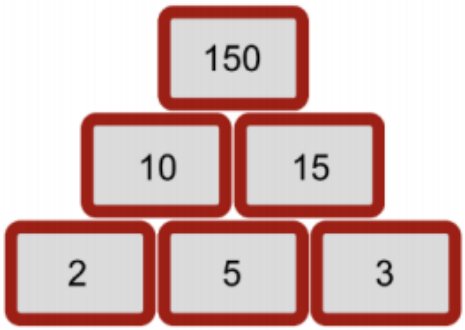
Question 1 (6 marks)

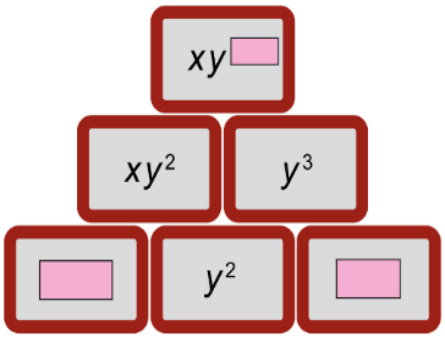
The following image shows a completed multiplication pyramid.



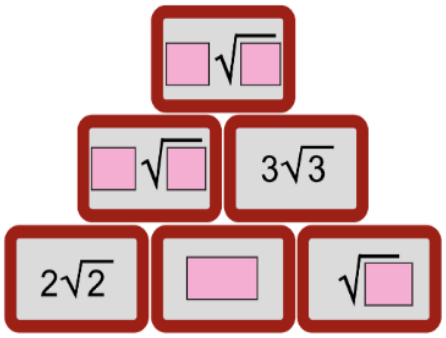
Determine the missing values in each of the following multiplication pyramids.

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

Question 1a (3 marks)



Question 1b (3 marks)



Question 2 (7 marks)

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

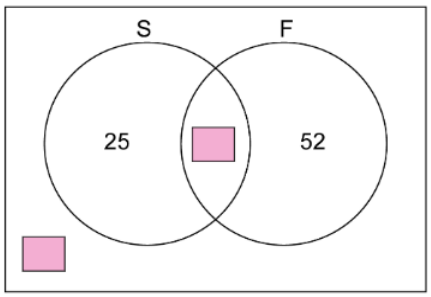
There are 96 students in MYP5:

43 chose Science (S)
70 chose Football (F)

The information is presented in the following Venn diagram.

Question 2a (2 marks)

Determine the missing values in the Venn diagram.



Question 2b (1 mark)

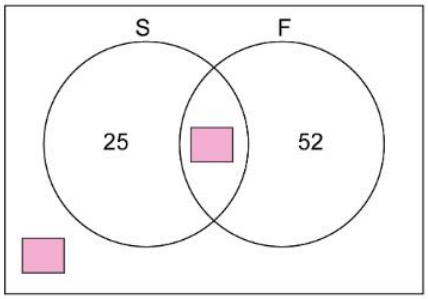
Write down the probability that a student selected at random is in the Science club.

Question 2c (1 mark)

Write down what $S \cap F'$ represents in context of this question.

Question 2a (2 marks)

Determine the missing values in the Venn diagram.



Question 2d (3 marks)

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

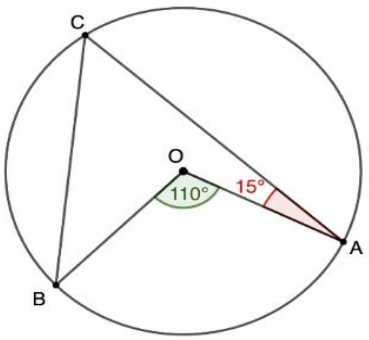
Styles

Question 3 (7 marks)

Question 3a (1 mark)

The following circle has centre O. The points A, B and C lie on the circle.

Diagram not to scale

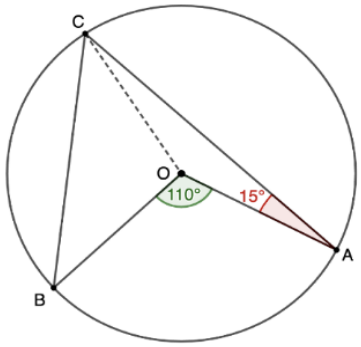


State the reason why angle BCA is 55°.

Styles

Question 3b (1 mark)

A line is drawn from C to O.



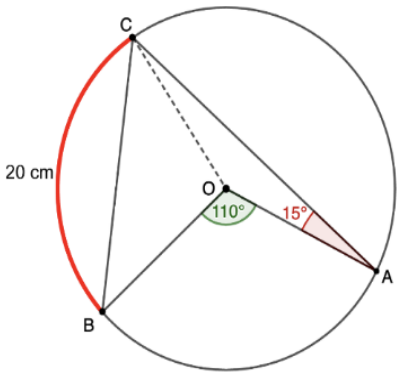
Determine angle BCO.

Question 3c (1 mark)

Determine angle BOC.

Question 3d (2 marks)

Diagram not to scale



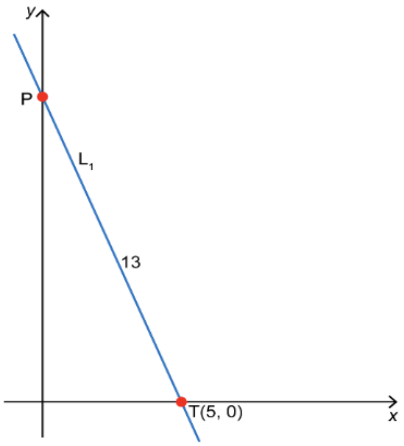
Given that the length of arc BC is 20 cm, **determine** the circumference of the circle.

Question 3e (2 marks)

Hence or otherwise, **determine** the radius of the circle.

Question 4 (8 marks)

The line L_1 passes through points P and T, where the length of PT is 13 units.



Question 4a (1 mark)

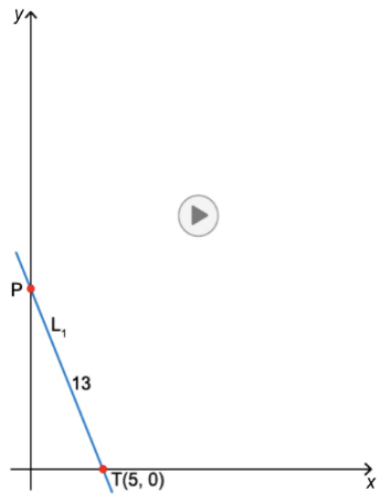
The coordinates of point P are $(0, p)$.
Show that $p = 12$.

Question 4b (2 marks)

Determine the equation of line L_1.

The line L_2 passes through point S(10, 4) and is parallel to L_1.

This media is interactive



Scroll down to continue

Question 4c (3 marks)

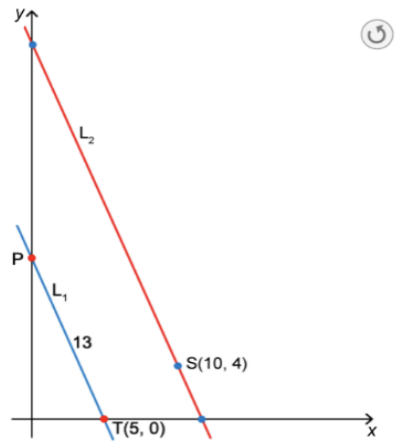
Find the equation of line L_2.

Question 4d (2 marks)

Hence, **determine** the x-intercept of line L_2.

The line L_2 passes through point S(10, 4) and is parallel to L_1.

This media is interactive



Question 4c (3 marks)

Find the equation of line L_2.

Question 4d (2 marks)

Hence, **determine** the *x*-intercept of line L_2.

Question 5 (8 marks)

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

The height of the slide is modelled by the quadratic function

$$f(x) = a(x-5)^2 \text{ where } 0 \leq x \leq L$$

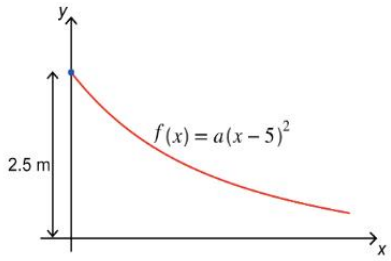
such that:

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 (2 marks)



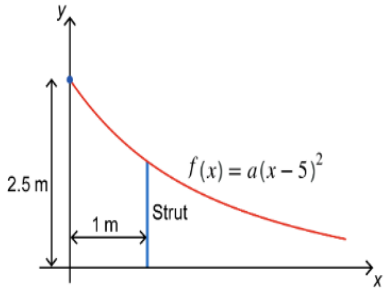
The initial height of the slide is 2.5 metres (m).

Show that $a = 0.1$.

B I ⟲ ⟳ U x_2 x^2 Styles

Question 5b (2 marks)

A strut is positioned at a horizontal distance of 1 m, as shown in the diagram.

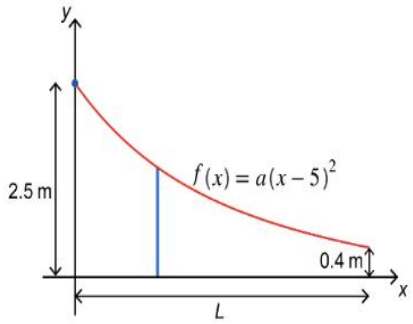


Determine the height of the strut.

B I ⟲ ⟳ U x_2 x^2 Styles

Question 5c (4 marks)

The end of the slide has a height of 0.4 m, as shown in the following diagram.



Calculate the horizontal length L.

B I U X_2 X^2 Styles

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.

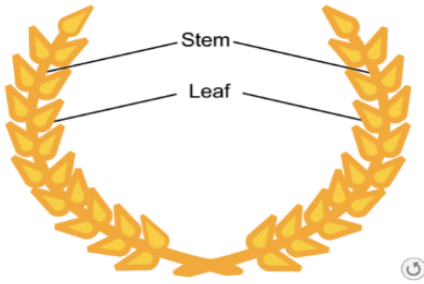
B I ⟲ ⟳ U x_2 x^2 Styles

Scroll down to continue

Question 6b (1 mark)

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.

This media is interactive



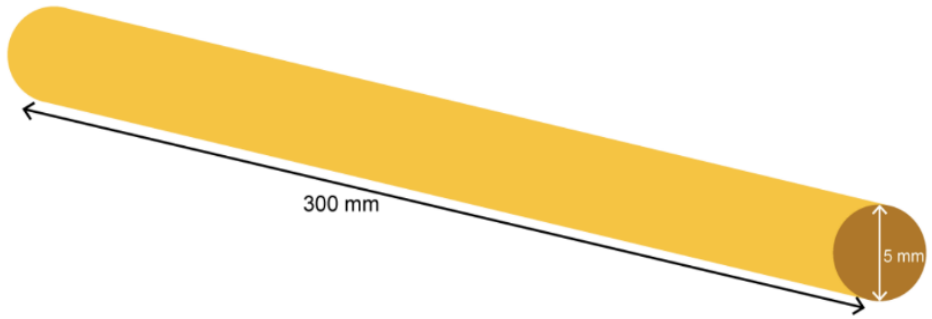
Draw the line of symmetry on the crown.

Draggable:

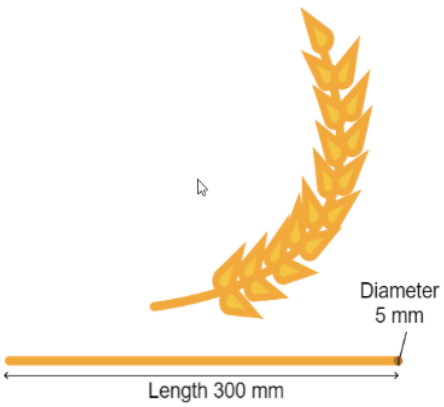
Question 6c (2 marks)

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

Diagram not to scale



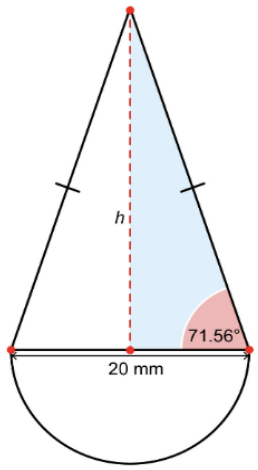
This media is interactive



Determine the volume of both stems.

Question 6d (3 marks)

Diagram not to scale



Each leaf can be modelled as a combination of two shapes: an isosceles triangle and a semicircle. **Show that** the height, h, of the triangle is 30 mm to the nearest whole number.

B I U x_2 x^2 Styles

Question 6e (3 marks)

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

Question 6f (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 (c)*
Volume of all leaves (mm^3)	17 366
Total volume of the crown (mm^3)	
Total volume of the crown (cm^3)	

Reset

Question 6g (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 (f)*	25
Density (g/cm^3)		19.32
Minimum accepted density for the gold crown		
Conclusion		

Question 7 (19 marks)

Video | Script

Pigeons were once used to deliver messages by different cultures all over the world. They were even used by the military for delivering messages, largely due to their ability to sense magnetic fields and use ultra-low sound frequencies to find their way back home with a very high success rate.

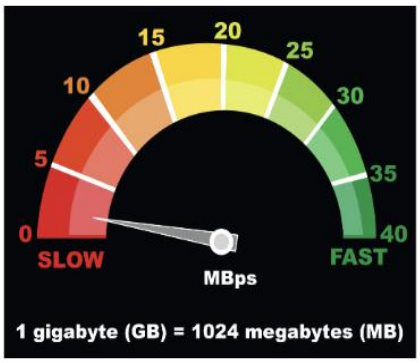
These days, messages are mostly sent using the internet. However, the internet speed in some areas is very slow, causing messages to take a long time to send. Also, where the electricity supply is not reliable, there may be power cuts.

Depending on the size of the data and the distance it needs to travel, pigeons could be faster than the internet – especially when the data files are large.

Pigeons fly for nearly 14 hours during the daytime, and they sleep for about 10 hours at nighttime. Their average flying speed is around 90 km/h.

In this question you will compare the speed of the internet versus pigeons when sending very large data files.

Question 7a (2 marks)



The upload speed of your internet is 1.6 MB per second (MBps).

Show that the time required to upload 100 GB is 18 hours to the nearest hour.

Question 7b (5 marks)

The following table shows the amount of time for 50 pigeons to each fly a distance of 170 km.

Time (t) in minutes	$85 \le t < 95$	$95 \le t < 105$	$105 \le t < 115$	$115 \le t < 125$	$125 \le t < 135$	$135 \le t < 145$
Number of pigeons	3	10	15	13	7	2

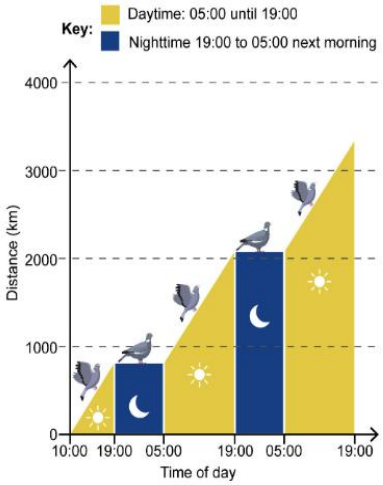
Show that an estimate for the mean time is 2 hours to the nearest hour.

B I ↩ ↪ U x_2 x^2 Styles

Question 7c (2 marks)

Pigeon flight pattern

Pigeons fly for 14 hours during the daytime, and they sleep for 10 hours at nighttime.



Given that:

- the average speed of a pigeon is 90 km/h

$$Speed = \frac{Distance}{Time}$$

- the pigeon flies during the daytime and rests during the nighttime.

A pigeon must fly 2250 km to deliver a message. It starts on Saturday at 10:00.

Show that it will arrive the following Monday at 07:00.

B I ↩ ↪ U x_2 x^2 Styles

Question 7d (10 marks)

You plan to send large data files to three friends on **Saturday at 10:00**, using either the internet or pigeons.

Analyse the information to decide whether the internet or the pigeon is the fastest option for each friend. In your answer, you should:

- identify **three** relevant factors
- complete the tables by
  - writing the day and time of delivery using the internet and using pigeons
  - selecting the fastest option
  - calculating the minimum file size to justify using pigeons
- show suitable rounding in your working and results.

Tools and tables are provided to support your answer.

Identify three relevant factors

,

Internet upload speed: 1.6 MBps

1

Calculate

Time: 0 hours

The information for 50GB has been completed for you.

File size	Number of hours taken to send files	Day and time of delivery
50 GB	9	Saturday at 19:00
100 GB		
300 GB		

Reset

Pigeon speed 90 km/hr

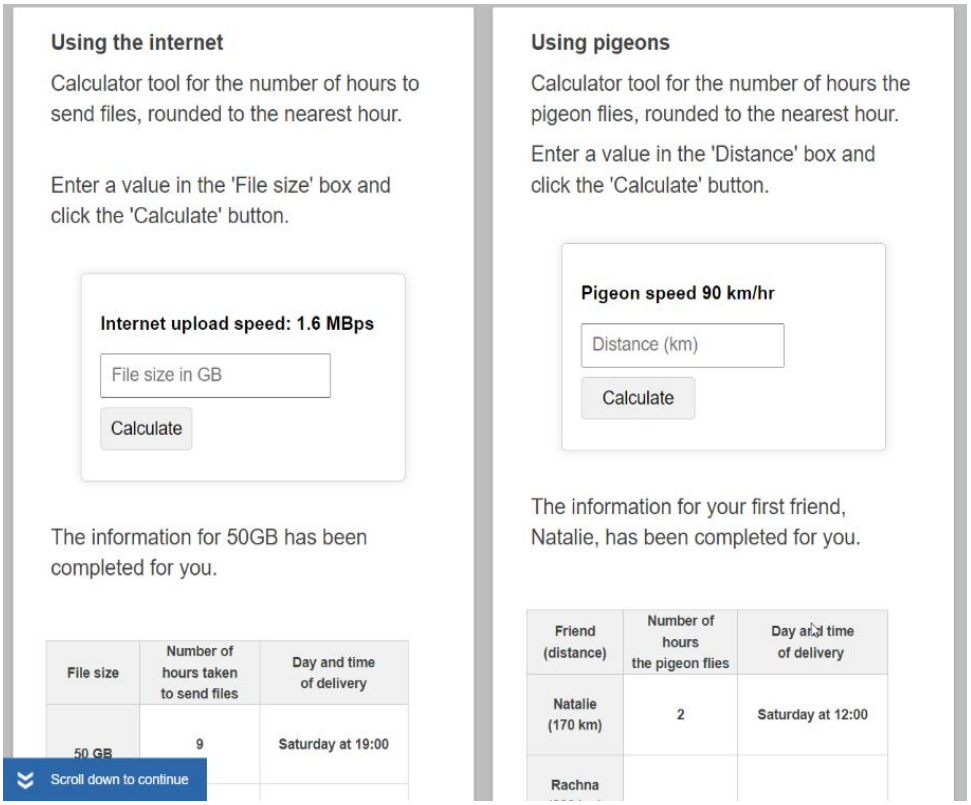
Distance (km)

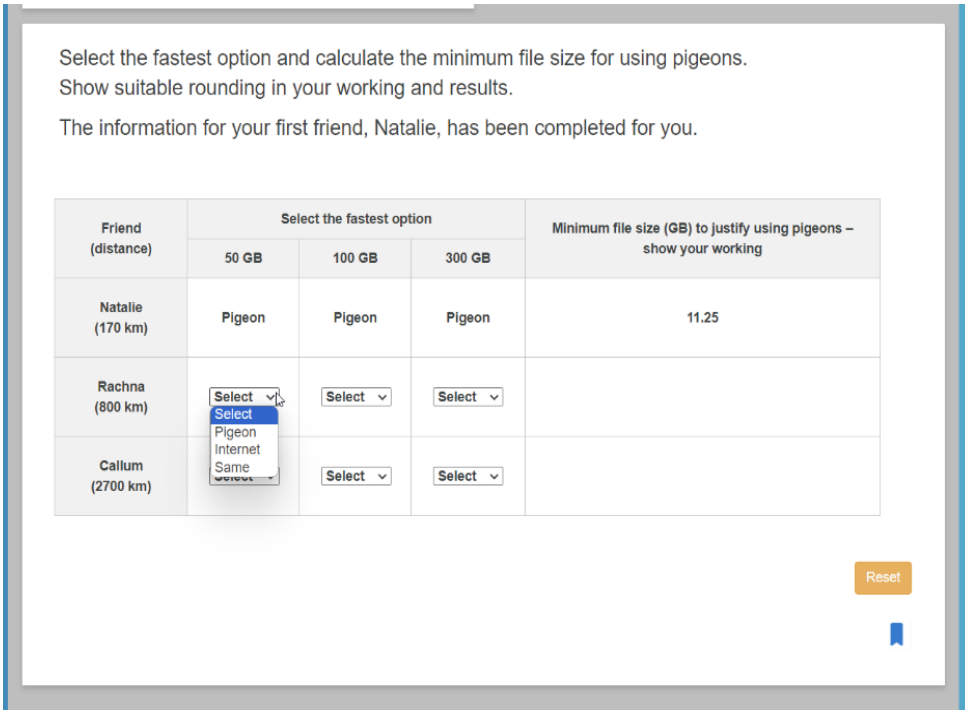
Calculate

The information for your first friend, Natalie, has been completed for you.

Friend (distance)	Number of hours the pigeon flies	Day and time of delivery
Natalie (170 km)	2	Saturday at 12:00
Rachna (800 km)		
Callum (2700 km)		

Reset


Using the internet
Calculator tool for the number of hours to send files, rounded to the nearest hour.
Enter a value in the 'File size' box and click the 'Calculate' button.
Internet upload speed: 1.6 MBps
File size in GB
Calculate
The information for 50GB has been completed for you.
File size
Number of hours taken to send files
Day and time of delivery
50 GB
9
Saturday at 19:00
Scroll down to continue
Using pigeons
Calculator tool for the number of hours the pigeon flies, rounded to the nearest hour.
Enter a value in the 'Distance' box and click the 'Calculate' button.
Pigeon speed 90 km/hr
Distance (km)
Calculate
The information for your first friend, Natalie, has been completed for you.
Friend (distance)
Number of hours the pigeon flies
Day and time of delivery
Natalie (170 km)
2
Saturday at 12:00
Rachna


Select the fastest option and calculate the minimum file size for using pigeons.
Show suitable rounding in your working and results.
The information for your first friend, Natalie, has been completed for you.
Friend (distance)
Select the fastest option
50 GB
100 GB
300 GB
Minimum file size (GB) to justify using pigeons – show your working
Natalie (170 km)
Pigeon
Pigeon
Pigeon
11.25
Rachna (800 km)
Select
Select
Pigeon
Internet
Same
Select
Select
Callum (2700 km)
Select
Select
Reset

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

Question 8 (30 marks)

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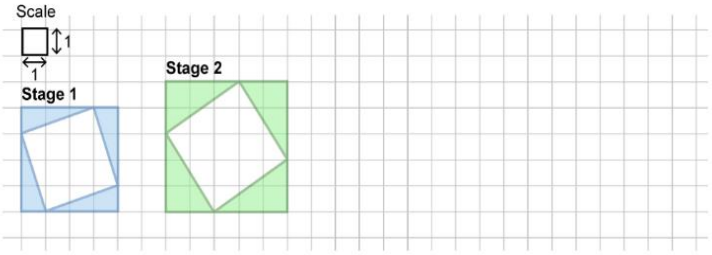
Stage Control



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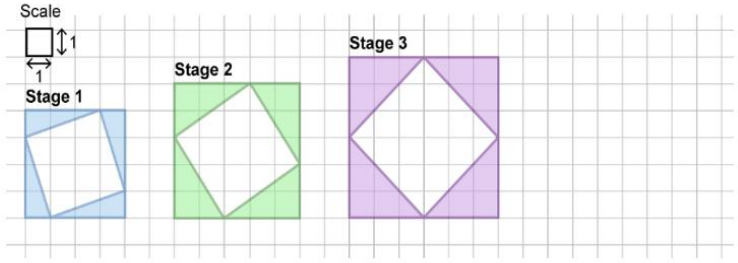

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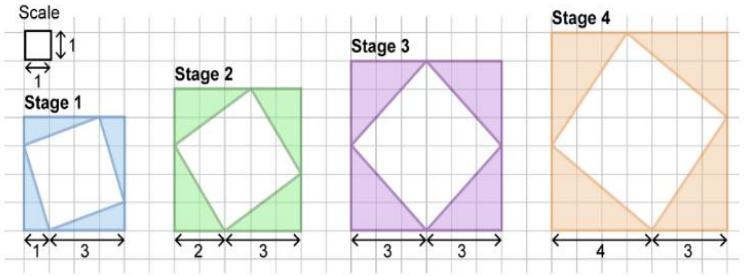
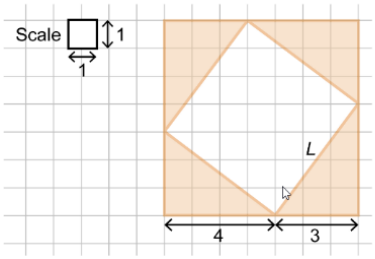
Stage Control



Stage 4



Question 8a (1 mark)

Determine the length of L.

Question 8b (1 mark)

Show that the shaded area in stage 4 is 24.

Scroll down to continue

Question 8c (1 mark)

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

Stage number (n)	Shaded area (S)
1	6
2	12
3	18
4	24
5	
6	

Reset

Question 8d (2 marks)

Identify two patterns for S.

Question 8e (2 marks)

Determine the general rule for S in terms of n.

Question 8c (1 mark)

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

Stage number (n)	Shaded area (S)
1	6
2	12
3	18
4	24
5	
6	

Reset

Question 8f (3 marks)

Verify your general rule for S.

B I ↶ ↷ U x_2 x^2 Ω Styles

Question 8g (20 marks)

Stage number (n)	Shaded area (S)	Area of outer square (A)	Unshaded area (U)
1	6	16	10
2	12	25	13
3	18	36	18
4	24	49	25
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