Mathematics
Practical Problems
Standard Paper

RAQ

No time limit

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- You are permitted access to any calculator for this paper.
- Write your answers in the spaces provided on this question paper.
- You must **show all your working**.

Advice to candidates

- Answer **all** questions.
- Read each question carefully before answering it.
- Check your answers at the end of each question.

Candidate name

Candidate number

Centre number

For Examiner's Use	
Question	**Mark**
TOTAL	

BLANK PAGE

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 1

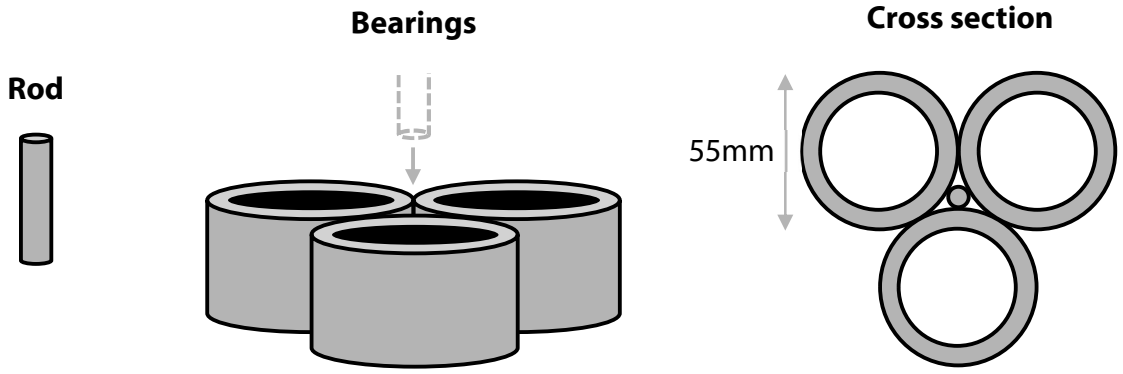
(a)

There are three identical bearings which are mutually tangent to one another.

An engineer fits a circular rod with the same height as the bearings between the three bearings.

Each bearing has an outer diameter of 55mm.

The rod has a radius of 3mm.



Calculate the percentage of space remaining between the three bearings after the rod has been fully fitted.

Give your answer to **one** decimal place.

(6 marks)

Answer: ..... %

Question 1

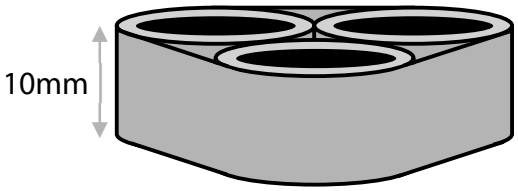
(b)

The engineer collects a smaller set of bearings and assembles them in the same position.

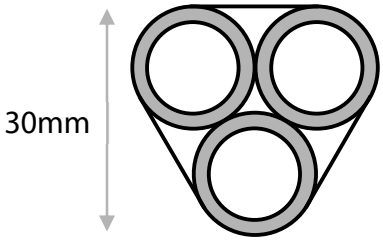
They wrap an elastic band around the bearings.

The elastic band has the same height as the bearings.

Bearings



Cross section



Calculate the outer surface area of the elastic band.

Give your answer to **one** decimal place.

(5 marks)

Answer: ..... mm^2

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 2

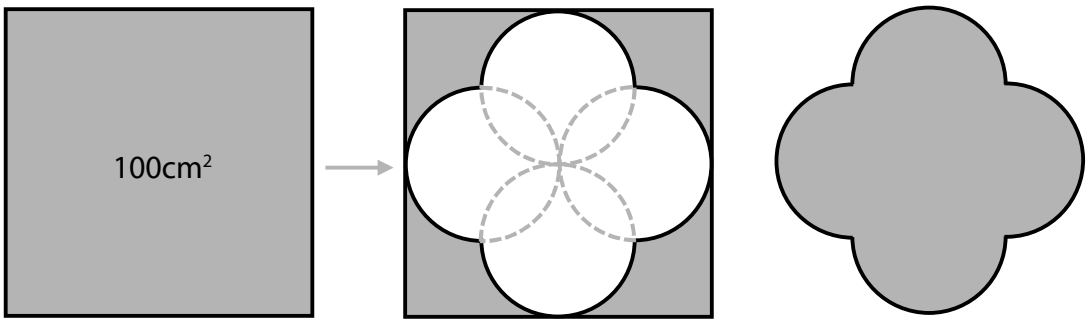
(a)

A square piece of paper has an area of $100cm^2$.

A student cuts a flower-like shape out of the paper.

The flower-like shape is formed by four identical circles, each tangent to one side of the paper.

In the flower-like shape, all four circles intersect at the centre of the paper.



Calculate what percentage of the $100cm^2$ paper is cut out to form the flower-like shape.

Give your answer to **one** decimal place.

(4 marks)

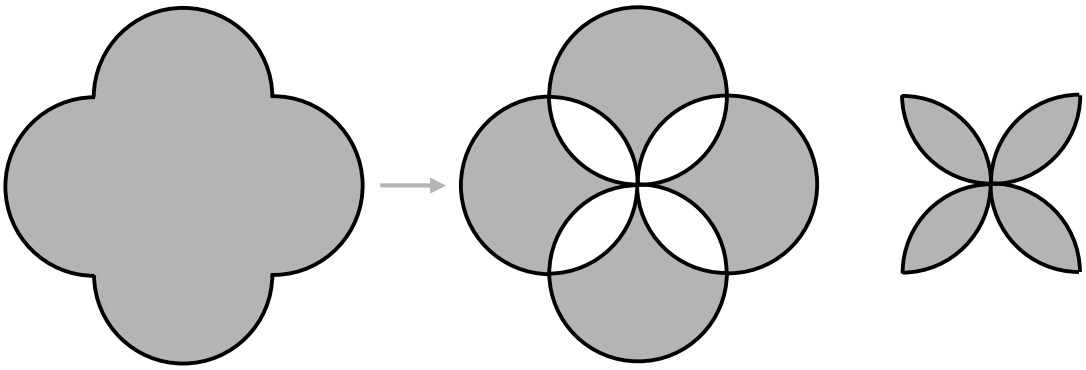
Answer: ..... %

Question 2

(b)

The student then cuts another flower-like shape out of the shape from the previous shape.

They do this by doing eight curved cutting strokes.



(i) Calculate the area of the second flower-like shape that has been cut out.

Find a and b given the area is $a\pi - b$ cm^2.

(4 marks)

$a =$ ..... , $b =$ .....

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 2

(b)

The student cut the shape at a constant speed of 3cm/s.

After each of the first seven strokes, they paused for 5 seconds before cutting the next.

(ii) Calculate the total time it took the student to cut out the second flower-like shape.

Give your answer to **one** decimal place.

(2 marks)

Answer: ..... s

Question 3

A student wants to study English and mathematics equally in a day.

Every day, they sleep at 22:15 for 8 hours.

They have meals at 8:00, 13:00, and 19:30, each lasting 30 minutes, during which they do not study.

Assuming they can study at all other times,
Work out the time when the student switches subjects.

Give your answer in **24-hour clock format**.

(4 marks)

Answer: ..... : .....

Question 4

1 in every 250 people are infected with a disease.

A test for the disease is 99.5% accurate.

A teacher is randomly selected to be tested for the disease and tests positive.

Work out the probability the teacher has the disease.

(1 mark)

Answer: .....

Question 5

A wave pool generates artificial waves for surfing.

The total mass of water in the facility is constant at 3.6kt.

The peak height of a wave, h, decreases as the resistance setting, r, increases, where $1 < r \leq 10$.

The resistance setting, r, is the inverse of the wave height function, $f(r)$, and is defined by:

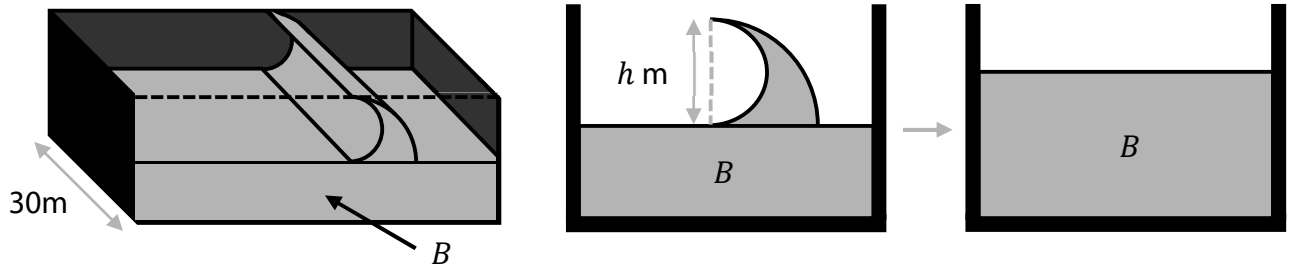
$$f^{-1}(h) = \frac{h^4 - h^3 - 2h^2}{h^4 - 5h^2 + 4}$$

Each wave forms a prism across the full width of the pool.

The cross-section of a wave at its peak height is made up of a quarter-circle with radius h, and a subtracted semi-circle with diameter h.

The water beneath each wave forms a rectangular block, B.

As a wave collapses, the volume of B increases.



By **finding the function $f(r)$**, work out the percentage increase in the volume of B beneath the **smallest** possible wave, from peak to collapse.

Give your answer to **two significant figures**.

[Density of water = 997 kg/m^3] [1kt = 1,000,000kg]

(12 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

Question 5

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 5

Answer: ..... %

End of paper

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

BLANK PAGE

BLANK PAGE

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA