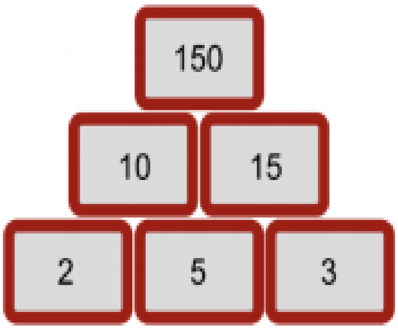
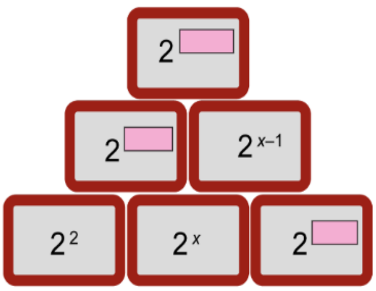
Question 1 (5 marks)

The following image shows a completed multiplication pyramid.

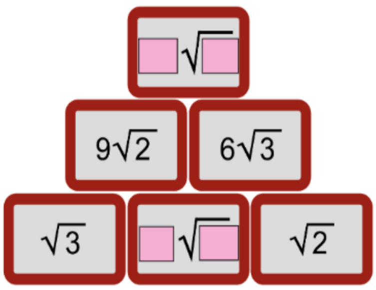


Determine the missing values in each of the following multiplication pyramids.

Question 1a (2 marks)



Question 1b (3 marks)



Question 2 (8 marks)

A school offers MYP5 students a selection of after-school clubs.

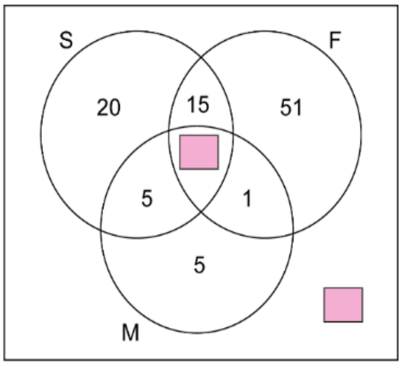
There are 106 students in MYP5:

43 chose Science (S)
70 chose Football (F)
14 chose Music (M)

The information is presented in the following Venn diagram.

Question 2a (1 mark)

Determine the missing values in the Venn diagram.



Question 2b (3 marks)

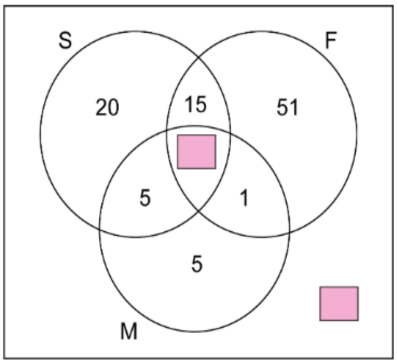
Two students are selected at random. **Calculate** the probability that both students are in the Science club **and** the Football club.

Question 2c (2 marks)

Given that a student is in the Science club, **determine** the probability that they are in the Football club.

Question 2a (1 mark)

Determine the missing values in the Venn diagram.



Question 2d (2 marks)

Show that events S and F are not independent.

Question 3 (6 marks)

Question 3a (2 marks)

A geometric sequence, U, has the following first **three** terms: 3, 6, 12, …

Determine the general term, U_n, in terms of n.

Question 3b (1 mark)

An arithmetic sequence, A, has the following first **three** terms:

$$\log_2 3,\ \log_2 6,\ \log_2 12,\ \ldots$$

Write down the next term in the sequence.

Question 3c (1 mark)

The common difference of sequence A is $\log_2 a$.

Determine the value of a.

Question 3d (2 marks)

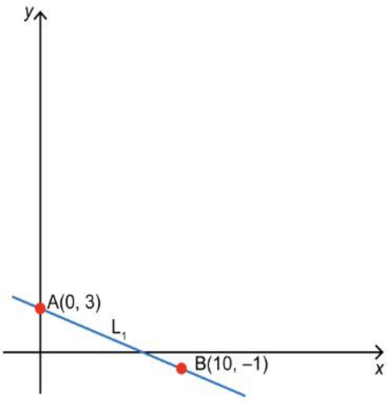
Determine the general term A_n of the arithmetic sequence. Give your answer as a single logarithm.

Question 4 (8 marks)

Question 4a (1 mark)

The line L_1 passes through points A and B.

Diagram not to scale



Show that the gradient of line $L_1 = -\frac{2}{5}$.

The line L_2 passes through point B and is perpendicular to L_1.

Diagram not to scale

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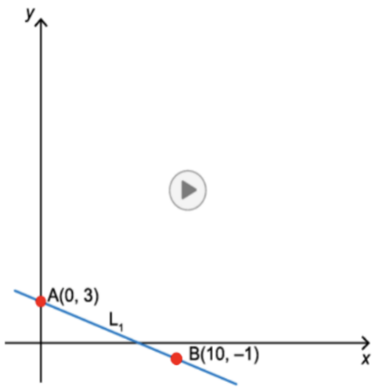


Question 4b (3 marks)

Find the equation of line L_2.

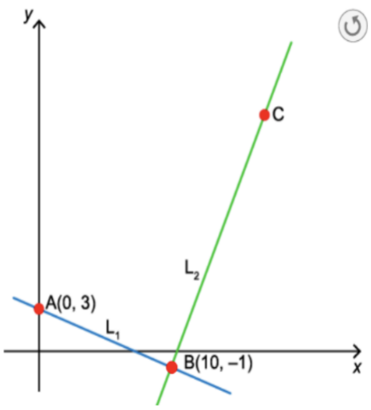
Question 4c (2 marks)

The point C has coordinates (k, 24).
Determine the value of k.

The line L_2 passes through point B and is perpendicular to L_1.

Diagram not to scale

This media is interactive



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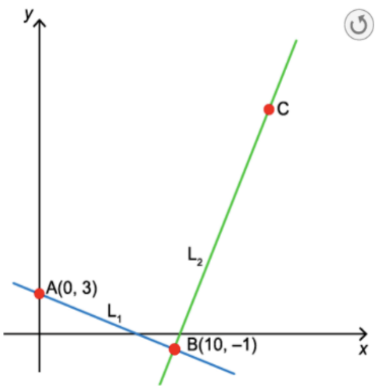


Question 4d (2 marks)

Hence, **determine** the distance between A and C.

Question 5 (9 marks)

A new slide is designed for a children's playground.

The height of the slide is modelled by the rational function

$$f(x) = \frac{5-x}{x+2} \text{ where } 0 \leq x \leq D$$

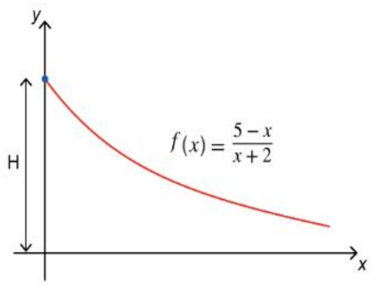
such that:

x is the horizontal distance from the start of the slide

$f(x)$ is the height of the slide at any distance x

x and $f(x)$ are in metres (m)

Question 5a (1 mark)

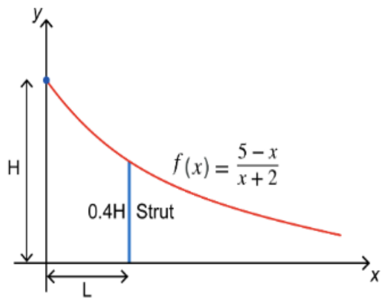


H is the initial height of the slide in metres (m).

Show that H = 2.5 m.

Question 5b (3 marks)

A strut is positioned at a horizontal distance (L) from the intercept of the axes. The height of the strut is 40 % of the initial height.

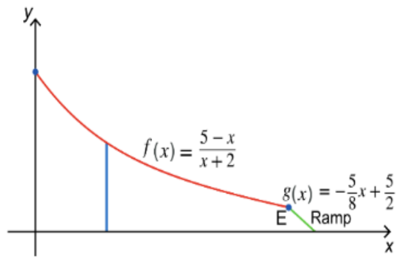


Calculate the horizontal distance L.

Question 5c (5 marks)

A ramp is added at point E as shown in the diagram. The ramp is modelled by the linear function

$$g(x) = -\frac{5}{8}x + \frac{5}{2}$$



Calculate the height at point E.

Question 6 (15 marks)

Video Script

Archimedes was a famous mathematician and scientist. He made many important discoveries.

Archimedes was asked to compare the Emperor's gold crown with a pure gold bar.

He knew that two gold objects with the same mass and volume would have the same density, and therefore the same purity.

He measured the mass of each and found they were the same.

He was not able to calculate the volume of the crown as it was not a uniform shape.

While taking a bath he discovered a way to find the volume of a non-uniform shape.

I will immerse each object into the same volume of water.

If the displaced water of the crown and gold bar is the same, then they have the same density and the crown is pure gold.

But if the displaced water of the crown and pure gold bar is not the same, then they do not have the same density and the crown is not pure gold.

In this question, you will use the Archimedes Principle to determine whether the crown is pure gold or not.

Question 6a (1 mark)

The density of an object can be calculated using the formula

$$Density = \frac{Mass}{Volume}$$

Given that:

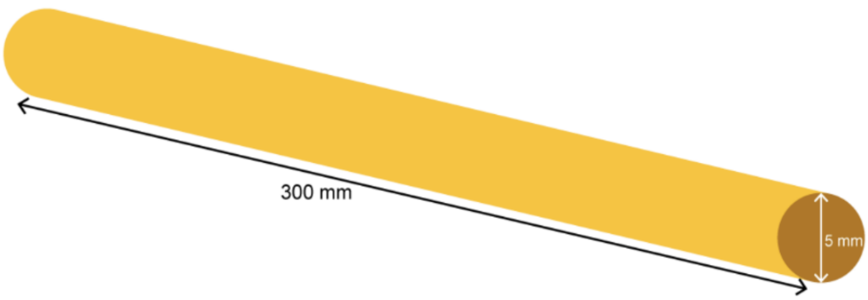
- the density of the gold bar is 19.32 g/cm^3
- the volume of the gold bar is 25 cm^3

Determine the mass of the gold bar.

Question 6b (2 marks)

Each stem is made from a cylinder of length 300 mm and diameter 5 mm.

Diagram not to scale



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Determine the volume of both stems.

The gold bar is used to create the Emperor's crown. The crown is symmetrical and has **2** stems, with an equal number of leaves on each stem.

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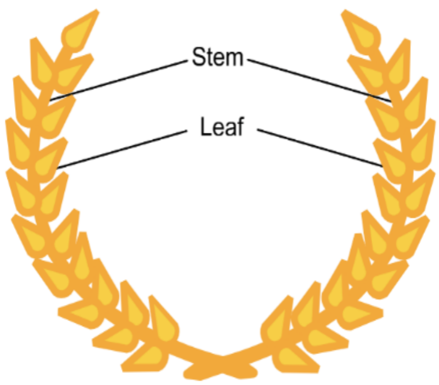
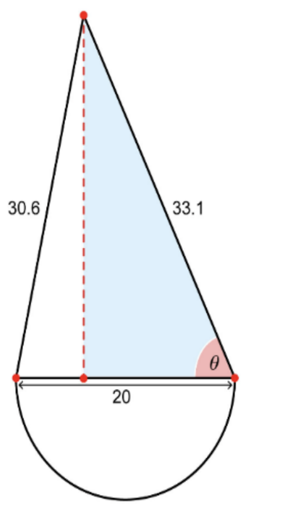


Question 6c (3 marks)

Diagram not to scale

Dimensions in mm



Each leaf can be modelled as a combination of two shapes: a triangle and a semicircle. **Show that** angle θ is 65° to the nearest degree.

Question 6d (4 marks)

Hence, **calculate** the area of one leaf. Give your answer correct to **two** decimal places.

Question 6e (2 marks)

By completing the table, **determine** the total volume of the crown in cm^3. Give your answer correct to **one** decimal place.

Volume of both stems (mm^3)	*your answer from (b)*
Volume of all leaves (mm^3)	17 366
Total volume of the crown (mm^3)	
Total volume of the crown (cm^3)	

Reset

Question 6f (3 marks)

The gold crown is accepted by the Emperor if the density is at least 90 % of the density of the pure gold bar.

By completing the table, **deduce** if the gold crown is accepted.

	Gold crown	Gold bar
Mass (g)	*your answer from (a)*	*your answer from (a)*
Volume (cm^3)	*your answer from (e)*	25
Density (g/cm^3)		19.32
Minimum accepted density for the gold crown		
Conclusion		

Question 8 (30 marks)

A sequence of shapes is created using squares. In this question you will investigate the area of shaded regions formed by these shapes.

Interact with the stage control to see how the shapes are formed.

Stage Control

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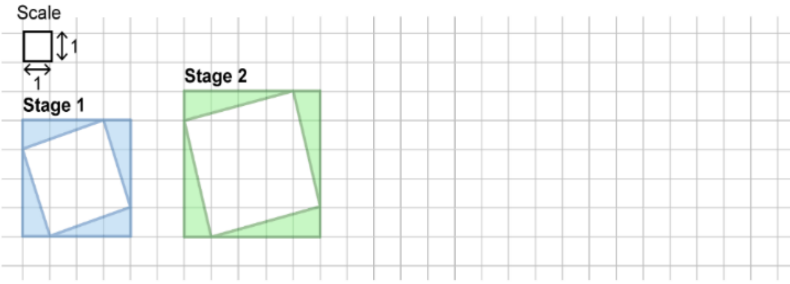
Stage Control



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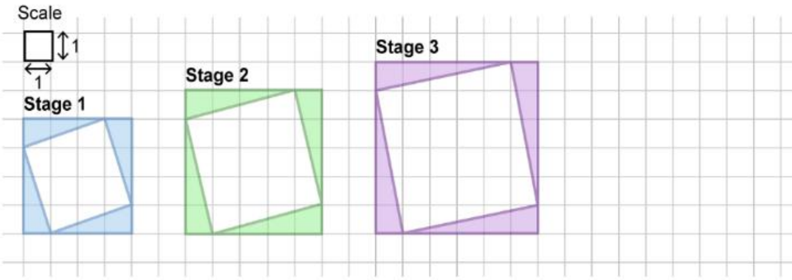

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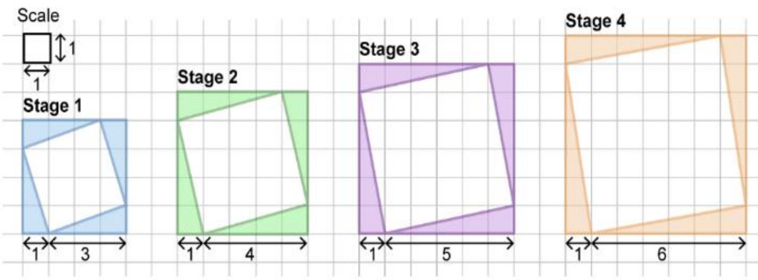
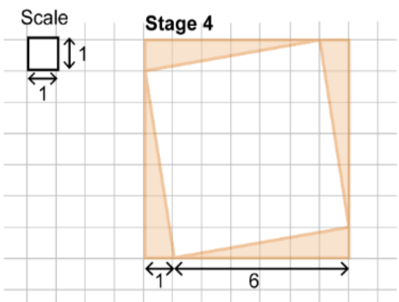


Question 8a (2 marks)



Show that the shaded area in stage 4 is 12.

Styles

Question 8b (1 mark)

Predict the **two** missing values in the table.

Question 8c (2 marks)

Identify **two** patterns for *S*.

Question 8b (1 mark)

Predict the **two** missing values in the table.

Stage number (n)	Shaded area (S)
1	6
2	8
3	10
4	12
5	
6	

Reset

Question 8c (2 marks)

Identify two patterns for S.

Question 8d (2 marks)

Determine the general rule for S in terms of n.

Question 8b (1 mark)

Predict the **two** missing values in the table.

Stage number (n)	Shaded area (S)
1	6
2	8
3	10
4	12
5	
6	

Reset

Question 8e (3 marks)

Verify your general rule for S.

Question 8f (20 marks)

Stage number (n)	Shaded area (S)	Area of outer square (A)	Unshaded area (U)
1	6	16	10
2	8	25	17
3	10	36	26
4	12	49	37
5			
6			

Reset

Investigate to find a relationship for U in terms of n. In your answer, you should:

- predict more values and record these in the table
- identify **one** pattern for A
- identify **one** pattern for U
- determine the general rule for U in terms of n
- test and verify your general rule for U
- justify your general rule for U.

Remember, you should communicate in an organized and coherent manner.

B I ↶ ↷ U x_2 x^2 Ω Styles