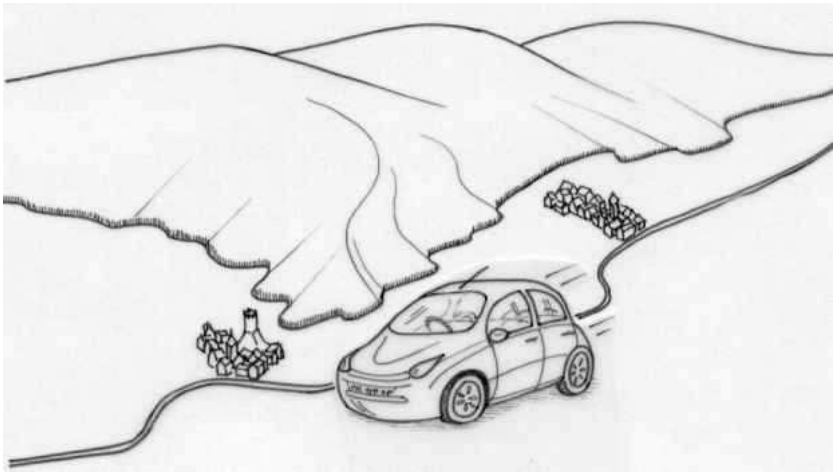
Draw the net for every possible different example of a standard dice using this grid as your starting point.



(Note: the singular of dice is die, so we should say " one die". Would you?)

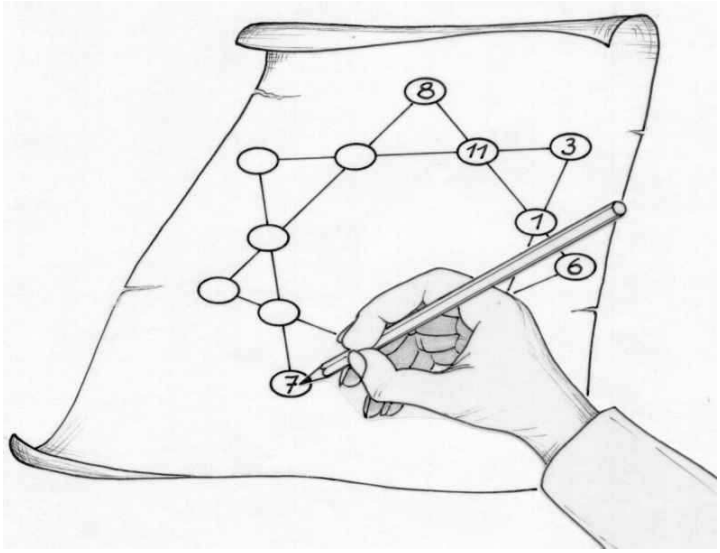
Question 3 Speed trap 7 marks

Four people enjoy driving. They drive the same journey of 24 km every day.
Sylvie who is very cautious drives very carefully. She always takes the same time for the journey. Christine does the journey 6 minutes faster. Michel drives too fast and takes 6 minutes less than Christine. Antoine is quite irresponsible and takes 6 minutes less than Michel.
In fact Antoine's speed is double Christine's speed.



Find the average speed of each driver.

Question 4 Magic Heptagon 5 marks



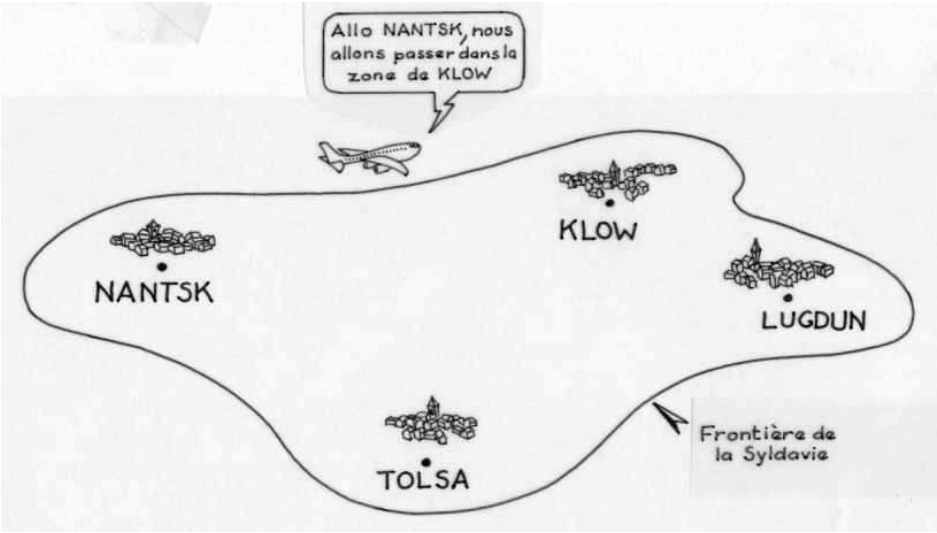
Maurice draws a magic star in which he is going to put the whole numbers 0 to 13. The sum of any four numbers in a line has to be the same.

Complete Maurice's star and draw it neatly on your answer paper.

Question 5 In control 7 marks

Towards the end of the 20th century, Syldavia needed 4 centres to control its airspace. They were based at Nansk, Klow, Lugdun and Tolsa.
To coordinate the work of the four centres the Syldavian authorities had a simple rule:

“ Every aircraft flying over the country must be controlled by the airspace control centre nearest to its position.”
Because of this rule Syldavia was divided into 4 control zones.



Show the positions of the four centres on your answer sheet using a scale 1 cm to 50 km.
Show the 4 zones on four different colours after drawing the boundaries carefully.

You are given the distances: KT = 600 km KL = 350 km NK = 350 km TL = 400 km NT = 450 km

Question 6 Ever increasing! 5 marks

Hector, who is 50 years old today, finds out that life expectancy in his country is now 78 years. It goes up 2 months every year.

If this trend continues in which year of Hector’s life will his age be the same as the life expectancy in his country?

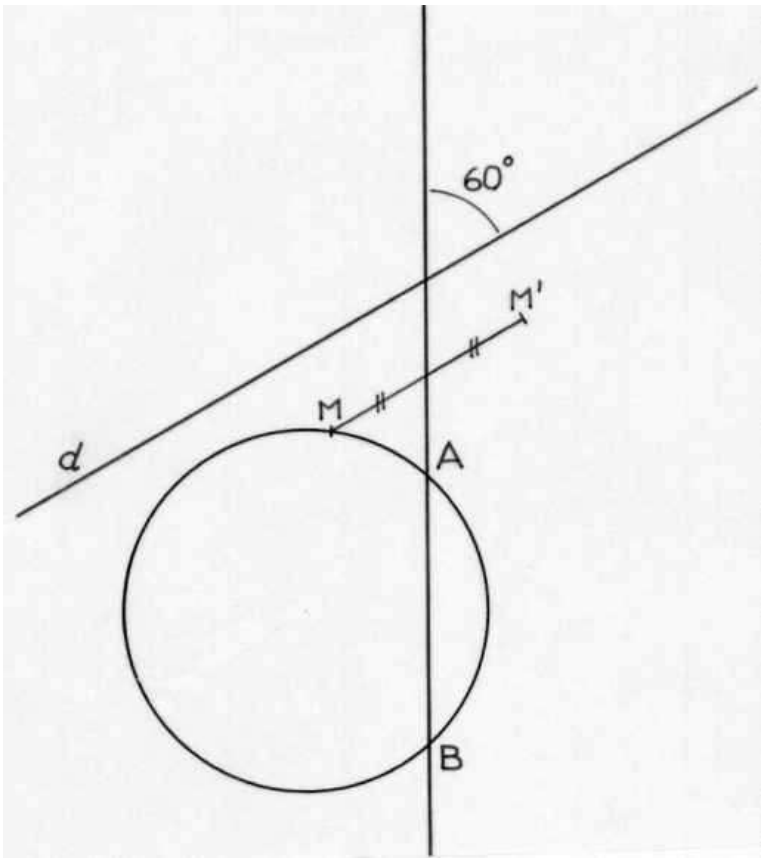
Question 7 Nonconformist 7 marks

" So reflection symmetry has to be at right angles! Why?"

Jacques wants to change the rules so that reflection in a line is no longer at right angles but can be oblique. He invents oblique symmetry with the rules:
The point M' is the image of M on reflection in the line AB and parallel to the line *d* when
1) the lines MM' and *d* are parallel
2) the mid-point of MM' is on the line AB.

Draw on your answer sheet a diagram similar to the one below. Construct on it the image of the circle under this oblique symmetry by drawing a large enough number of points.

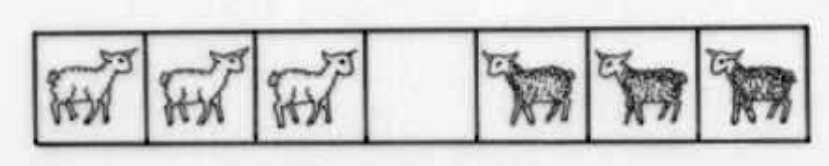
The lines AB and *d* make an angle of 60*



Question 8 Baa – baa black sheep 5 marks

The white sheep and the black sheep want to change fields with each other. The problem can be turned into a game:

3 white sheep and three black sheep are placed in the grid below made up of 7 boxes.

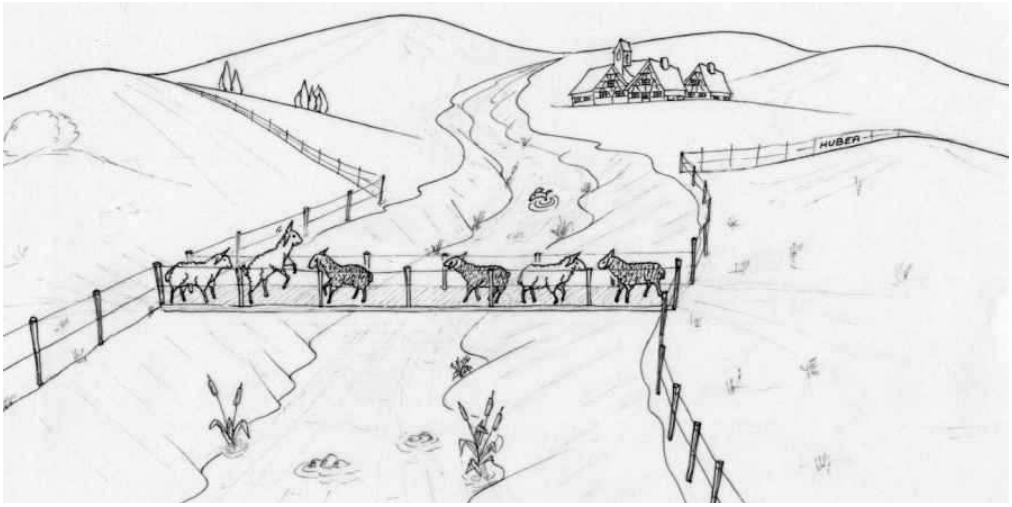


You can move the sheep in two ways:

- you can move a sheep forward into an empty box if there is one in front of it
- you can jump a sheep over a neighbouring sheep to get to an empty box.

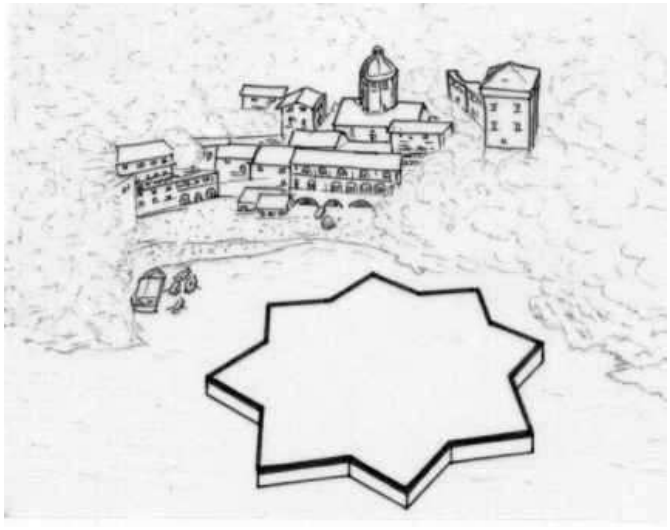
You have to get the white sheep on the right and the black sheep on the left, separated by an empty box.

Write down a sequence of moves which will bring this about.



Question 9 On the tiles 7 marks

During an archeological "dig" at the monastery of San Fruttuoso near Genoa, they found a tiled floor made from an equal number of two different kinds of tiles.
One kind was the regular eight-pointed star that is made by taking two squares of side 10 cm and putting one on top of the other, making sure that the centres of the squares are also one on top of the other.



The other kind of tile has the same length of perimeter as the first type. This second kind fits with the first to form a tiled floor without any gaps.

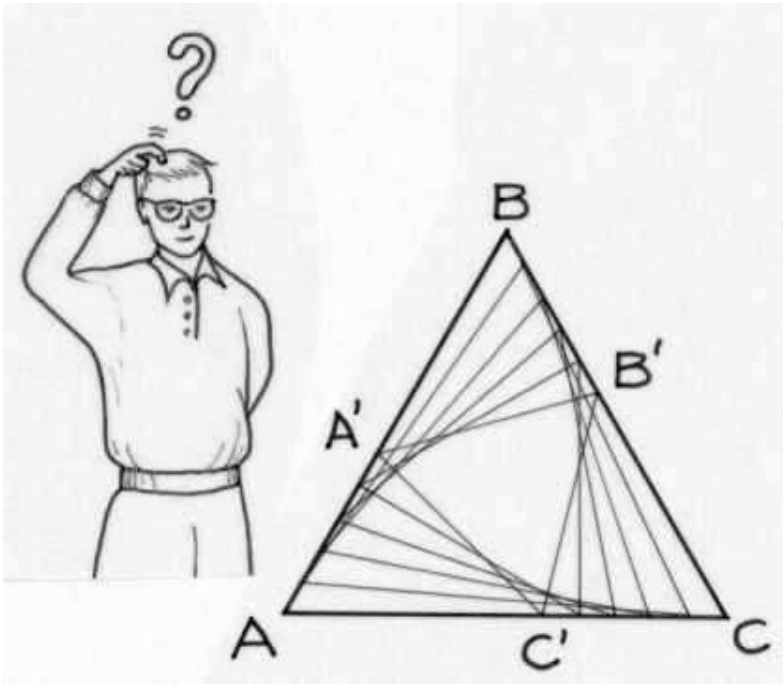
Show on your answer sheet an arrangement of 6 tiles, 3 of each kind. Use a scale of 1:2.

Question 10 Triangle puzzle 10 marks

ABC is an equilateral triangle with side 8 cm.

Three points A',B',C' are placed respectively on AB, BC and CA, so that AA' = BB' = CC'.

How can you find the distance AA' so that the triangles AA'C', BB'A' and CC'B' are right-angled triangles with the right angle at A',B' and C' respectively. Justify your answer.

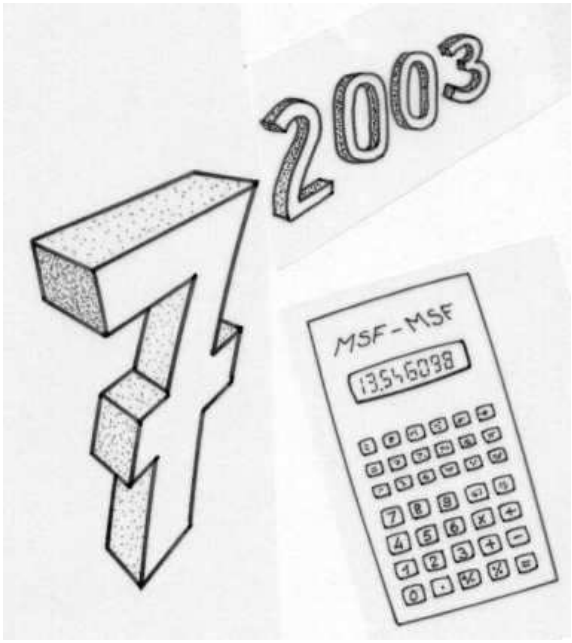


Question 11 Means to an end 5 marks

Senior classes only

Marc has been playing with his calculator. He says that he now knows how to find the last two digits of any power of 7.

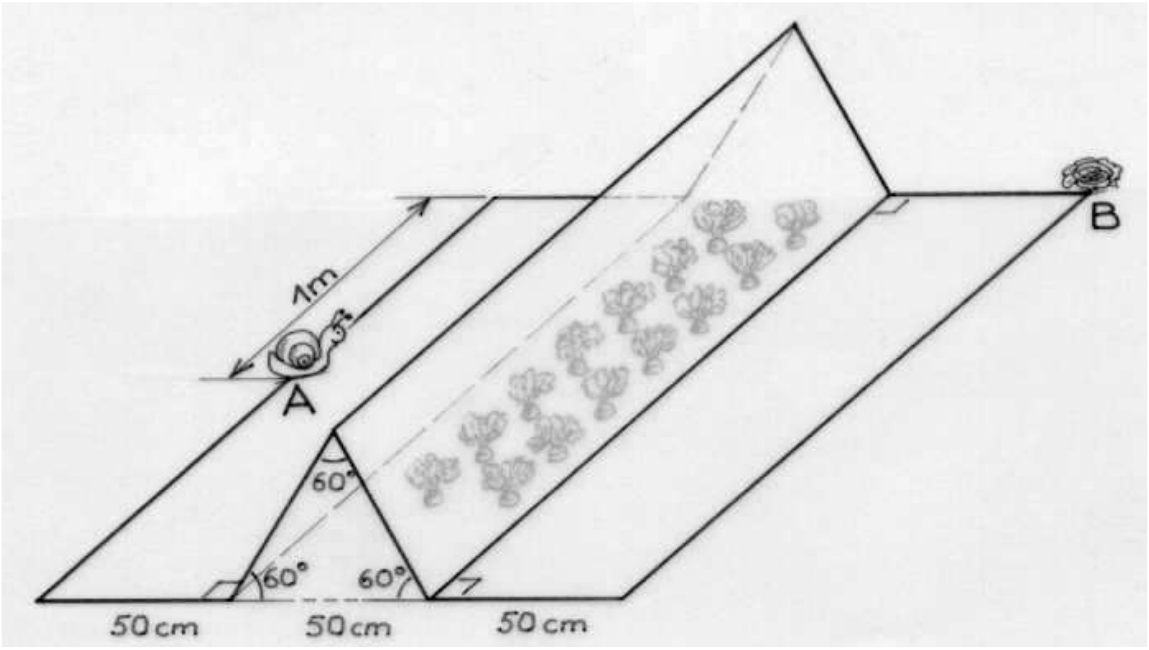
What are the last two digits of 7^{2003}? Explain how you found them.



Question 12 Snail's pace 7 marks

Senior classes only

A snail wants to get from point A to point B by the shortest route. On the way it will have to climb over the glass covering the plants. The sizes are shown here on the diagram. The glass cover is in the shape of a prism.

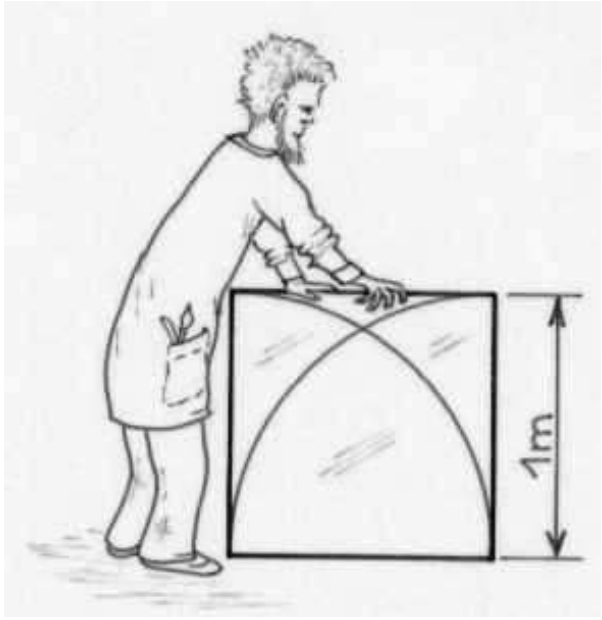


Work out the length of the shortest route. Explain your answer.

Question 13 Handle with care 10 marks

Senior classes only

A square window-frame of side 1 metre holds the stain-glass window shown below.



The four sections of glass are bounded by parts of the two quarter circles whose centres are the bottom corners of the square.
Work out the area of each section of glass.