



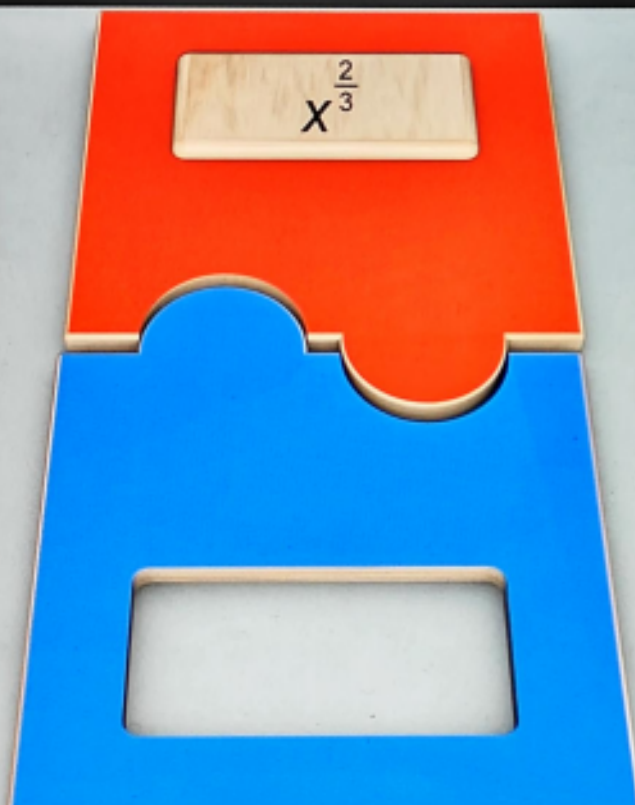
Draggable:

$$\sqrt{x^3}$$

$$\sqrt[3]{x^2}$$

$$\frac{x^2}{3}$$

$$x^{\frac{2}{3}}$$





Question 1b (1 mark)



Draggable:

$$9^{2x}$$

$$9^x$$

$$27^x$$

$$\frac{9^x \times 3^{2x}}{3^x}$$



Question 1c (1 mark)



Draggable:

$$e^{5x}$$

$$e^{6x}$$

$$e^{8x^3}$$

$$(e^{2x})^3$$





Question 1d (1 mark)



Draggable:

1

$$\frac{\cos^2 \theta}{\sin \theta}$$

$\sin \theta$

$\cos \theta \tan \theta$





Question 1e (1 mark)



Draggable:

$$2\log x - \log y$$

$$\frac{2\log x}{\log y}$$

$$\log 2x - \log y$$

$$\log \left(\frac{x^2}{y} \right)$$



Question 1f (1 mark)



Draggable:

$$0$$

$$2\sin^2 \theta$$

$$2\cos^2 \theta$$

$$1 - \sin^2 \theta + \cos^2 \theta$$





Question 1g (1 mark)



Draggable:

not a
sequence

geometric
sequence

arithmetic
sequence

$e^x, e^{2x}, e^{3x}, e^{4x}, \dots$



Question 2 (7 marks)



Question 2a (1 mark)

Let $f(x) = \ln x$ and $g(x) = x - 6$.

Given that $h(x) = 2f(g(x))$, **write down** $h(x)$.

B

I



U

x_0

x^2

\int

\sum

Ω

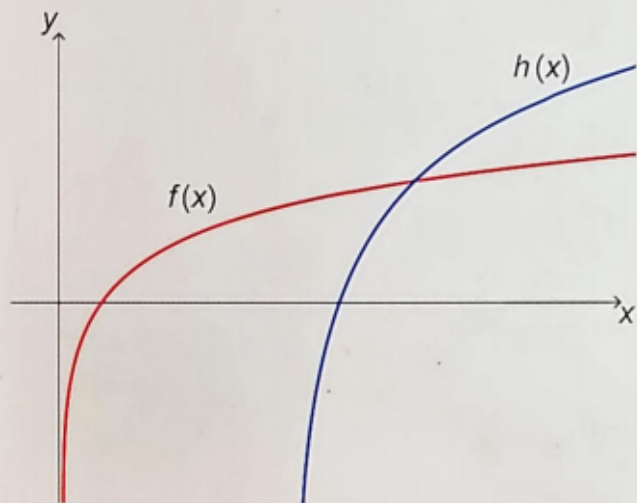
Σ

Styles



The $h(x)$ from part (a) is the transformation of $f(x)$ by:

- a vertical dilation with a scale factor s
- a horizontal translation of t units to the right.



Question 2b (2 marks)

Write down the values of s and t .

Rich text editor toolbar with buttons for Bold (B), Italic (I), Undo, Redo, Underline (U), x₂, x², Bulleted list, Numbered list, Omega (Ω), and Sigma (Σ). Below the toolbar is a text input area.

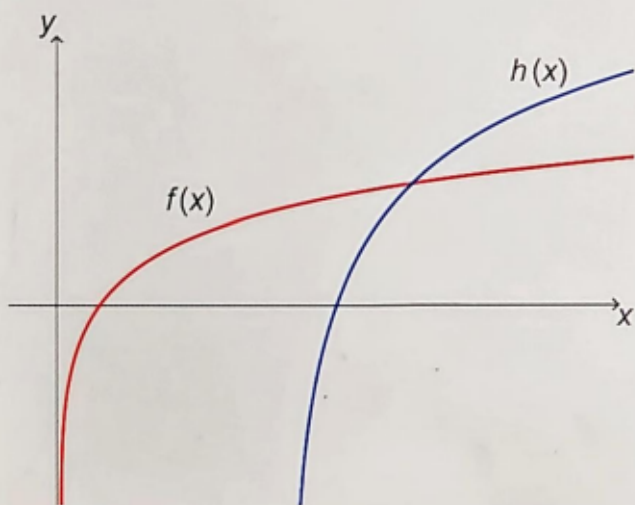


Question 2c (4 marks)

Solve $h(x) = f(x)$.

The $h(x)$ from part (a) is the transformation of $f(x)$ by:

- a vertical dilation with a scale factor s
- a horizontal translation of t units to the right.



Question 2c (4 marks)

Solve $h(x) = f(x)$.

Rich text editor toolbar with buttons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x_2), Superscript (x^2), Bulleted list, Numbered list, Insert link, and Insert image. Below the toolbar is a "Styles" dropdown menu and a "Media" icon.

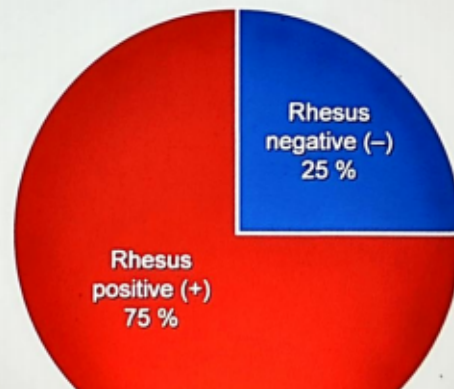
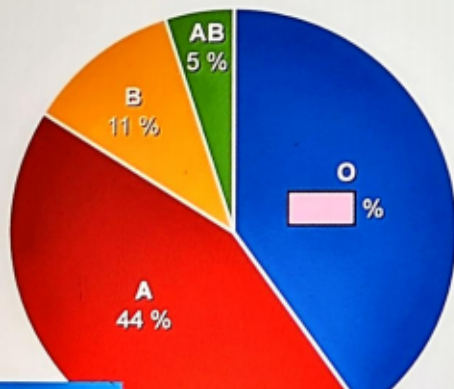
Question 3 (10 marks)

Question 3a (2 marks)

One of four main blood types can be found in a human body. They are known as **A**, **B**, **AB** and **O**. Each blood type can be further classified as either a Rhesus positive (+) or Rhesus negative (-).

For example, a possible combination is blood type **O** and Rhesus negative which is written as **O-**.

The pie charts below shows the distribution of the blood types and Rhesus types for a blood donor centre recorded in 2019.





Question 3a (2 marks)

People with blood type $O-$ are known as universal donors. They can donate their blood to patients with any blood type.

Show that the probability that a randomly selected person has blood type $O-$ is 0.1.

B *I* | ← → x₂ x² := :: Ω Σ

Styles -



Question 3b (1 mark)

Thirty people donate blood one morning.
Determine the expected number of people that have blood type $O-$.

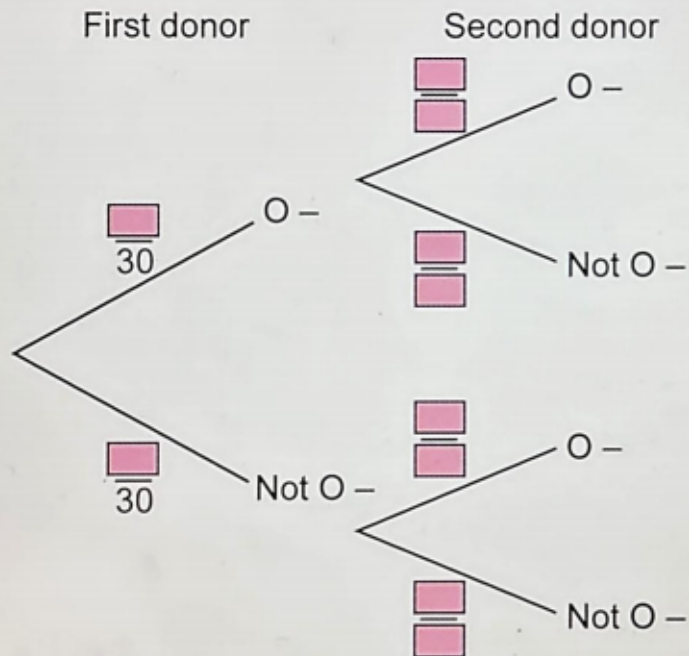
B *I* | ← → x₂ x² := :: Ω Σ

Styles -



Question 3c (3 marks)

Two of the thirty donors are selected at random. **Write down** the missing values in the tree diagram below.





Question 3d (4 marks)

Given that the second donor has blood type $O-$, **find** the probability that the first donor does not have blood type $O-$.

B *I* | ← → U x_2 x^2 \int \sum Ω Σ Styles -

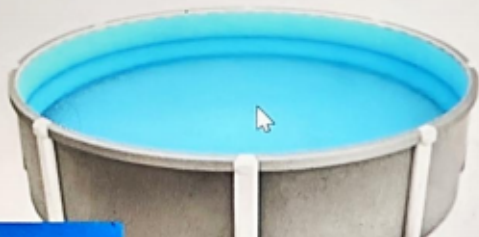


Question 4 (11 marks)

An above-ground pool can be represented as a cylinder filled with water. If we look at the pool from above, we can see a circle.

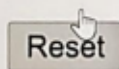
This media is interactive

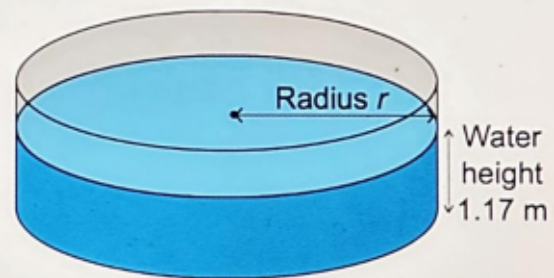
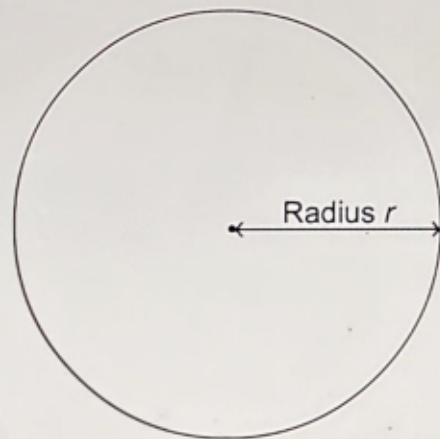
Diagram not to scale



Cylindrical pool



 Reset



The height of water in the pool is 1.17 metres (m). A pump is used to remove all water from the pool in 5 hours and 15 minutes. The pump removes water at a rate of 11 200 litres (L) per hour.

$$1000 \text{ L} = 1 \text{ m}^3$$



Question 4a (5 marks)

Show that the radius of the pool is 4 m to the nearest m.

B *I* | ← → | x₂ x² | := := | Ω Σ | Styles - | ↕

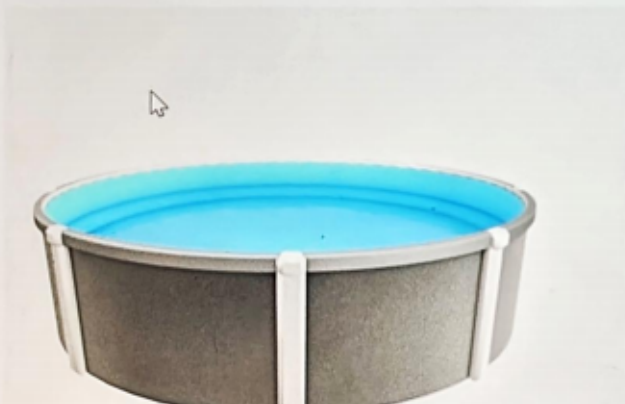


Question 4b (5 marks)

A cylindrical pool cover is placed over the pool. The pool cover has a radius of 4 m and a depth of 0.3 m.

This media is interactive

Diagram not to scale



Find the outer surface area of the pool cover, to the nearest square metre.

B *I* ← → x₂ x² ∫ ∫ ∫ Ω Σ

Styles -



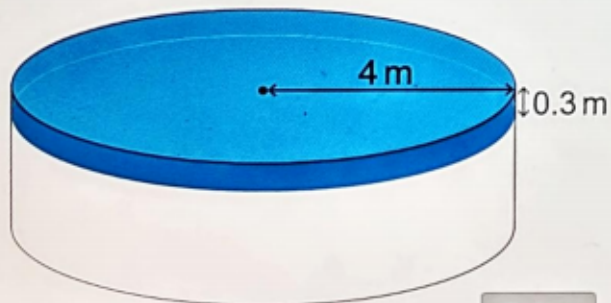


Question 4b (5 marks)

A cylindrical pool cover is placed over the pool. The pool cover has a radius of 4 m and a depth of 0.3 m.

This media is interactive

Diagram not to scale



Reset

Find the outer surface area of the pool cover, to the nearest square metre.

B *I* ← → U x_2 x^2 \int $\frac{1}{x}$ Ω Σ

Styles -



Question 4c (1 mark)

Material for the pool cover costs \$3.40 per square metre. **Determine** the cost of the pool cover.

B *I* | ← → | U x_2 x^2 | \int \sum | Ω Σ | Styles - |



Question 5 (14 marks)

The following video explains the use of sleeves for paper cups.

Video

Script

Hot beverages are commonly served in paper cups.

Cardboard sleeves are used to reduce the discomfort of holding a hot paper cup.

When the sleeve is unfolded, the sleeve forms part of a sector of a circle as shown.

The dimensions of the unfolded sleeve are measured as shown.

Manufacturers produce a sleeve from a rectangular piece of cardboard.

In this question, you will make calculations to find the area of the sleeve and consider the amount of cardboard wasted in their production.


The dimensions of the sleeve are provided on the diagram, in centimetres (cm).

This media is interactive

Stage 1



Stage control

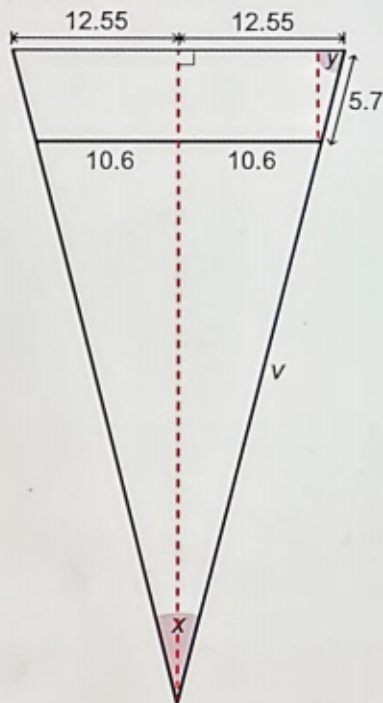


Stage: **1**

The dimensions of the sleeve are provided on the diagram, in centimetres (cm).

This media is interactive

Stage 4



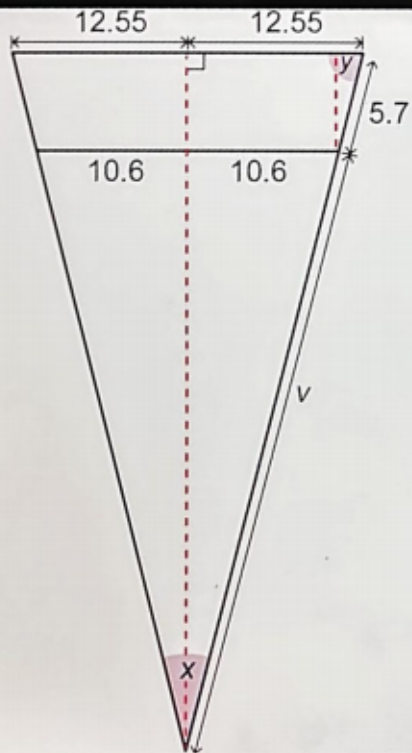
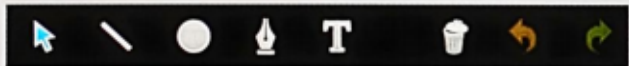
Stage control

Stage: 4

The stage control interface consists of a horizontal slider bar with a black rectangular marker at the right end. Below the slider, the text "Stage: 4" is displayed, with the number "4" inside a black square box. A mouse cursor is positioned over the right end of the slider bar.



Question 5a (3 marks)



Show that the value of angle y is 70° , to the nearest degree.

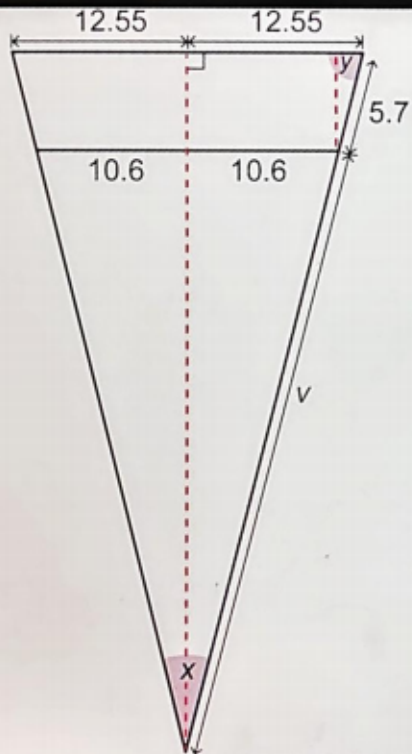
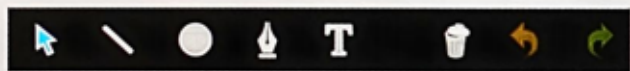
B *I* ← → x_2 x^e \int $\frac{1}{x}$ $\frac{1}{x^2}$ $\frac{1}{x^3}$ Ω Σ

Styles -



Question 5b (2 marks)

Hence, show that the value of angle x is $\frac{2}{\pi}$ radians.



Question 5b (2 marks)

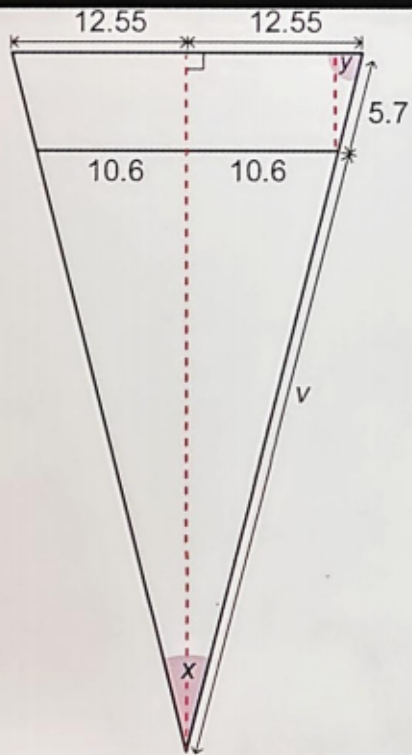
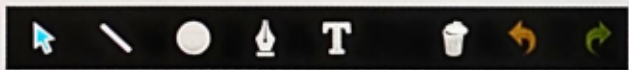
Hence, **show that** the value of angle x

is $\frac{2}{9}\pi$ radians.

B **I** ← → U \times_2 \times^2 \int $\frac{d}{dx}$ Ω Σ

Styles -





Styles -



Question 5c (3 marks)

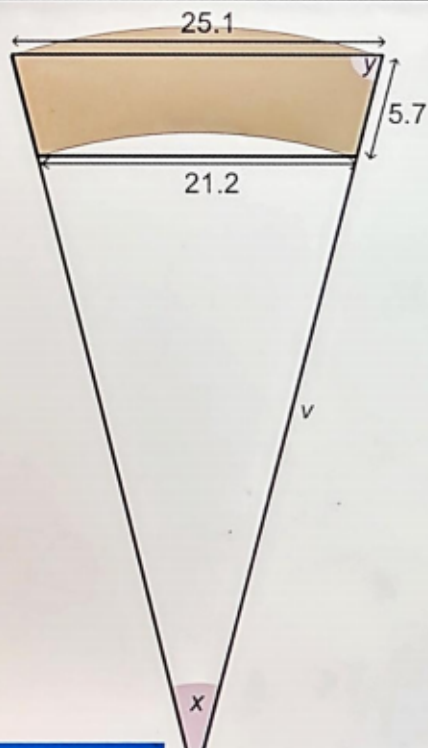
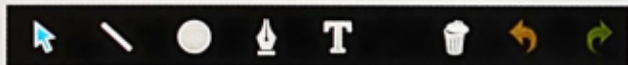
Calculate the value of v .

B *I* ← → \times_2 \times^2 \therefore \therefore Ω Σ

Styles -



Question 5d (3 marks)



θ in radians

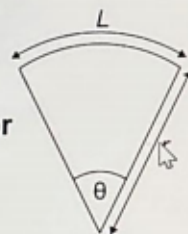
Arc length of sector L

$$L = r\theta$$

Area of a sector A

$$A = \frac{1}{2} r^2 \theta$$

Sector



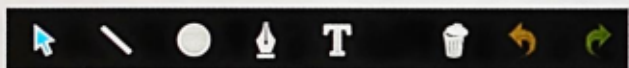
Find the area of the sleeve.

B **I** x_2 x^2 \int $\frac{1}{x}$ $\frac{1}{x^2}$ Ω Σ

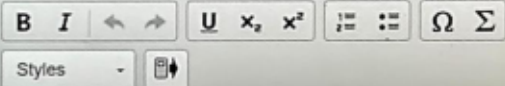
Styles



Question 5e (3 marks)



The sleeve is cut out from a 25.1 cm by 7.6 cm rectangle. **Calculate** the percentage of material wasted.



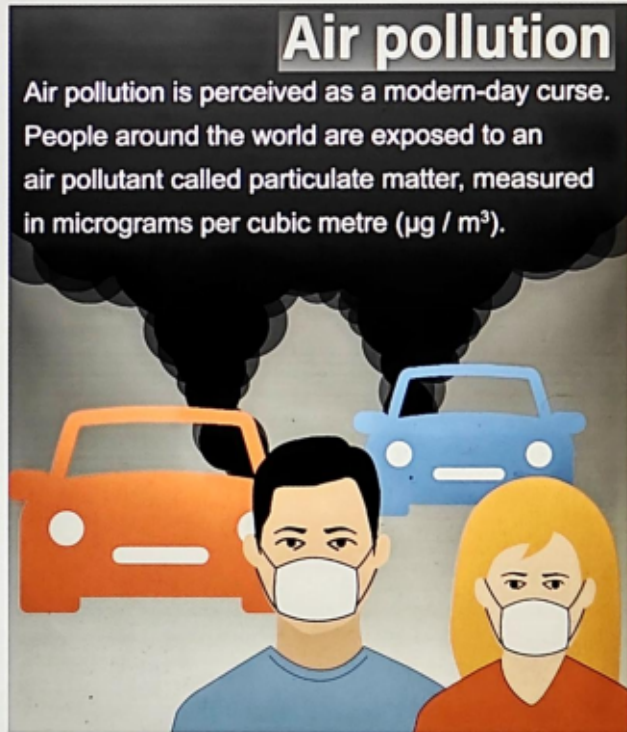


Question 6 (19 marks)

Many efforts have been made through the years to put into action solutions to resolve the problem of exposure to particulate matter in order to reach a globally agreed goal. In this question, you will make calculations and analyse exposure to particulate matter over a period of time.

Air pollution

Air pollution is perceived as a modern-day curse. People around the world are exposed to an air pollutant called particulate matter, measured in micrograms per cubic metre ($\mu\text{g} / \text{m}^3$).





Question 6a (2 marks)

Annual exposure to particulate matter across Europe in 1990.

Annual exposure (E) to particulate matter in $\mu\text{g} / \text{m}^3$	$0 \leq E < 10$	$10 \leq E < 20$	$20 \leq E < 30$	$30 \leq E < 40$	$40 \leq E < 50$	$50 \leq E < 60$
Number of European countries	3	17	6	9	3	1

To visualize the level of exposure across Europe in 1990, use the table to **construct** a histogram.

Particulate matter for 1990



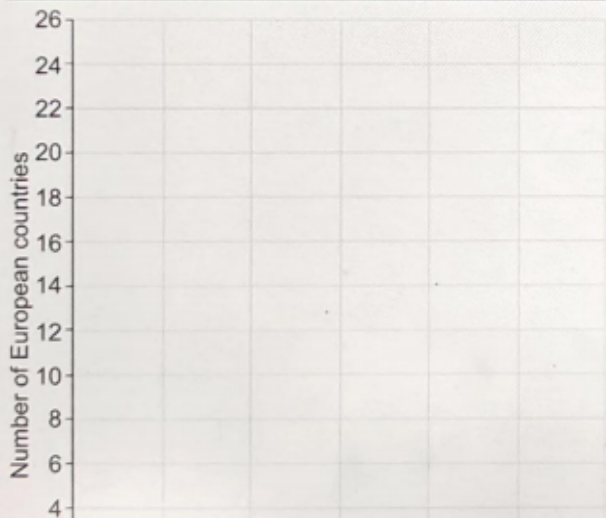
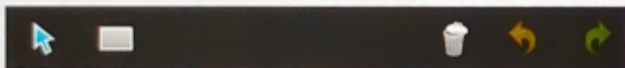
Below is the histogram for the annual exposure to particulate matter across Europe in 2016.

Particulate matter for 2016

This media is interactive

To visualize the level of exposure across Europe in 1990, use the table to **construct** a histogram.

Particulate matter for 1990

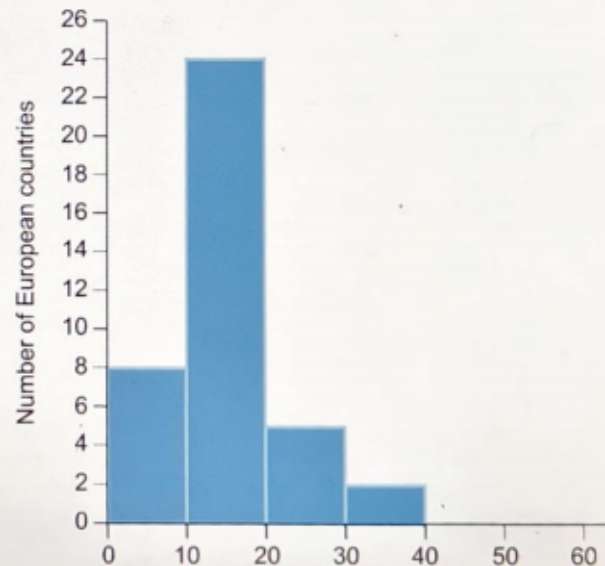


Scroll down to continue

Below is the histogram for the annual exposure to particulate matter across Europe in 2016.

Particulate matter for 2016

This media is interactive





Question 6b (1 mark)

In comparison with your histogram in part (a), **state** one difference between annual exposure to particulate matter in 1990 and 2016.

B *I* ← → U x_1 x^2 := :: Ω Σ
Styles -



Question 6c (4 marks)

Using the histogram for 2016, **show that** an estimate for the mean of E in 2016 is $15.3 \mu\text{g} / \text{m}^3$ to the nearest one decimal place.

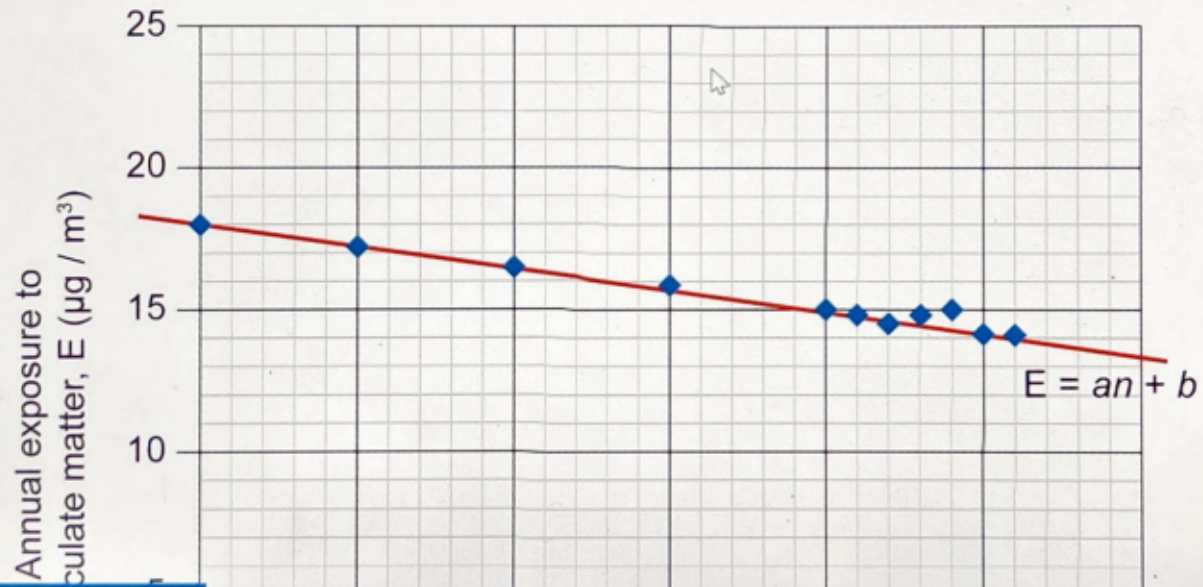


B *I* ← → U x_1 x^2 := :: Ω Σ
Styles -

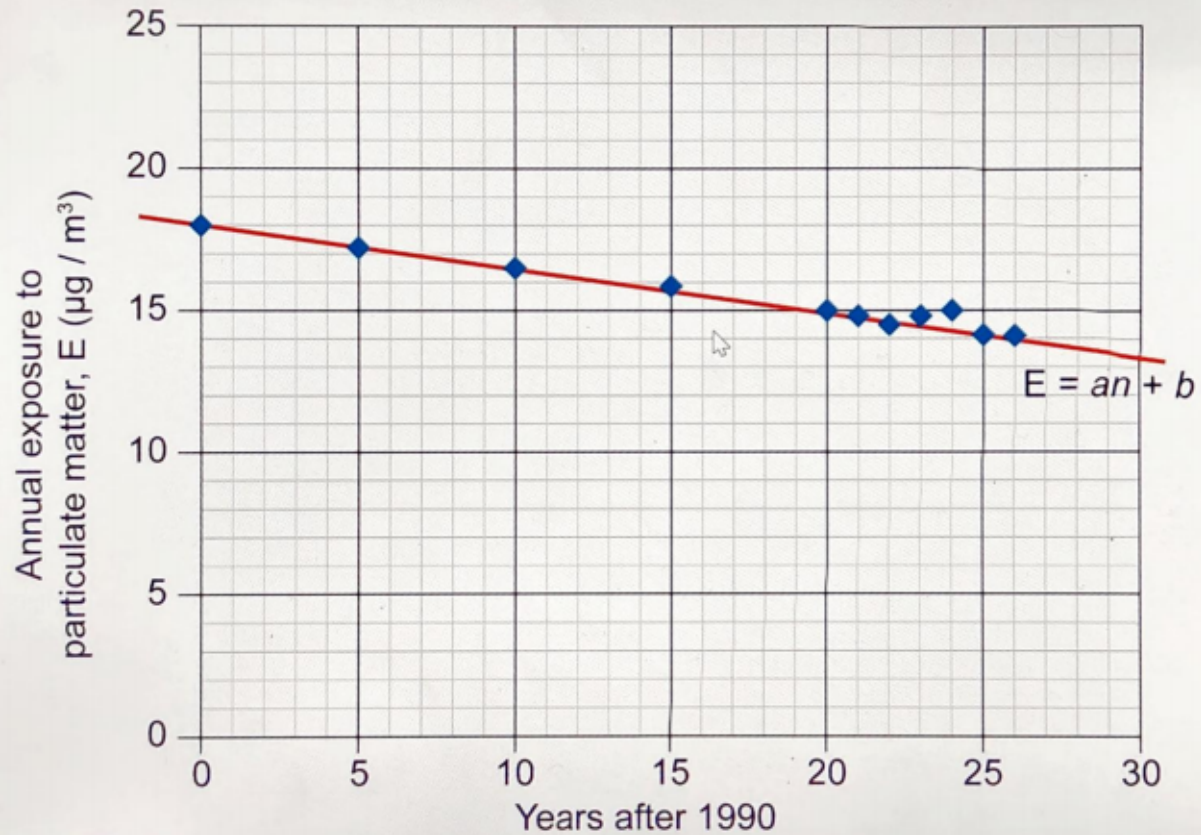
The data from 1990 to 2016 can be modelled by a line of best fit as shown in Graph 1.

Graph 1

Annual exposure to particulate matter across Europe



Annual exposure to particulate matter across Europe



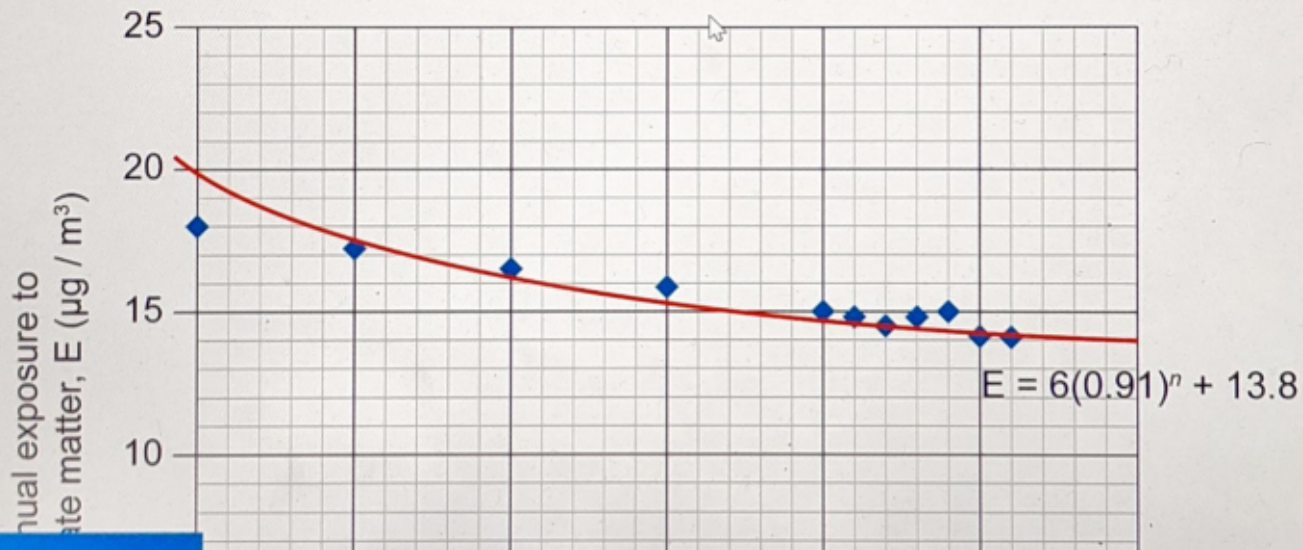


Question 6e (10 marks)

The data from 1990 to 2016 can also be modelled by $E = 6(0.91)^n + 13.8$ as shown in Graph 2.

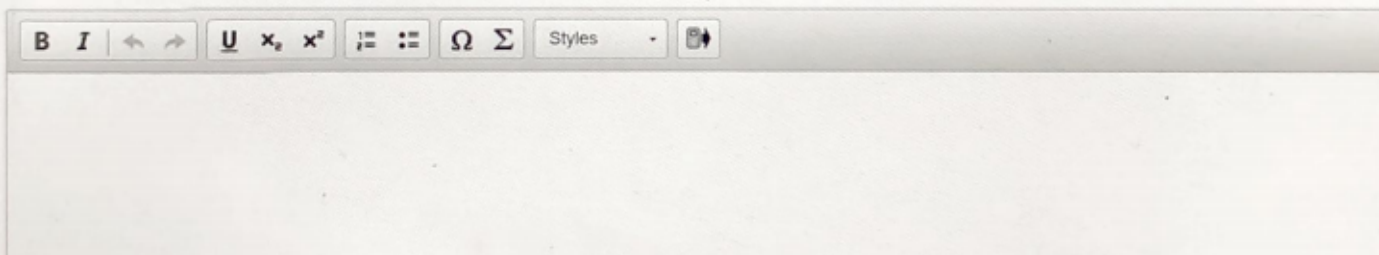
Graph 2

Annual exposure to particulate matter across Europe



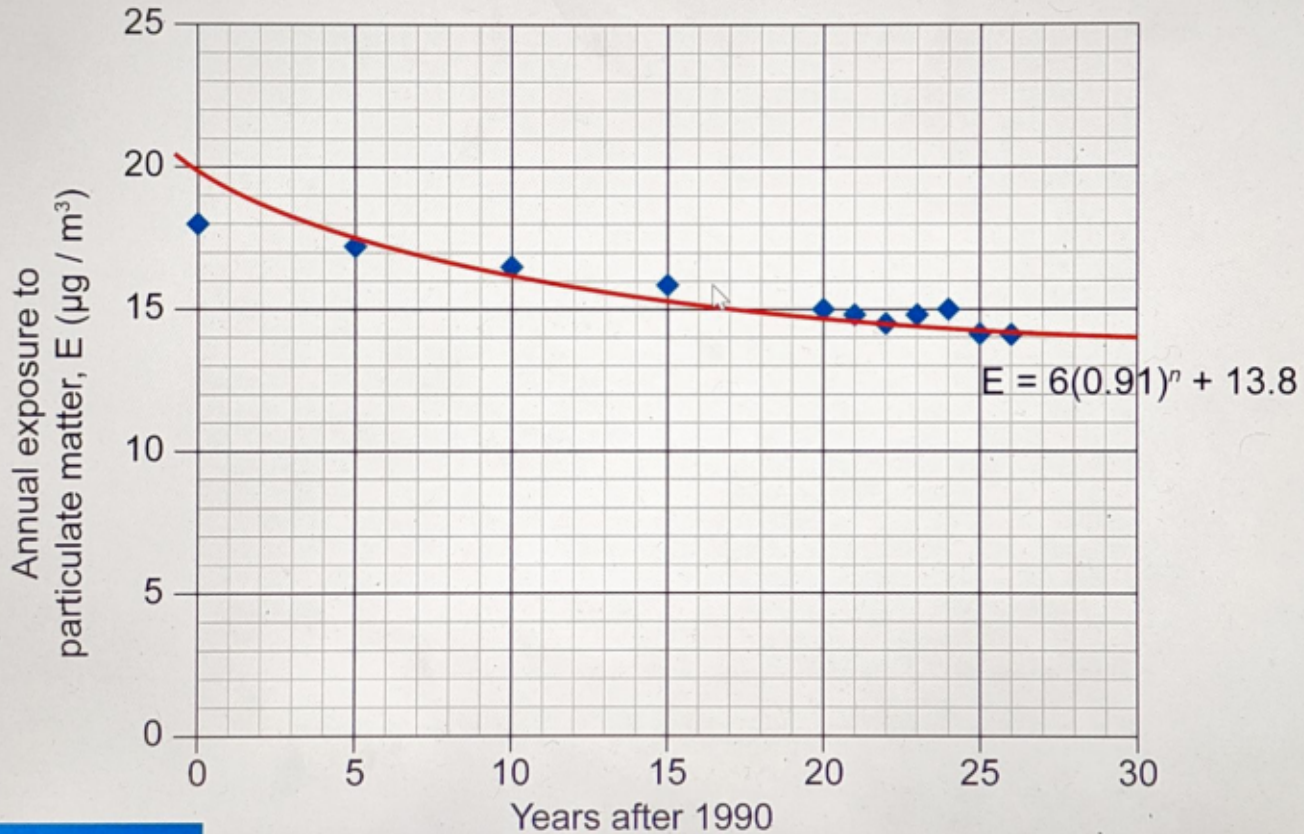
The equation of the line of best fit can be written as $E = an + b$, where E is the annual exposure to particulate matter and n is the number of years after 1990.

Determine the values of a and b .



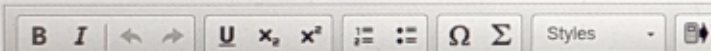
The image shows a toolbar for a rich text editor. The toolbar contains the following elements from left to right: a bold icon (B), an italic icon (I), a left arrow icon, a right arrow icon, an underline icon (U), a subscript icon (x₂), a superscript icon (x²), a list icon (bulleted list), an ordered list icon (numbered list), a link icon (Ω), a link icon (Σ), a 'Styles' dropdown menu, and a trash icon.

Annual exposure to particulate matter across Europe



You are a statistical adviser on a government panel that wants to reduce annual exposure to particulate matter in Europe to a level below $13 \mu\text{g} / \text{m}^3$ by 2030. **Analyse** the two models to make a prediction of annual exposure to particulate matter in 2030. In your answer, you should:

- identify a factor from the data to be considered when making your prediction
- predict the level of annual exposure to particulate matter in 2030 using models from both graphs
- comment on the accuracy of your predictions
- advise the government which is a better model to make predictions and justify your answer.





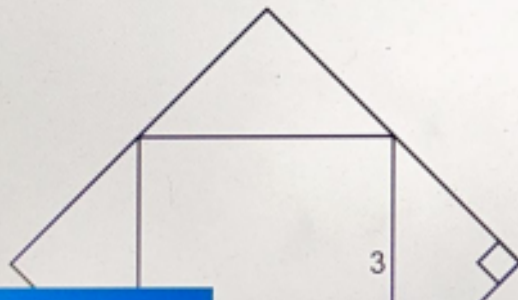
Question 7 (32 marks)

In this task you will investigate the area and perimeter of squares.



Question 7a (3 marks)

In the two squares below the vertex of the smaller square is the midpoint of the side of the larger square. The side length of the smaller square is 3 units.



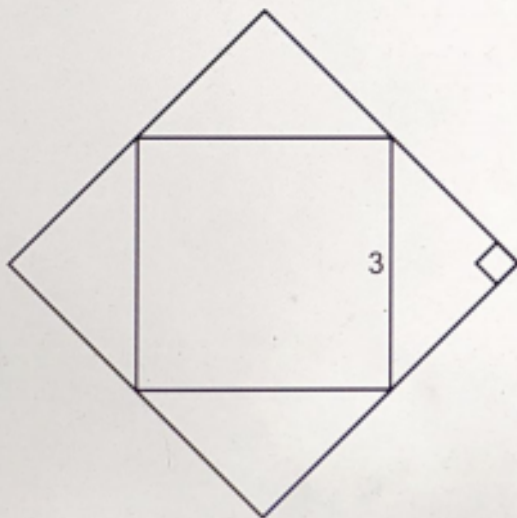
Show that the side length of the larger square is $3\sqrt{2}$ units.

Rich text editor toolbar with the following icons: Bold (B), Italic (I), Undo (left arrow), Redo (right arrow), Underline (U), Subscript (x₂), Superscript (x²), Bulleted list, Numbered list, Link (Ω), and Unlink (Σ). Below the toolbar is a text input area with a "Styles" dropdown and a "Format" icon.



Question 7a (3 marks)

In the two squares below the vertex of the smaller square is the midpoint of the side of the larger square. The side length of the smaller square is 3 units.



Show that the side length of the larger square is $3\sqrt{2}$ units.

B *I* ← → U x , x^2 \therefore \therefore Ω Σ

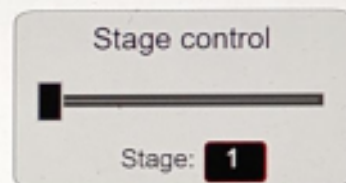
Styles



Drag the slider to see how the squares of different stages are produced

This media is interactive

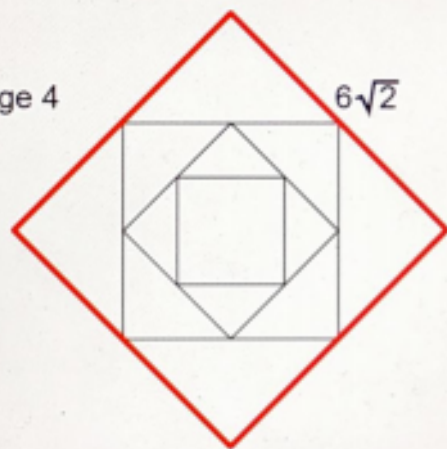
Stage 1



Drag the slider to see how the squares of different stages are produced

This media is interactive

Stage 4



Stage control



Stage: **4**



Question 7b (2 marks)

Write down the missing values in the table up to row 6.

Double click inside a cell to show the equation toolbar.

Stage number (n)	Area of square (A)
1	9
2	18
3	36
4	72
5	
6	



Question 7c (2 marks)

Describe in words two patterns in the table for area of square (A).

B *I* ← → U \times_n \times^e \int \sum Ω Σ

Styles -

I





Question 7b (2 marks)

Write down the missing values in the table up to row 6.

Double click inside a cell to show the equation toolbar.

Stage number (n)	Area of square (A)
1	9
2	18
3	36
4	72
5	
6	



Question 7d (2 marks)

Write down a general rule for A in terms of n .

B *I* ← → u \times_n \times^n \int \sum Ω Σ

Styles -



Question 7b (2 marks)

Write down the missing values in the table up to row 6.

Double click inside a cell to show the equation toolbar.

Stage number (n)	Area of square (A)
1	9
2	18
3	36
4	72
5	
6	



Question 7e (3 marks)

Verify your general rule for A .

Equation toolbar with icons for Bold, Italic, Undo, Redo, Underline, Subscript, Superscript, Bulleted List, Numbered List, Insert, and Sum. Below the icons is a 'Styles' dropdown menu.



Question 7f (20 marks)


This media is interactive

Stage 1



3

Stage control



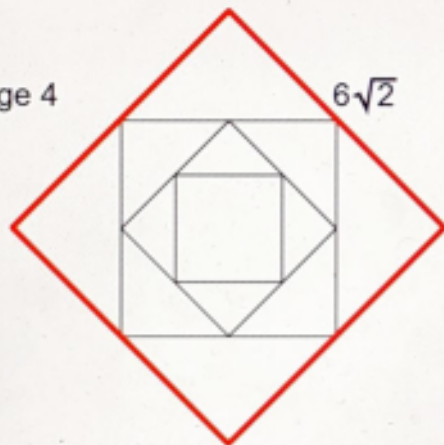
Stage: **1**



Question 7f (20 marks)

This media is interactive

Stage 4



$6\sqrt{2}$

Stage control



Stage: 4

Double click inside a cell to show the equation toolbar.

Stage number (n)	Perimeter of square (P)	
1	12	
2	$12\sqrt{2}$	
3	24	
4	$24\sqrt{2}$	
5		
6		

Reset

Investigate the values in the table to find a relationship for the perimeter of each square (P) in terms of n . In your answer, you should:

- predict more values and record these in the table
- describe in words a pattern in the table for perimeter of square (P)
- write down a general rule for P in terms of n
- test your general rule for P
- verify and justify your general rule for P in relation to the squares
- ensure that you communicate all your working appropriately.