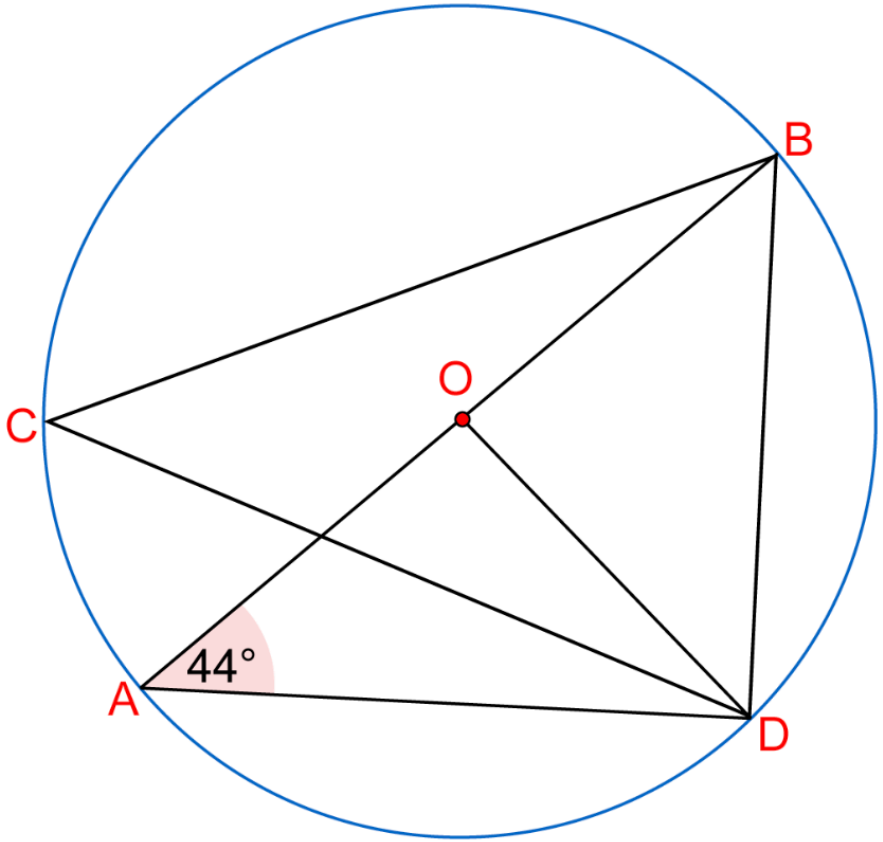
Question 1 (8 marks)

Question 1a (3 marks)

The following circle has centre O. The points A, B, C and D lie on the circumference such that O lies on AB.

Diagram not to scale



Given that angle DAB is 44°, **determine** the size of the following angles.

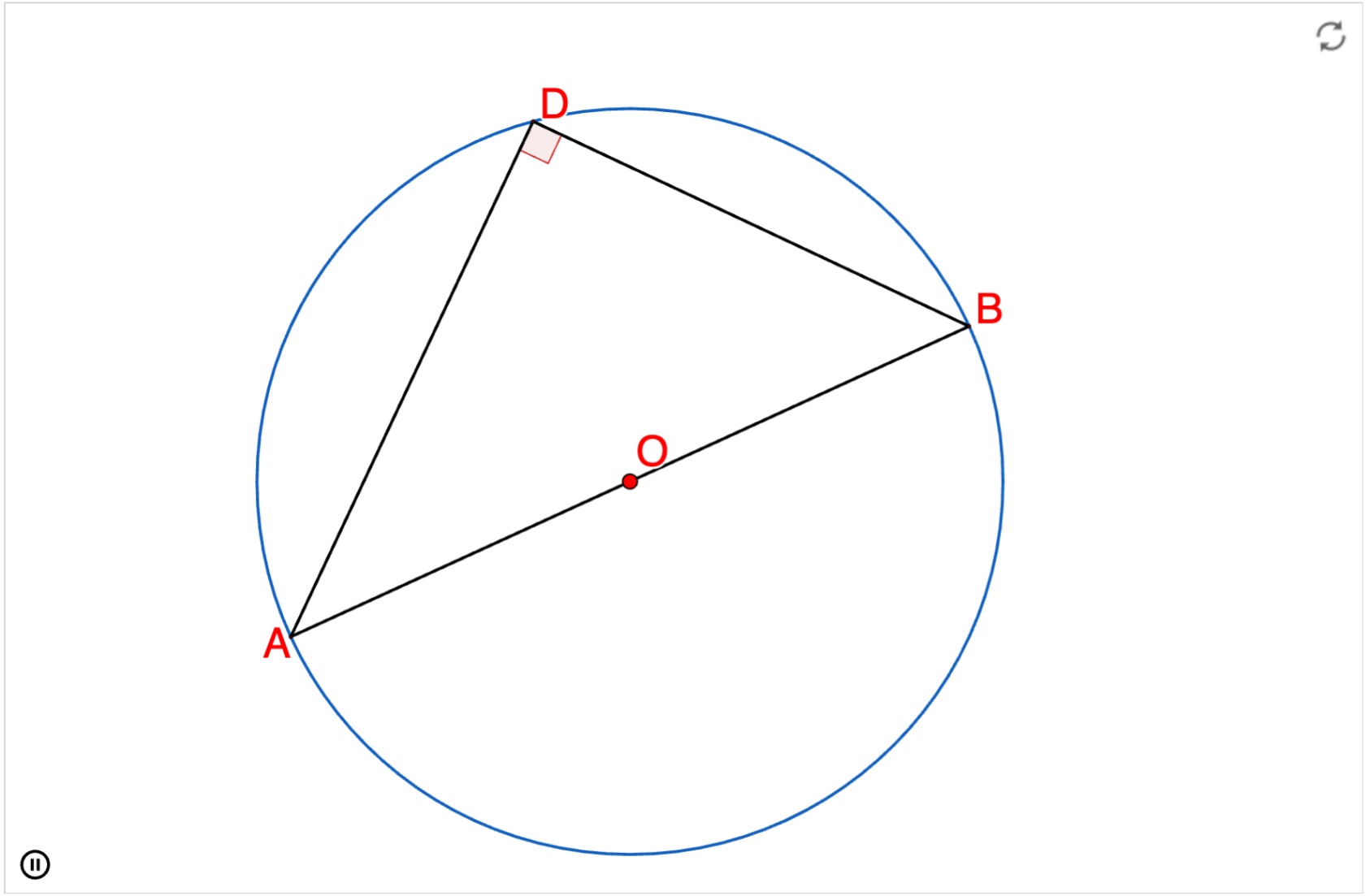
Angle AOD ____ °

Angle DOB ____ °

Angle DCB ____ °

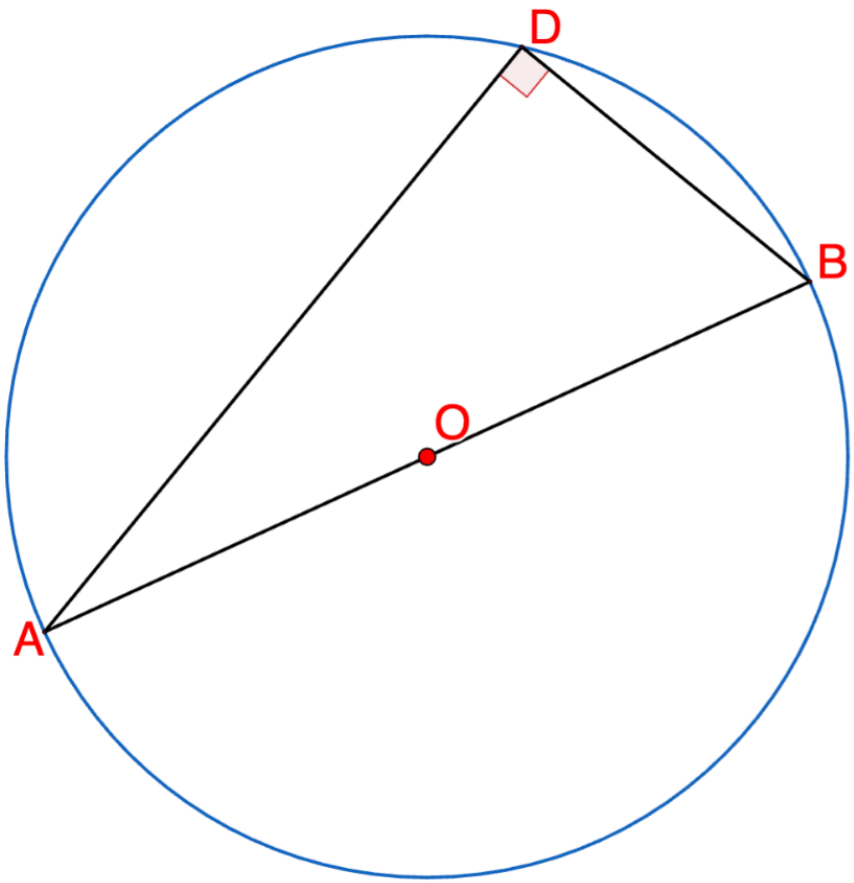
Question 1b (1 mark)

This media is interactive



Using your knowledge of circle theorems, **write down** why angle ADB is 90°.

Diagram not to scale



Question 1c (2 marks)

Given that, AD = 12 cm and BD = 6 cm, **find** the length of AB. Give your answer in simplified surd form $a\sqrt{b}$ where a and b are integers.

B I U $\times_2$ $\times^2$ Ω Σ

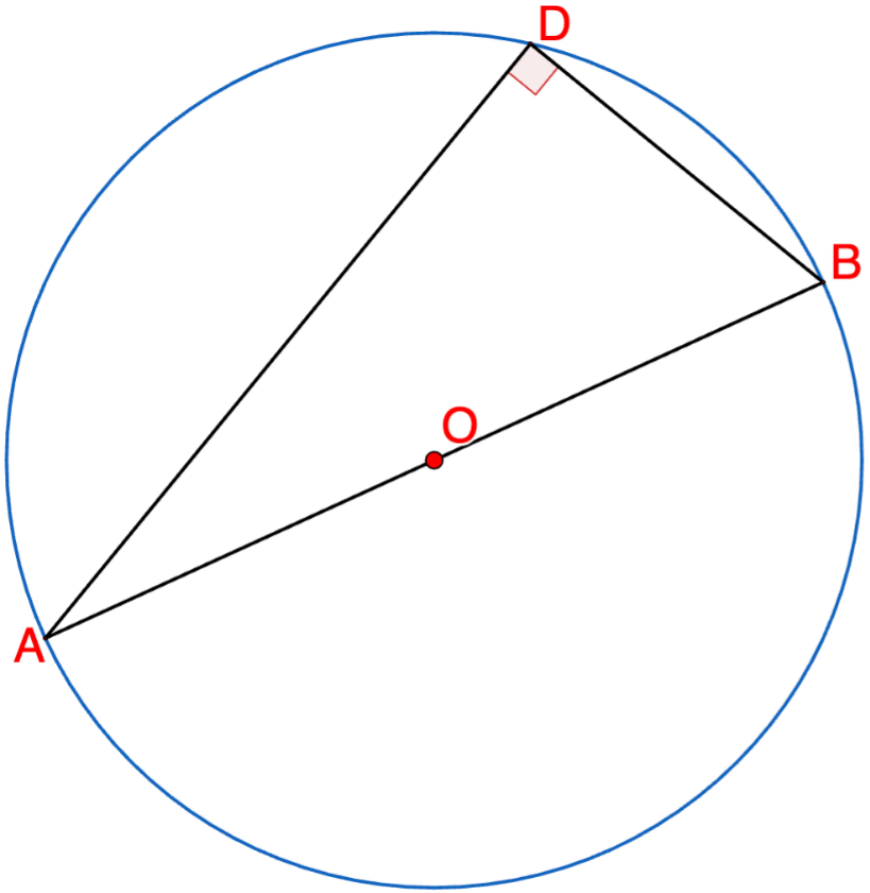
Styles

Question 1d (2 marks)

Hence, **determine** the area of the circle.

B I U $\times_2$ $\times^2$ Ω Σ

Diagram not to scale



Question 1d (2 marks)

Hence, **determine** the area of the circle.

B I U x_2 x^2 Ω Σ

Styles

Question 2 (7 marks)

MYP Academy is presenting a talent show for their community.

Some students from the Academy and some members of the community are performing in the show.

Question 2a (1 mark)

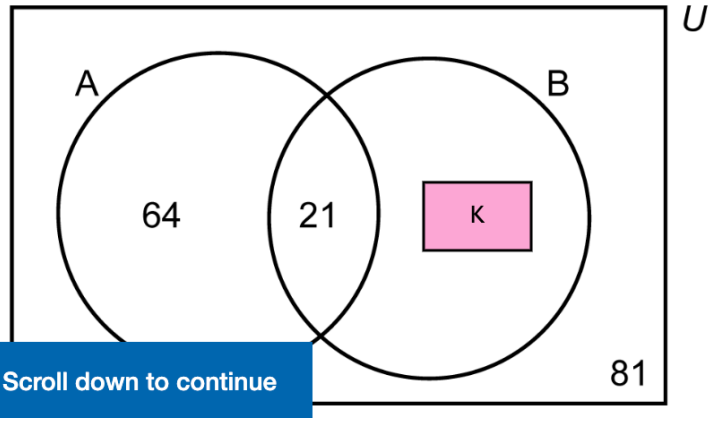
A total of 175 people will be at the show.

In the following Venn diagram:

Set A represents the number of Academy students at the show.

Set B represents the number of performers in the show.

Determine the value of K.



Scroll down to continue

Question 2b (1 mark)

Describe K in context.

Styles

Question 2c (2 marks)

One of the performers is selected at random to introduce the show.

Question 2a (1 mark)

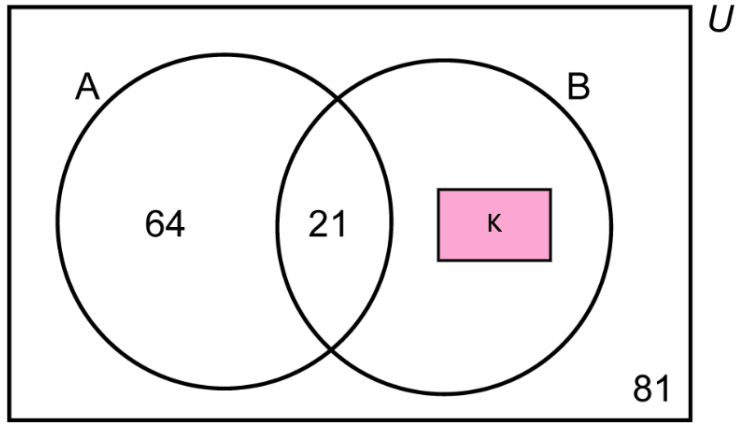
A total of 175 people will be at the show.

In the following Venn diagram:

Set A represents the number of Academy students at the show.

Set B represents the number of performers in the show.

Determine the value of K.



Question 2d (3 marks)

Three people at the show are selected at random.

Calculate the probability that the three people are performers.

B I U x_2 x^2 Ω Σ

Styles

Question 3 (7 marks)

Question 3a (3 marks)

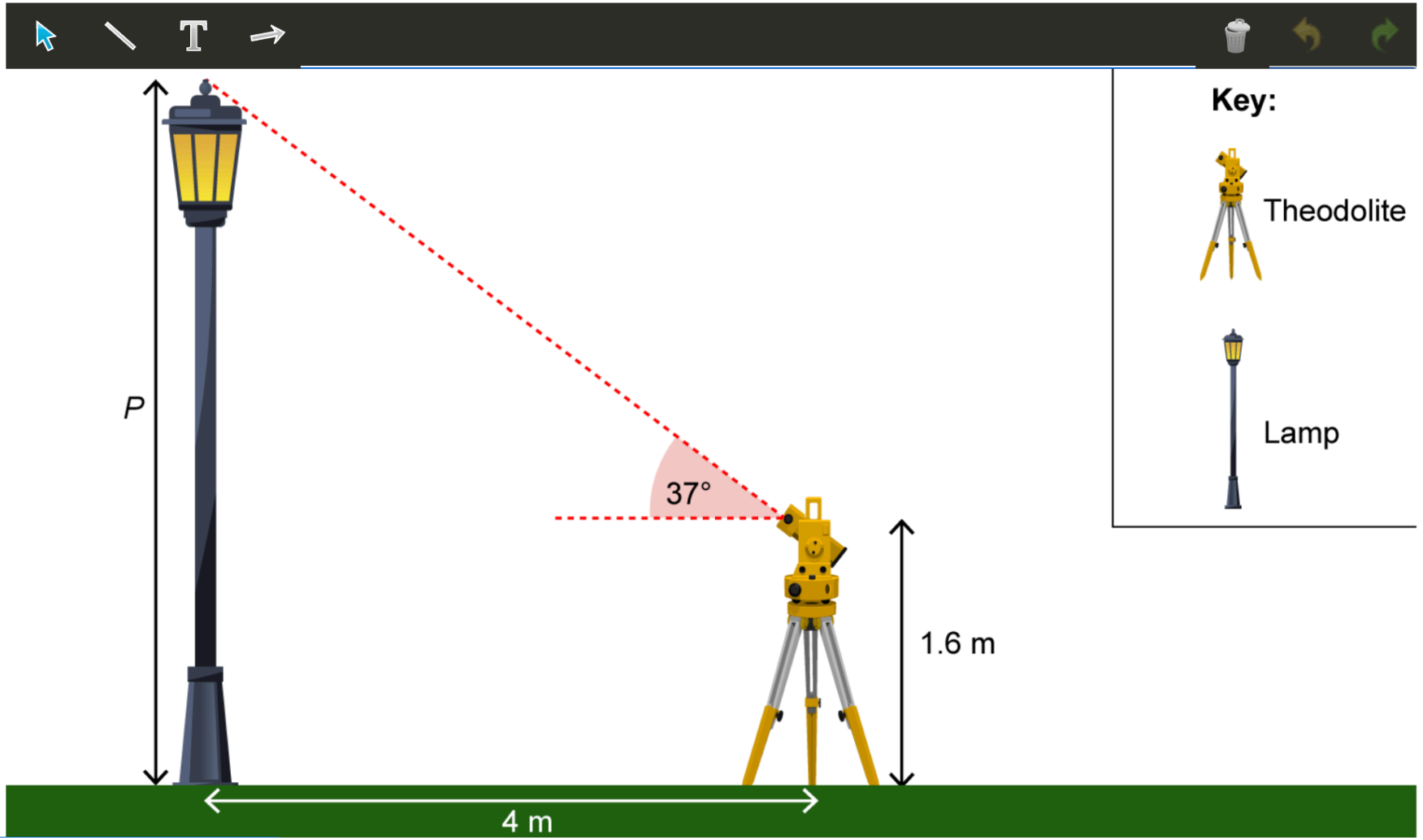
The height of a lamp is calculated using a measuring instrument called a theodolite.
The theodolite measures angles. The theodolite has a height of 1.6 metres and is positioned 4 metres from the lamp. The angle of elevation to the top of the lamp is 37 degrees.
The measurements are shown on the following diagram.

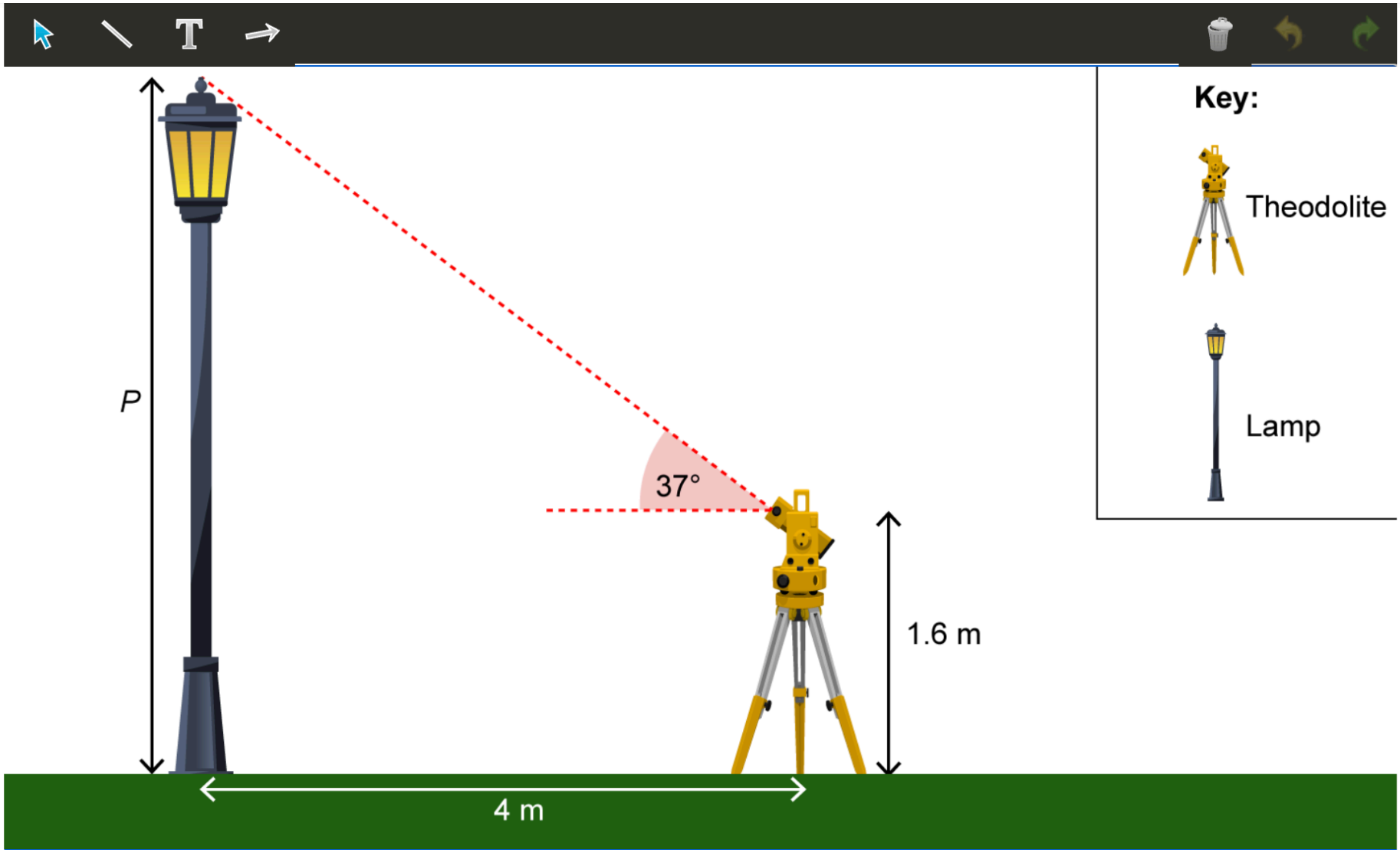
Diagram not to scale

Question 3a (3 marks)

The height of a lamp is calculated using a measuring instrument called a theodolite.
The theodolite measures angles. The theodolite has a height of 1.6 metres and is positioned 4 metres from the lamp. The angle of elevation to the top of the lamp is 37 degrees.
The measurements are shown on the following diagram.

Diagram not to scale





Calculate the height of the lamp *P*.

B I U x_2 x^2 Ω Σ Styles

Question 3b (4 marks)

The lamp is 20 metres from a building as shown in the diagram.

Diagram not to scale

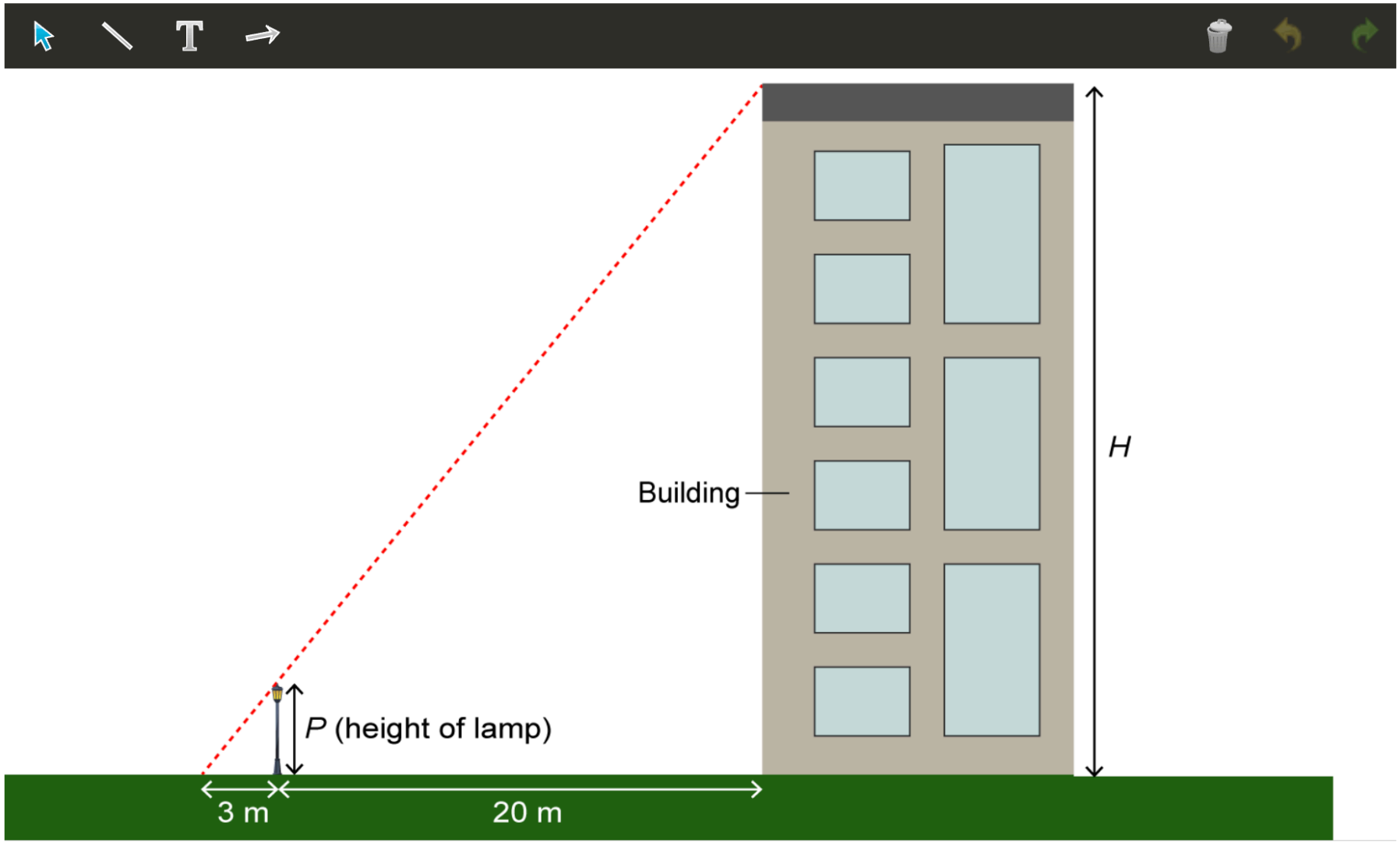
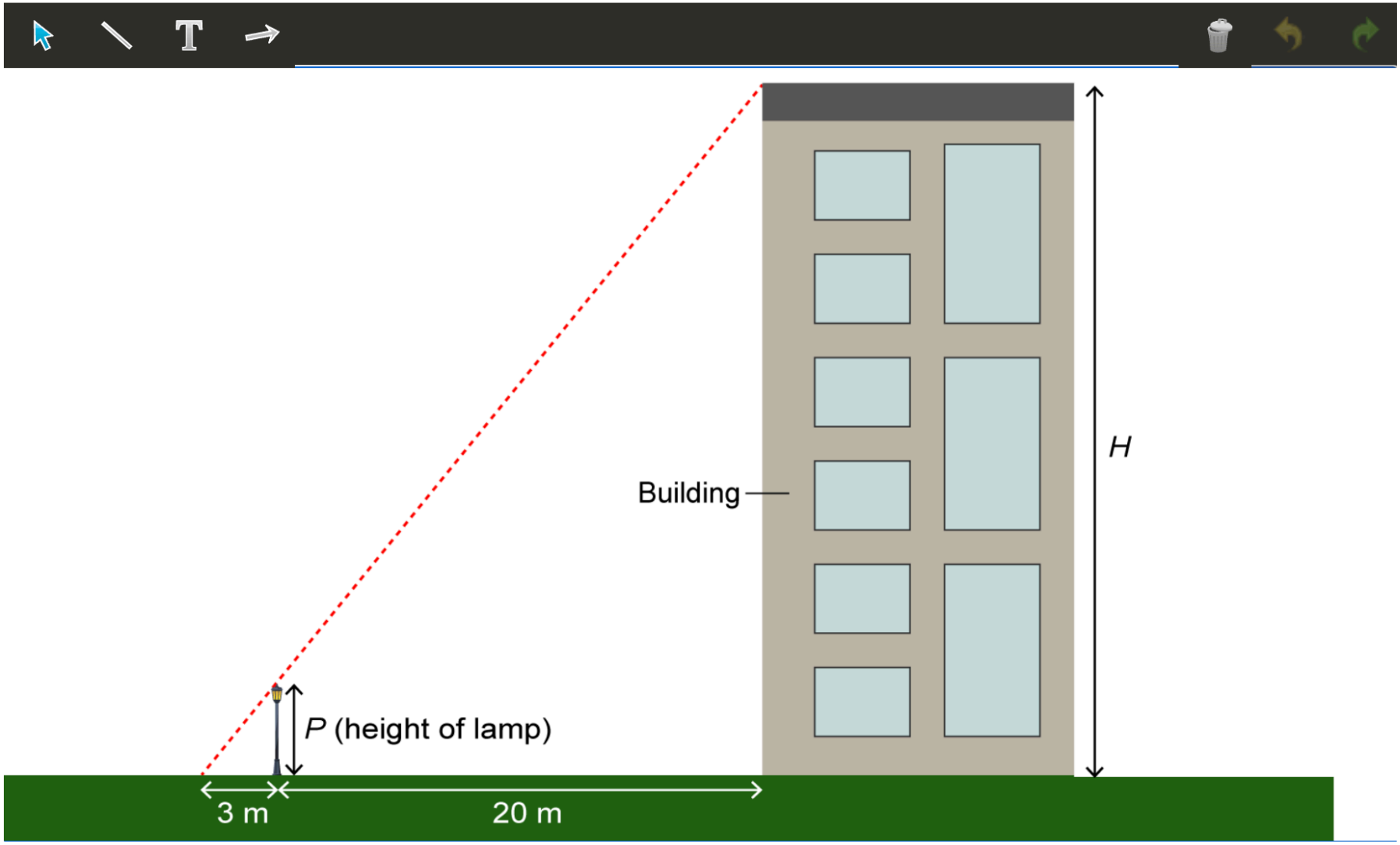


Diagram not to scale



Calculate the height (*H*) of the building. Write your answer to the nearest metre (m).

Question 4 (6 marks)

Question 4a (3 marks)

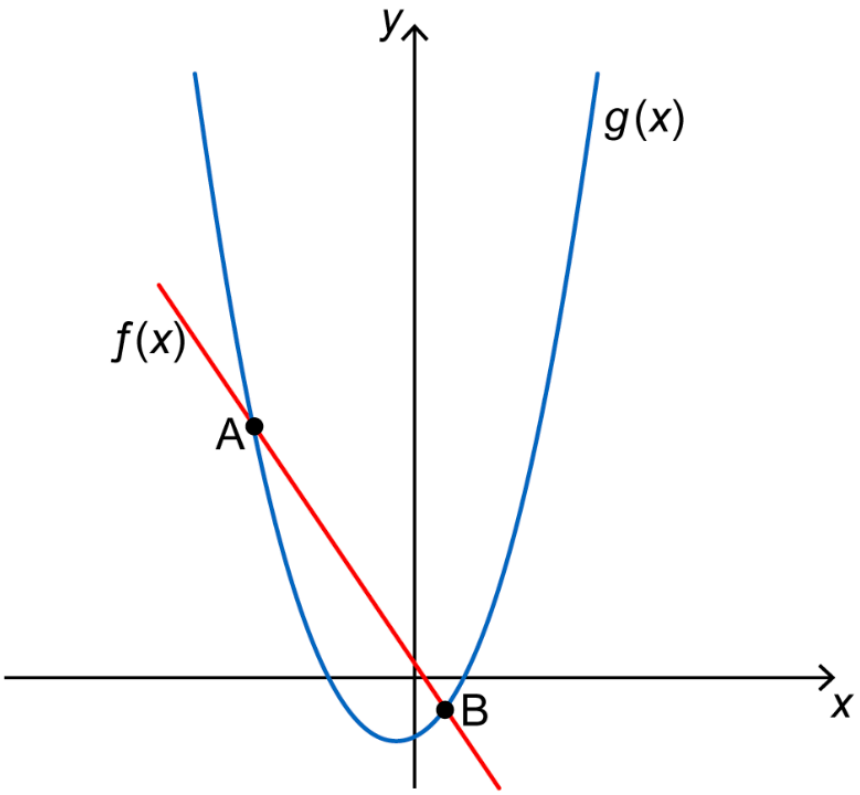
Given that, $f(x) = 1 - 3x$ and $g(x) = x^2 + x - 4$

Solve $f(x) = g(x)$

B I U x_2 x^2 Ω Σ Styles

Question 4b (3 marks)

The solutions of the equation $f(x) = g(x)$ are the x coordinates of the points A and B shown on the following graph.

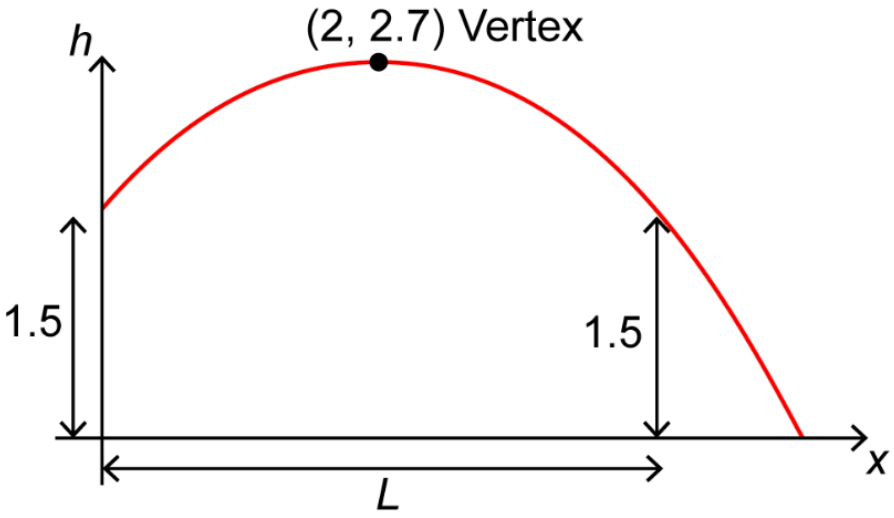


Using your answers from (a), **find** the values of the y coordinates of points A and B.

Styles

Question 5 (7 marks)

A basketball is thrown in the air from a height of 1.5 metres (m). The path of the basketball is represented by a parabola.



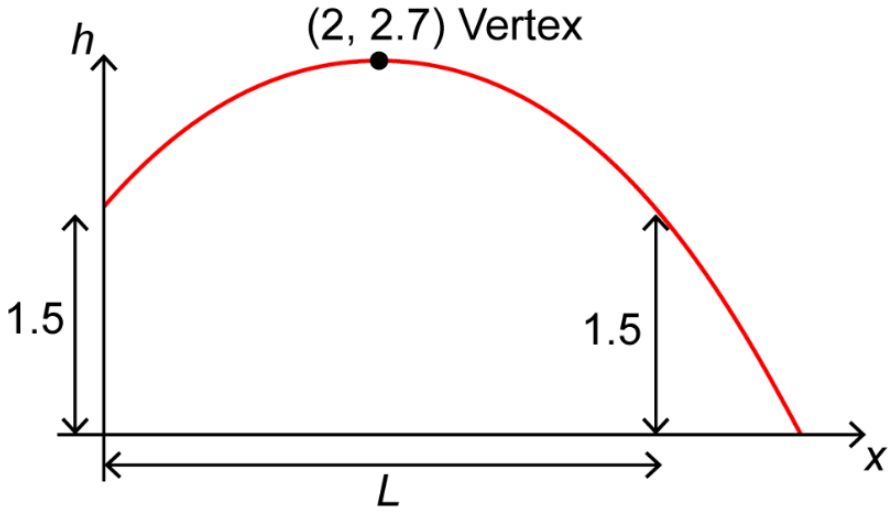
Question 5a (1 mark)

The ball is at the height 1.5 m again when its distance from the starting point is L. **Determine** the value of L.

B I U x_2 x^2 Ω Σ

Styles

A basketball is thrown in the air from a height of 1.5 metres (m). The path of the basketball is represented by a parabola.



Question 5b (2 marks)

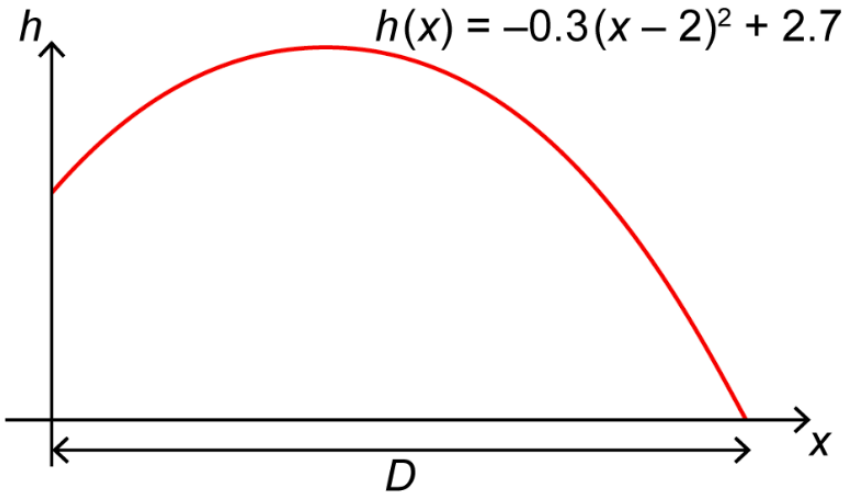
The path of the basketball is represented by a parabola in the form $h(x) = a(x - 2)^2 + 2.7$.

Show that $a = -0.3$.

B I U x_2 x^2 Ω Σ

Styles

Question 5c (4 marks)



The ball hits the ground at distance *D*.

Find the value of *D*.

B I U x_2 x^2 Ω Σ

Styles

Question 6 (18 marks)

Video | Script

Around the time of the French revolution, in 1790, French scientists created the metric system to measure weights and distances.

For a few years, the French abandoned the Gregorian 24 hour measure of time and adopted a metric measure of time.

This metric time was called 'The French Revolutionary time' and began officially on the 24 of November 1793.

Humans have evolved to live within the routine of a day.

Metric time uses 10 hours for one day instead of 24 hours for one day. Each metric hour has 100 minutes and each metric minute has 100 seconds.

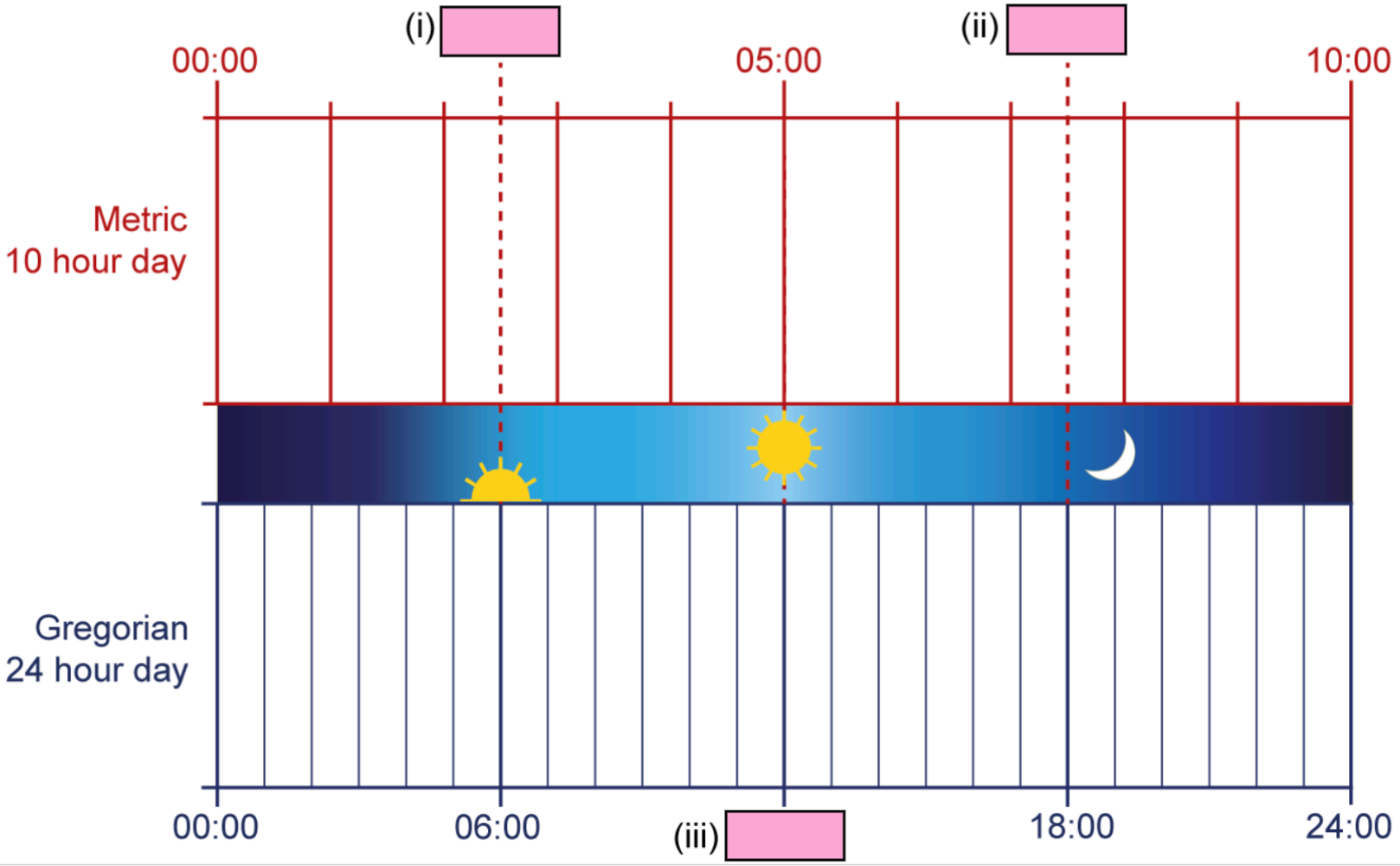
Despite its simplicity, the new system was not at all popular. Replacing all clocks was expensive and it became increasingly difficult to trade with other countries which did not adopt the metric time.

In this question you will make comparisons between Gregorian and metric time and observe how simple calculations are in terms of metric time.

Question 6a (2 marks)

The following diagram shows one day in two systems of time, metric and Gregorian.

Write down the missing times on the diagram.



Question 6b (2 marks)

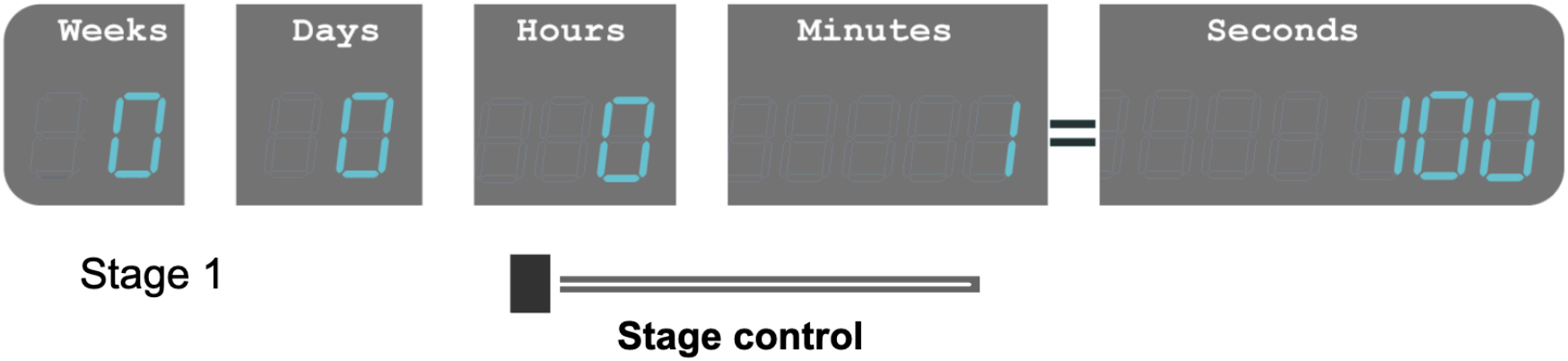
Determine the number of Gregorian hours and minutes in one metric hour.

Metric system	Gregorian system
1 hour(s) 0 minute(s)	____ hour(s) ____ minute(s)

Question 6c (4 marks)

Metric time conversions are shown in the following infographic.

This media is interactive



For example: 528 030 metric seconds is equivalent to:

Write down the missing times in the following table.

Write down the missing times in the following table.

School event	Metric time	Metric seconds in standard form
Examination	90 minutes	$\square \times \square^{\square}$
School day	2 hours and 40 minutes	$\square \times \square^{\square}$
Time to run 10 kilometres		5.3×10^3
Climbing mount Kilimanjaro	4 days, 2 hours and 5 minutes	$\square \times \square^{\square}$

Question 6d (2 marks)

A school timetable is created using metric time. All the following questions are in the context of metric time.

The timetable has a number of single lessons and a number of double lessons.

The mathematics department is requested to plan the lessons for the year with the following information:

- S represents the number of single lessons
- D represents the number of double lessons
- S + D = 160
- Single lessons are 20 metric minutes long
- Double lessons are 40 metric minutes long
- 20S + 40D = 4000

Describe the equations in the table in words.

Equation	Description in words
S + D = 160	
20S + 40D = 4000	

Reset

Question 6e (4 marks)

By solving simultaneous equations, **find** the values of S and D.

B I U x_2 x^2 Ω Σ Styles

The MYP 5 chemistry class is creating copper sulphate crystals from a solution.

It takes **one** metric day for the solution to form 2.987 grams of copper sulphate crystal.

Question 6f (1 mark)

Show that the rate of production is 2.987 milligrams per minute.

Styles

Question 6g (3 marks)

Calculate the maximum number of grams that can be produced from 04:00 on Day 1 to 04:90 on Day 2. Give your answer to the nearest gram.

Styles

Question 7 (17 marks)

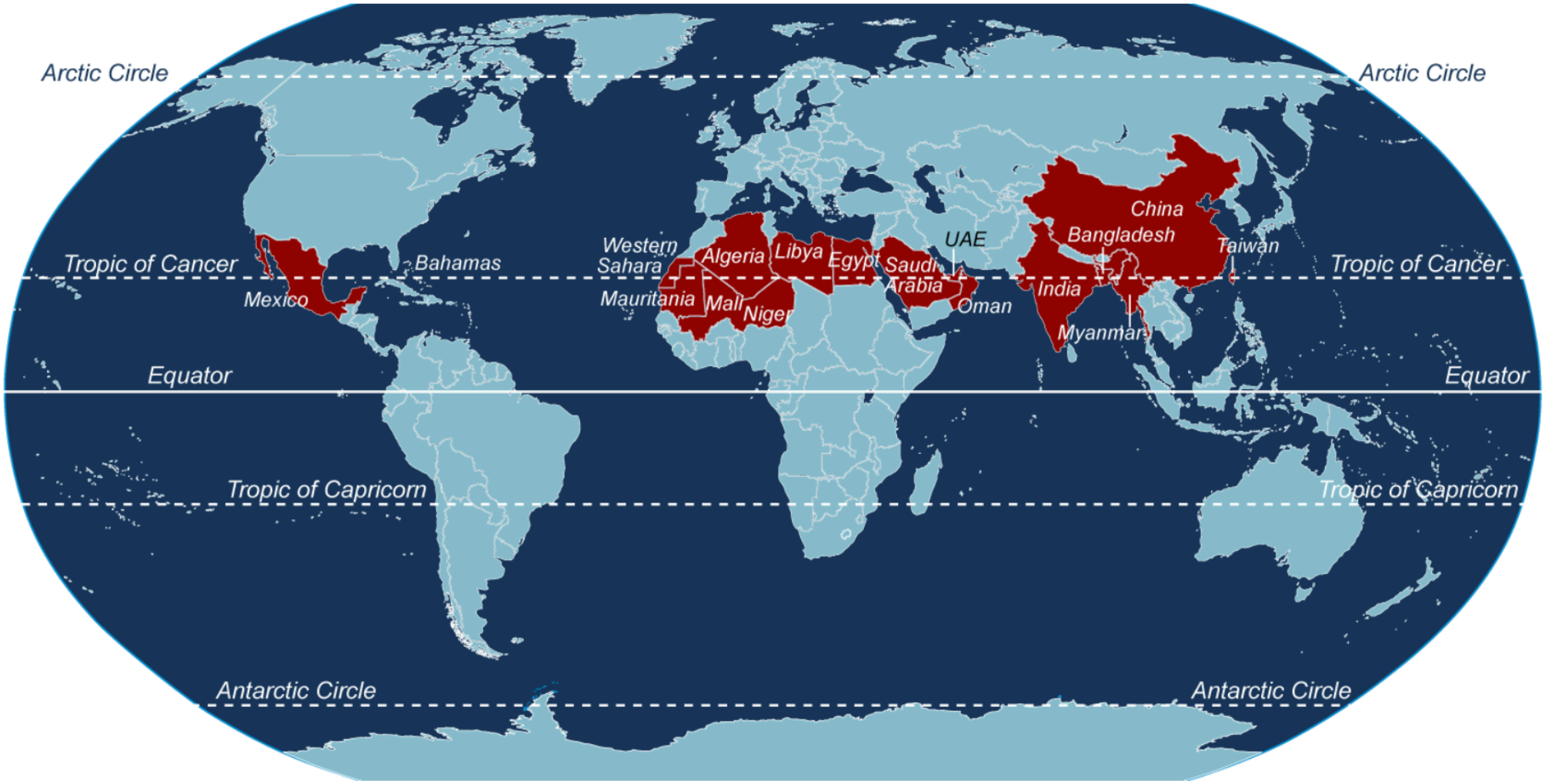
The Tropics of Cancer and Capricorn are lines of latitude that are parallel to the equator of the Earth.

There are eleven countries on the Tropic of Capricorn and seventeen countries in the Tropic of Cancer.

In this question, you will analyse the data on the life expectancies of countries on the two Tropics.

Click on the tab titles to switch between the Tropics.

Countries that fall on Tropic of Cancer | Countries that fall on Tropic of Capricorn



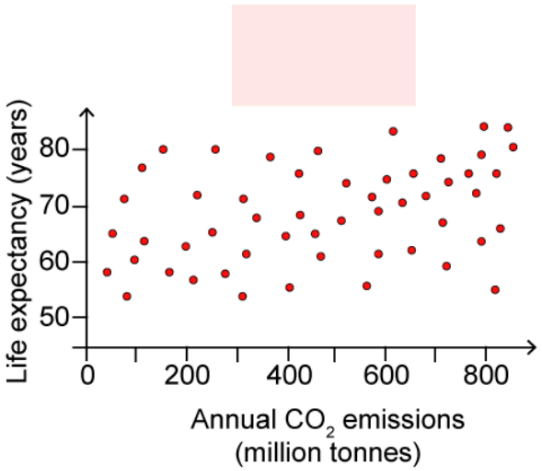
Countries that fall on Tropic of Cancer | Countries that fall on Tropic of Capricorn

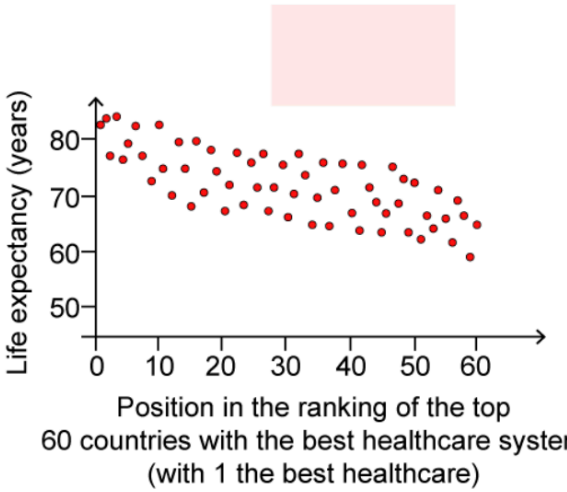
The relationship between life expectancy and other factors is represented on the following scatter graphs.

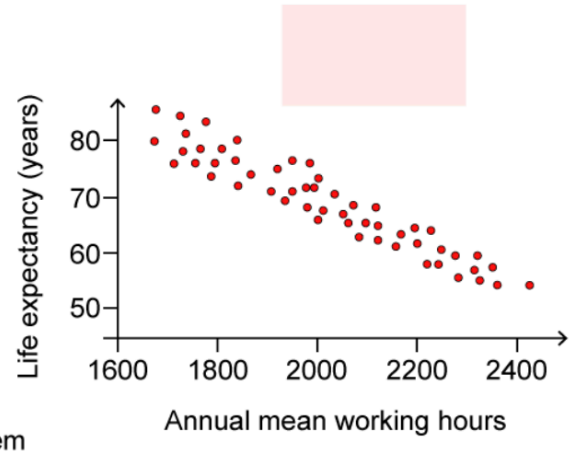
Identify the correlation for each of the scatter graphs.

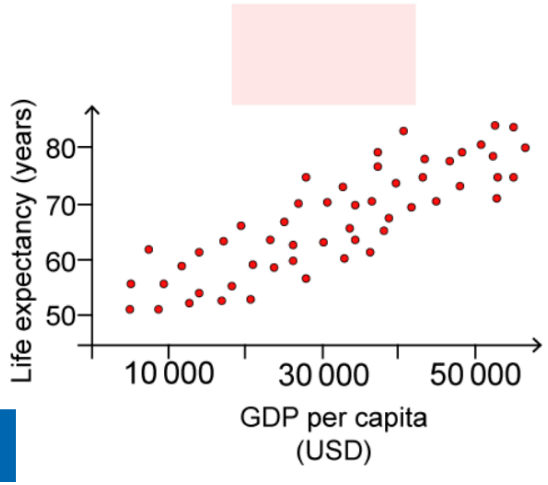
Draggable correlation description:

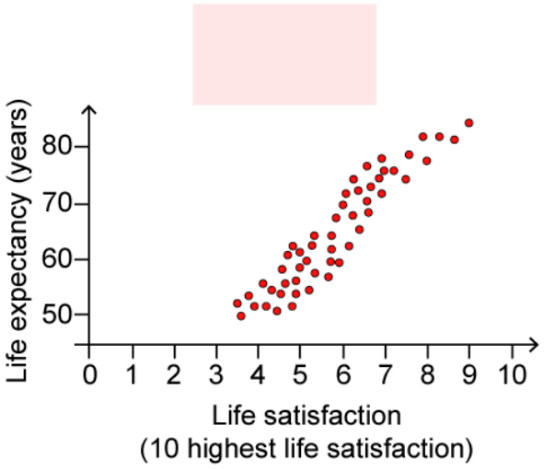
Strong negative	None	Strong positive	Positive	Negative











Scroll down to continue

There are **eleven** countries positioned on the **Tropic of Capricorn**. The life expectancies in 2021 for these (11) countries are as follows.

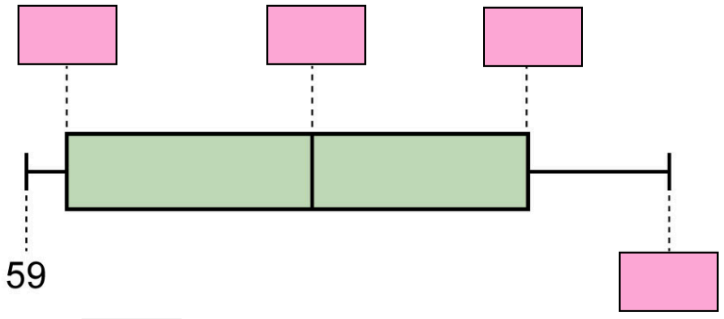
Life expectancy (Age in years)										
59	59	61	62	65	71	73	75	79	80	85

Question 7b (3 marks)

Write down the missing values in the box and whisker plot.

Box-and-whisker plot for life expectancy in 2021

Tropic of Capricorn



Mode:

Question 7c (2 marks)

Hence, **determine** the following measures of dispersion.

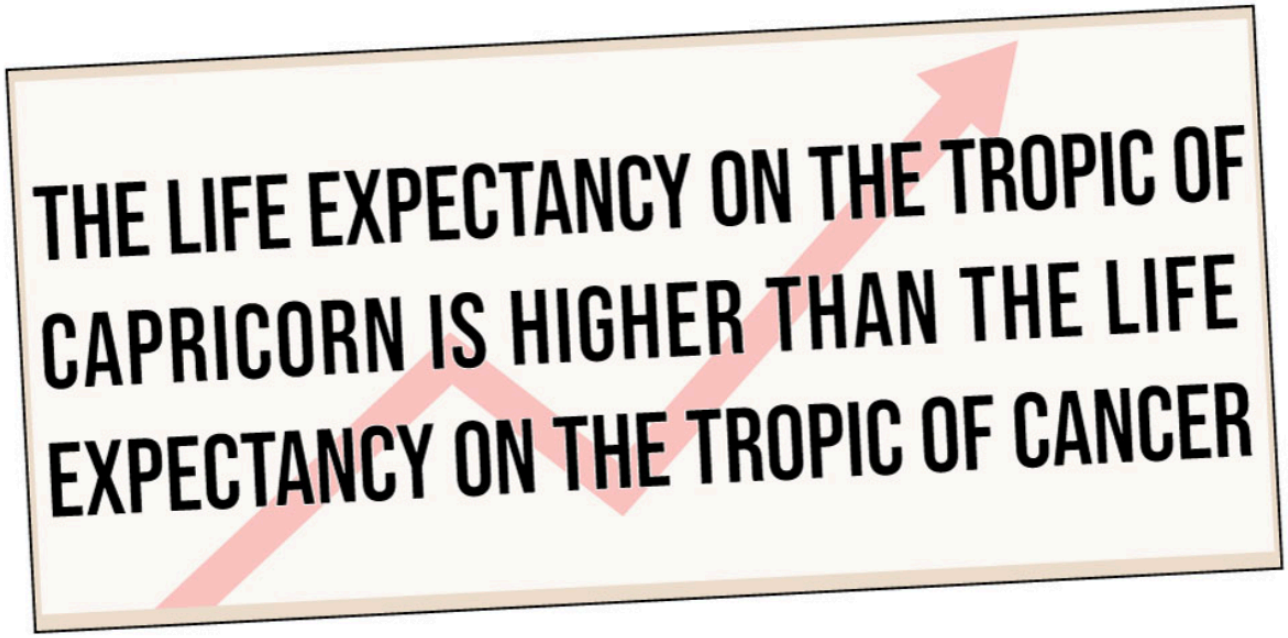
Range:

Styles

Interquartile range (IQR):

Question 7d (10 marks)

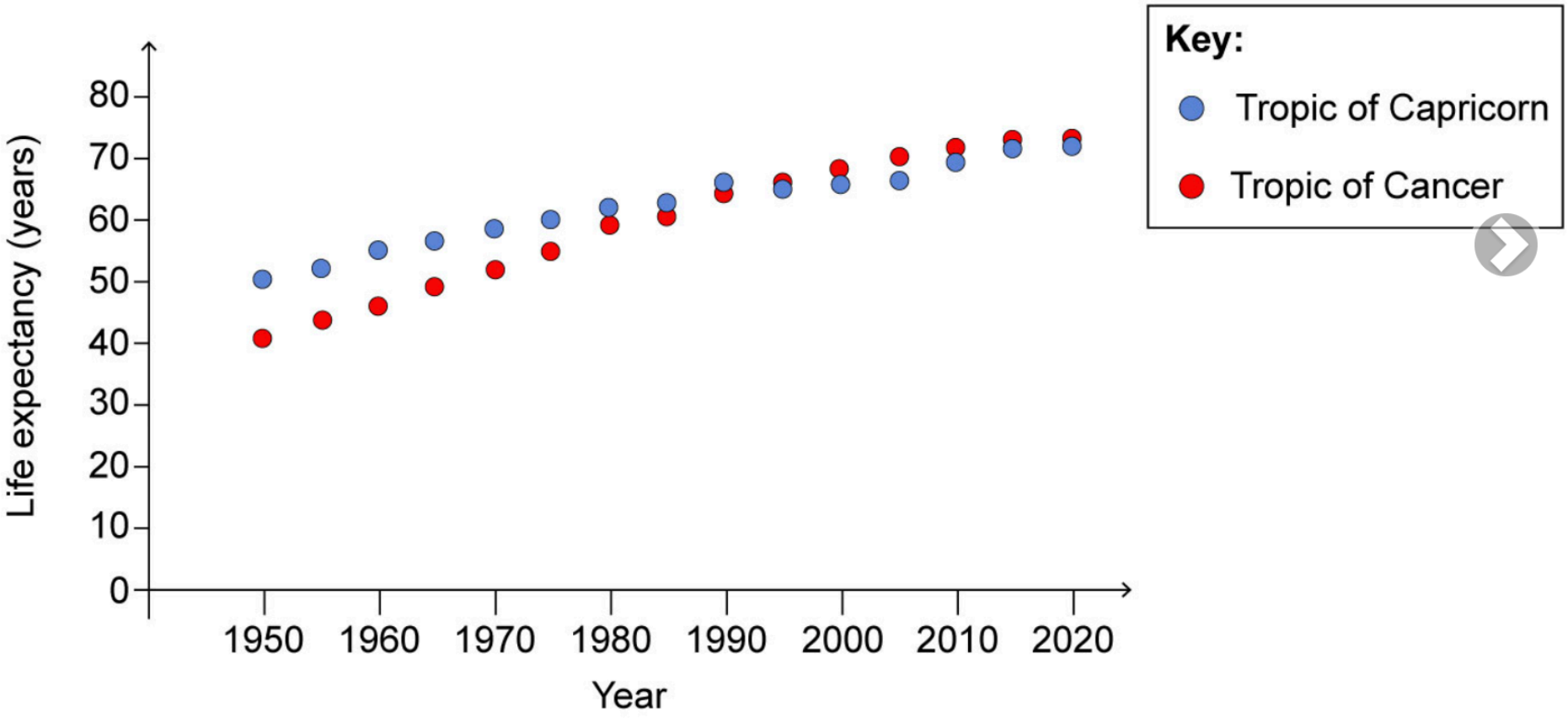
News Headline:



Scroll through the image gallery to see life expectancy data for the Tropic of Cancer and the Tropic of Capricorn.

Image 1

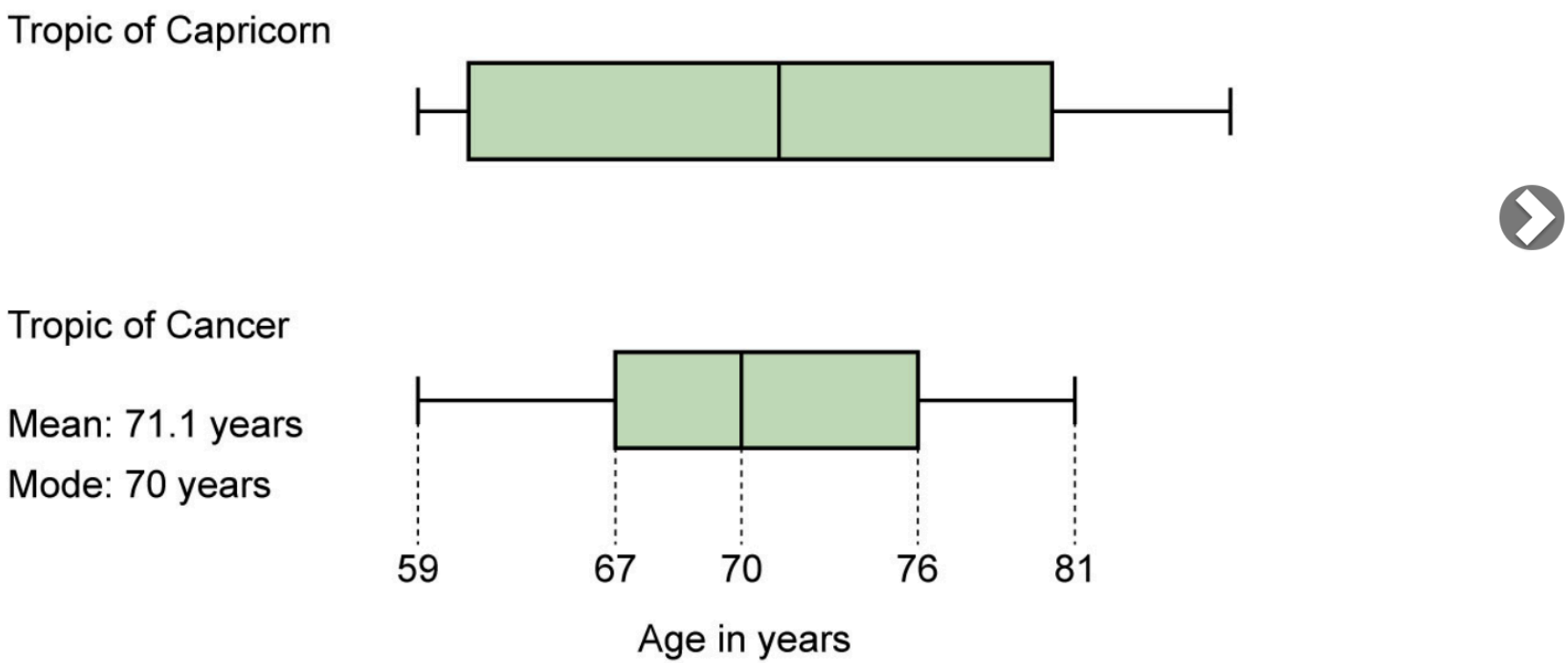
Life expectancy from 1950 to 2020 for Tropic of Capricon and Tropic of Cancer



Scroll through the image gallery to see life expectancy data for the Tropic of Cancer and the Tropic of Capricorn.

Image 2

Box-and-whisker plot for life expectancy in 2021



Analyse the data on life expectancy and comment on the headline. In your answer you should:

- identify the elements relevant to your comparison
- compare measures of central tendency, measures of dispersion, and any other relevant information
- comment on the headline
- justify the degree of accuracy of your results.

Elements relevant to your comparison.

Comparison, comment and justification.

Question 8 (30 marks)

A diagonal line starts at point A(0,10) and reaches point B(1,0).

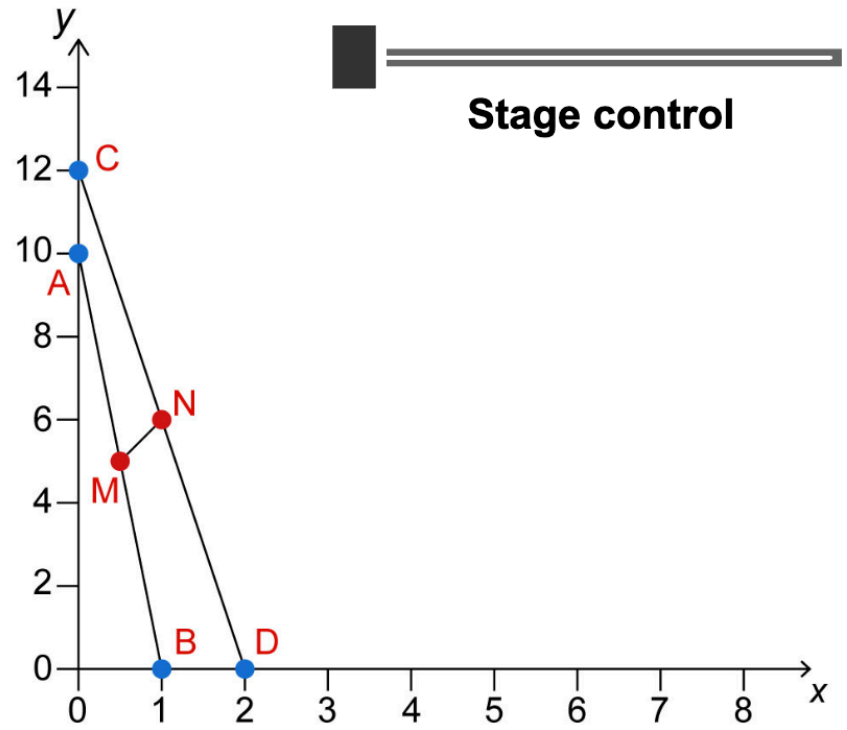
A second diagonal line starts at point C(0,12) and reaches point D(2,0).

M is midpoint of AB and N is midpoint of CD.

B will move to the right **one** unit each stage and D will move to the right **two** units each stage.

Use the slider to see the different stages.

Question 8a (1 mark)



Stage control

Stage	B	D	M	N
1	(1 , 0)	(2 , 0)	(0.5 , 5)	(1 , 6)

Show that the gradient of MN in stage 4 is $\frac{1}{2}$

B I U $\times_2$ $\times^2$ Ω Σ

Styles

Question 8b (2 marks)

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

n	B	D	M	N	Gradient MN (*G*)
1	(1 , 0)	(2 , 0)	(0.5 , 5)	(1 , 6)	$\frac{2}{1}$
2	(2 , 0)	(4 , 0)	(1 , 5)	(2 , 6)	$\frac{2}{2}$
3	(3 , 0)	(6 , 0)	(1.5 , 5)	(3 , 6)	$\frac{2}{3}$
4	(4 , 0)	(8 , 0)	(2 , 5)	(4 , 6)	$\frac{2}{4}$
5	(5 , 0)	(10 , 0)			
6	(6 , 0)	(12 , 0)			

Reset

Question 8c (2 marks)

Describe in words two patterns you see in the table for the gradient (G).

B I U x_2 x^2 Ω Σ

Styles

Question 8d (2 marks)

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

B I U x_2 x^2 Ω Σ

Styles

Question 8e (3 marks)

Verify your general rule for G.

B I U x_2 x^2 Ω Σ Styles

Question 8f (20 marks)

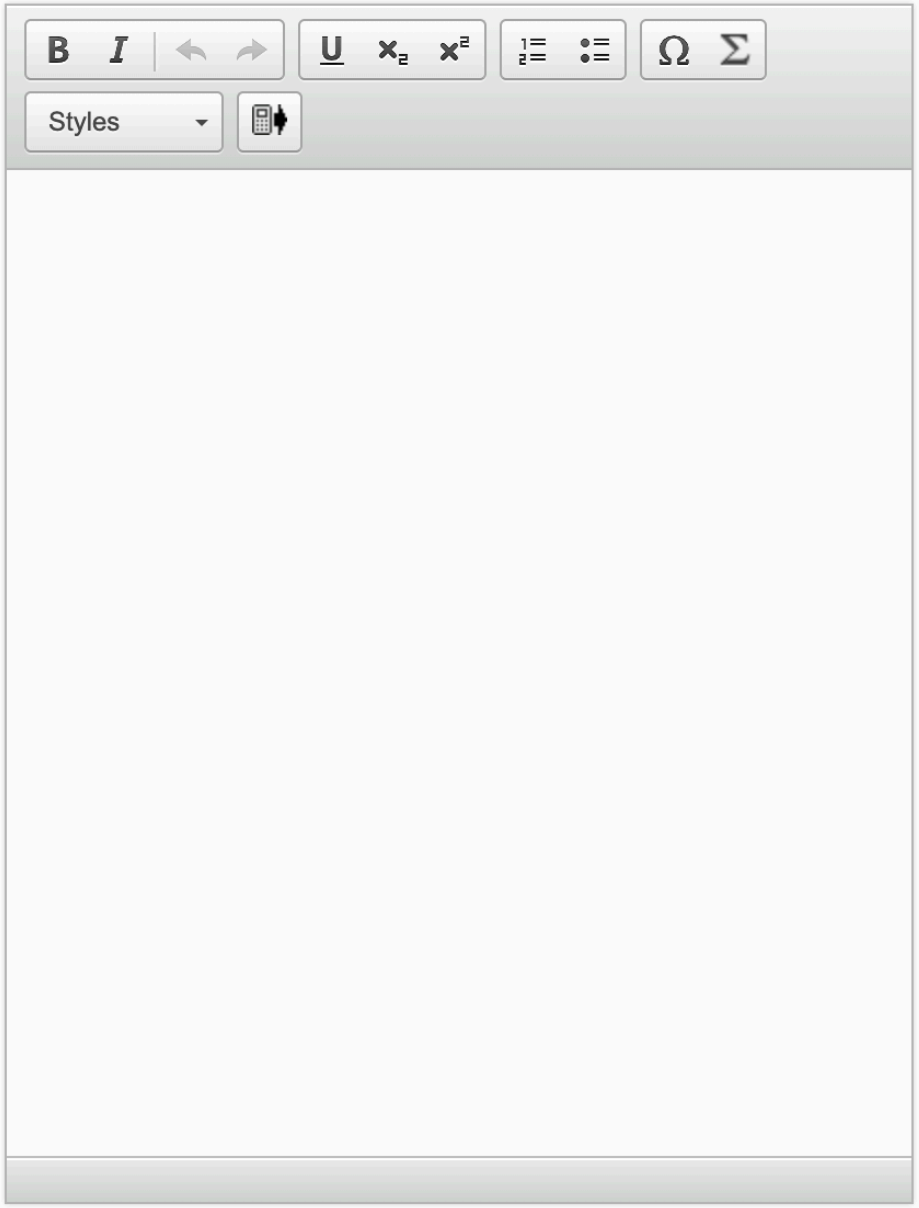
You will now consider how the length of MN changes in each stage.

n	B	D	M	N	Length MN (*L*)
1	B (1 , 0)	D (2 , 0)	(0.5 , 5)	(1 , 6)	$\sqrt{\frac{5}{4}}$
2	B (2 , 0)	D (4 , 0)	(1 , 5)	(2 , 6)	$\sqrt{\frac{8}{4}}$
3	B (3 , 0)	D (6 , 0)	(1.5 , 5)	(3 , 6)	$\sqrt{\frac{13}{4}}$
4	B (4 , 0)	D (8 , 0)	(2 , 5)	(4 , 6)	$\sqrt{\frac{20}{4}}$
5	B (5 , 0)	D (10 , 0)			
6	B (6 , 0)	D (12 , 0)			

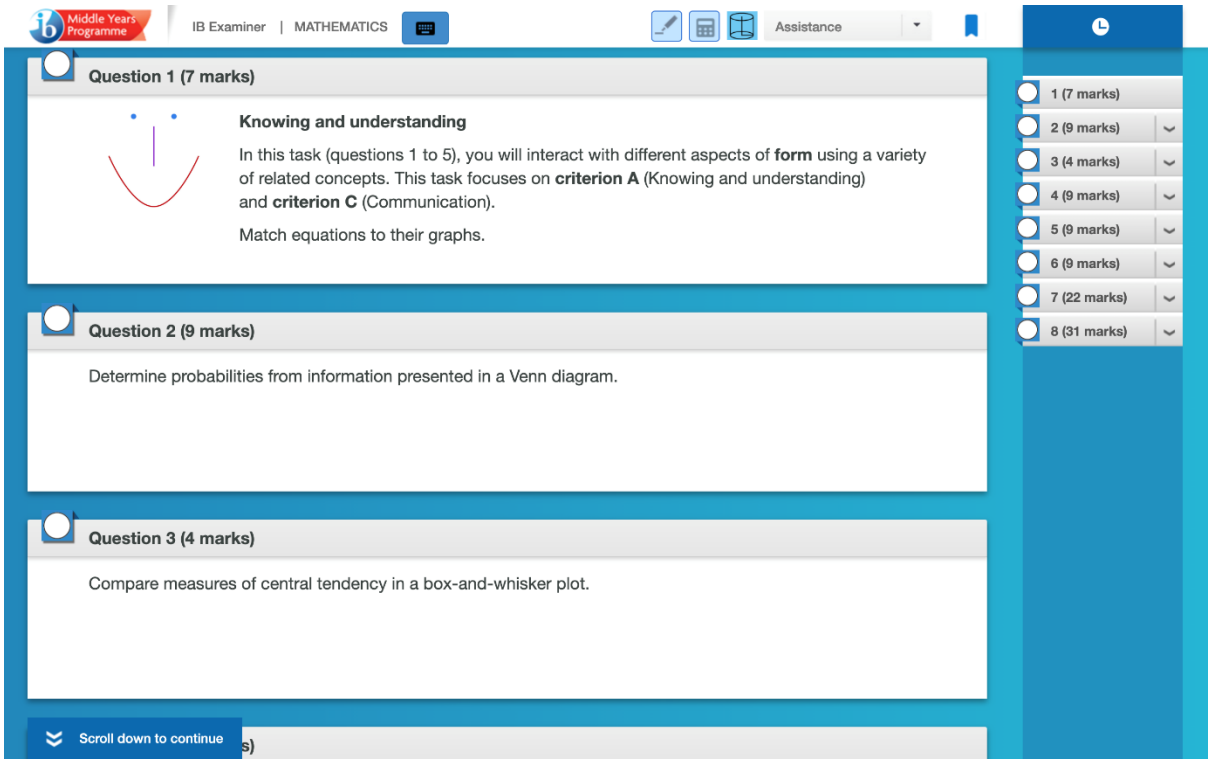
Reset

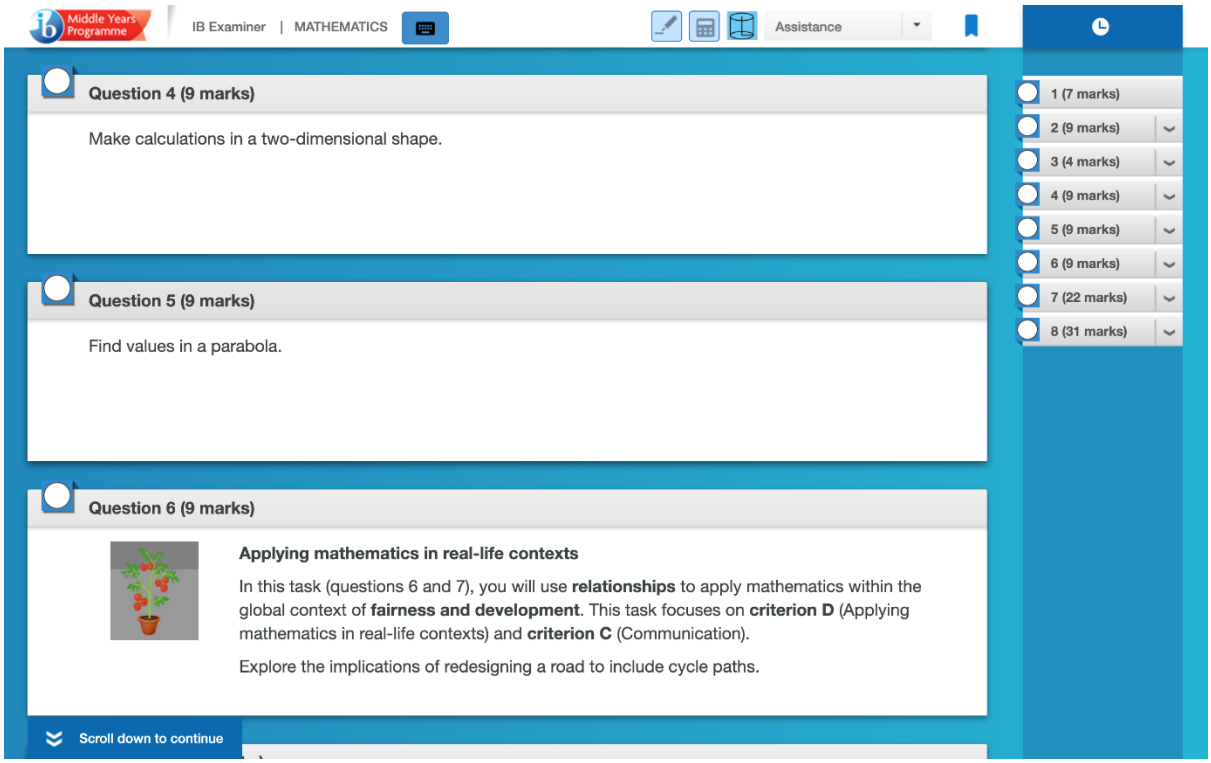
Investigate the values in the table to find a relationship for the length L in terms of n. In your answer, you should communicate the following in an organized and coherent manner:

- predict more values and record these in the table
- describe in words a pattern in the table for the length (L)
- write down a general rule for L in terms of n
- test and verify your general rule for L
- justify your general rule for L.



Nov 24 Standard Math





Question 6 (9 marks)

Applying mathematics in real-life contexts

In this task (questions 6 and 7), you will use **relationships** to apply mathematics within the global context of **fairness and development**. This task focuses on **criterion D** (Applying mathematics in real-life contexts) and **criterion C** (Communication).

Explore the implications of redesigning a road to include cycle paths.

Question 7 (22 marks)

Make calculations to design a rooftop garden.

Question 8 (31 marks)

Investigating patterns

In this task (question 8), you will use **logic** to investigate shapes created by sticks. You will be assessed using **criterion B** (Investigating patterns) and **criterion C** (Communication).

Describe patterns and find general rules for shapes made by sticks.

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Question 1 (7 marks)

Label the graphs by dragging the matching equation to the correct place.

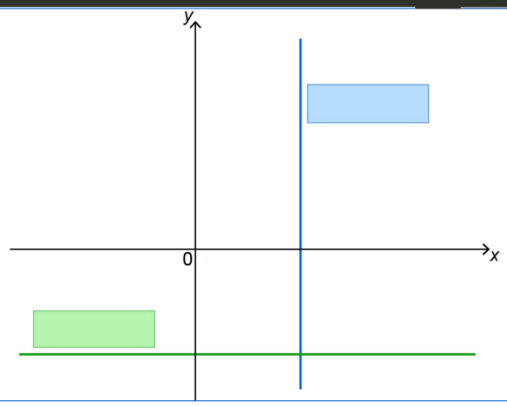
Draggable equations:

$x = 3$

$x = -3$

$y = 3$

$y = -3$



Scroll down to continue

1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)

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1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)

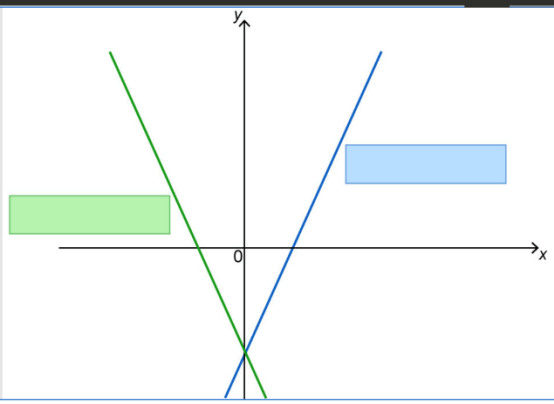
Draggable equations:

$y = 2x + 3$

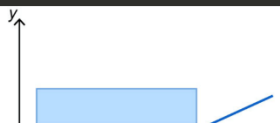
$y = 2x - 3$

$y = -2x + 3$

$y = -2x - 3$



Draggable equations:



Scroll down to continue

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1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)

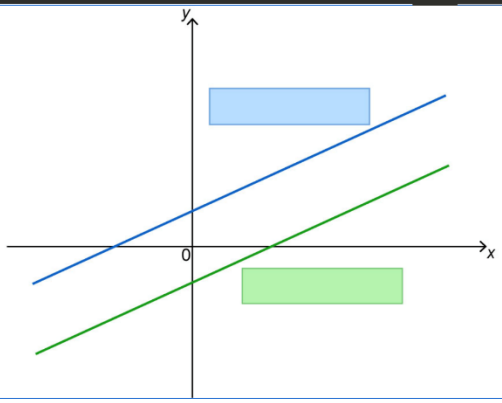
Draggable equations:

$x + 2y = 3$

$x + 2y = -3$

$x - 2y = 3$

$x - 2y = -3$



Draggable equations:

Scroll down to continue

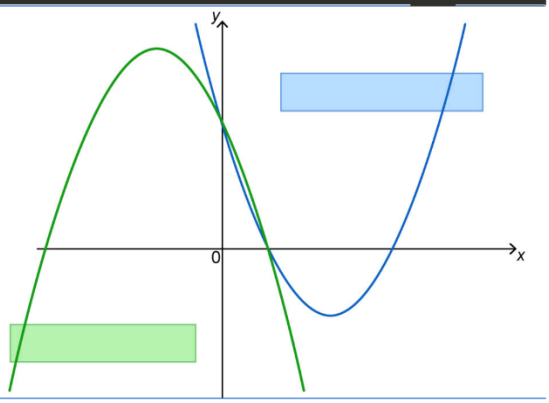
Draggable equations:

$y = (x + 1)(x + 3)$

$y = (x - 1)(x - 3)$

$y = (1 - x)(x + 3)$

$y = (x + 1)(3 - x)$

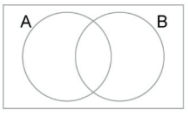
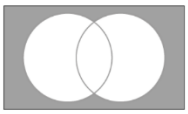
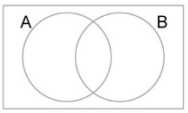
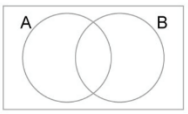


Question 2 (9 marks)

Question 2a (3 marks)

The two sets, A and B, are intersecting as seen in the Venn diagram below.

Select the shading(s) that represent the sets in the Venn diagrams below.

Set	Venn diagram	Draggable shading
(i) A'		
(ii) $A' \cap B$		
(iii) $A' \cup B$		

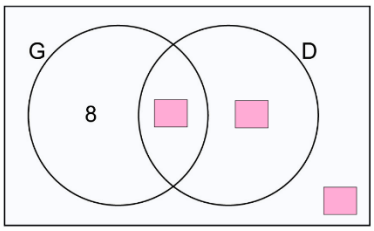
Scroll down to continue

Question 2b (2 marks)

There are 24 students in a class. Of these students:

- 15 play the guitar (G)
- 12 play the drums (D)
- 4 play neither.

Determine the missing values in the Venn diagram below.



Question 2c (1 mark)

A student is selected at random. **Determine** the probability that this student plays only one musical instrument.

Styles

Paste ⌘+V

Question 2d (3 marks)

Three students are selected at random. **Determine** the probability that the three students do not play any musical instruments.

1 (7 marks)
2 (9 marks)
Question 2a
Question 2b
Question 2c
Question 2d
3 (4 marks)
4 (9 marks)
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)

Scroll down to continue

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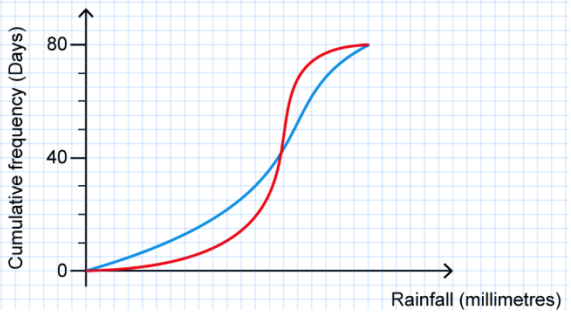
Question 3 (4 marks)

Aaron is comparing the rainfall for the first 80 days in 2021 and in 2022. The graph below shows two cumulative frequency curves for the rainfall in 2021 and in 2022.

Question 3a (2 marks)

On the canvas below, **draw** the box-and-whisker plot for 2021.

Guidelines:

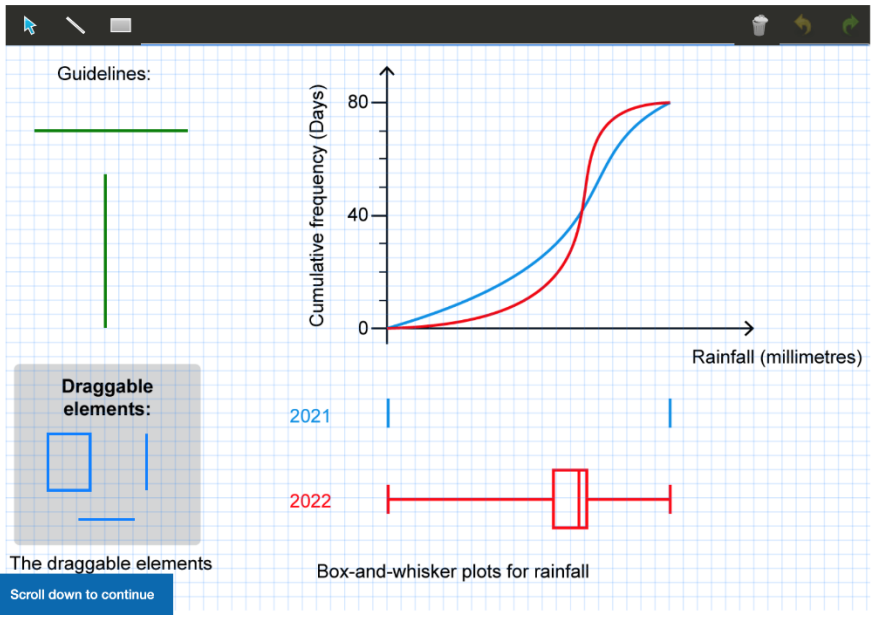


1 (7 marks)
2 (9 marks)
3 (4 marks)
Question 3a
Question 3b
4 (9 marks)
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)

Scroll down to continue

Question 3a (2 marks)

On the canvas below, **draw** the box-and-whisker plot for 2021.



Scroll down to continue

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Question 3b (2 marks)

Compare the median and the interquartile range for the two distributions.

Styles

1 (7 marks)
2 (9 marks)
3 (4 marks)
Question 3a
Question 3b
4 (9 marks)
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)

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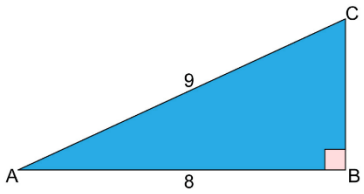
Question 4 (9 marks)

The diagram shows the right-angled triangle ABC.

Diagram not to scale



Question 4a (2 marks)

Show that BC = 4 to the nearest unit.

Question 4b (1 mark)

Hence, **determine** the area of the triangle ABC.

Scroll down to continue

1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
Question 4a
Question 4b
Question 4c
Question 4d
Question 4e
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)

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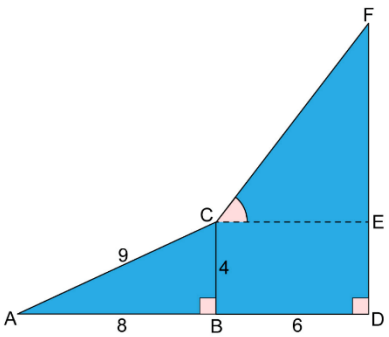
The line AB is extended and the trapezium BCFD is formed as shown in the diagram.

Diagram not to scale



Question 4c (1 mark)

The areas of trapezium BCFD and triangle ABC are in the ratio

area BCFD : area ABC

3 : 1

Determine the area of the trapezium BCFD.

Question 4d (2 marks)

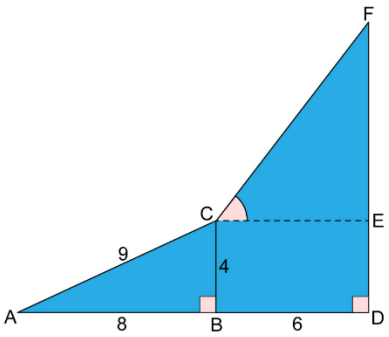
Determine FD.

Scroll down to continue

1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
Question 4a
Question 4b
Question 4c
Question 4d
Question 4e
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)

The line AB is extended and the trapezium BCFD is formed as shown in the diagram.

Diagram not to scale



Question 4d (2 marks)

Determine FD.

Question 4e (3 marks)

Find the size of the angle FCE.

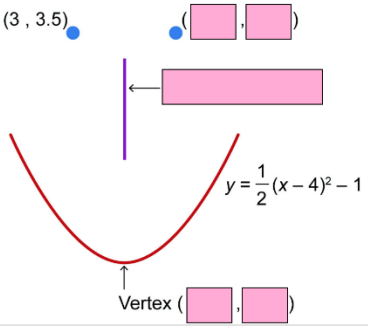
Scroll down to continue

Question 5 (9 marks)

Question 5a (3 marks)

A **symmetrical** smiley face is plotted using two points, a line, and a parabola.

Determine the missing coordinates and the equation of the line.



Scroll down to continue

Question 5b (2 marks)

By expanding the brackets, **show that** $y = \frac{1}{2}(x-4)^2 - 1$ can be written as

$y = \frac{1}{2}x^2 - 4x + 7$.

Question 5c (4 marks)

Scroll down to continue

rdinates of the x-intercepts of the parabola

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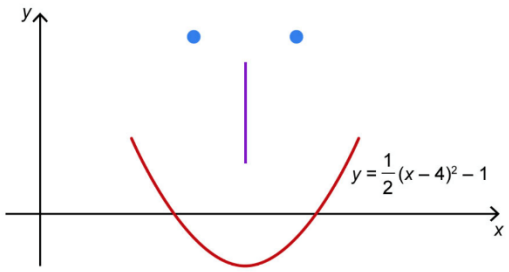
Question 5c (4 marks)

Calculate the coordinates of the x-intercepts of the parabola

$y = \frac{1}{2}(x-4)^2 - 1$.

Give your answer to the nearest one decimal place.



Scroll down to continue

1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
5 (9 marks)
Question 5a
Question 5b
Question 5c
6 (9 marks)
7 (22 marks)
8 (31 marks)

Question 6 (9 marks)

The city council have decided to improve the road safety for cyclists. A survey was conducted to determine the type of cycle facility that the community would like to see built. The result is shown below.

Type of cycle facility	A shared cycle path with pedestrians	A road with cycle lanes	A road with separated cycle paths
			
Number of votes	40	1180	1620

Scroll down to continue

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Number of votes 40 1180 1620

Question 6a (2 marks)

The city council will build the type of cycle facility that receives more than 55 % of the total number of votes.

Show that the city council will build "a road with separated cycle paths".

1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
5 (9 marks)
6 (9 marks)
Question 6a
Question 6b
Question 6c
Question 6d
7 (22 marks)
8 (31 marks)

Key:

cycle path, in metres (m)

Diagram not to scale

Scroll down to continue

The plan is to construct a **3 km long** road with separated cycle paths.The cost to construct each part of the road is listed in the table below.

Item	Cost
One cycle path	$0.6 million per kilometre (km)
One barrier	$115 per metre (m)
One car lane	$3.1 million per kilometre (km)

Calculate the total cost to construct the road.

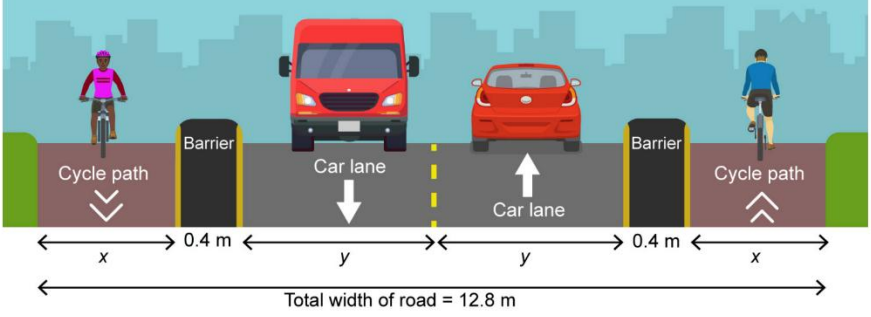
Styles

Key:

x = width of one cycle path, in metres (m)

y = width of one car lane, in metres (m)

Diagram not to scale



Question 6b (1 mark)

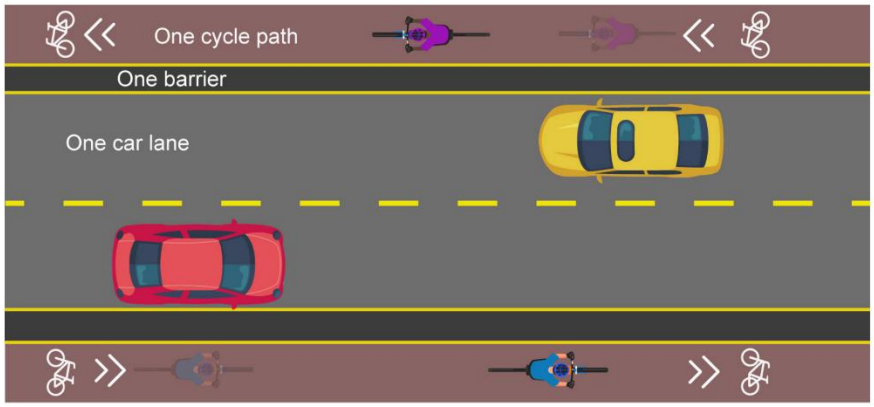
Using the information given in the diagram, **show that** $y = 6 - x$.

Question 6c (3 marks)

Given that $y = \frac{3}{2}x$ and $y = 6 - x$, **find** the value of x and the value of y.

Scroll down to continue

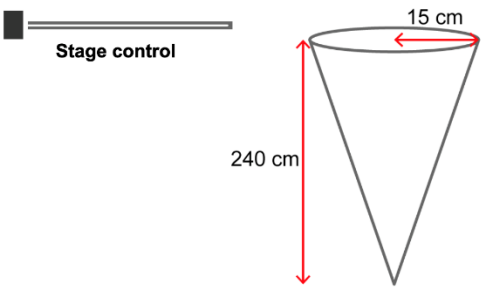
Question 6d (3 marks)



Scroll down to continue

Question 7 (22 marks)

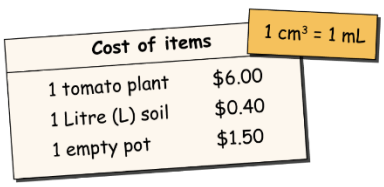
In this question you will make calculations to help a community design a rooftop garden to grow tomato plants.
Tomato plants are grown in a pot. A pot is a truncated cone. Interact with the simulation to reveal how a pot is formed.



Scroll down to continue

Question 7a (4 marks)

Calculate the volume of the pot. Give your answer to the nearest 10 cm^3.



Question 7b (2 marks)

Pots will be filled with soil up to 90 % of maximum capacity. **Determine** the volume in litres (L) of soil needed for one pot.

Scroll down to continue

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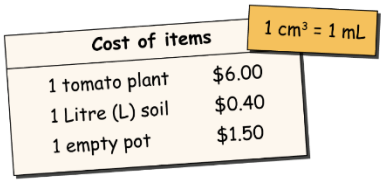

Question 7c (2 marks)

Determine the total cost to grow one tomato plant in a pot.

Scroll down to continue

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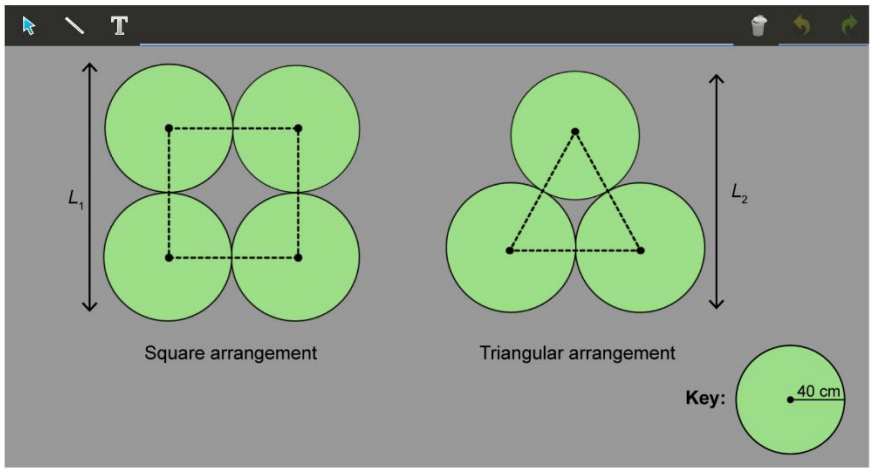
Question 7d (1 mark)



Scroll down to continue

- 1 (7 marks)
- 2 (9 marks)
- 3 (4 marks)
- 4 (9 marks)
- 5 (9 marks)
- 6 (9 marks)
- 7 (22 marks)
  - Question 7a
  - Question 7b
  - Question 7c
  - Question 7d
  - Question 7e
  - Question 7f
- 8 (31 marks)

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Question 7d (1 mark)

Determine the length of L_1 for the square arrangement.

Styles

Question 7e (3 marks)

Find the length of L_2 for the triangular arrangement.

Styles

Scroll down to continue

arks)

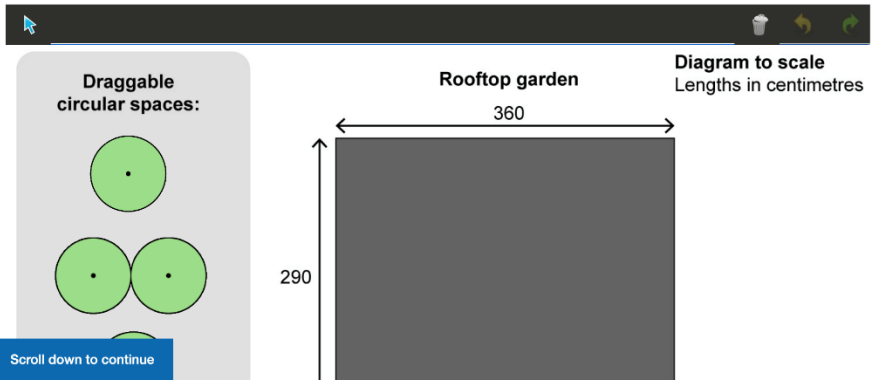
- 1 (7 marks)
- 2 (9 marks)
- 3 (4 marks)
- 4 (9 marks)
- 5 (9 marks)
- 6 (9 marks)
- 7 (22 marks)
  - Question 7a
  - Question 7b
  - Question 7c
  - Question 7d
  - Question 7e
  - Question 7f
- 8 (31 marks)

Question 7f (10 marks)

Design a rooftop garden to grow the tomato plants. Your design should make best use of all the rooftop garden space to grow as many tomato plants as possible.

In your answer you should:

- identify **three** relevant factors for your design
- show calculations for your design
- show your design on the canvas
- calculate the cost to a sensible degree of accuracy (using your result in part (c))
- justify whether your results make sense in the context of the question.



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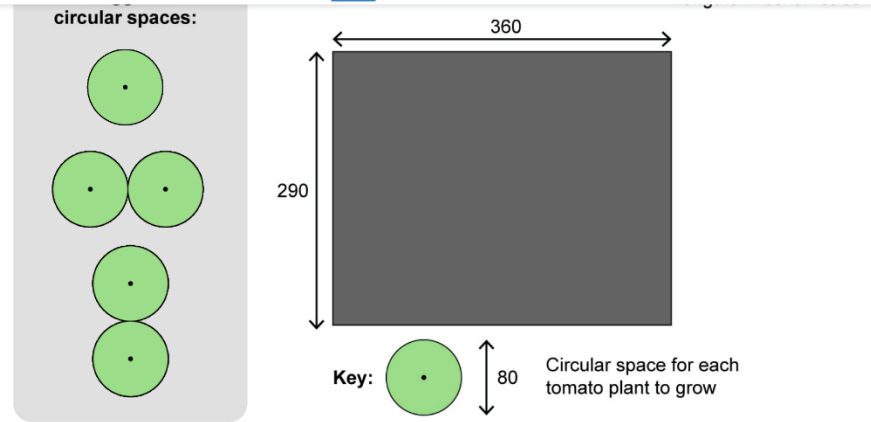

Relevant factors:

Calculations and justification:

Scroll down to continue

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Question 8 (31 marks)

A sequence of shapes is created using sticks. In this question you will investigate the number of sticks (S) forming these shapes.

Interact with the stage control to see how S increases.

Stage control

Stage 1

$S = 4$

Scroll down to continue

1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)
- Question 8a
- Question 8b
- Question 8c
- Question 8d
- Question 8e
- Question 8f

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Question 8a (1 mark)

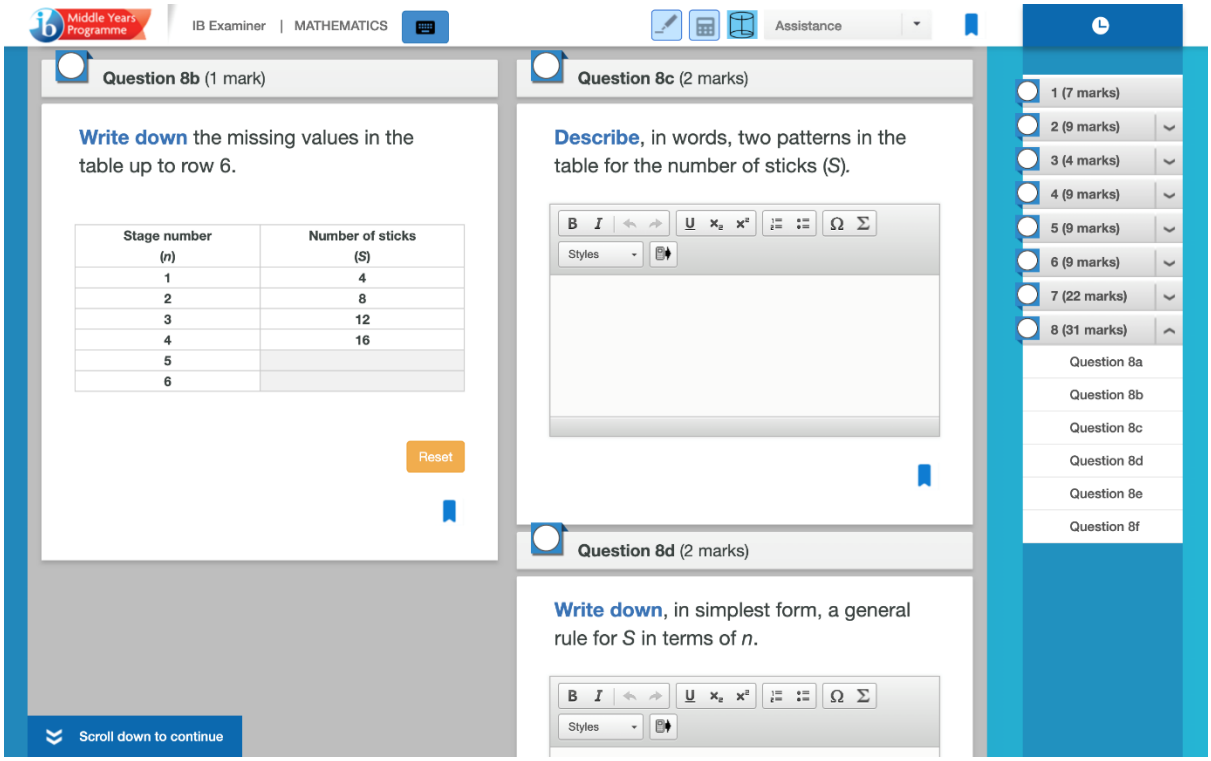
Construct stage 5 by completing the diagram on the canvas.

Draggable sticks:

Stage 5

Scroll down to continue

1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)
- Question 8a
- Question 8b
- Question 8c
- Question 8d
- Question 8e
- Question 8f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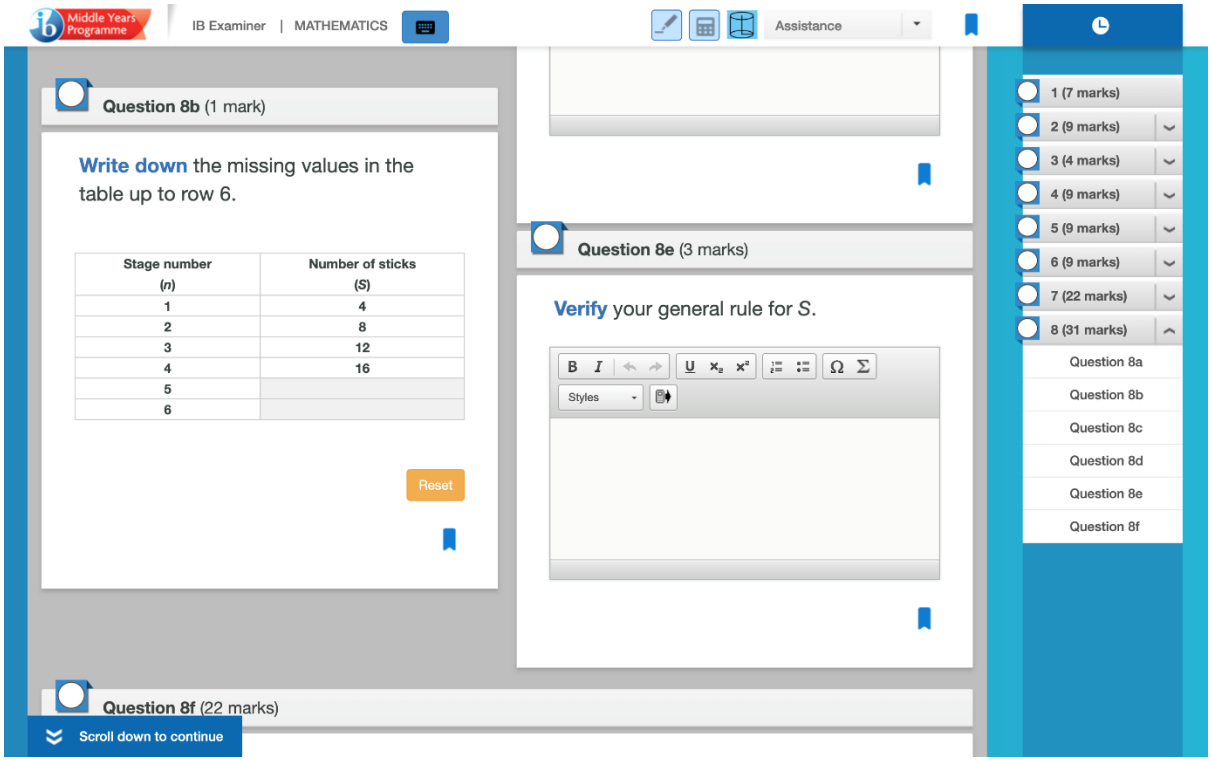
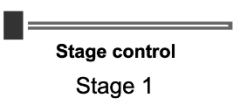
Question 8b (1 mark)
Write down the missing values in the table up to row 6.
Stage number (n)
Number of sticks (S)
1
4
2
8
3
12
4
16
5
6
Reset
Scroll down to continue
Question 8c (2 marks)
Describe, in words, two patterns in the table for the number of sticks (S).
Styles
Question 8d (2 marks)
Write down, in simplest form, a general rule for S in terms of n.
Styles
1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)
Question 8a
Question 8b
Question 8c
Question 8d
Question 8e
Question 8f


Middle Years Programme
IB Examiner | MATHEMATICS
Assistance
Question 8b (1 mark)
Write down the missing values in the table up to row 6.
Stage number (n)
Number of sticks (S)
1
4
2
8
3
12
4
16
5
6
Reset
Question 8e (3 marks)
Verify your general rule for S.
Styles
Question 8f (22 marks)
Scroll down to continue
1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)
Question 8a
Question 8b
Question 8c
Question 8d
Question 8e
Question 8f

Question 8f (22 marks)

The following sequence of shapes is formed using external and internal sticks. You will now investigate the total number of sticks (T) which includes the external and internal sticks.

Interact with the stage control to see how T increases.



Stage 1

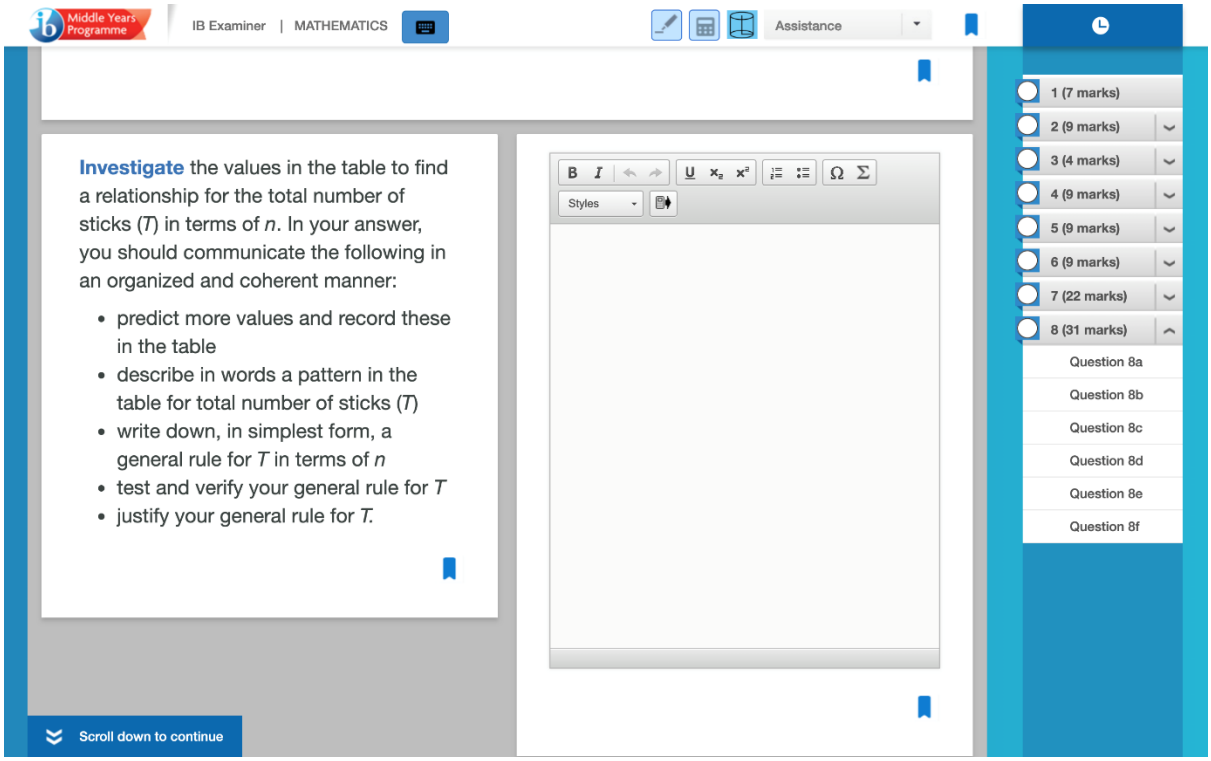
$T = 4$

Stage number (n)	External sticks (S)	Internal sticks (L)	Total number of sticks (T)
1	4	0	4
2	8	2	10
3	12	6	18
4	16	12	28
5			
6			

Reset

Scroll down to continue

lues in the table to find


Middle Years Programme
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1 (7 marks)
2 (9 marks)
3 (4 marks)
4 (9 marks)
5 (9 marks)
6 (9 marks)
7 (22 marks)
8 (31 marks)
Question 8a
Question 8b
Question 8c
Question 8d
Question 8e
Question 8f
Investigate the values in the table to find a relationship for the total number of sticks (T) in terms of n. In your answer, you should communicate the following in an organized and coherent manner:
predict more values and record these in the table
describe in words a pattern in the table for total number of sticks (T)
write down, in simplest form, a general rule for T in terms of n
test and verify your general rule for T
justify your general rule for T.
Styles
Scroll down to continue

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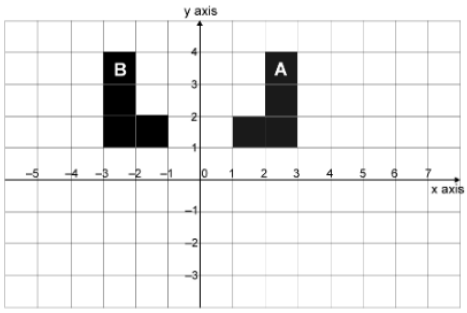
Question 1 (6 marks)

Question 1a (1 mark)

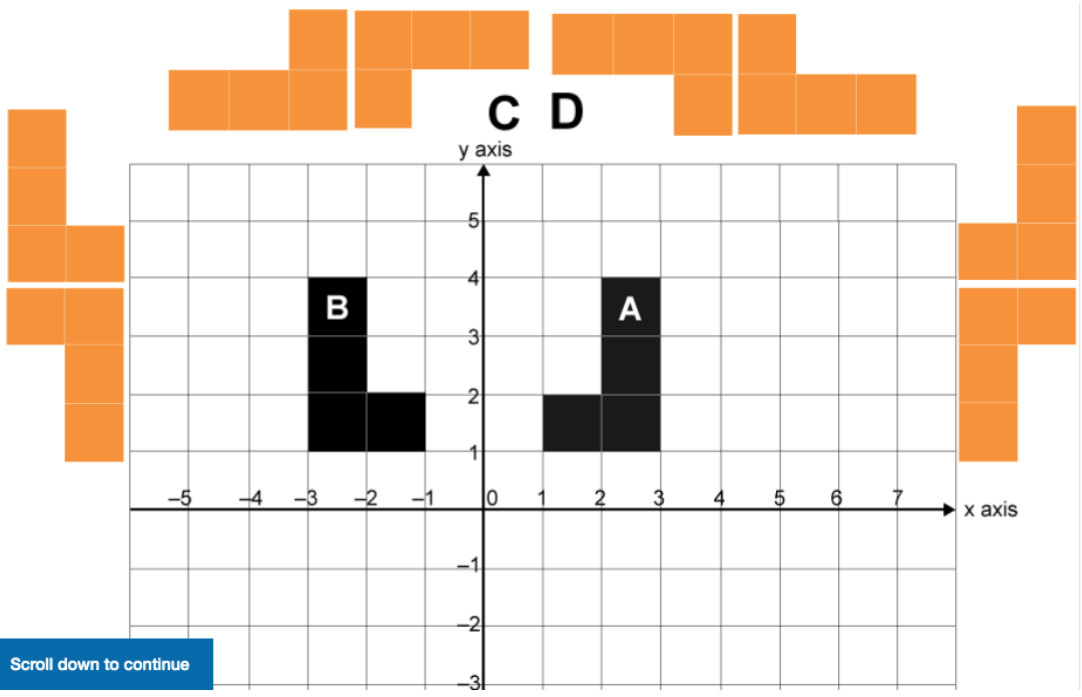


Write down the equation of the line that reflects shape A on to shape B.

Question 1b (3 marks)

Translate shape B by vector $\begin{pmatrix} 8 \\ 2 \end{pmatrix}$, **draw** and label the new shape C; next reflect shape C in the line $y = 1$ and label the new shape D.

Ensure both shape C and shape D are on your final grid.



Scroll down to continue

Question 1c (2 marks)

Describe fully the rotation that maps shape D to shape A.

B I U Styles

Question 2 (8 marks)

A manufacturer makes shoes to sell internationally. The manufacturer is contracted to make shoes for Egypt and Brazil.

Image Formulas

Question 2 (8 marks)

A manufacturer makes shoes to sell internationally. The manufacturer is contracted to make shoes for Egypt and Brazil.

Image | Formulas

Interquartile range

$$IQR = Q_3 - Q_1$$

Complementary events

$$P(A) + P(A') = 1$$

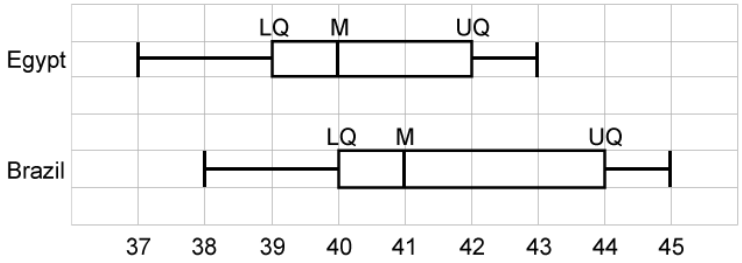
Independent events

$$P(A \cap B) = P(A)P(B)$$

Combined events

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

The box plots show the sizes of shoes sold in Egypt and Brazil. The distributions shown in the box plots are based on the medians and quartiles of the shoe sizes sold.



LQ Lower quartile
UQ Upper quartile
M Median

Question 2a (2 marks)

Compare the sizes of shoes sold in the two countries.

B I U x_2 x^2 Ω Σ Styles

Question 2b (2 marks)

Determine the range of shoe sizes required for manufacture.

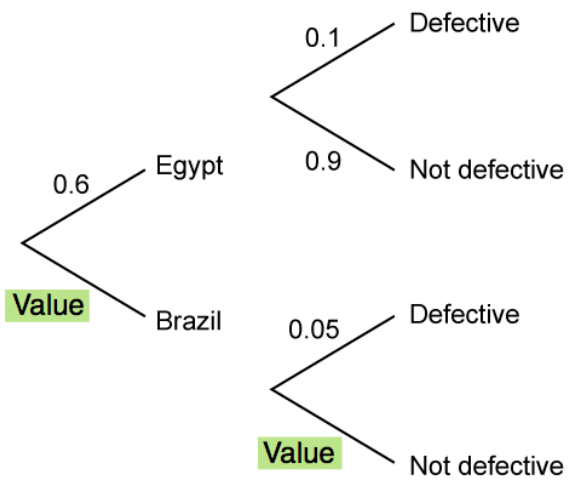
Range

The manufacturer makes shoes in two factories; one in Egypt and one in Brazil. The factory in Egypt makes 60 % of the shoes and 10 % are defective. The factory in Brazil makes the rest of the shoes and 5 % are defective.

This information is illustrated in the tree diagram.

Question 2c (1 mark)

Write down the **two** missing values in the tree diagram.



Scroll down to continue

Question 2d (3 marks)

Find the probability that a shoe, chosen at random from either factory, is defective.

B I U x_2 x^2 Ω Σ Styles

Question 3 (8 marks)

Question 3a (3 marks)

Given that a straight line L_1 has the equation $\frac{2y-1}{2} = x$, **show** y as the subject, by rearranging the equation for L_1.

Question 3b (5 marks)

Another straight line L_2 has the equation $y = \frac{x+5}{2}$.

Find the coordinates of point of intersection between L_1 and L_2.

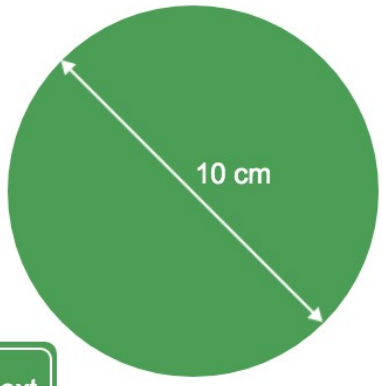
Not Started

Question 4 (10 marks)

The diagram shows a circle with diameter 10 cm. Inside the circle is a square, the vertices of the square touch the circumference of the circle.

Click the next button to insert a square.

Simulator | Formulas



Next

Diagram not to scale

Question 4a (1 mark)

Show that the total area enclosed by the circle is 25π.

Question 4b (3 marks)

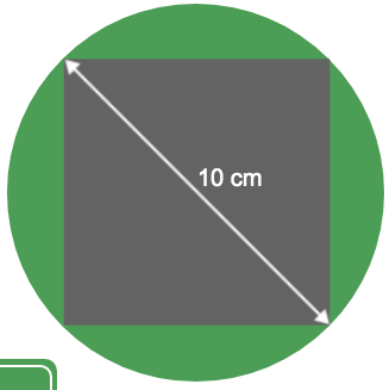
Find the length of one side of the square and write your answer as an exact value.

Question 4c (3 marks)

Calculate the total area of the green shaded segments that do not include the square. Write your answer to one decimal place.

Question 4d (3 marks)

Click the next button to insert the outer circle.



Next

Diagram not to scale

Find the circumference of the outer circle.

B I U x_2 x^2 Ω Σ Styles

Question 5a (2 marks)

Find the maximum height achieved by the ball.

Question 5 (10 marks)

A ball is kicked from (0,0) towards the posts and describes the path of a parabola as shown in Tab 2.

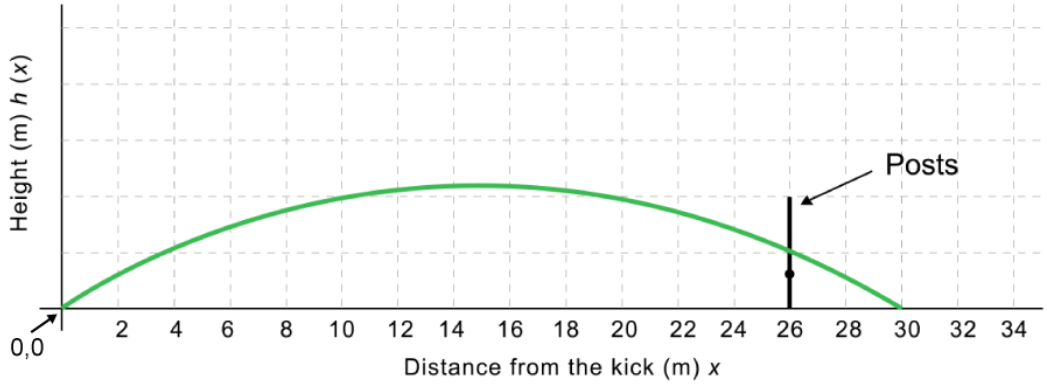
Tab 1 | Tab 2 | Formulas

A ball is kicked at the posts shown, the ball describes the path of a parabola.

Question 5 (10 marks)

A ball is kicked from (0,0) towards the posts and describes the path of a parabola as shown in Tab 2.

Tab 1 | Tab 2 | Formulas



Question 5 (10 marks)

A ball is kicked from (0,0) towards the posts and describes the path of a parabola as shown in Tab 2.

Tab 1 | Tab 2 | Formulas

Axis of symmetry of graph of a quadratic function

$$f(x) = ax^2 + bx + c \Rightarrow \quad axis\ of\ symmetry\ x = -\frac{b}{2a}$$

Solutions of a quadratic equation

$$ax^2 + bx + c = 0 \Rightarrow \quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad , \quad a \neq 0$$

Discriminant

$$\Delta = b^2 - 4ac$$

The height in metres (m) of the ball above the ground is given by the function $h(x) = \frac{x(30 - x)}{25}$.

To score points the ball is kicked from the point (0,0) and must go over a bar on the posts that is
3 m above the ground and 26 m away from the point the ball was kicked. This is illustrated in the diagram in Tab 2 above.

Remember the function for the height of the ball is $h(x) = \frac{x(30 - x)}{25}$.

Question 5b (3 marks)

Using the equation, **show that** the team scored points.

Later in the game another kick is taken from the point $(x,0)$ towards the posts.

This time the height of the ball above ground is represented by the function

$$g(x) = \frac{-x^2 + 30x - 125}{25}.$$

Note that the posts cannot be moved.

Question 5c (3 marks)

Solve $g(x) = 0$.

Question 5d (2 marks)

Did the team score points? **Explain** your answer.

Question 6 (21 marks)

Music is a widely accepted form of artistic expression and creativity. In this question you will be presented with the instrument design of a piano.

Video | Hearing range

Note	Frequency (Hz)	
A	440	
B	493	
C	523	
D	587	
E	659	
F	698	
G	783	
A	880	

We measure the frequency of the note in hertz.

Not Started

Question 6 (21 marks)

Music is a widely accepted form of artistic expression and creativity. In this question you will be presented with the instrument design of a piano.

Video | Hearing range

Humans can only hear between 20 and 20 000 Hertz.

Here is a table with some information on the first four octaves and frequencies of the note A on the piano.

Octave (n)	0	1	2	3
Note (A)	A_0	A_1	A_2	A_3
Frequency (F) Hertz (Hz)	27.5	55	110	220

Question 6a (1 mark)

Write down what happens to the frequency F as the octaves increase.

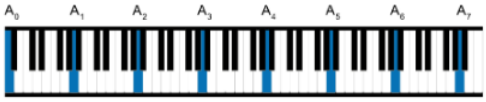
Question 6b (1 mark)

Write down the frequencies for A_4 and A_5.

A_4

A_5

Question 6c (2 marks)



Deduce that all the A notes on the piano are within human hearing.

B I U x_2 x^2 Ω Σ
Styles

Question 6d (3 marks)

The frequency F_3 can be written as $F_0 \times 2^k$. **Calculate** the value of k, where k is an integer.

Question 6e (2 marks)

Find a formula for F in terms of n.

Question 6f (2 marks)

A note has frequency 28 160 Hz. Is it an A note? **Justify** your answer.

Question 6g (10 marks)

Piano | Keys | Hearing range | Arm span

A new design for a piano will contain all of the A notes within human hearing.

Use the information provided in the tabs on the left to **discuss** the practicality of the new design for the piano. In your discussion you should:

- identify the relevant information for the new design
- calculate relevant measurements for the new design
- justify your degree of accuracy
- justify the practicality of the new design.

Question 7 (18 marks)

Ancient civilizations built pyramids to express cultural identity. In this question you will make calculations for a model of Chichén Iztá pyramid.

Video | Formulas

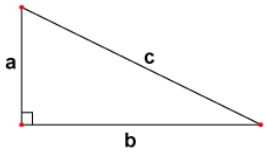
Question 7 (18 marks)

Ancient civilizations built pyramids to express cultural identity. In this question you will make calculations for a model of Chichén Iztá pyramid.

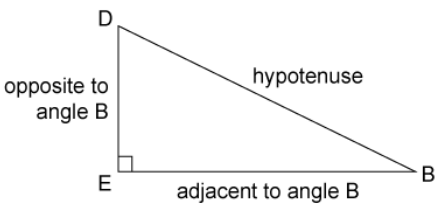
Video | Formulas

Pythagoras' Theorem

$c^2 = a^2 + b^2$



Trigonometric ratios



$$\sin B = \frac{\text{opposite to angle } B}{\text{hypotenuse}}$$

$$\cos B = \frac{\text{adjacent to angle } B}{\text{hypotenuse}}$$

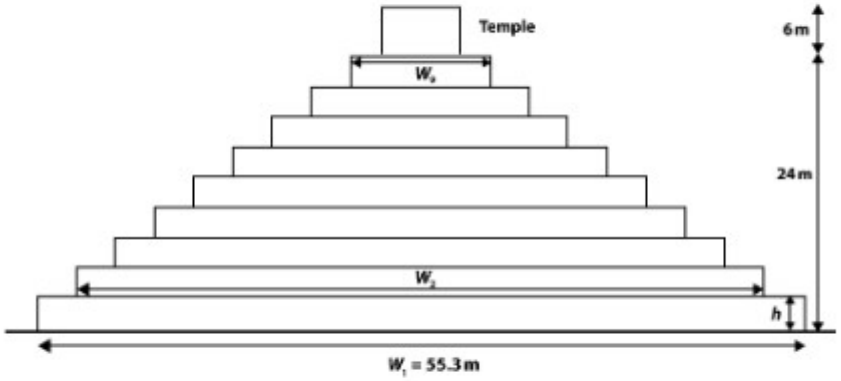
$$\tan B = \frac{\text{opposite to angle } B}{\text{adjacent to angle } B}$$

Chichén Iztá pyramid is composed of nine platforms. The width of the first platform is 55.3 m and on the ninth platform there is a temple that is 6 m high.

All lengths provided are given to the nearest centimetre (cm) and angles are to the nearest whole degree.

You are planning to construct a scale model of the Chichén Iztá Pyramid and will use 1:100 as scale for your model. In this question you will work out values of lengths. The validity of the accuracy of your model will be required in part (e).

Tab 1 Tab 2



a platform

Tab 1 | Tab 2

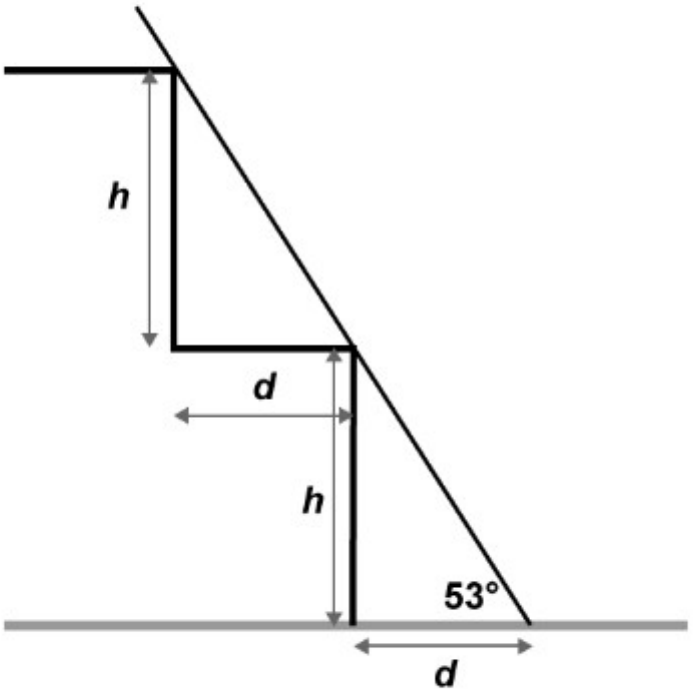


Diagram not to scale

Question 7a (2 marks)

Using the diagram in Tab 1,
determine the total height of your model pyramid including the nine platforms and the temple. Write your answer in cm.

Total height = _____ cm

Question 7b (3 marks)

Using the diagram in Tab 1, **find** the height h of each platform in your model. Write your answer in cm correct to one decimal place.

Model height h = _____ cm

Question 7c (4 marks)

The average inclination of the slant is 53° to the nearest degree.

Using the diagram in Tab 2, **find** the depth d of each pyramid step. Write your answer in cm correct to the nearest whole number.

Model d = _____ cm

Question 7d (3 marks)

Using the diagram in Tab 1, **find** the width W_9 in cm of the top platform in your model.

Model width W_9 = _____ cm

Question 7e (6 marks)

Discuss the validity of your model for Chichén Iztá pyramid. In your discussion you should:

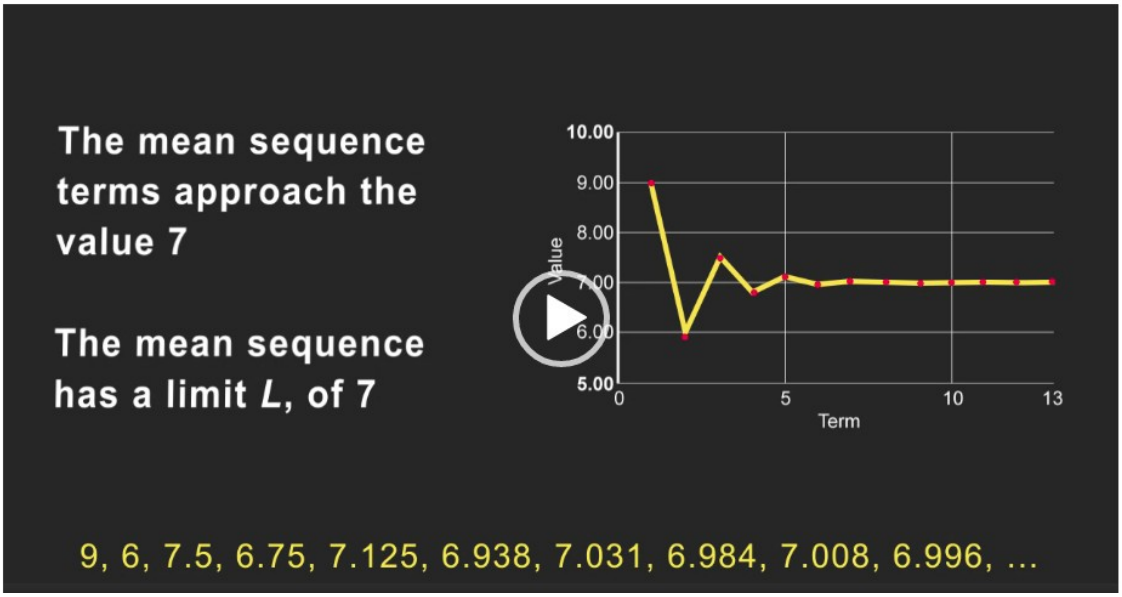
- identify relevant information required to discuss the validity
- consider the implications of the chosen degree of accuracy
- comment on the validity of the model to Chichén Iztá.

Question 8 (20 marks)

A recursive sequence is one where the next term is a specific combination of the previous terms.

In this question the recursive sequence is created where the next term is the mean of the previous two terms. This is called a mean sequence.

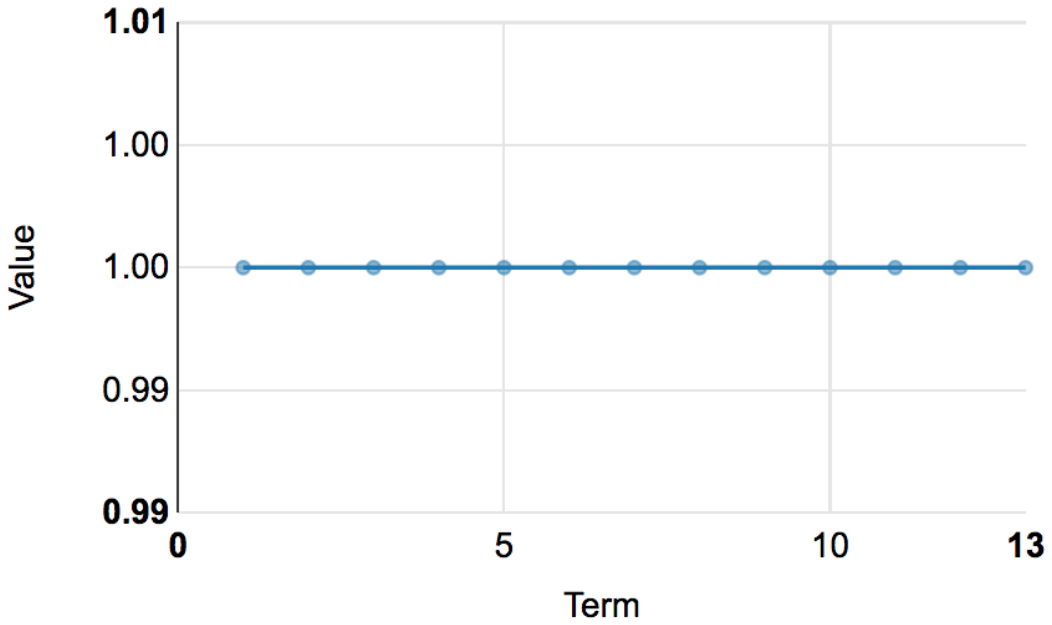
Note: This video contains **no** audio



You can use the simulator to find the limit of a mean sequence. Input the first two terms of the sequence into the simulator and click 'Calculate mean sequence'.

Term 1 | Term 2

Calculate mean sequence



Question 8a (2 marks)

Here is a mean sequence with starting terms 6 and 9.

6, 9, 7.5, 8.25, ...

Show that the next term in the sequence is 7.875 and **write down** the limit of the sequence.

All mean sequences have limits and there is a connection between the first two terms *a* and *b* and the limit *L* of each sequence.

Question 8b (2 marks)

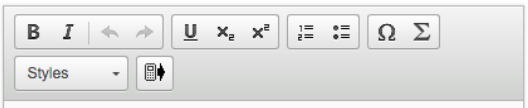
The table below shows the first two terms and the limit *L*, for some mean sequences. The different starting terms *a* are provided and *b* is fixed at 3.

Write down in the table the limit values *L*, for row 2, 3 and 4 for the mean sequences provided. Use the simulator to help you.

Row	First term (a)	Second term (b)	Limit (L)
1	6	3	4
2	9	3	
3	12	3	
4	15	3	

Question 8c (2 marks)

Describe in words **two** patterns you have found from the table.



Question 8d (2 marks)

Find a general rule connecting *a* and *L*.

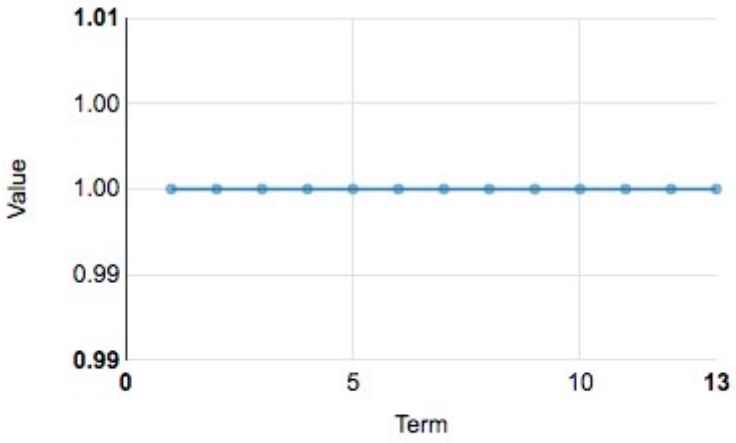
Question 8e (12 marks)

Using your previous results, **investigate** and **find** a general rule connecting *a*, *b* and *L*. The simulator and a blank table are provided below to support your investigation. In your answer you should:

- describe patterns
- find a general rule
- test your general rule
- use correct mathematical notation
- prove or verify and justify your general rule.

Term 1 | Term 2

Calculate mean sequence



First term (a)	Second term (b)	Limit (L)

Question 9 (19 marks)

We can also use an algebraic approach to investigate mean sequences.

If a and b are the first two terms, the mean sequence will start with the terms below.

$a, b, \frac{1}{2}a + \frac{1}{2}b, \ldots$

Question 9a (1 mark)

Explain why the third term is $\frac{1}{2}a + \frac{1}{2}b$.

Question 9b (4 marks)

Predict the seventh and eighth terms from the table and write your answers in the relevant response box.

Term (T)	Sequence
1	a
2	b
3	$\frac{1}{2}a + \frac{1}{2}b$
4	$\frac{1}{4}a + \frac{3}{4}b$
5	$\frac{3}{8}a + \frac{5}{8}b$
6	$\frac{5}{16}a + \frac{11}{16}b$
7	$\frac{\square}{\square}a + \frac{\square}{\square}b$
8	$\frac{\square}{\square}a + \frac{\square}{\square}b$

Term 7:

Styles

Term 8:

Styles

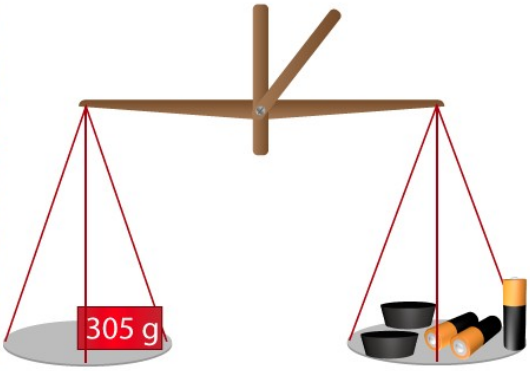
2016 November Maths eAssessment

Question 1 (5 marks)

The basic scales as shown in the image use specific items to weigh fruit and vegetables at a market. The handler uses batteries and metal weights.

Image

Diagram



Key:

Metal weight

Battery

As shown in the diagram, the combined weight of **two** metal weights and **three** batteries is 305 grams (g).

One metal weight measures 100 g.

Question 1a (3 marks)

Using the information from the diagram, **find** the weight of one battery.

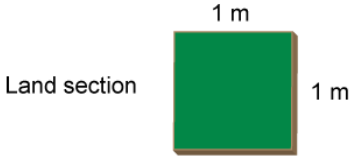
Weight of one battery

Question 1b (2 marks)

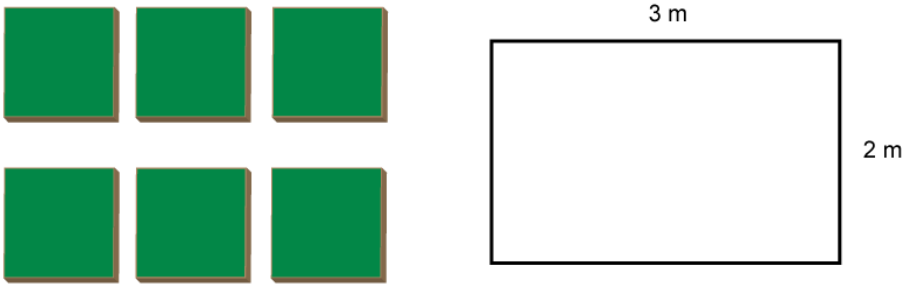
Ten similar sized tomatoes weigh the same as **three** metal weights and **two** batteries. **Calculate** the weight in grams of one tomato.

Question 2 (13 marks)

In order for a player to make progress in online games such as *Farmville* the player gains sections of land. The land sections usually take the form of 1 metre (m) squares as shown in the diagram below.



As more and more sections of land are gained they can be arranged to form rectangles as shown in the diagram below.



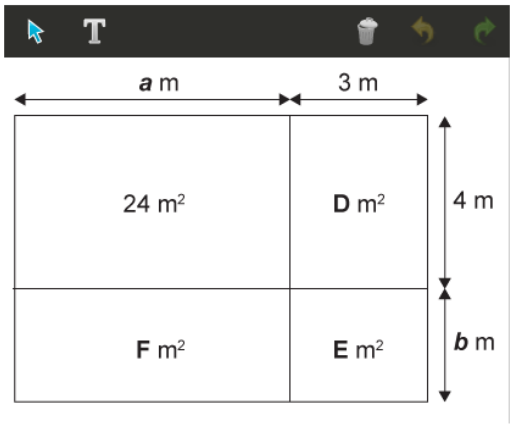
The video below shows an outline of land that has been gained and arranged into sections.

This media contains no audio

In the diagram below we have an online game that has made some progress. Land has been gained and arranged into sections. Use this diagram to answer parts (a) to (d).

Question 2a (1 mark)

You can annotate the diagram below if required.



Write down the area of the section labelled **D**.

B I U x_2 x^2 Ω Σ

Styles

Question 2b (1 mark)

Determine the value of the length labelled ***a***.

Question 2c (2 marks)

Write down an expression for the total area of the rectangle in terms of length ***b***.

Question 2d (4 marks)

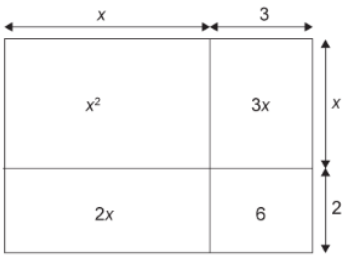
The total area is 63 m^2, **determine** the value of the length ***b*** and areas **F** and **E**.

Question 2e (5 marks)

Diagram | Formulas

The diagram below shows an outline of another piece of land that has been gained and arranged into sections with a total area of 210 m^2.

Express the area of the land as a quadratic equation in x and hence **find** the value of x.



Question 3 (12 marks)

The grades of 20 students in mathematics are shown in the table and pictogram below.

Table and pictogram | Formulas

Grade	1	2	3	4	5	6	7
Number of students	0	1	4	3	6	4	2

Grade	Number of students
1	
2	
3	
4	
5	
6	
7	

Scroll down to continue

Question 3a (1 mark)

Write down the modal grade.

Question 3b (4 marks)

Show that the arithmetic mean grade of the students in mathematics is 4.7 .

Question 3c (2 marks)

Determine the median grade.

Question 3d (2 marks)

A student is selected at random from the 20 students. **Determine** the probability that the student achieved a grade of 6 or more.

Question 3e (3 marks)

The grades of these same 20 students in physics are shown in the table and pictogram below.

Table and pictogram | Formulas

Grade	1	2	3	4	5	6	7
Number of students	0	1	5	2	4	5	3

Grade	Number of students
1	
2	
3	
4	
5	
6	
7	

The students achieving a grade of 6 or more in mathematics **and** physics will be selected to participate in a competition.

Find the probability that a randomly selected student will participate in the competition.

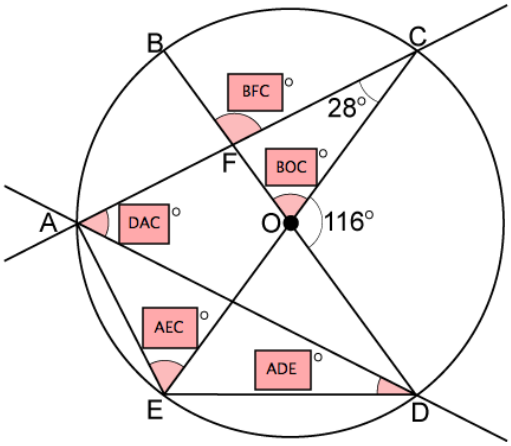
B I U x_2 x^2 Ω Σ Styles

Question 4 (7 marks)

The lines BD and CE pass through the centre (O) of the circle.

- **Determine** the value of the angle BOC.
- **Determine** the value of the angle DAC.
- **Determine** the value of the angle BFC.
- **Write down** the value of the angle ADE.
- **Determine** the value of the angle AEC.

To insert your answers on the diagram, click inside the box and replace the letters with your answers in the "Add label" box. A text tool is available for you to add working where required.

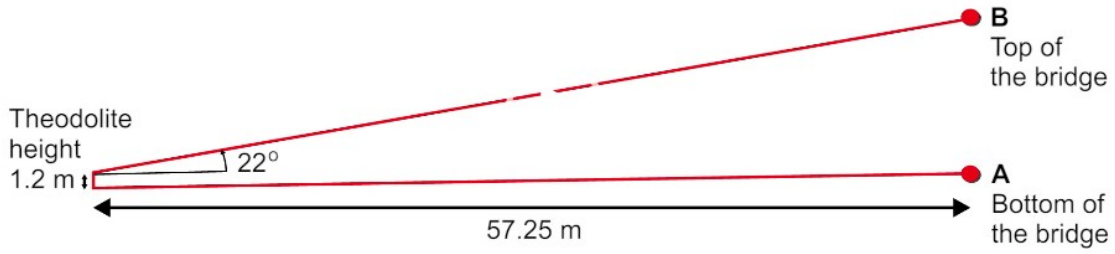


Question 5 (5 marks)

An engineer is examining a weak bridge from a safe distance. In order to make a calculation for the height of the bridge to the ground vertically below she uses a measuring instrument called a theodolite that allows her to measure angles accurately. The theodolite is set at a height of 1.2 metres (m). It is placed 57.25 m, to the nearest centimetre, from the point A at the bottom of the bridge. The angle of elevation from the horizontal to the top of the arch at B is measured at 22° to the nearest degree. This information is shown in the animation below.

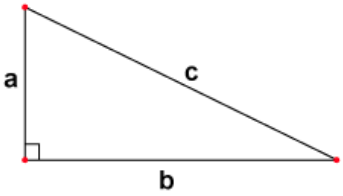
Animation | Formulas

This media contains no audio

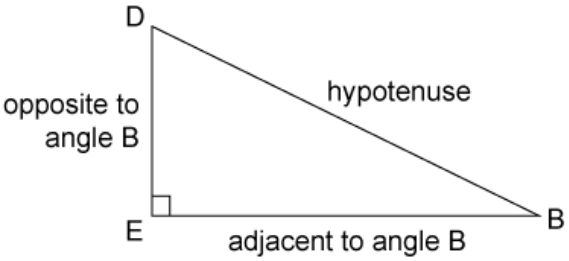


Pythagoras' Theorem

$$c^2 = a^2 + b^2$$



Trigonometric ratios



$$\sin B = \frac{\text{opposite to angle } B}{\text{hypotenuse}}$$

$$\cos B = \frac{\text{adjacent to angle } B}{\text{hypotenuse}}$$

$$\tan B = \frac{\text{opposite to angle } B}{\text{adjacent to angle } B}$$

The measurements are modelled in the diagram below which is a side view from the bridge to the theodolite. The canvas below has been provided for annotating if required.

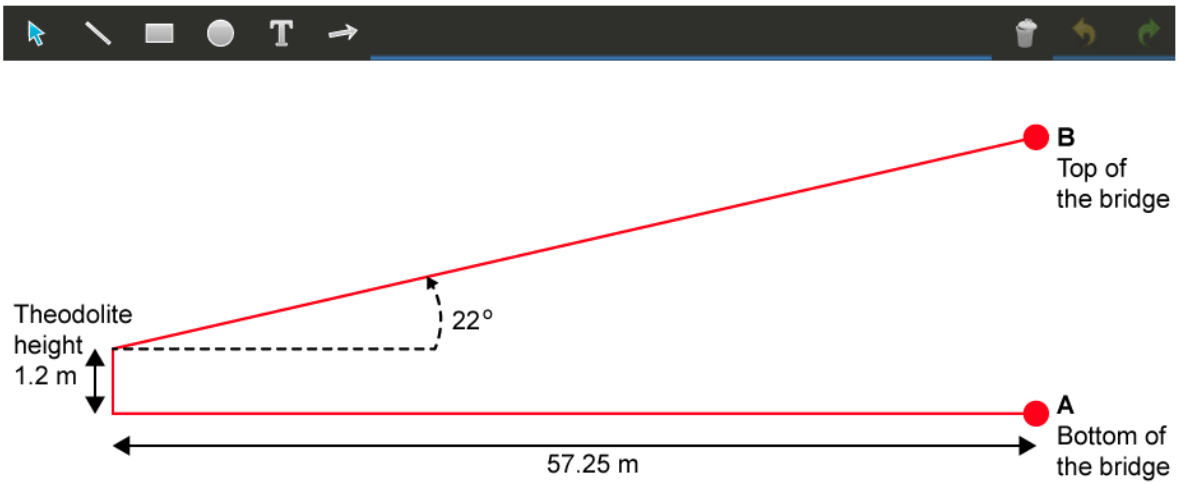


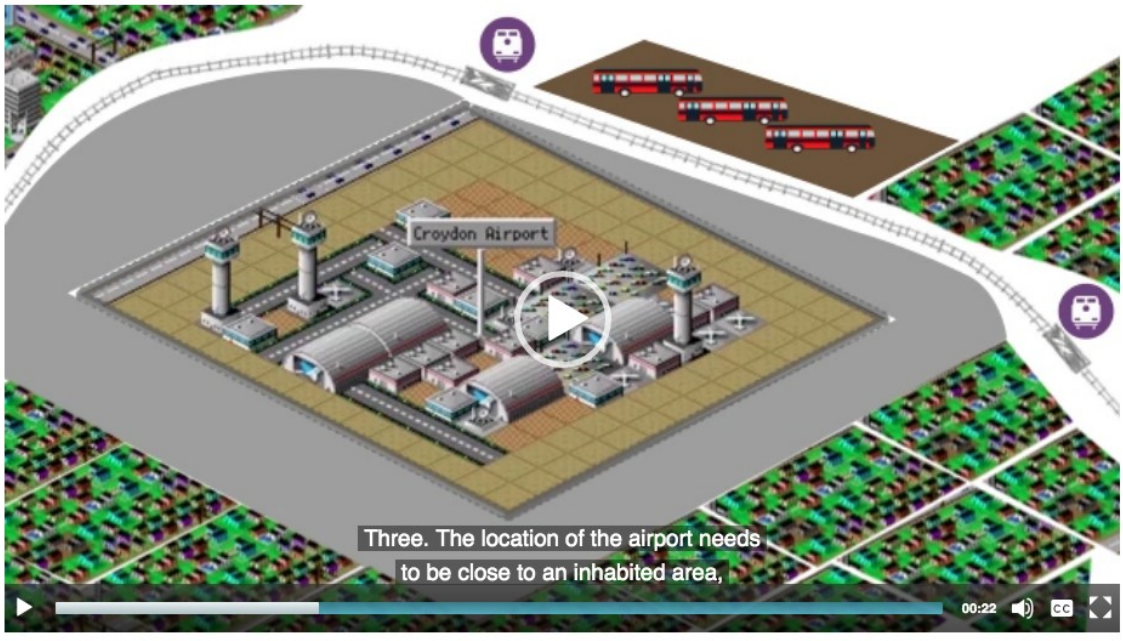
Diagram not to scale

Calculate the height from the top of the bridge at B to the ground vertically below at A to the nearest centimetre.

Question 6 (20 marks)

In this question you will interpret information to discuss the sustainability of a proposed airport development.

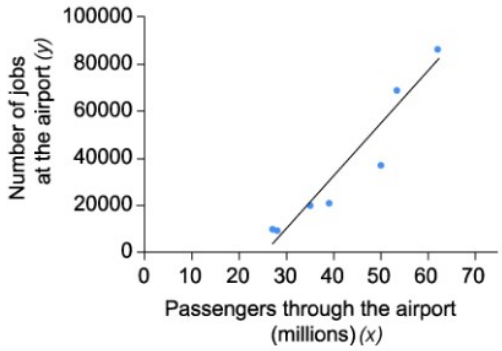
The video below provides some background information for this question.



Tab 1 | Tab 2 | Tab 3

Airport employment data for 2013

$y = 2110x - 52818$



The airport employment data for 2013 in Tab 1 shows the relationship between the number of jobs at the airport (y) and the number of passengers (x) through the airport in millions. The line of best fit is represented by the equation:

$$y = 2110x - 52818.$$

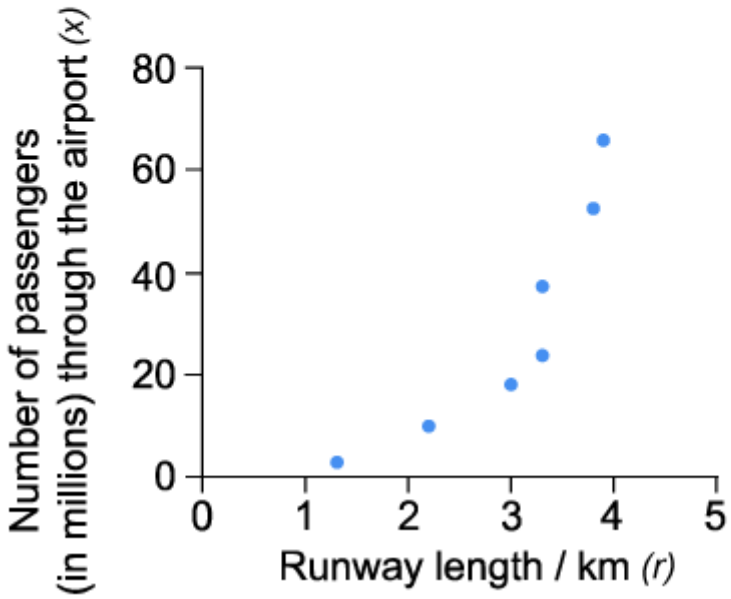
Question 6a (3 marks)

The number of jobs at Hong Kong International Airport was 65 000 in 2013. Use the equation of the line of best fit from Tab 1 to **estimate** the number of passengers passing through the airport. Round your answer to the nearest million.

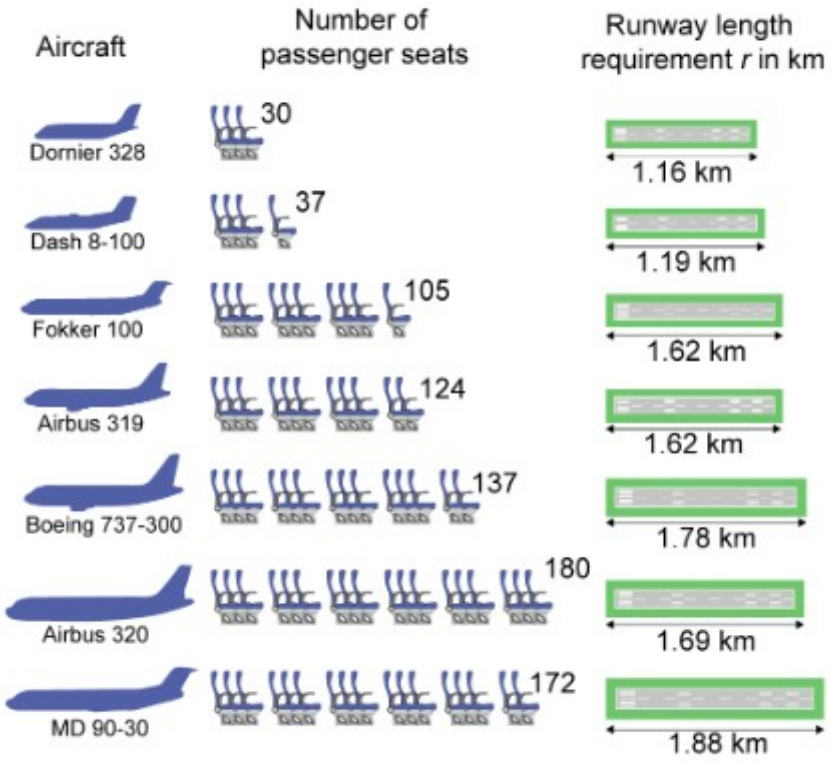
Tab 1 | Tab 2 | Tab 3

Airport runway data for 2013

$x = 0.7(3)^r$



Tab 1 | Tab 2 | Tab 3



Question 6b (3 marks)

The actual number of passengers through Hong Kong International Airport was 68 488 000. **Calculate** the percentage error of your rounded answer from part (a).

$$\text{Percentage error} = \left| \frac{\text{rounded value} - \text{actual value}}{\text{actual value}} \right| \times 100\ \%$$

Question 6c (2 marks)

According to economic predictions, 1 million more passengers through the airport would generate approximately 2000 more jobs. **Justify** how the line of best fit in Tab 1 supports this claim.

The airport runway data for 2013 in Tab 2 shows an exponential relationship between the longest airport runway length (r) in kilometres and the number of passengers (x) through the airport in millions and is modelled by the equation:

$$x = 0.7(3)^r$$

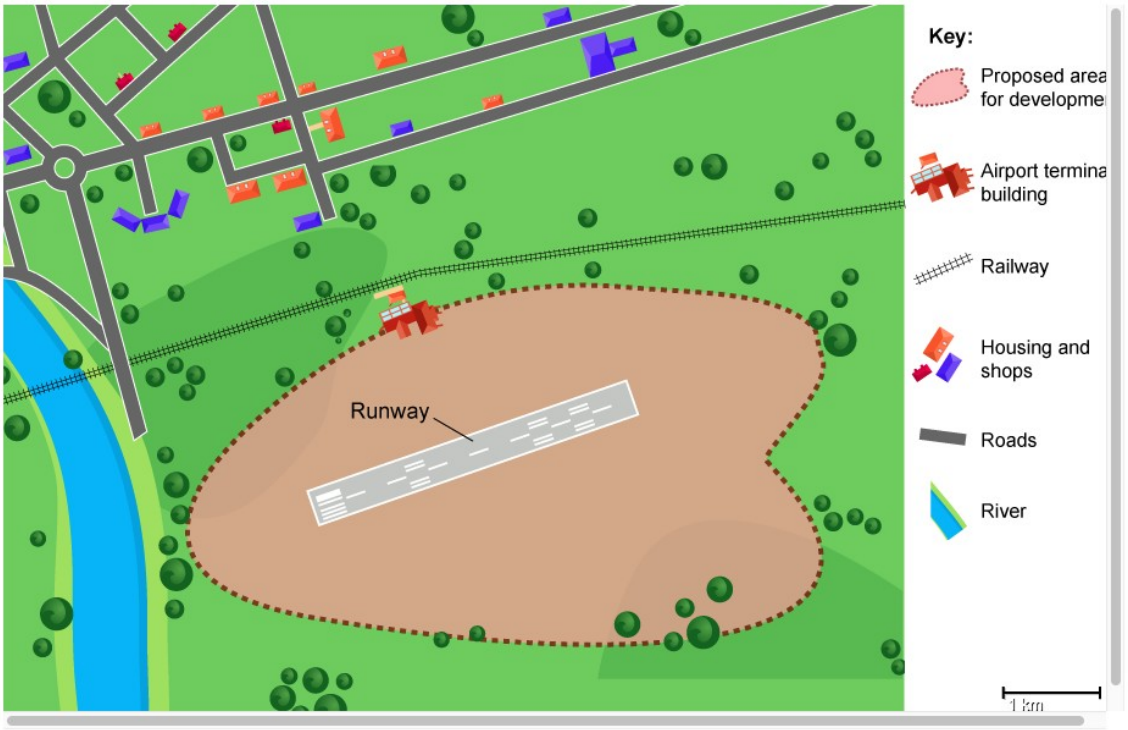
Question 6d (2 marks)

The longest runway length at Motu Mute Airport in Bora Bora is 1.5 km (correct to 2 significant figures).

Use the equation from Tab 2 to **determine** the number of passengers x, through Motu Mute Airport to the nearest million.

Question 6e (10 marks)

Here is a map for a proposed airport development. A measurement tool is provided if required.



The local government claims the airport development will create around 18 000 jobs.
You should write a report in which you **discuss** the claim made by the local government.

Your report will be assessed on the mathematical evidence you provide in your discussion and you should consider the future of the proposed airport using the data provided in the tabs. In your answer you should:

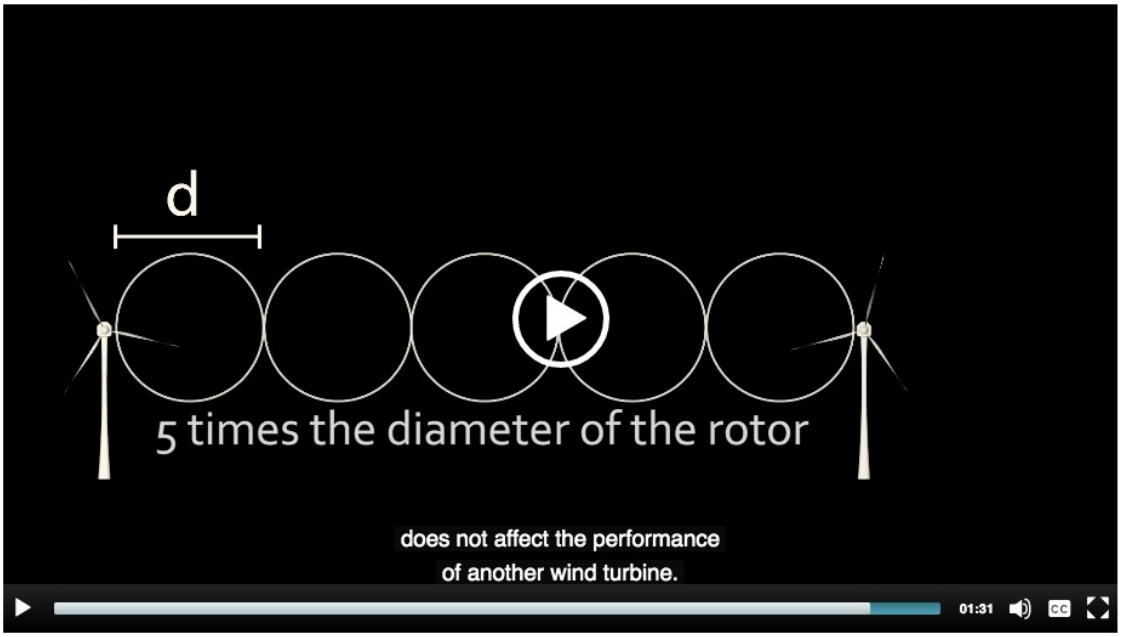
- identify the relevant mathematical information for the opportunities available by the proposed airport
- make appropriate calculations to provide evidence to support your report
- consider the accuracy of your predictions
- comment on the sustainability of the airport.

Question 7 (19 marks)

In this question you will obtain relevant information and use reasoning methods in order to design a sustainable wind farm.

The video below provides some background information for this question.

Video | Formulas



Video | Formulas

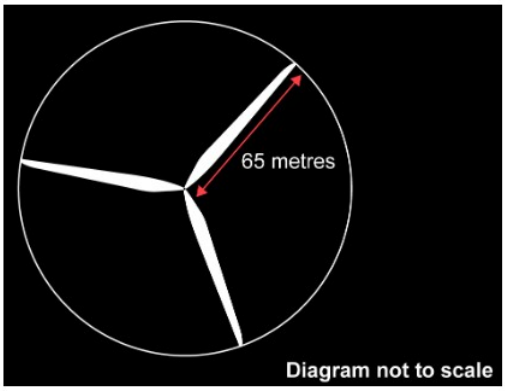
Cicumference of a circle

$C = 2\pi r$, where r is the radius

Area of a circle

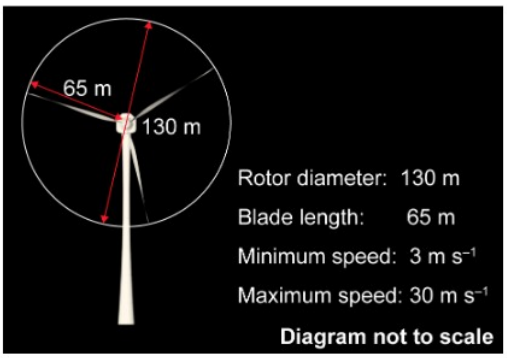
$A = \pi r^2$, where r is the radius

Question 7a (2 marks)



Determine the exact area of the circle covered by the rotors as they turn. Give your answer in terms of π.

Question 7b (5 marks)



The wind turbine efficient power P_E in Watts (W) is calculated as about 45 % of its available power P_A. This is calculated by the formulas:

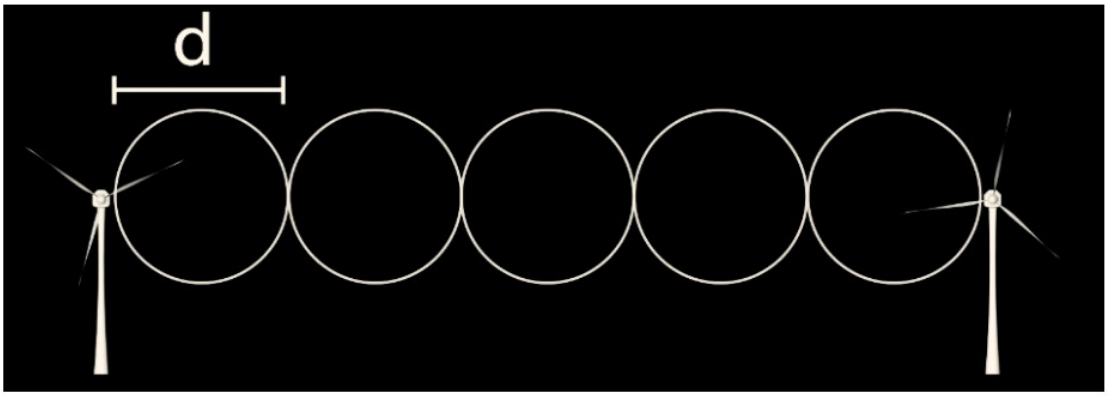
$$P_E = 0.45P_A \text{ where } P_A = 0.6AU^3$$

U is wind speed in metres per second (m s^{-1}).

A is the area of the circle covered by the rotors as they turn.

Calculate, to the nearest kilowatt (kW), the **maximum** efficient power P_E, which is supplied from a maximum wind speed U of 30 m s^{-1}. (Note: 1 kW = 1000 W)

Wind turbines need to be placed quite far apart so that the air turbulence from one wind turbine does not affect another. The wind turbines are spaced out at a distance based on the diameter of the rotors. For many wind turbines the distance between the bases of the towers is 5 times the diameter of the rotors *d*. We will call this the turning zone.



You are provided with a rectangular area to plan a wind farm using turbines with rotor diameter 130 metres (m). The rectangle has length 4000 m and width 1800 m.

Question 7c (2 marks)

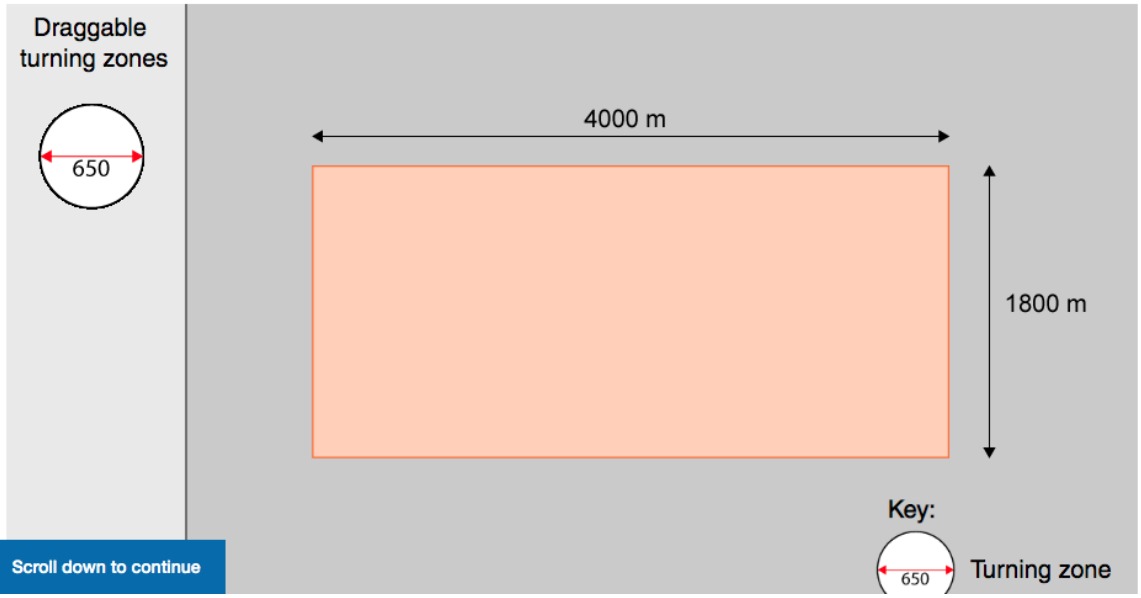
Show that the radius of the circular zone (turning zone) needed for one wind turbine is 325 m.

Question 7d (10 marks)

Design a wind farm using these 130 m diameter turbines in the 4000 m by 1800 m rectangular area provided below. The wind average speed is 30 m s^{-1}. The draggable turning zones below can be placed in the area provided.

In your answer you should:

- identify your strategy for the most efficient wind turbine arrangement
- determine the maximum number of wind turbines that can fit inside this rectangular area
- estimate the maximum efficient power output of your designed wind farm
- consider the sustainability features of the planned wind farm
- justify the degree of accuracy of your estimate.



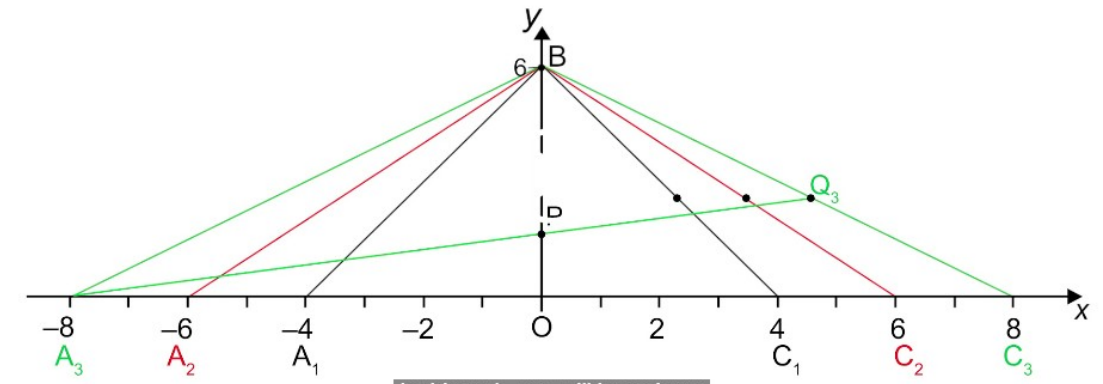
Scroll down to continue

Question 8 (39 marks)

In this question you will investigate relationships in cable-stayed bridges.

The video below provides some background information for this question.

Video | Formulas



Video | Formulas

Coordinates of the midpoint of a line segment with endpoints (x_1, y_1) and (x_2, y_2) $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

Equation of a straight line

$y = mx + c; \quad ax + by + d = 0$

Gradient formula

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Tab 1 | Tab 2

The coordinates of the points C, A and Q as the cables move along the *x* axis are shown in the table.

n	Coordinates C	Coordinates A	Coordinates Q
1	(4,0)	(-4,0)	(2,3)
2	(6,0)	(-6,0)	(3,3)
3	(8,0)	(-8,0)	(4,3)
4	(10,0)	(-10,0)	
5	(12,0)	(-12,0)	
6	(14,0)	(-14,0)	

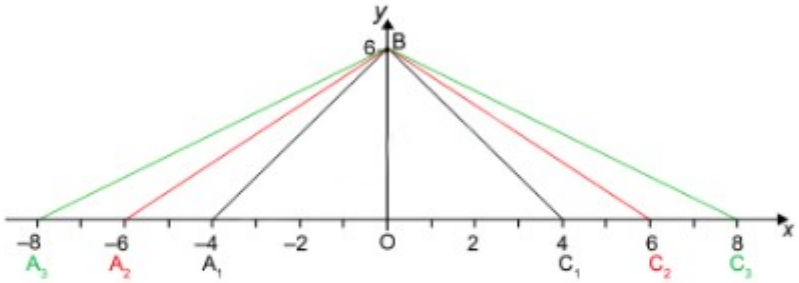
Question 8a (2 marks)

Write down the relationship between the coordinates of C and the coordinates of A.

B I U x_2 x^2 Ω Σ

Styles

Tab 1 | Tab 2



Question 8b (1 mark)

Write down the relationship between X_Q, the *x* coordinates of the midpoint Q, and X_C, the *x* coordinates of C.

Question 8c (3 marks)

Predict the coordinates of the remaining midpoints Q_4, Q_5, Q_6 and write your answers in the table.

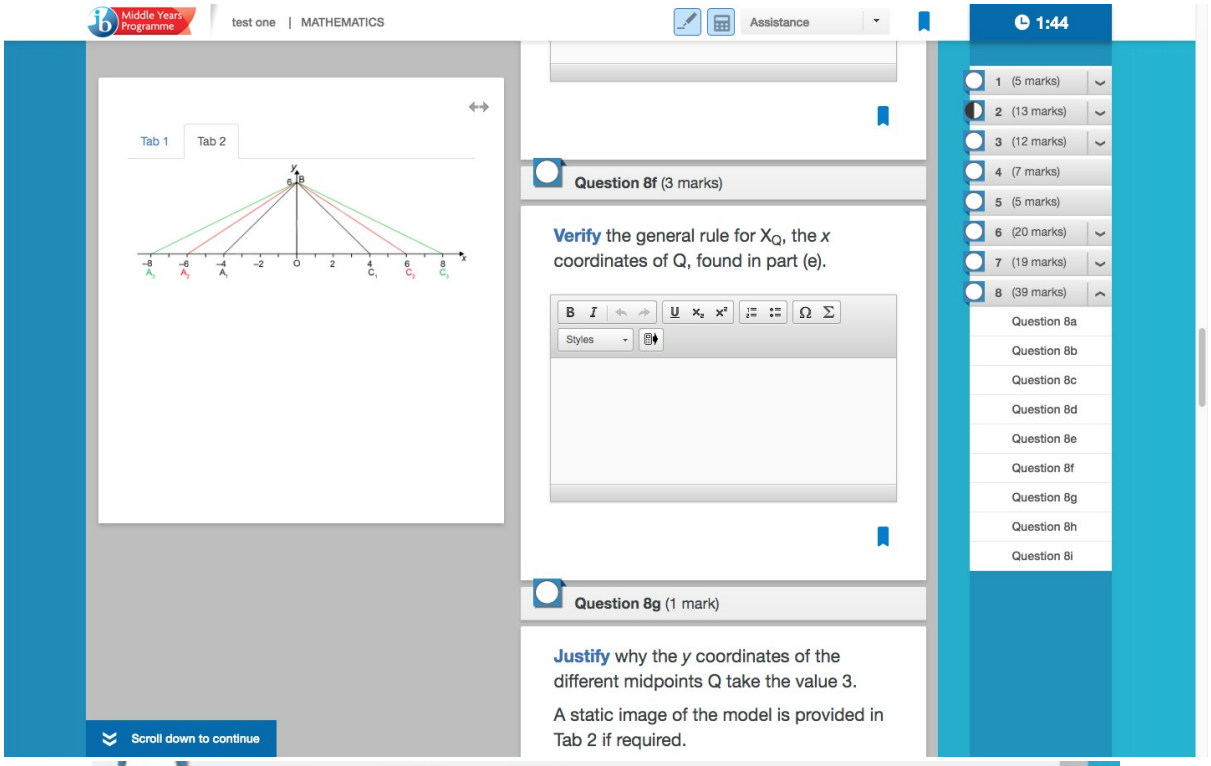
n	Coordinates C	Coordinates A	Coordinates Q
1	(4,0)	(-4,0)	(2,3)
2	(6,0)	(-6,0)	(3,3)
3	(8,0)	(-8,0)	(4,3)
4	(10,0)	(-10,0)	
5	(12,0)	(-12,0)	
6	(14,0)	(-14,0)	

Question 8d (2 marks)

Determine the general rule for X_C, the x coordinates of C, in terms of n.

Question 8e (1 mark)

Hence, write down the general rule for X_Q, the x coordinates Q, in terms of n.



Question 8f (3 marks)

Verify the general rule for X_Q, the x coordinates of Q, found in part (e).

Question 8g (1 mark)

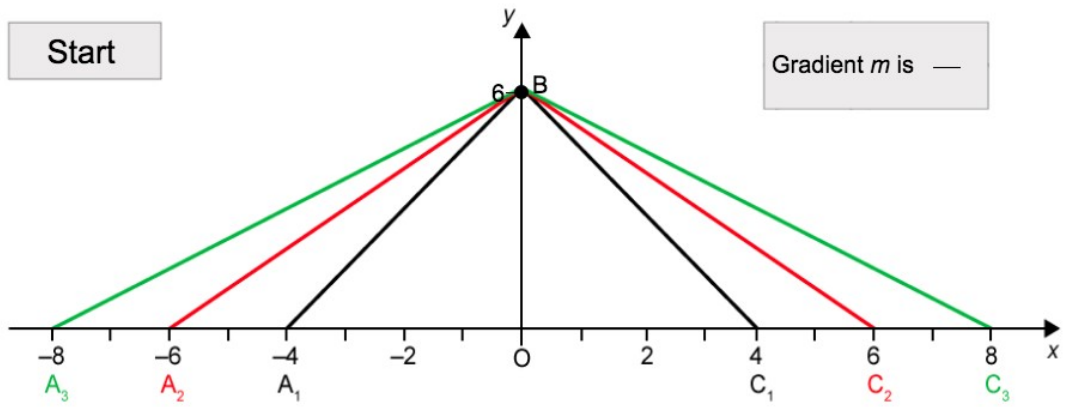
Justify why the y coordinates of the different midpoints Q take the value 3.

A static image of the model is provided in Tab 2 if required.

Question 8h (2 marks)

Using the animation and table below, **show** that the gradient from A_1 to Q_1 is $\frac{3}{6}$.

Click on "Start" and "Next" to see the gradient animated.



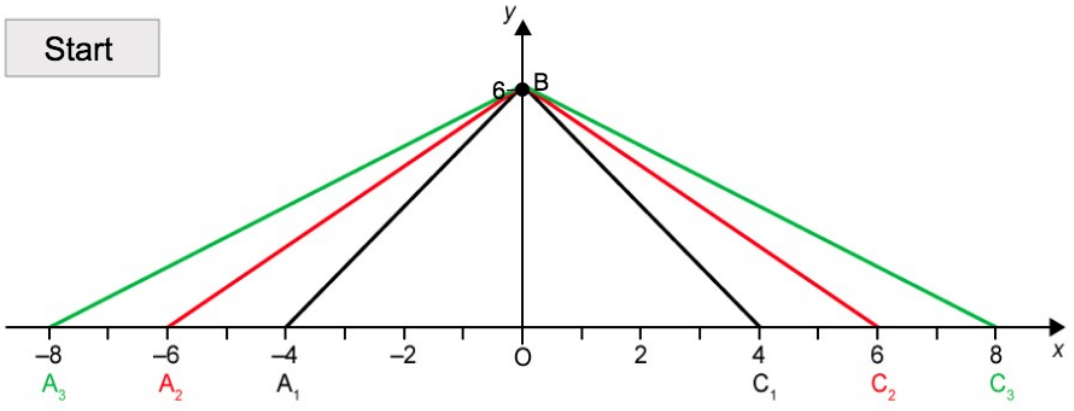
n	1	2	3	4
C	(4,0)	(6,0)	(8,0)	(10,0)
A	(-4,0)	(-6,0)	(-8,0)	(-10,0)
Q	(2,3)	(3,3)	(4,3)	(5,3)

Question 8i (24 marks)

Investigate the equation of the line AQ for all line segments of AQ by considering the equation of a line or otherwise. In your answer you should:

- describe any patterns you see for the gradient of AQ and for the coordinates of P
- find a general rule for the gradient of AQ in terms of *n*
- hence find the general equation of all lines AQ
- test your general rule for the gradient of AQ
- test your general equation of all lines of AQ
- prove or verify and justify your general rule and general equation
- ensure that you communicate the above appropriately.

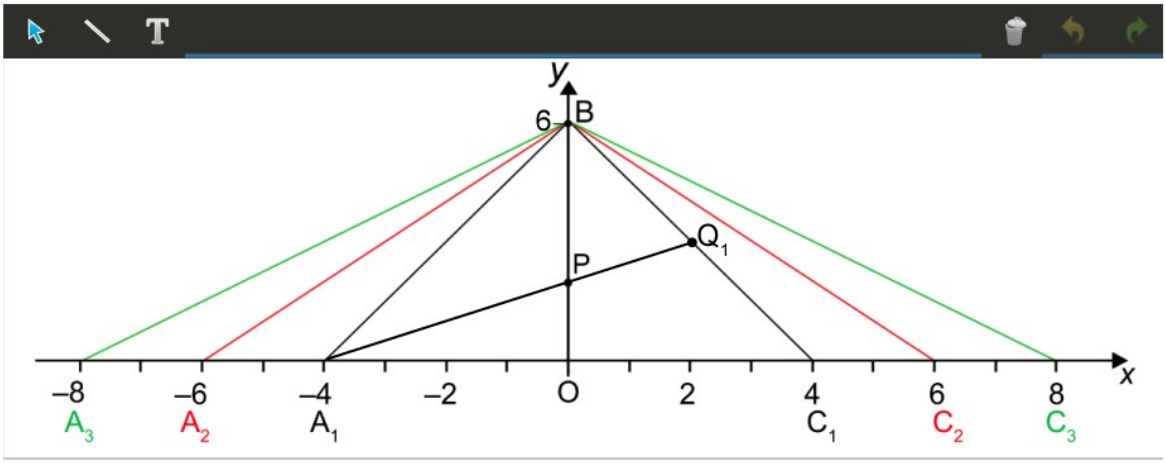
Click on "Start" and "Next" to animate the line segments of AQ.



The canvas and table below have been provided for annotating if required.

To insert your answer into the table, click in the table cell and write your answer in the "Add label" box.

n	1	2	3	4	5	6
C_n	(4,0)	(6,0)	(8,0)	(10,0)		
A_n	(-4,0)	(-6,0)	(-8,0)	(-10,0)		
Q_n	(2,3)	(3,3)	(4,3)	(5,3)		
P	(0,2)					
m = *gradient*	$\frac{3}{6}$					



2017 May Maths eAssessment

Question 1 (10 marks)

Question 1a (2 marks)

Find 40 as a product of prime factors.

Question 1b (2 marks)

Consider two sets: A and B. Set A contains the factors of 40 and set B contains the multiples of 4 less than 21.

Determine the missing elements for set A and set B.

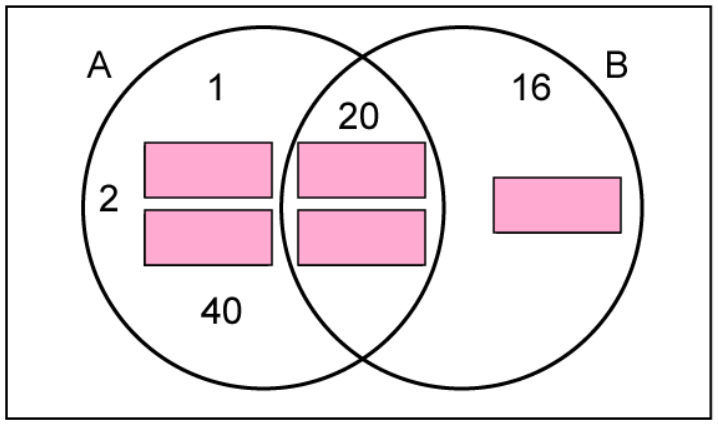
A = {1, 2, ☐, ☐, ☐, ☐, 20, 40}

B = {4, ☐, ☐, 16, 20}

Question 1c (3 marks)

Determine the missing values and complete the Venn diagram with the elements of sets A and B.

To insert your answers in the Venn diagram below, click inside the relevant box, then write the value in the "Add Label" box.



Question 1d (1 mark)

Write down the elements of A ∩ B.

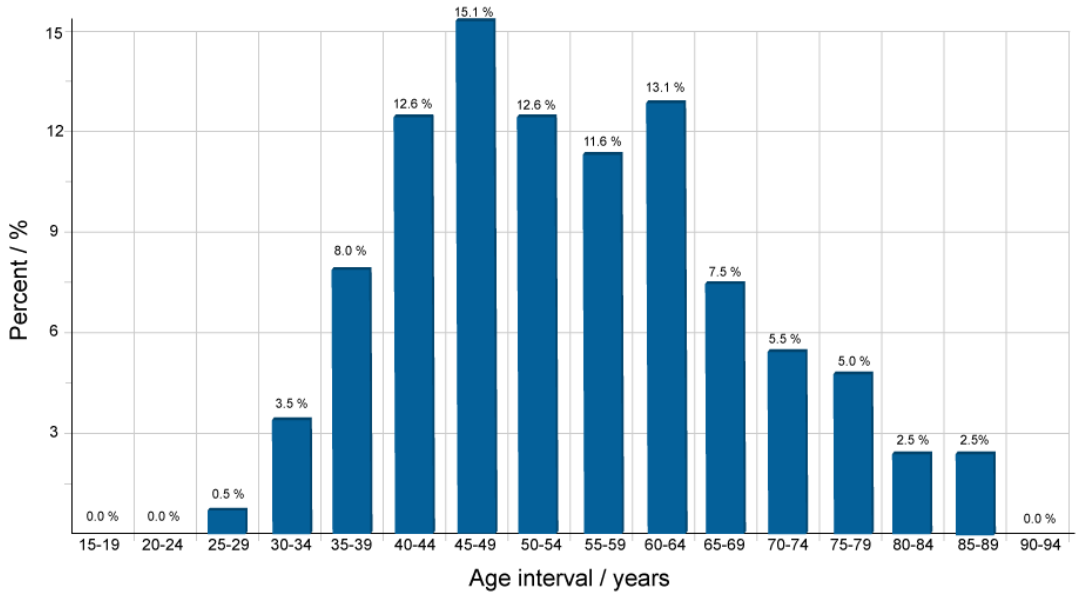
Question 1e (2 marks)

Describe the properties of the elements of A ∩ B in the context of the problem.

Question 2 (9 marks)

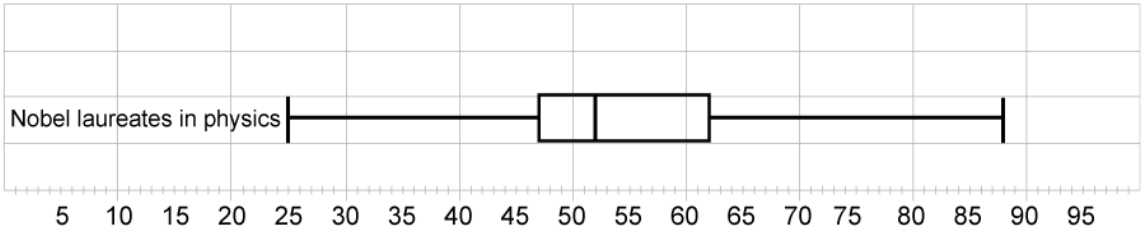
The Nobel Prize is a set of awards presented annually in recognition of academic, cultural and scientific advances. Every year, the Nobel Prize is awarded in recognition of discoveries made. Winners of a Nobel Prize are called Nobel laureates.

The bar chart below shows the distribution of the ages of the physics laureates the year they received their Nobel Prize. The data provided is taken from 2016.



Here is a box-and-whisker plot of Nobel laureates in physics. Hover over the box-and-whisker plot to reveal the values.

This media is interactive



Question 2a (1 mark)

Write down the modal interval for the age of the laureates of the physics award.

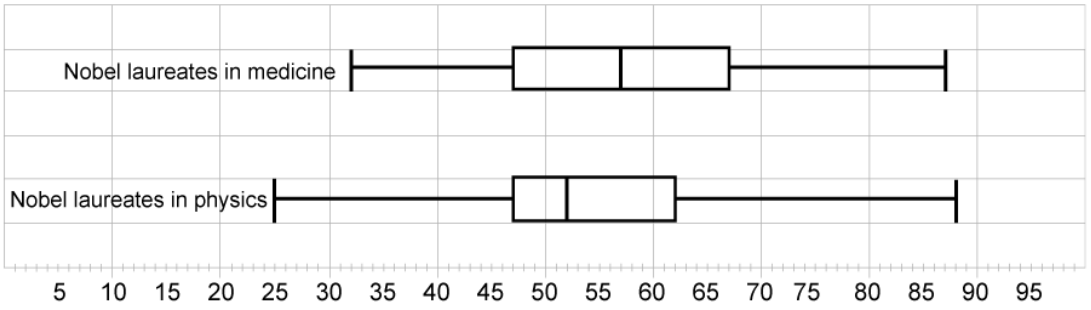
Question 2b (1 mark)

Write down the median age of the laureates of the physics award.

Question 2c (3 marks)

Here are the box-and-whisker plots of Nobel laureates in medicine and physics. Hover over each box-and-whisker plot to reveal the values.

This media is interactive

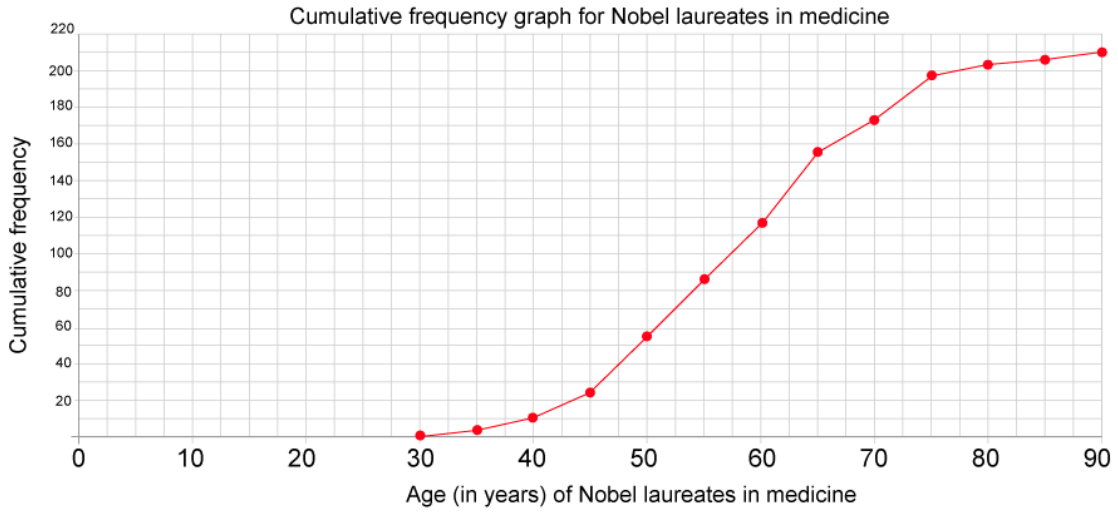


Compare the interquartile ranges of ages of the laureates of the medicine and physics awards.

Cumulative frequency graph | Cumulative frequency table

The cumulative frequency graph below shows the age (in years) of 210 Nobel laureates in medicine. Hover over the points to reveal the coordinates.

This media is interactive



Cumulative frequency graph | Cumulative frequency table

Age (in years) of Nobel laureates in medicine	Cumulative frequency
Under 30	0
Under 35	3
Under 40	12
Under 45	22
Under 50	55
Under 55	88
Under 60	118
Under 65	156
Under 70	172
Under 75	189
Under 80	201
Under 85	206
Under 90	210

Question 2d (2 marks)

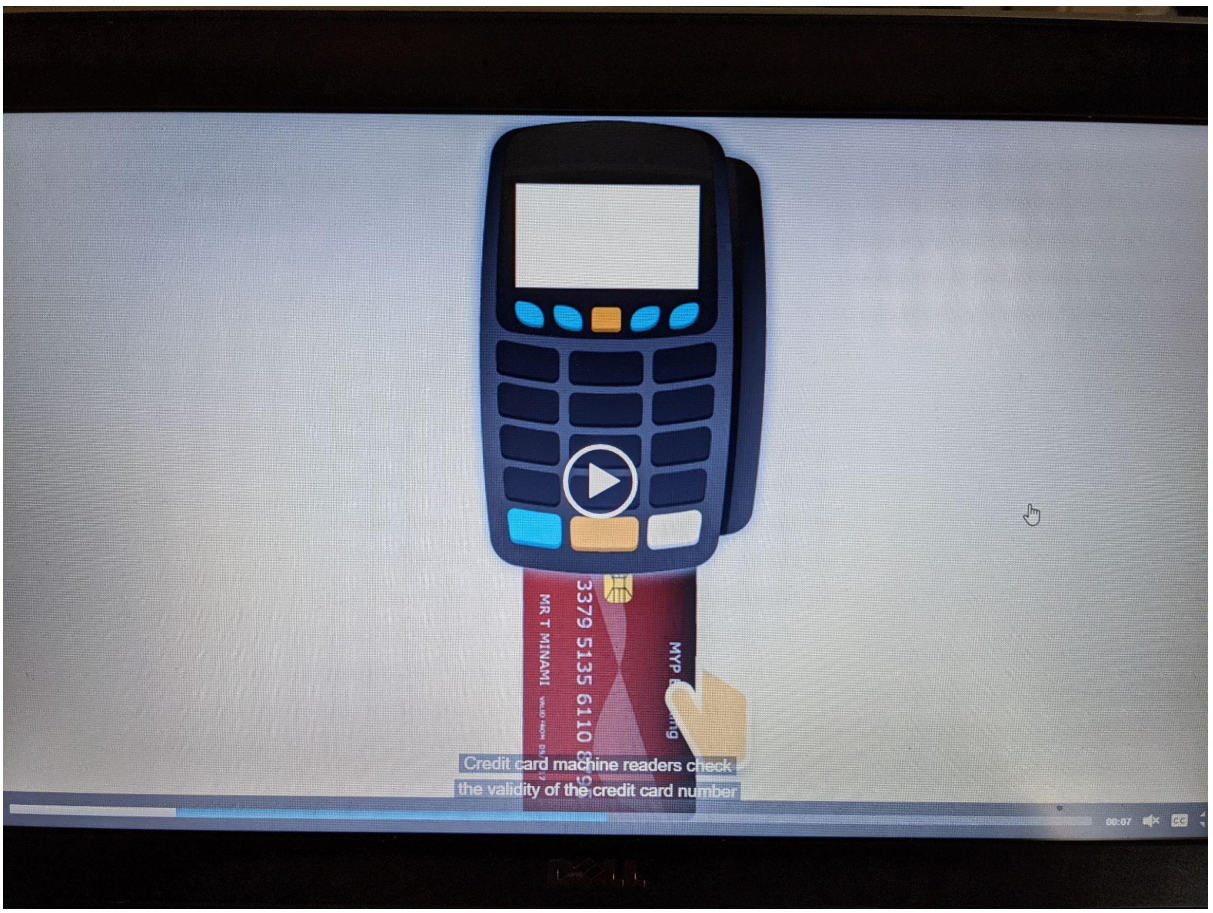
Using the cumulative frequency graph or table, **find** an estimate for the probability that the next Nobel laureate in medicine will be below 50 years old.

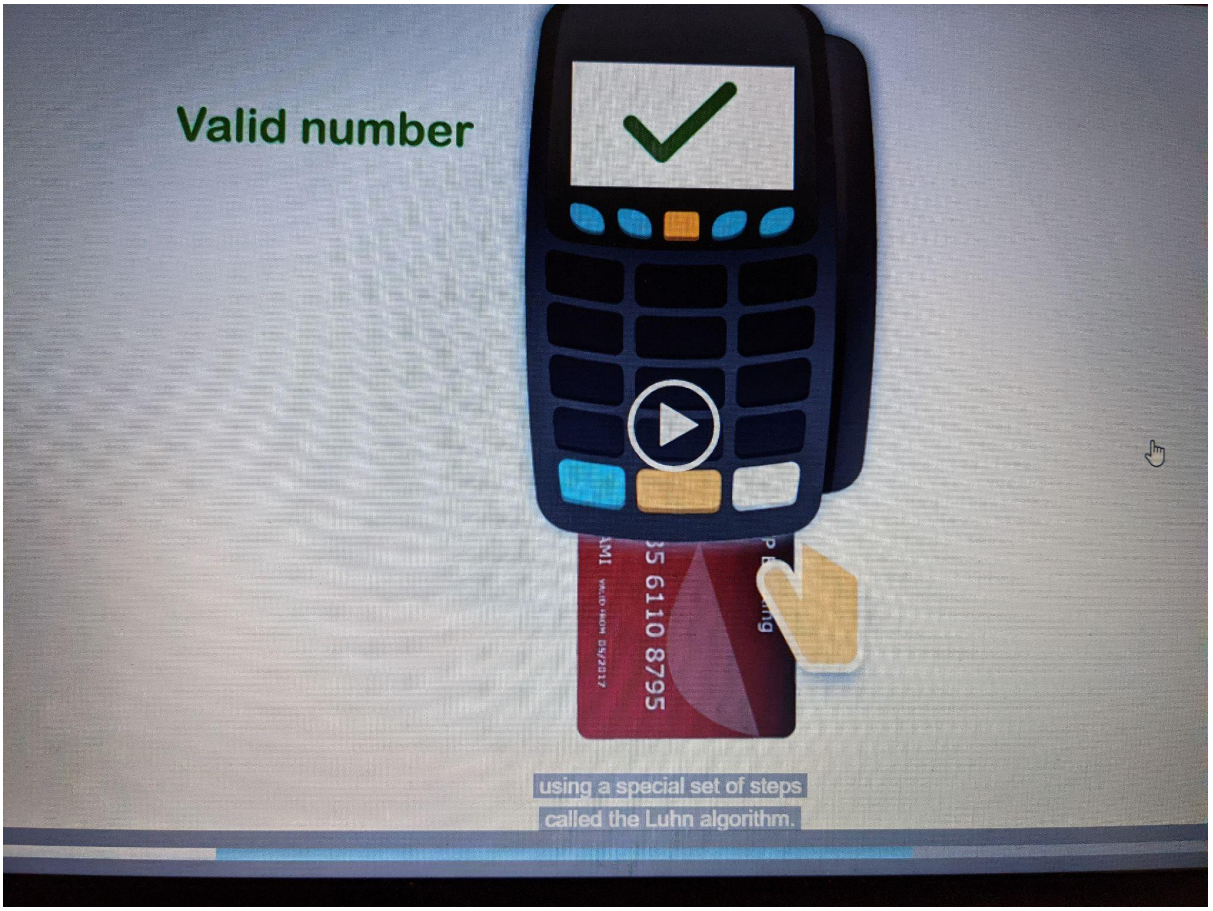
Question 2e (2 marks)

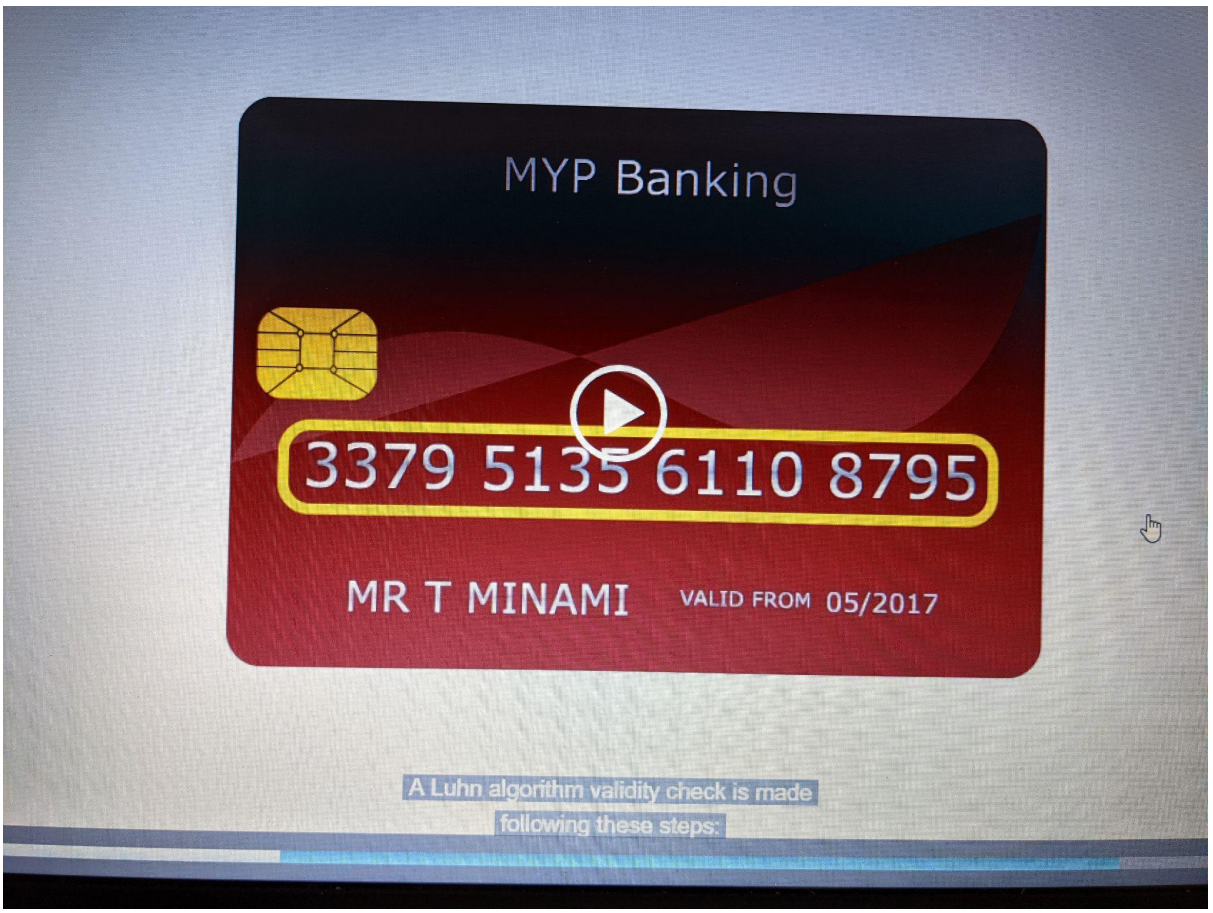
Given that 20 % of the Nobel Prize laureates in medicine are over x years old, **find** an estimate for the age x.

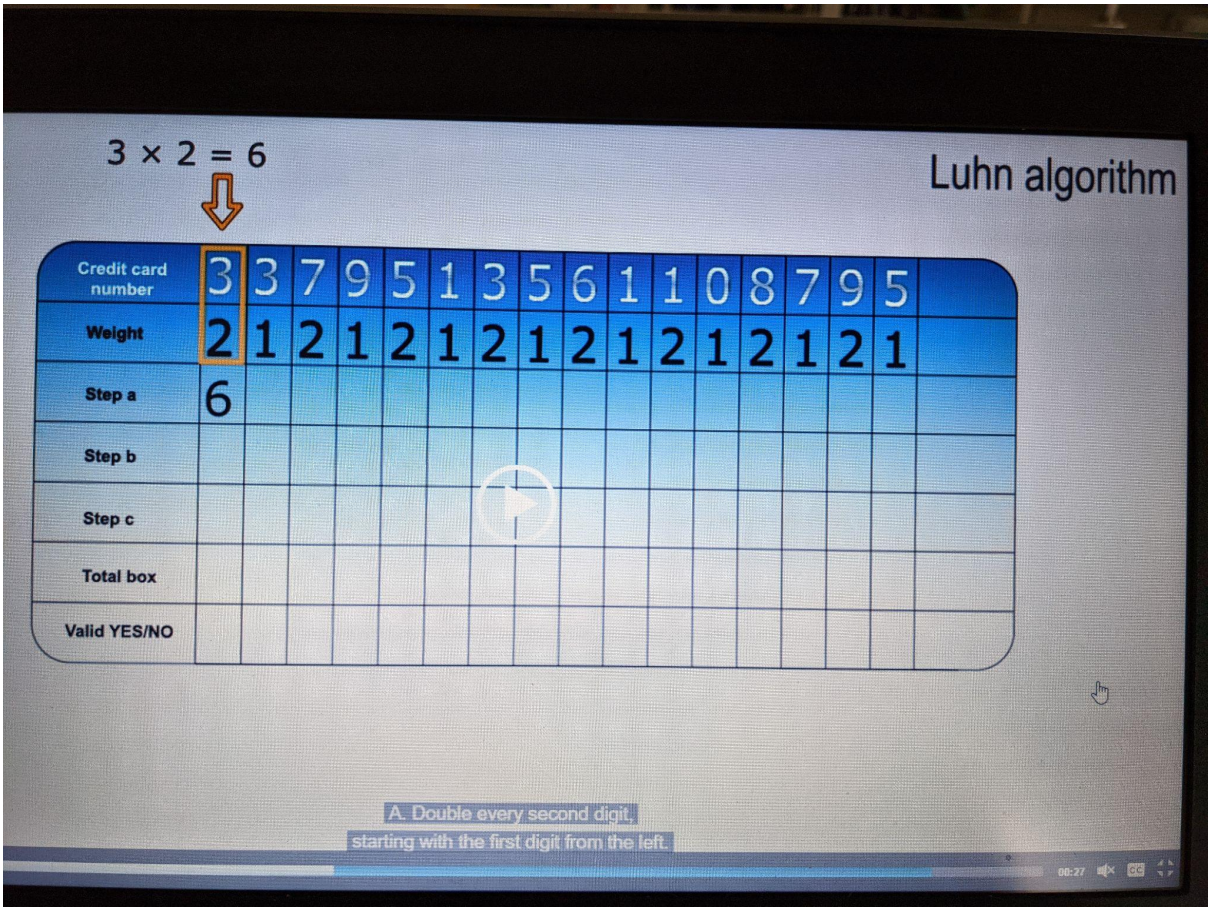
Question 3 (9 marks)

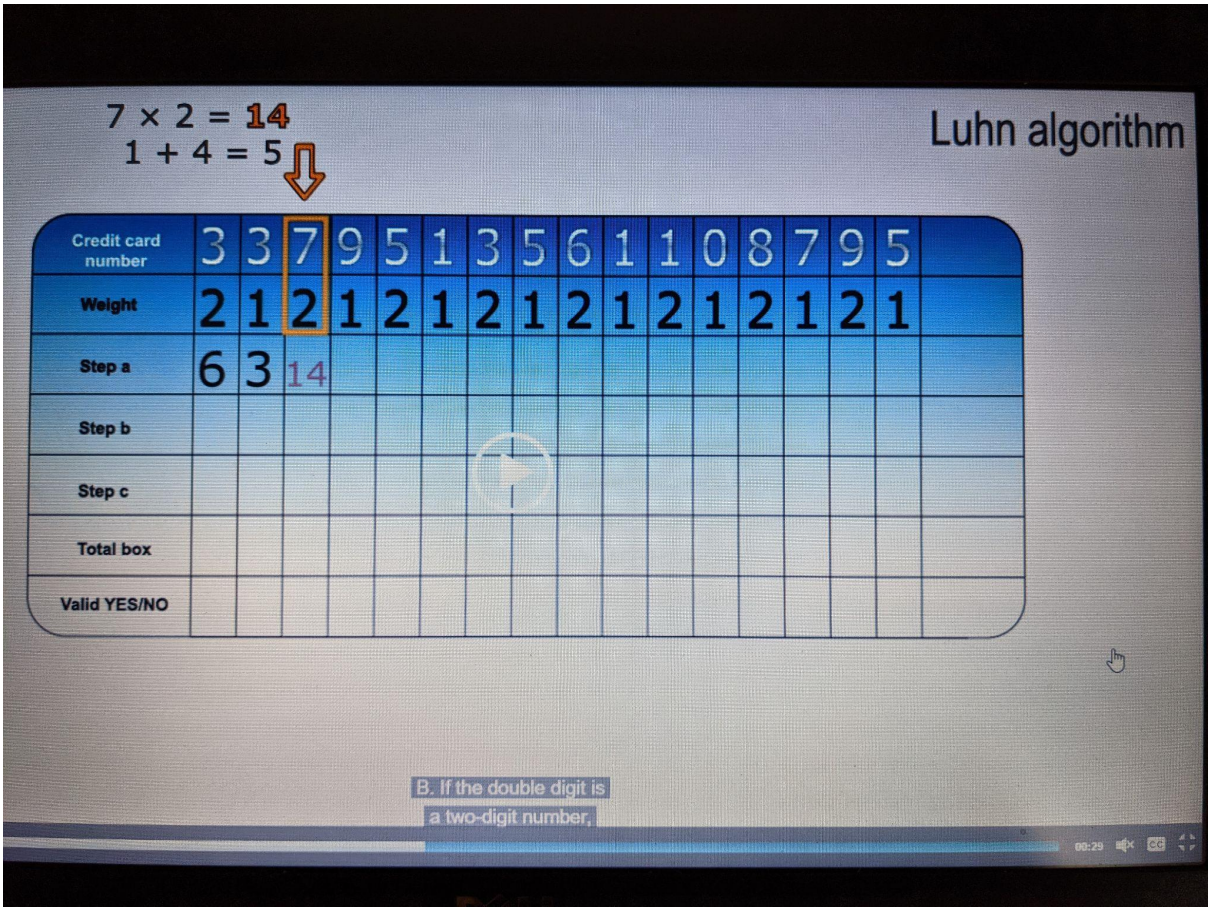
The following video describes the Luhn algorithm credit card validity check.

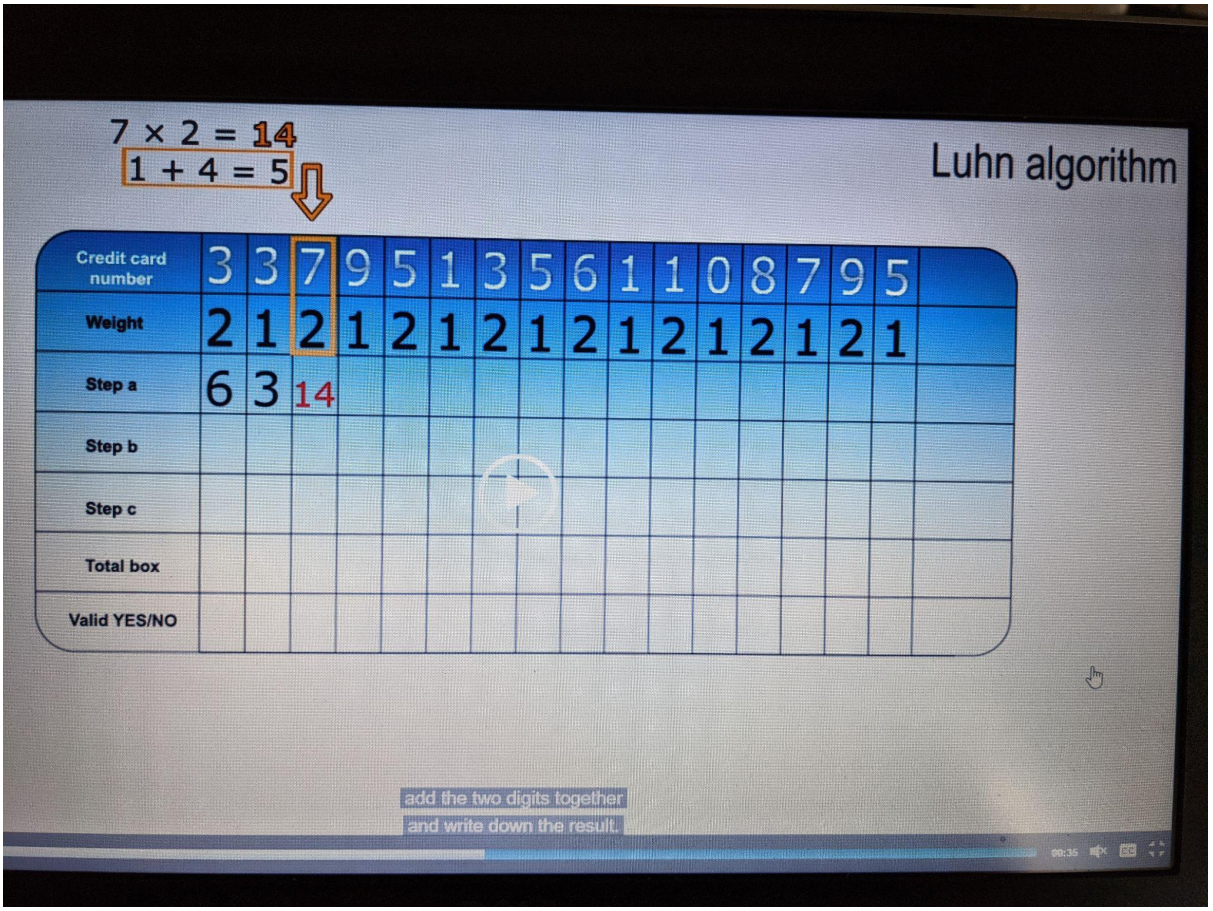

MR T MINAMI
3379 5135 6110 8795
Credit card machine readers check
the validity of the credit card number


Valid number
using a special set of steps
called the Luhn algorithm.


MYP Banking
3379 5135 6110 8795
MR T MINAMI
VALID FROM 05/2017
A Luhn algorithm validity check is made
following these steps:


3 × 2 = 6
Luhn algorithm
Credit card number
Weight
Step a
Step b
Step c
Total box
Valid YES/NO
A. Double every second digit,
starting with the first digit from the left.


7 × 2 = 14
1 + 4 = 5
Luhn algorithm
Credit card number 3 3 7 9 5 1 3 5 6 1 1 0 8 7 9 5
Weight 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1
Step a 6 3 14
Step b
Step c
Total box
Valid YES/NO
B. If the double digit is
a two-digit number,

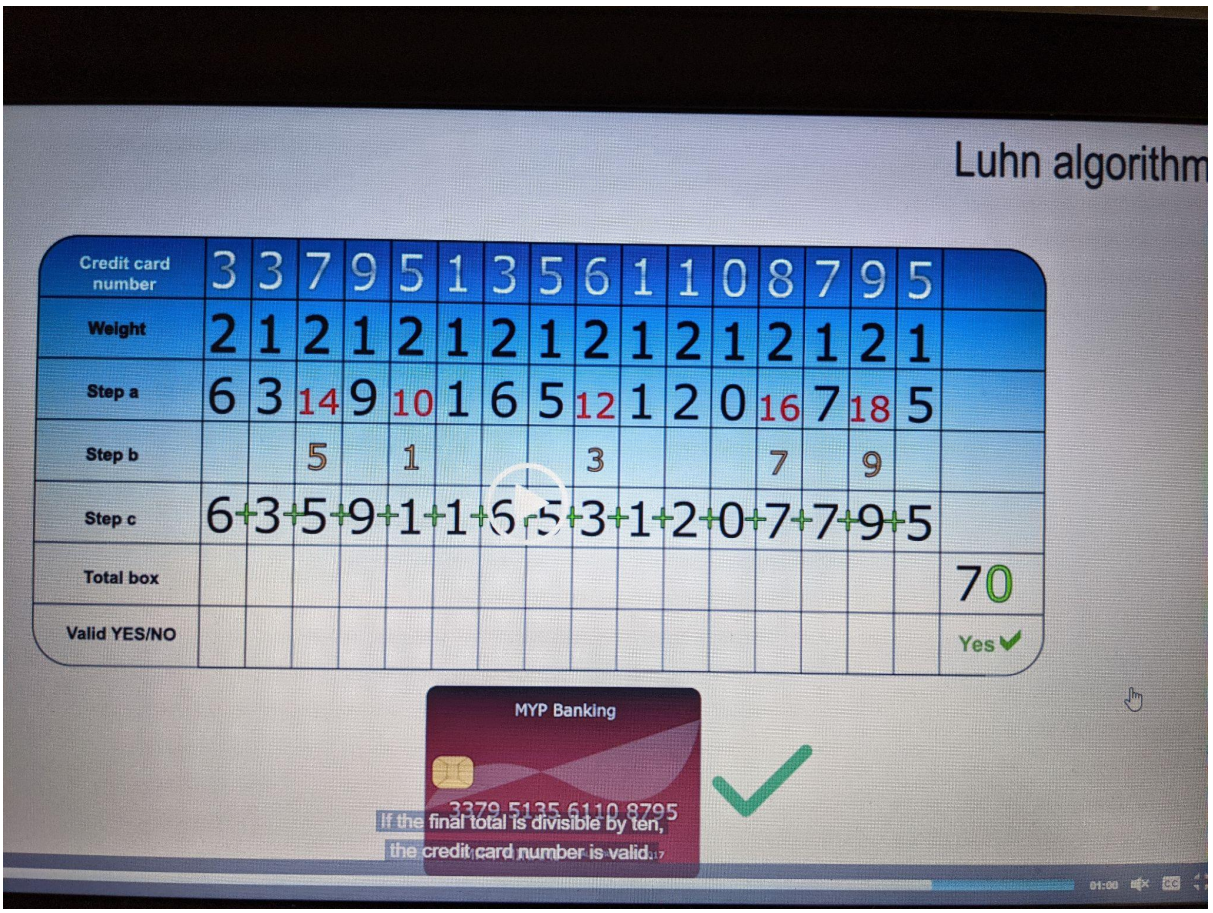

7 × 2 = 14
1 + 4 = 5
Luhn algorithm
Credit card number 3 3 7 9 5 1 3 5 6 1 1 0 8 7 9 5
Weight 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1
Step a 6 3 14
Step b
Step c
Total box
Valid YES/NO
add the two digits together
and write down the result.

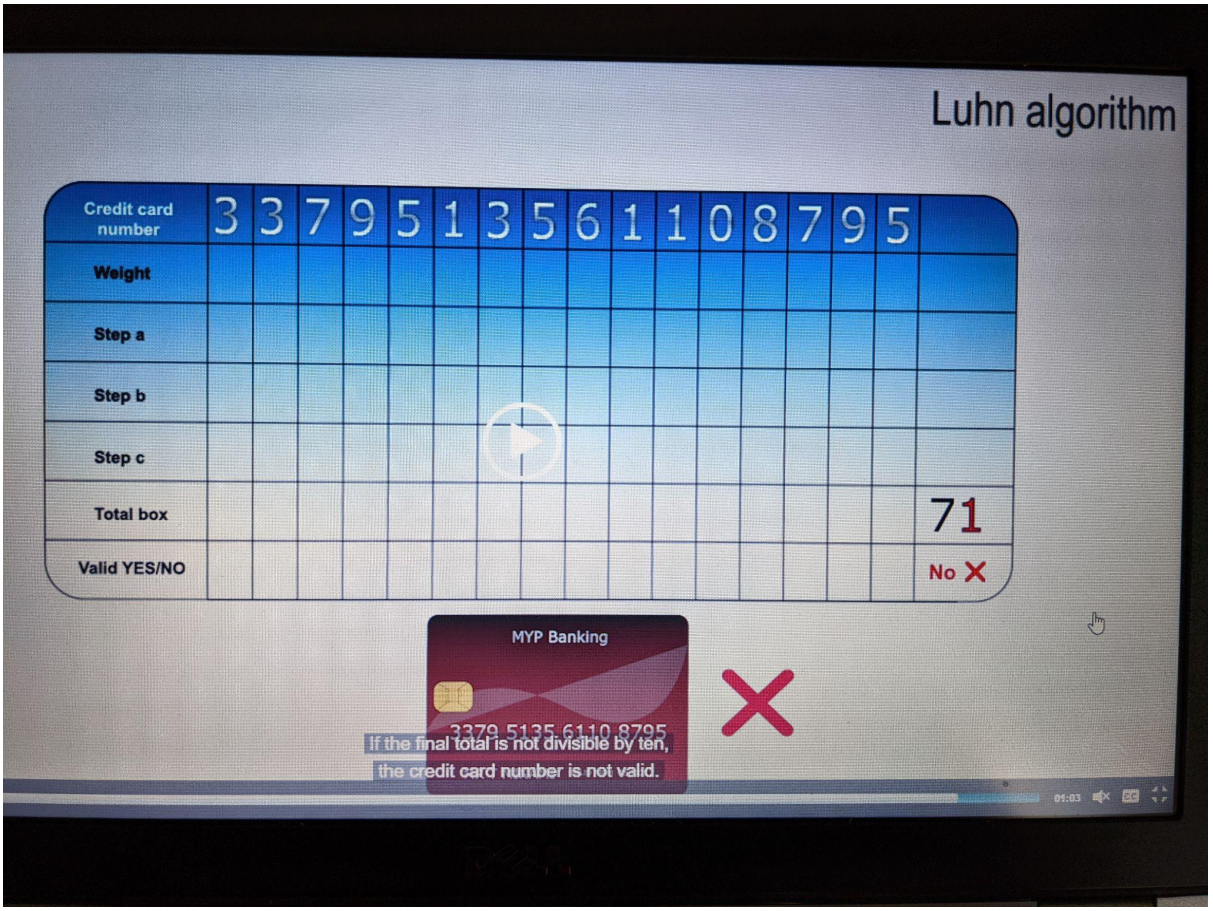
Luhn algorithm

Credit card number	3	3	7	9	5	1	3	5	6	1	1	0	8	7	9	5
Weight	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1
Step a	6	3	14	9	10	1	6	5	12	1	2	0	16	7	18	5
Step b			5		1				3				7		9	
Step c	6	3	5	9	1	1	6	5	3	1	2	0	7	7	9	5
Total box																
Valid YES/NO																

C. Add all digits together
to find the final total.

00:38


Luhn algorithm
Credit card number 3 3 7 9 5 1 3 5 6 1 1 0 8 7 9 5
Weight 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1
Step a 6 3 14 9 10 1 6 5 12 1 2 0 16 7 18 5
Step b 5 1 3 7 9
Step c 6+3+5+9+1+1+6+5+3+1+2+0+7+7+9+5
Total box 70
Valid YES/NO Yes
MYP Banking
3379 5135 6110 8795
If the final total is divisible by ten,
the credit card number is valid.


Luhn algorithm
Credit card number 3 3 7 9 5 1 3 5 6 1 1 0 8 7 9 5
Weight
Step a
Step b
Step c
Total box 71
Valid YES/NO No
MYP Banking
3379 5135 6110 8795
If the final total is not divisible by ten,
the credit card number is not valid.

Credit card machine readers check the validity of credit card numbers using a special set of steps called the Luhn algorithm. A Luhn algorithm validity check is made following these steps:

A. Double every second digit, starting with the first digit from the left.
B. If the double digit is a two-digit number, add the two digits together and write down the result.
C. Add all the digits together to get the final total.

If the final total is divisible by ten, the credit card number is valid.
If the final total is not divisible by ten, the credit card number is not valid.

Question 3a (2 marks)

Determine the missing digits represented by the letters A, B, C, D and E to complete the table below.

To insert your answers in the table, click inside the box and replace the letters with your answers in the "Add Label" box.

Credit card number	1	5	4	3	4	1	3	8	7	2	3	5	8	3	4	6
Weight	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1
Step a	2	5	8	3	8	1	6	8	A	2	6	5	16	B	8	6
Step b																
Step c	2	5	8	3	8	1	6	8	C	2	6	5	D	E	8	6

Question 3b (2 marks)

Justify why the credit card number is invalid.

Question 3c (2 marks)

The credit card 4150 0811 1727 967X is a valid credit card number.

After the Luhn algorithm is applied, the final total is 61 + X. **Determine** the value of X.

Question 3d (3 marks)

Label the table below with further instructions F, G and H to clarify the workings of the algorithm. Some instructions have already been given.

Credit card number	3379 5135 6110 8795
Weight row	Identify the digits that are doubled
Product	Double the appropriate digits
Instruction F	
Result	Write down the new digit after instruction F
Instruction G	
Instruction H	

Question 4 (7 marks)

The function f(x) is defined for the domain {0, 2, 4, 6}. The values of f(x) are given in the table below.

x	0	2	4	6
f(x)	−4	0	2	3

Question 4a (1 mark)

Write down the value of f(4).

Question 4b (2 marks)

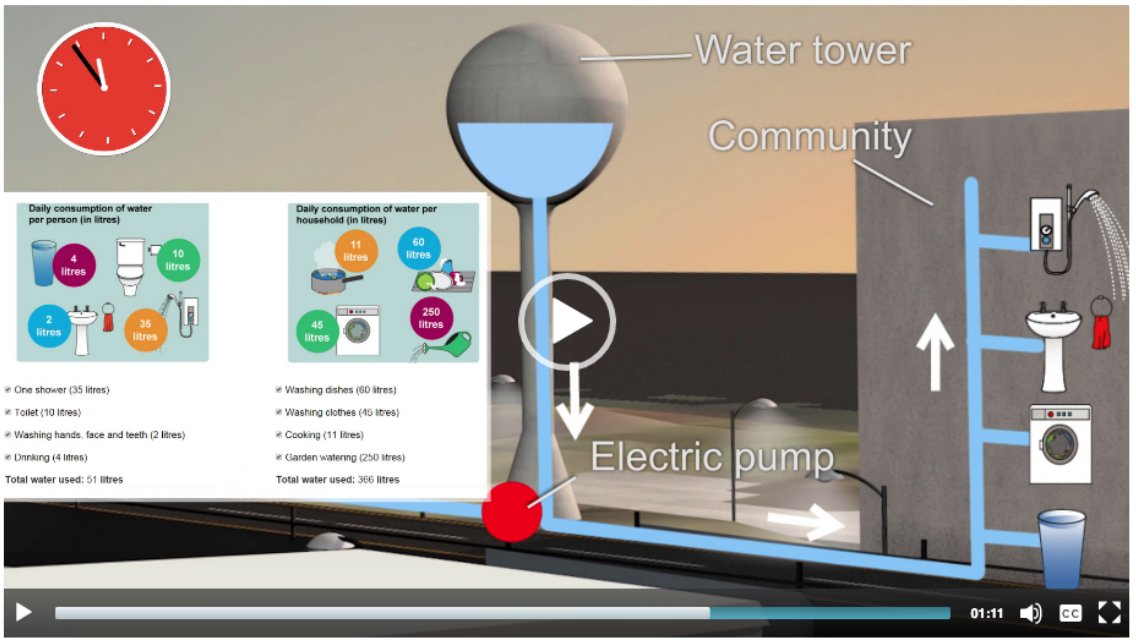
Determine the value of 3f(4) −1.

Question 4c (4 marks)

Determine the value of x if $3 - 2f(x) = 11$.

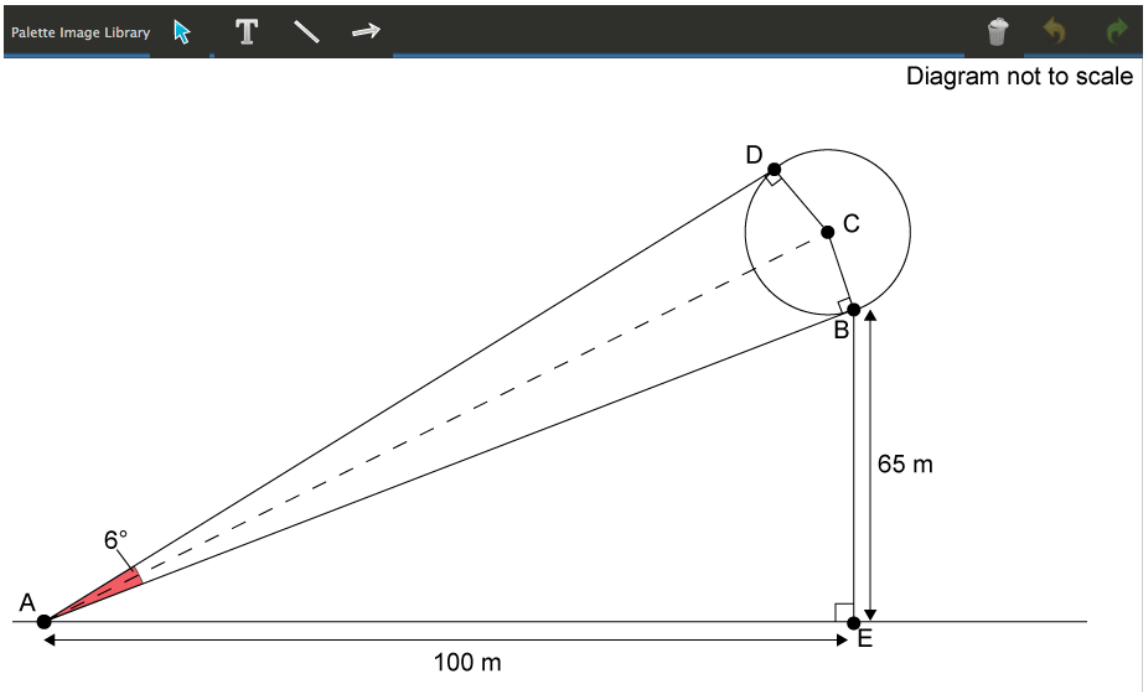
Question 5 (20 marks)

The following video describes how a water tower can be used to maintain residential water pressure for a community.



Question 5a (1 mark)

Diagram 1



The water is stored in a spherical water tank that is modelled by the cross section in Diagram 1, with centre C. The distances are recorded to the nearest metre (m). EB is 65 m and AE is 100 m. Angle BAD is 6° recorded to the nearest degree. AB and AD are tangents to the spherical water tank at points B and D respectively. Angle AEB, ABC and ADC are 90°. ABCD is a kite.

Write down the size of angle BAC.

Question 5b (4 marks)

Show that BC, the length of the radius of the spherical water tank is 6.25 m, to the nearest cm.

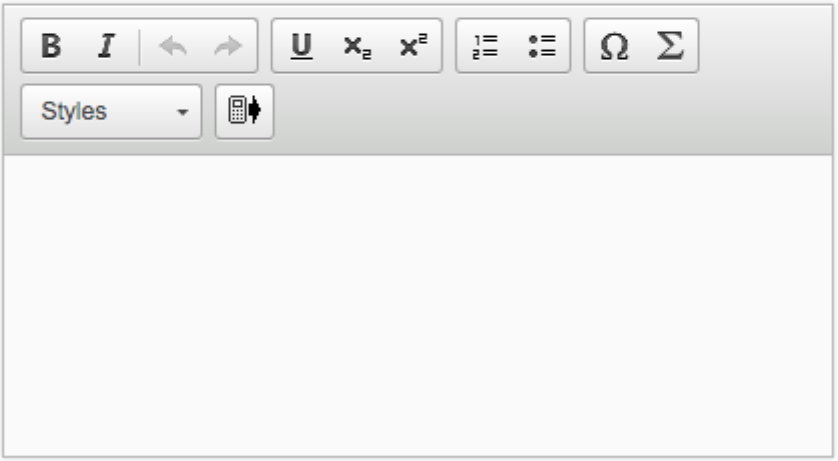
Question 5c (3 marks)

Hence, **calculate** the volume of the spherical water tank to the nearest cubic metre (m^3).

Question 5d (2 marks)

Given that the maximum volume of the water held in the spherical water tank is 950 m^3, **identify** **two** possible reasons for the difference between the volume you calculated and the maximum volume.

Reason 1



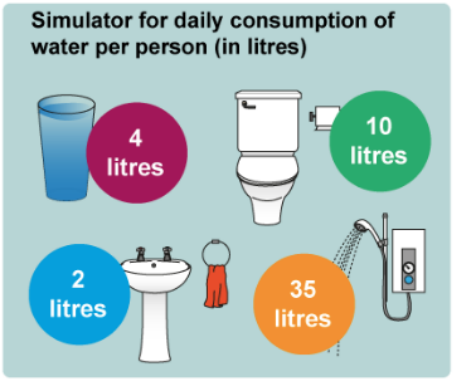
Reason 2

The MYP water tower serves the MYP county area with a population of approximately 300 000 people. On average there are four people per household and the typical water consumption distribution is shown in the simulations below (1000 litres = 1 m^3).

The water tower provides a supply of water for household use during a power outage. There will be a planned power outage for maintenance reasons on Tuesday 30th May 2017 between 9am and 1pm. You are responsible for gathering information on the possible impact to the water supply for the community during the power outage. An interactive simulator is provided for the different household activities.

Use the water consumption simulators below for the different activities.

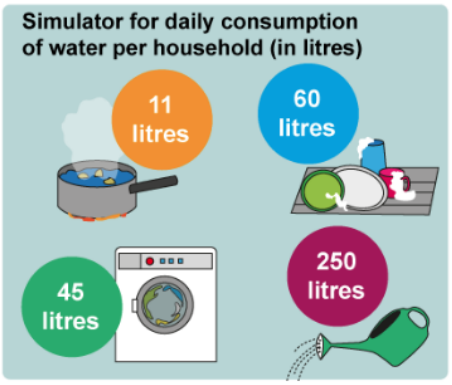
This media is interactive



- [ ] One shower (35 litres)
- [ ] Toilet (10 litres)
- [ ] Washing hands, face and teeth (2 litres)
- [ ] Drinking (4 litres)

Total water used:

This media is interactive



- [ ] Washing dishes (60 litres)
- [ ] Washing clothes (45 litres)
- [ ] Cooking (11 litres)
- [ ] Garden watering (250 litres)

Total water used:

Question 5e (10 marks)

Discuss the implications on water consumption for households in the community during this time.

In your answer you should:

- calculate the consumption in litres per hour (l/h) for the households and individuals in the community
- estimate the amount of time before the water (950 m^3) held in the tank runs out
- advise the community about the activities that should be avoided during the power outage
- justify the degree of accuracy of the time calculation.

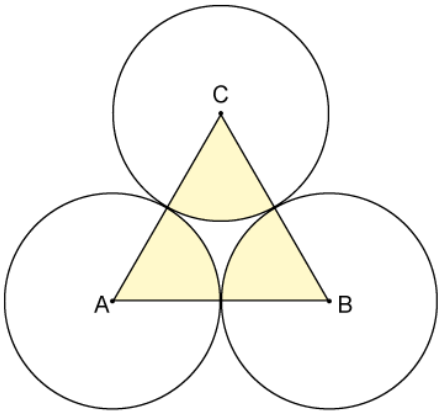
Question 6 (10 marks)

The following video explains the requirements for a reliable mobile phone signal.
Mobile phones are also known as cell phones.

In Diagram 1, identical transmitters are positioned at the vertices of an equilateral triangle. The equilateral triangle has sides of length 20 km and area 173 km^2. The transmitters are placed at A, B and C, and they emit a frequency in a circular radius up to 10 km.

Diagram 1

Diagram not to scale



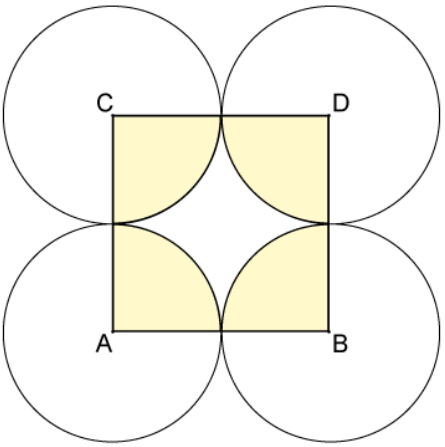
Question 6a (4 marks)

The unshaded area inside the triangle represents the part of the triangle that receives no signal.
Find the area of the triangle that does not receive a signal.

In Diagram 2, identical transmitters are positioned at the vertices of a square. The square has sides of length 20 km and area 400 km^2. The transmitters are placed at A, B, C and D, and they emit a frequency in a circular radius up to 10 km.

Diagram 2

Diagram not to scale



Question 6b (2 marks)

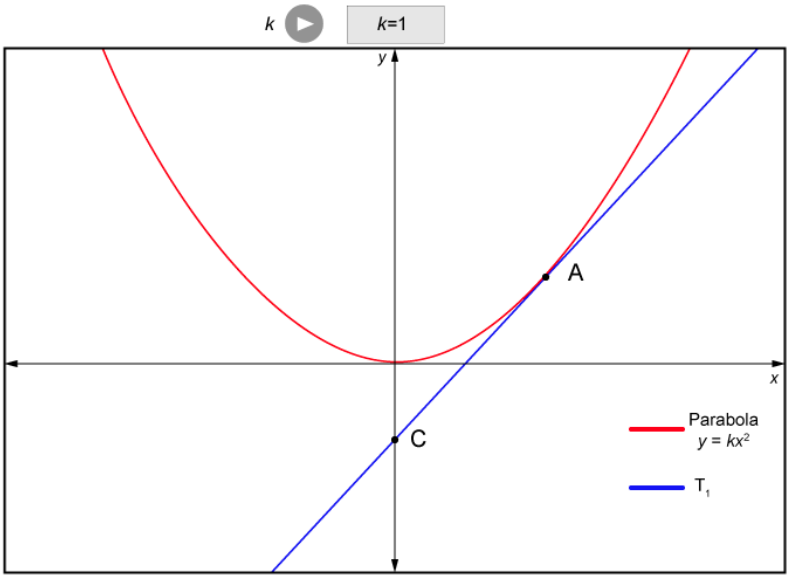
The unshaded area inside the square represents the part of the square that receives no signal.
Find the area of the square that does not receive a signal.

Question 6c (4 marks)

Compare your answers in parts (a) and (b). In your answer, refer to the different ways the transmitters have been positioned and propose the most suitable layout for the most efficient use of space and best signal coverage.

Question 7 (35 marks)

The straight line T_1 touches the parabola $y = kx^2$ once at point A as shown in the simulation below where k is the coefficient of x^2. As the value of k changes, the point A changes but the gradient of T_1 stays as 1. Click on the arrow to see what happens to the coordinate A as the value of k changes.



Question 7a (2 marks)

As the value of k changes, the following coordinates for point A are recorded in the table below.

If you would like to add more values in the table, click inside the relevant box, then write the values in the "Add Label" box.

k	1	2	3	4	5	6			
x coordinate of point A (x_A)	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{6}$	$\frac{1}{8}$	$\frac{1}{10}$	$\frac{1}{\square}$	$\frac{1}{\square}$	$\frac{1}{\square}$	$\frac{1}{\square}$
y coordinate of point A (y_A)	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{12}$	$\frac{1}{\square}$	$\frac{1}{\square}$	$\frac{1}{\square}$	$\frac{1}{\square}$	$\frac{1}{\square}$	$\frac{1}{\square}$

Describe in words a pattern for x_A.

Question 7b (1 mark)

Predict the value of x_A for $k = 6$.

Question 7c (1 mark)

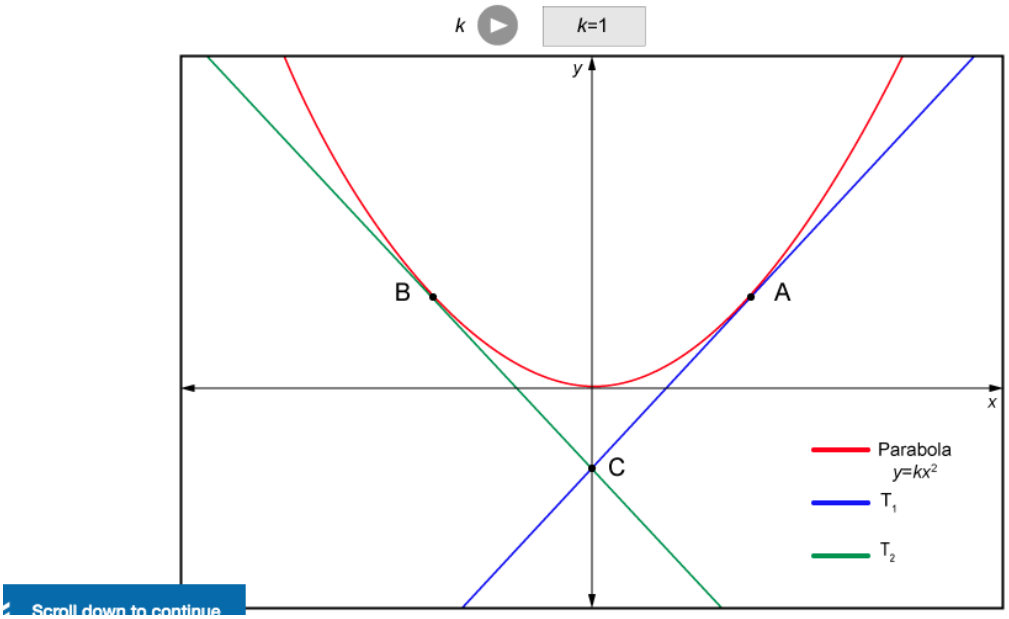
Write down a general rule for x_A in terms of k.

Question 7d (3 marks)

Verify your general rule for x_A.

Using the simulation below for the parabola $y = kx^2$, click on the arrow to see what happens as the value of k, the coefficient of x^2 changes. The lines T_1 and T_2 touch the parabola once as shown in the diagram at points A and B respectively. T_1 and T_2 intersect at the point C on the y-axis.

The coordinates of A, B and C change with k. The gradient of T_1 is fixed at 1 and the gradient of T_2 is fixed at -1. The lines T_1 and T_2 are perpendicular. The line T_1 has equation $y = x + c$.



Scroll down to continue

Question 7e (2 marks)

As the value of k changes, the following coordinates for A, B, and C have been recorded in the table below.

k	1	2	3	4	5	
x coordinate of point A (x_A)	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{6}$	$\frac{1}{8}$	$\frac{1}{10}$	$\frac{1}{\square}$
y coordinate of point A (y_A)	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{12}$	$\frac{1}{16}$	$\frac{1}{20}$	$\frac{1}{\square}$
x coordinate of point B (x_B)	$\frac{-1}{2}$	$\frac{-1}{4}$	$\frac{-1}{\square}$	$\frac{-1}{\square}$	$\frac{-1}{\square}$	$\frac{-1}{\square}$
y coordinate of point B (y_B)	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{\square}$	$\frac{1}{\square}$	$\frac{1}{\square}$	$\frac{1}{\square}$
y coordinate of point C (y_C)	$\frac{-1}{4}$	$\frac{-1}{8}$	$\frac{-1}{\square}$	$\frac{-1}{\square}$	$\frac{-1}{\square}$	$\frac{-1}{\square}$

Determine the missing values and complete the table for $k = 3$ and $k = 4$.

To add the missing values in the table, for $k = 3$ and $k = 4$, click inside the relevant box, then write the values in the "Add Label" box.

Question 7f (4 marks)

Describe two patterns for y_A, and **two** patterns for x_B.

y_A

Question 7f (4 marks)

Describe **two** patterns for y_A, and **two** patterns for x_B.

y_A

B I U x_2 x^2 Ω Σ Styles

x_B

Question 7g (22 marks)

Investigate the relationship between y_C and k.

In your answer you should:

- make predictions for more values of k
- describe the pattern
- find a general rule for y_C in terms of k
- test your general rule
- prove or verify and justify your general rule
- ensure you communicate the above appropriately.

2017 November Maths eAssessment

Question 1 (6 marks)

Question 1a (2 marks)

The set of natural numbers (ℕ) and the set of integer numbers (ℤ) are represented in the Venn diagram below.

Label the Venn diagram by placing the draggable numbers provided into the correct location.

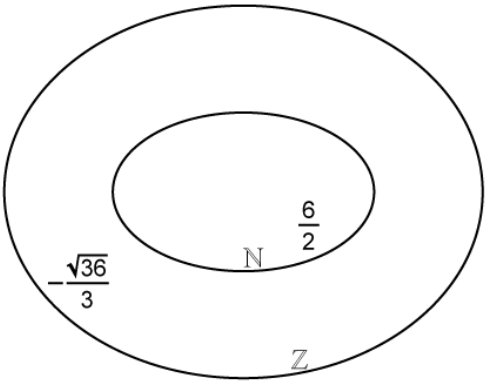
Draggable numbers

$\sqrt{49}$

$\frac{12}{3}$

0

$-\sqrt{9}$



Question 1b (3 marks)

The set of rational numbers (ℚ) and the set of real numbers (ℝ) are added to the Venn diagram as shown below.

Label the Venn diagram by placing the draggable numbers provided into the correct location.

Draggable numbers

$-\sqrt{7}$

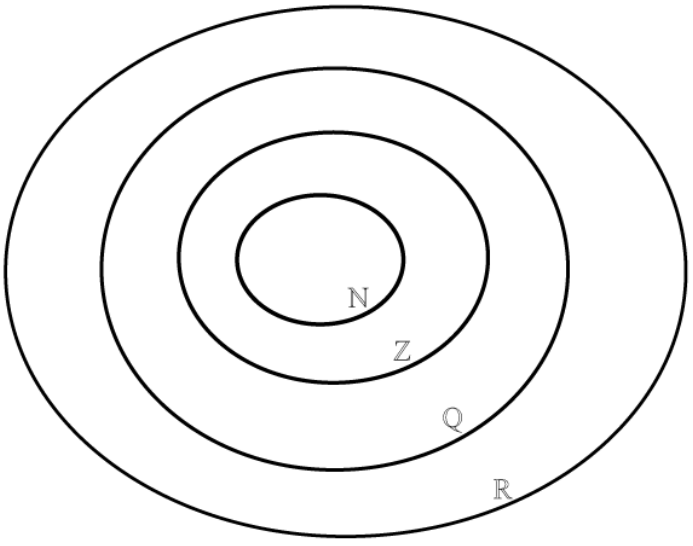
$\frac{22}{7}$

π

$|-2|$

tan 45°

2°



Question 1c (1 mark)

Write down in set notation an expression representing the shaded region shown in the Venn diagram below. Drag and drop the appropriate notation into the response area.

Draggable notations

$\subseteq$

$\cup$

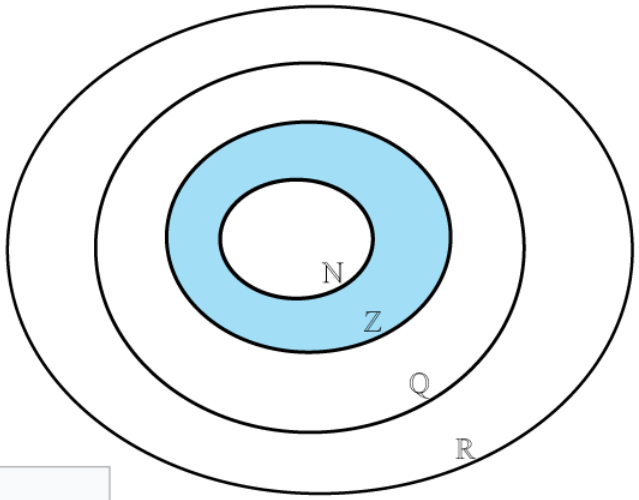
$\cap$

$\mathbb{N}$

$\mathbb{N}'$

$\mathbb{Z}$

$\mathbb{Z}'$



Response area

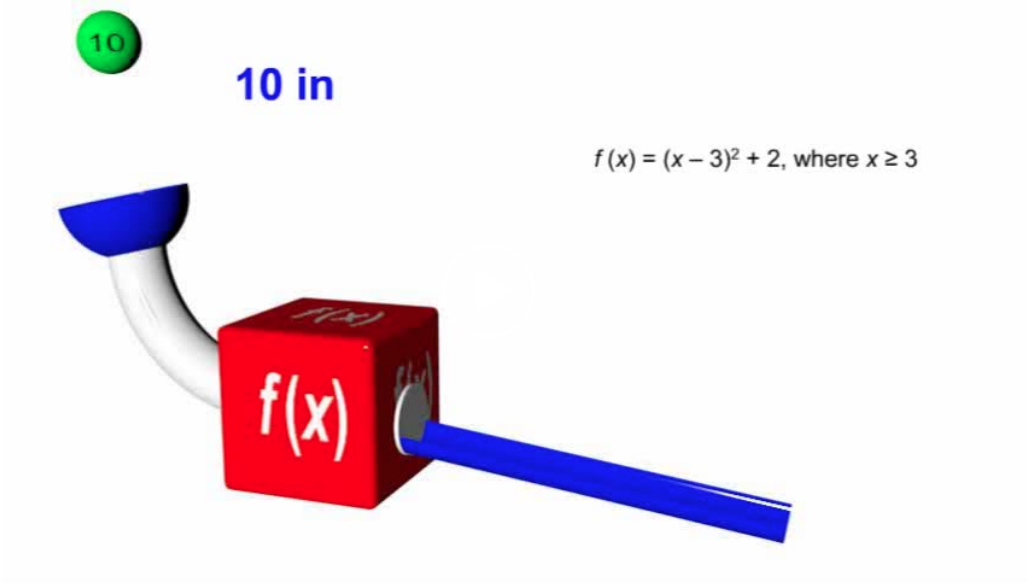
Question 2 (7 marks)

Question 2a (3 marks)

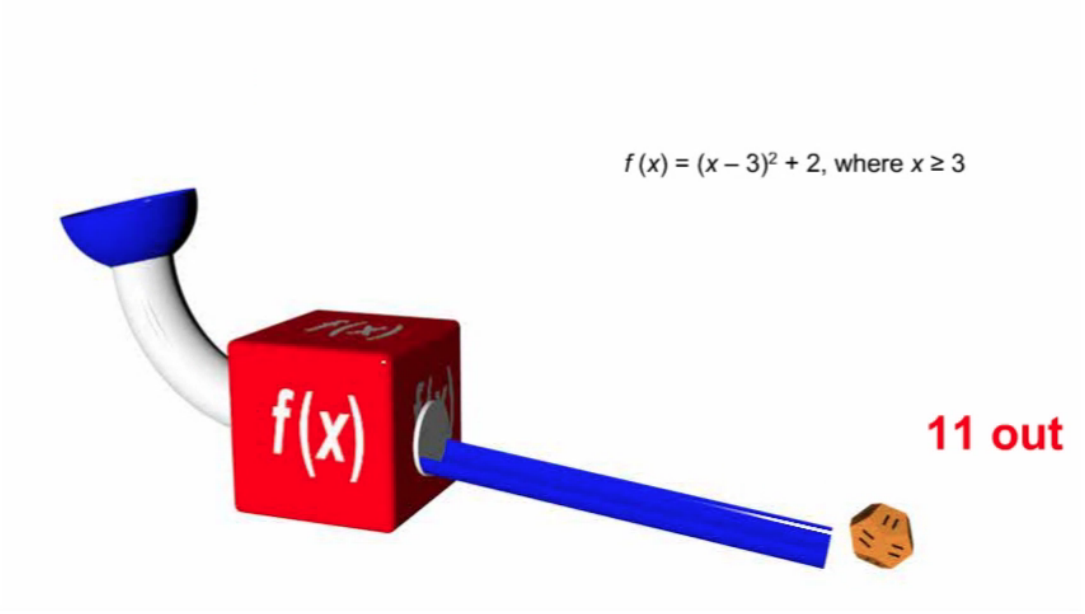
Given that $f(x) = (x - 3)^2 + 2$, where $x \geq 3$, and $g(x) = x^2$, **describe** how $g(x)$ is transformed onto $f(x)$.

Question 2b (4 marks)

This media contains no audio



Given that $f(a) = 11$, **find** the value of a.

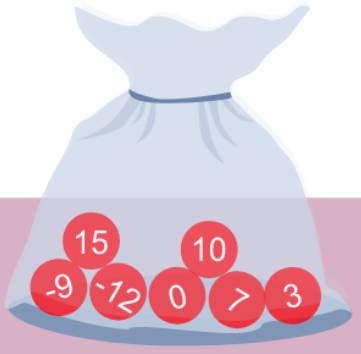


Given that $f(a) = 11$, **find** the value of a.

Question 3 (13 marks)

This media is interactive

Start



A bag contains seven identical balls numbered as follows: –12, –9, 0, 3, 7, 10, 15

A game consists of randomly selecting two balls from the bag without replacement.
The rules of the game are:

The player wins 5 Australian dollars (AUD) if both balls are numbered with even numbers.

The player wins 10 AUD if the total of both numbers is even.

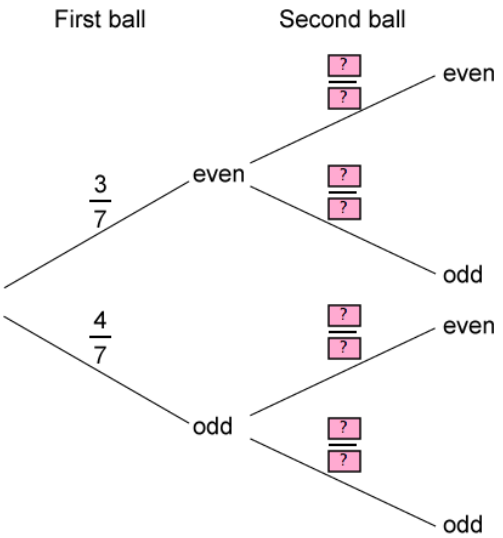
The player does not win anything otherwise.

Question 3a (2 marks)

The information provided in the animation is illustrated in the tree diagram below.

Write down the missing values in the tree diagram.

To insert your answers, click inside the box and replace the "?" with your answers in the "Add Label" box.



Question 3b (2 marks)

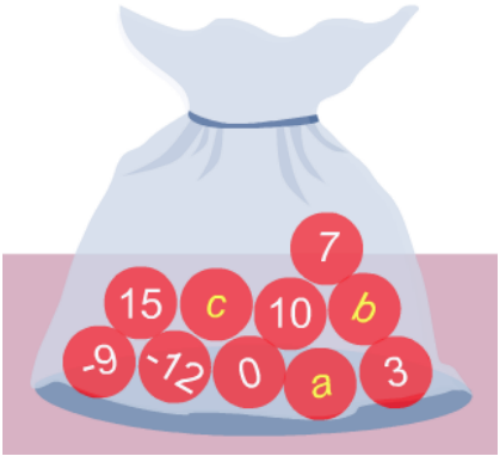
Determine the probability of winning 5 AUD.

Question 3c (2 marks)

Determine the probability of winning 10 AUD.

Three balls numbered *a*, *b* and *c* are added to the bag. The balls, arranged in numerical order, are now:

a, –12, –9, 0, 3, *b*, 7, 10, 15, *c*



Question 3d (1 mark)

Given that the median is 5, **show that** $b = 7$.

Question 3e (6 marks)

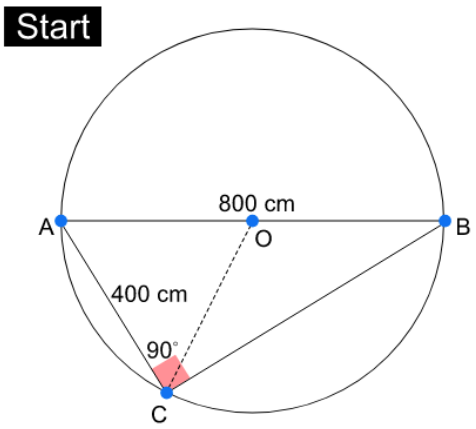
Given that the range is 34 and the arithmetic mean is 2.7, **find** the values of *a* and *c*.

Question 4 (6 marks)

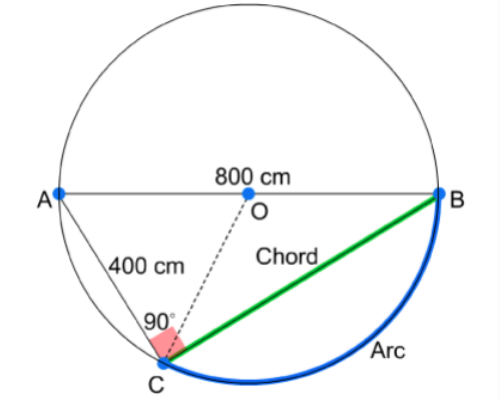
In the diagram below, AB is the diameter of a circle with centre O. The length of the diameter AB is 800 cm, the length of the chord AC is 400 cm and the angle ACB is 90°.

This media is interactive

Diagram not to scale



Question 4a (2 marks)

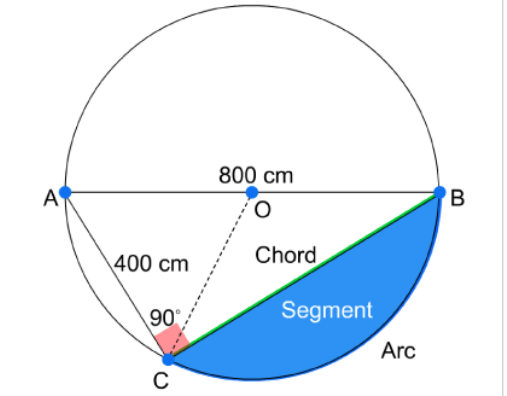


Show that the length of the chord BC is 693 cm to the nearest cm.

Question 4b (3 marks)

Find the length of the arc BC.

Question 4c (1 mark)



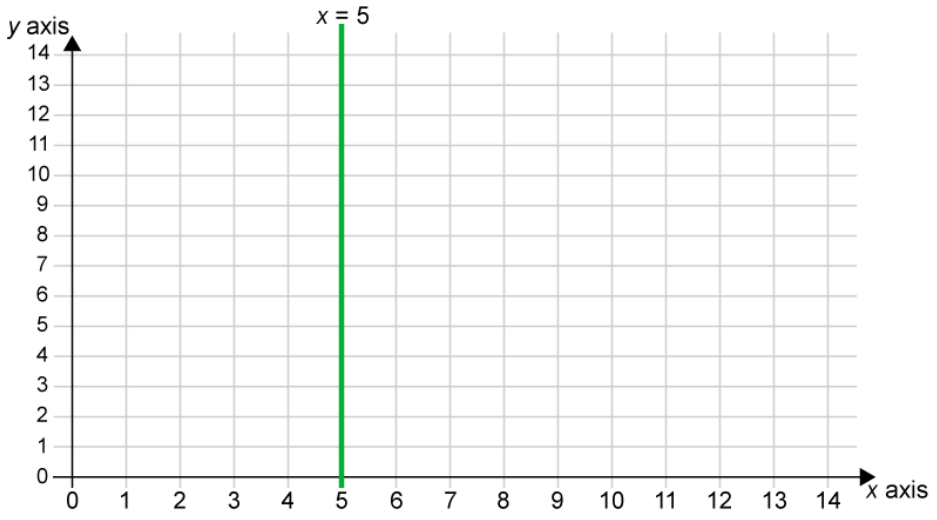
Determine the perimeter of the shaded segment.

Question 5 (5 marks)

The coordinate axes below show the line $x = 5$.

- **Draw** the lines $2y = x + 12$ and $2x + y = 12$ on the coordinate axes.
- **Identify** the region of the solution set for $x \leq 5$, $2y \leq x + 12$ and $2x + y \geq 12$ by dragging the region icon to the correct location.

Draggable: $2y = x + 12$ $2x + y = 12$ Region



Question 6 (15 marks)

The following video introduces a system of taxation used by governments to obtain money from working citizens.

Annual income bands in EUR	Tax rate
$0 < \text{income} \leq 6000$	0 %
$6000 < \text{income} \leq 12\,000$	5.5 %
$12\,000 < \text{income} \leq 25\,000$	14 %
$25\,000 < \text{income} \leq 70\,000$	30 %
Above 70 000	41 %

00:16

Annual income bands in EUR	Tax rate	Calculation of tax	Amount of tax
0 < income ≤ 6000	0 %	0	0
6000 < income ≤ 12 000	5.5 %	(12 000 - 6000) x 5.5 %	330
12 000 < income ≤ 25 000	14 %	(25 000 - 12 000) x 14 %	1820
25 000 < income ≤ 70 000	30 %	(36 000 - 25 000) x 30 %	3300
Above 70 000	41 %		
		Total tax paid on 36 000 EUR	

For a person earning 36 000 euros,
here is the calculation for the tax.

00:59

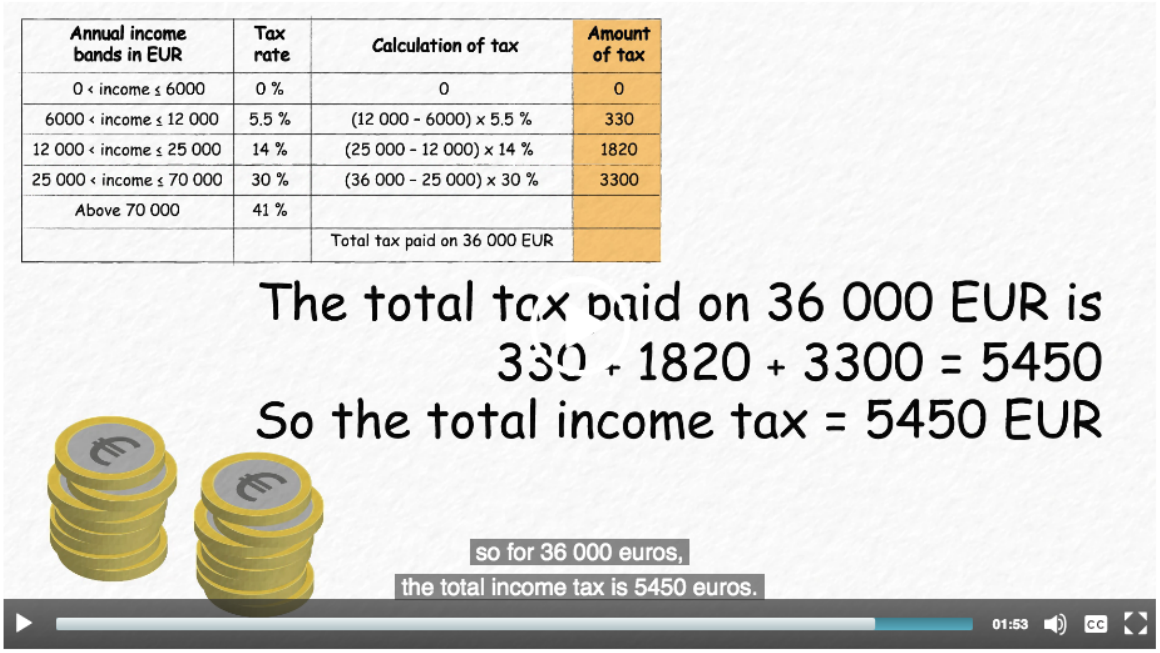
Annual income bands in EUR	Tax rate	Calculation of tax	Amount of tax
0 < income ≤ 6000	0 %	0	0
6000 < income ≤ 12 000	5.5 %	(12 000 - 6000) x 5.5 %	330
12 000 < income ≤ 25 000	14 %	(25 000 - 12 000) x 14 %	1820
25 000 < income ≤ 70 000	30 %	(36 000 - 25 000) x 30 %	3300
Above 70 000	41 %		
		Total tax paid on 36 000 EUR	

(12 000 - 6000) x 5.5 % = 6000 x 5.5 %

Amount of tax = 330 EUR

and this amount is taxed at 5.5 percent,
which amounts to 330 euros.

01:22



Question 6a (5 marks)

Calculate the total amount of tax for an income of 80 000 EUR, showing your working in the table.

Annual income bands in EUR	Tax rate	Calculation of tax	Amount of tax EUR
0 < income ≤ 6000	0 %	0	0
6000 < income ≤ 12 000	5.5 %	(12 000 – 6000) x 5.5 %	330
12 000 < income ≤ 25 000	14 %	(25 000 – 12 000) x 14 %	1820
25 000 < income ≤ 70 000	30 %		
Above 70 000	41 %		
		Total tax paid on 80 000 EUR	

Question 6b (10 marks)

The scenarios provided in the tabs below should be used to answer this question.

Scenario 1 – Do not relocate to another country | Scenario 2 – Relocate to another country

You have a reliable permanent job in your home town. You earn 40 000 EUR per annum, from this you will pay an annual tax. Tax is calculated using the system of taxation in part (a). The living expenses are outlined below.

Scenario 1 – Do not relocate to another country | Scenario 2 – Relocate to another country

Your employer offers you an opportunity to relocate to another country. You will earn 50 000 EUR per annum, from this you will pay an annual tax of 9650 EUR. The living expenses are outlined below.

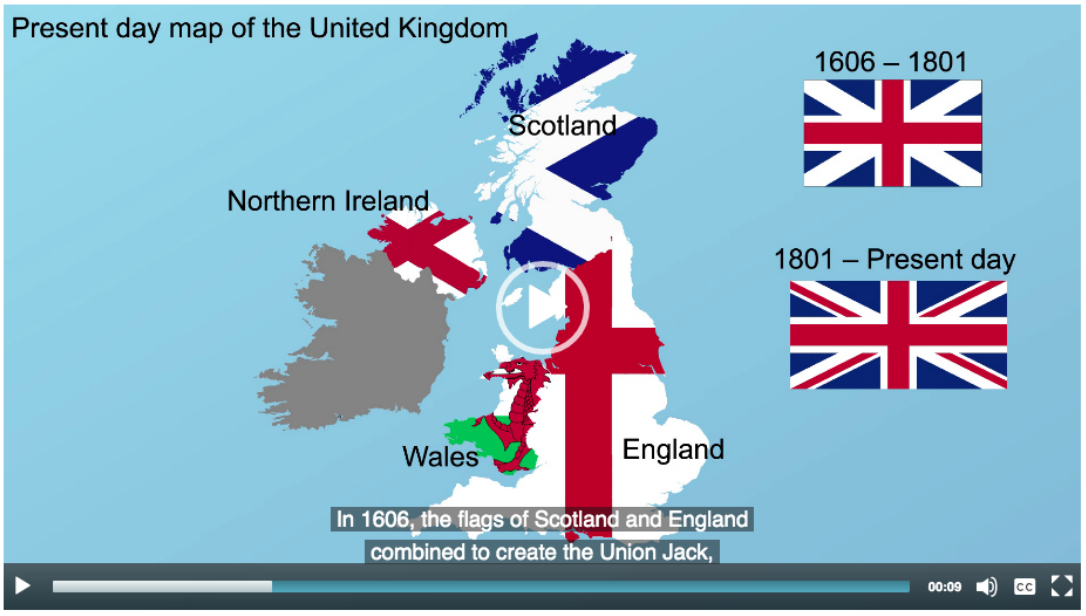
per year

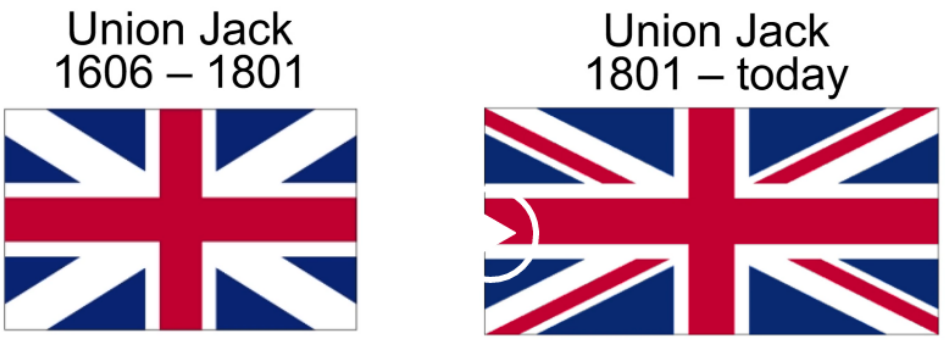
Evaluate the two scenarios by comparing the financial information provided and decide whether you should accept this opportunity to relocate. In your answer, you should:

- identify the relevant elements to consider when comparing the two scenarios
- make appropriate calculations to make a decision
- justify the accuracy of your calculations
- give your decision and a reflection on this offer to relocate, justifying your decision.

Question 7 (17 marks)

The following video explains how countries within a union have combined their national flags to create one common flag called the "Union Jack".





which is the flag for the United Kingdom.

St George's cross of England

St Andrew's cross of Scotland

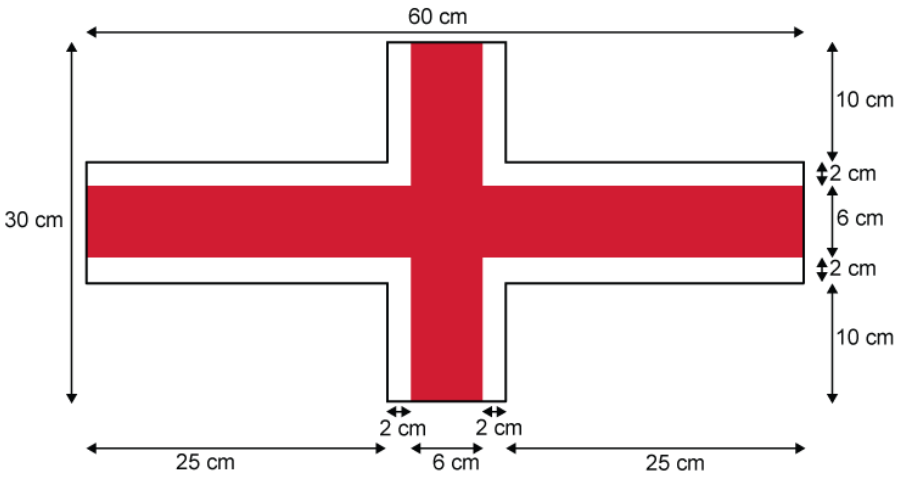
with the Scottish St Andrew's cross.

00:32

Question 7a (3 marks)

In Diagram 1 below, St George's cross is red and 6 cm wide, and its white border is 2 cm wide.
Show that the total area of St George's cross is 800 cm^2.

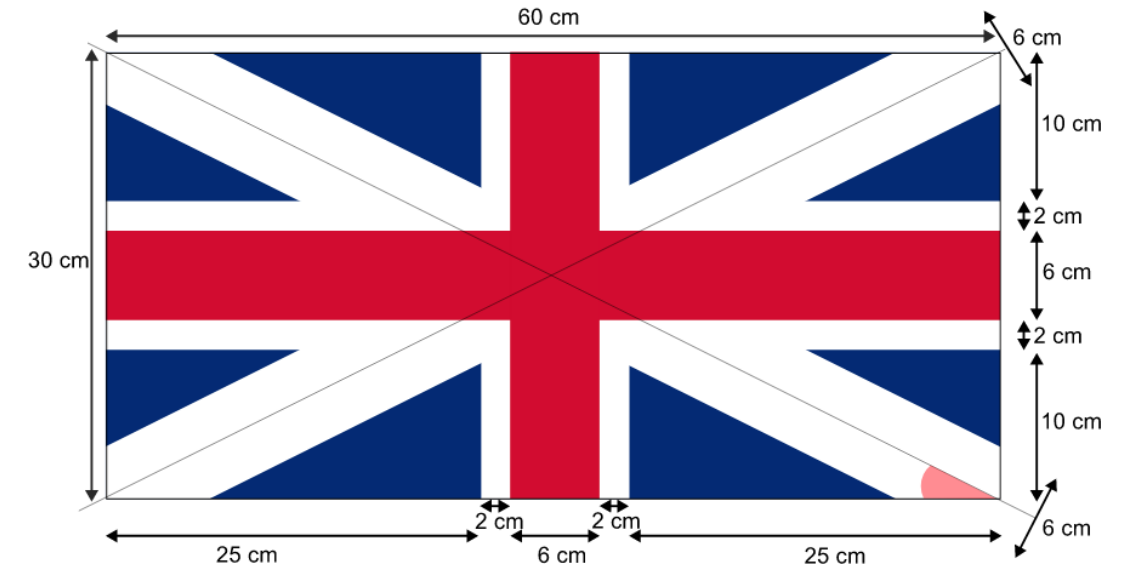
Diagram 1

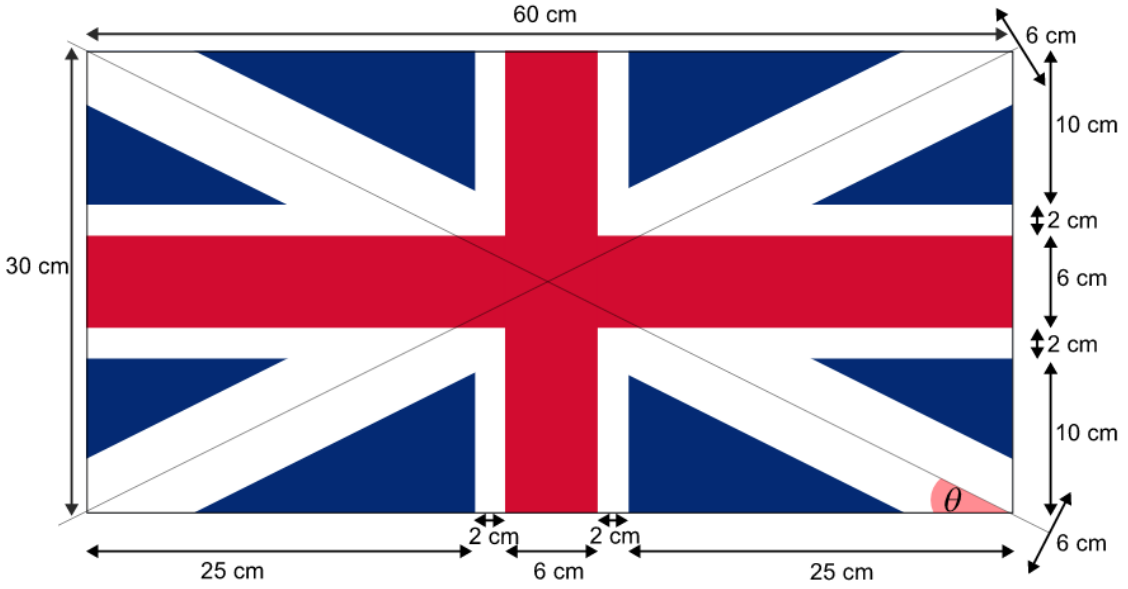


Question 7b (1 mark)

Diagram 2

This media is interactive





Using Diagram 2, **show that** $\tan\theta = \frac{1}{2}$.

Diagram 3

This media is interactive

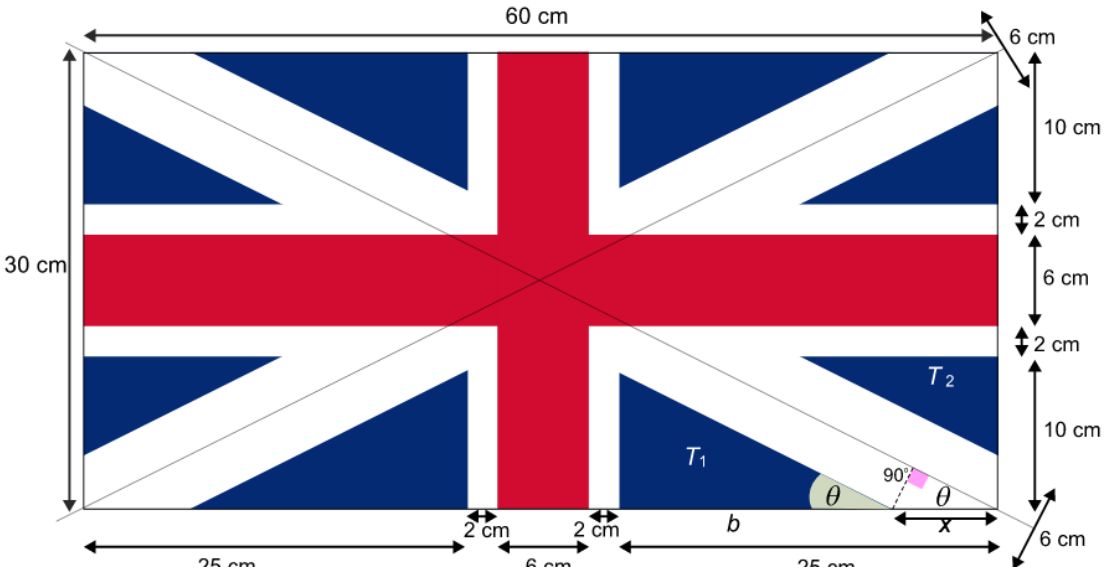
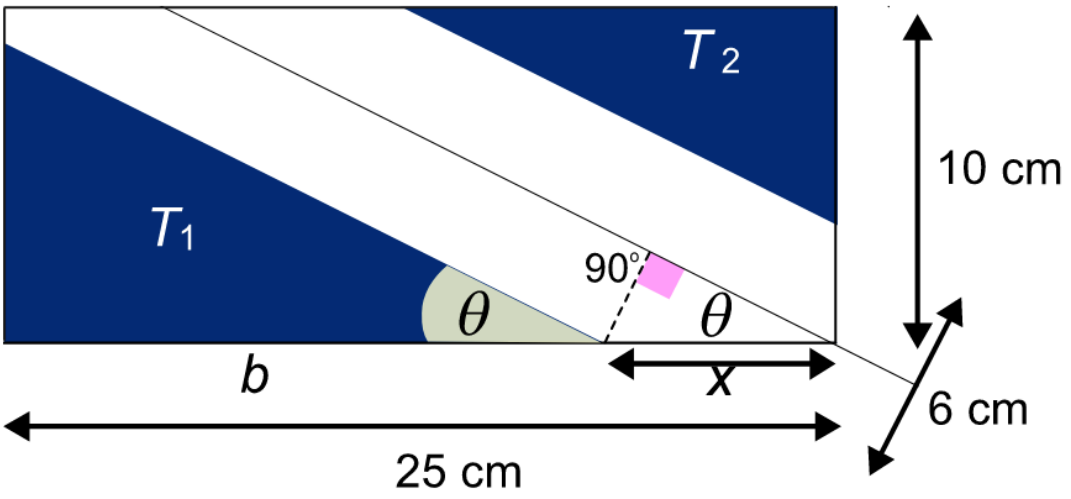


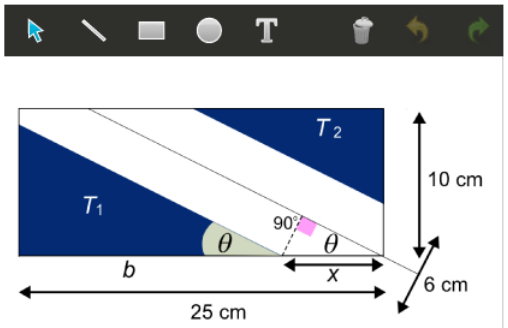
Diagram 3

This media is interactive



Question 7c (5 marks)

A section of the Union Jack | Union Jack



Find the value of x to the nearest one decimal place.

B I U x_2 x^2 Ω Σ Styles

A section of the Union Jack | Union Jack

Question 7d (4 marks)

Hence, **show that** the area of the blue triangle T_1 is 84 cm^2 to the nearest cm^2.

B I U x_2 x^2 Ω Σ Styles

Question 7e (2 marks)

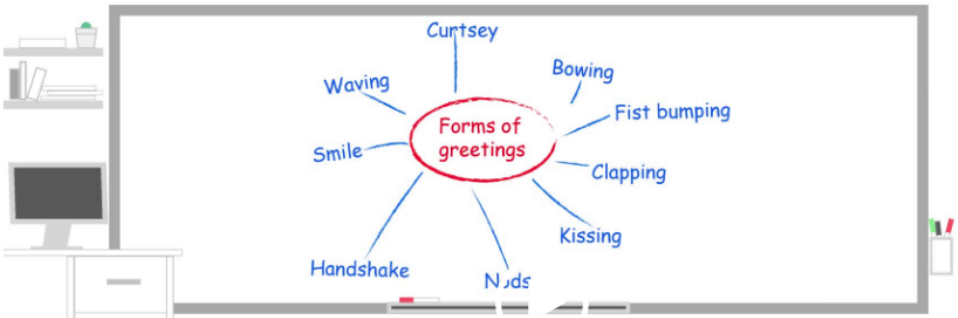
Given that the area of the triangle $T_2 = 44$ cm^2 to the nearest cm^2, **determine** the total area of blue triangles in the Union Jack to the nearest cm^2.

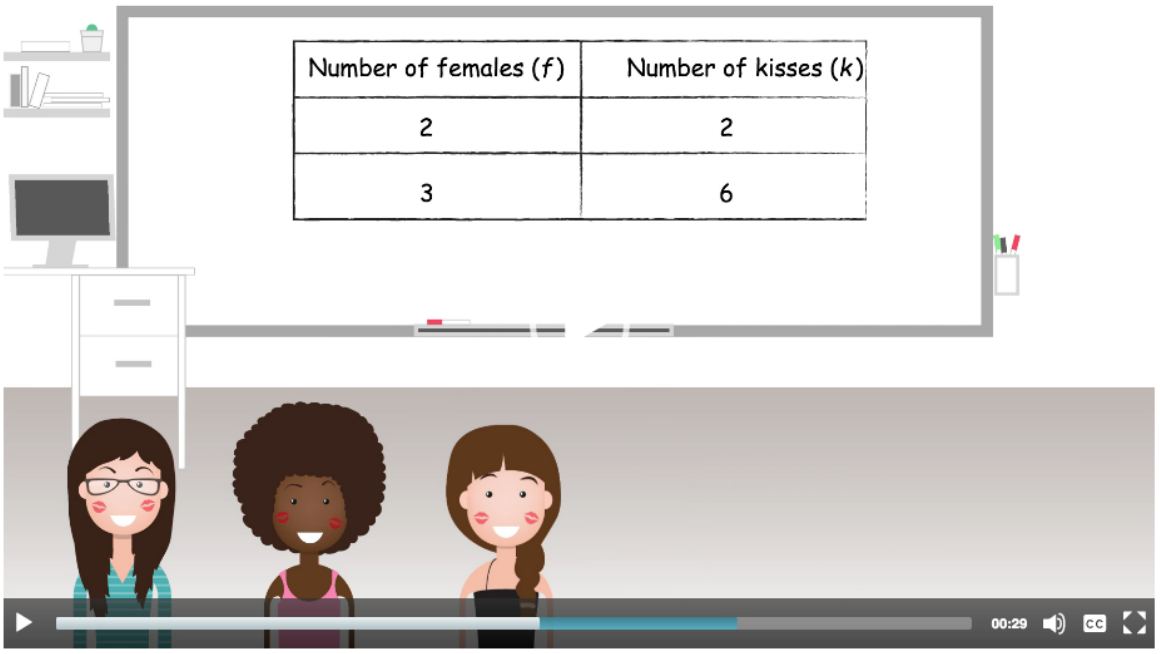
Question 7f (2 marks)

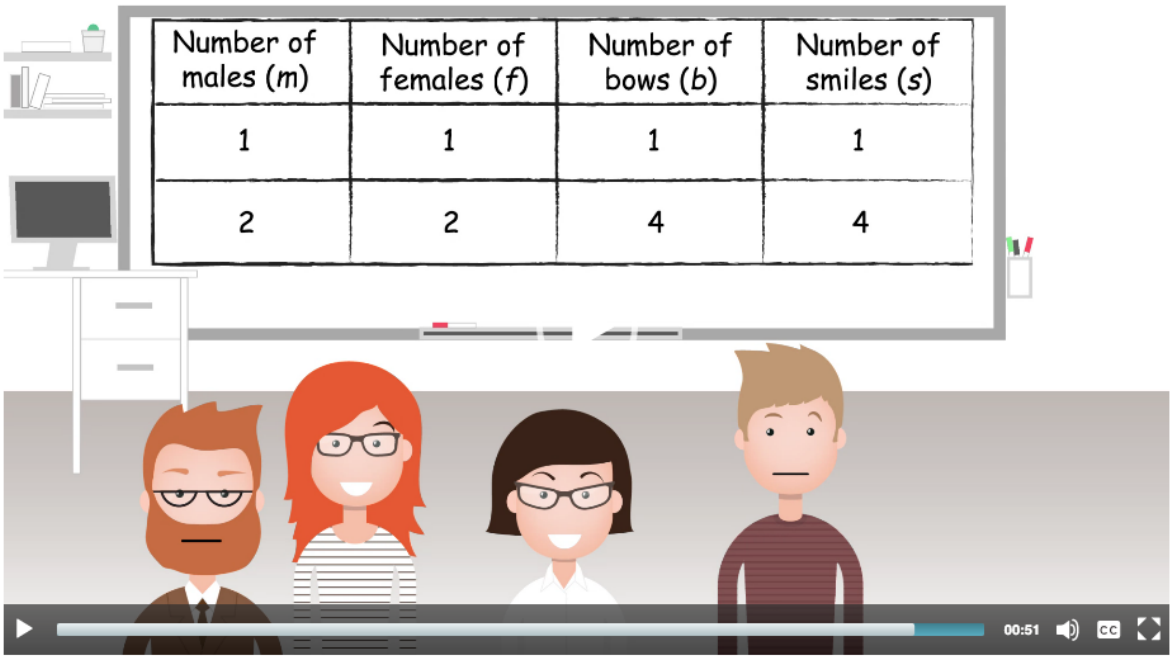
The blue triangles represent Scotland in the Union Jack. **Determine** the percentage of the area of the flag that is represented by Scotland.

Question 8 (31 marks)

The following video introduces some traditional greetings.







Five male colleagues and five female colleagues have gathered for an important meeting. They all greet each other. Table 1 below shows the number of different greetings exchanged when male and female colleagues meet. The following notation is used:

m represents the number of male colleagues
f represents the number of female colleagues
k represents the number of kisses
b represents the number of bows
s represents the number of smiles
G represents the total number of greetings, that is to say the number of kisses, smiles and bows.

Table 1

Select number of males and females: 2

Number of males (*m*)	Number of females (*f*)	Number of kisses (*k*)	Number of bows (*b*)	Number of smiles (*s*)	Total number of greetings (*G*)
2	2	2	4	4	10

For parts (a), (b) and (c) you should refer to table 2.

Table 2

Number of females (f)	Number of kisses (k)
1	0
2	2
3	6
4	12
5	20

Question 8a (2 marks)

Write down in words two patterns, from Table 2, for the number of kisses (k).

Question 8b (2 marks)

Determine a general rule for the number of kisses (k) in terms of the number of female colleagues (f).

Question 8c (3 marks)

Table 2

Number of females (f)	Number of kisses (k)
1	0
2	2
3	6
4	12
5	20

Reset

Verify your general rule.

B I U x_2 x^2 Ω Σ Styles

Question 8d (24 marks)

Investigate the general rules for the greetings when there are equal numbers of male and female colleagues. You can add more values in Table 3 to support your investigation. In your answer, you should:

- predict more values and record these in the table
- write down in words a pattern for s
- find a general rule for s in terms of m
- find a general rule for G in terms of m
- test your general rule for G
- verify and justify your general rule for G
- ensure you communicate all your working appropriately.

Table 3

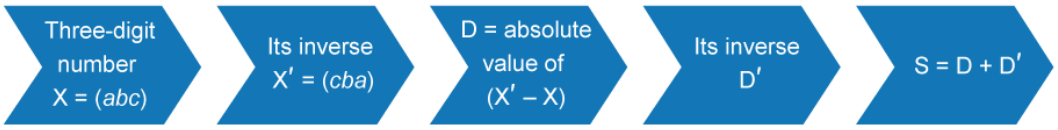
Number of males (m)	Number of females (f)	Number of kisses (k)	Number of bows (b)	Number of smiles (s)	Total number of greetings (G)
1	1	0	1	1	2
2	2	2	4	4	10
3	3	6	9	9	24
4	4	12	16	16	44
5	5	20	25	25	70

2018 May eAssessment Mathematics

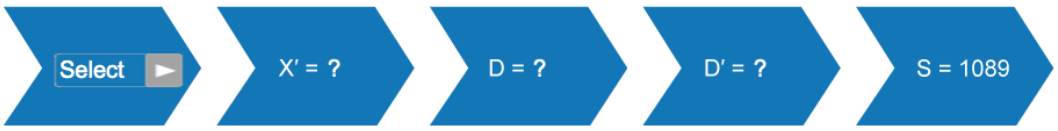
Question 1a (3 marks)

In this question, we will discover an interesting and magical property of three-digit numbers using a special algorithm, illustrated in the algorithm flow diagram below.

Algorithm flow diagram



Here is a simulator for the algorithm flow diagram which provides some examples of how this algorithm affects three-digit numbers. Select a number and see what happens.



Reset

Apply the same algorithm to 437 to complete the missing values.

Question 1b (2 marks)

A three-digit number can be written in terms of sum of multiples of its digits. For example, 437 can be written in the format shown below.

X is a three-digit number *abc*. **Write down** X and X′ as a sum of multiples of their digits.

X =

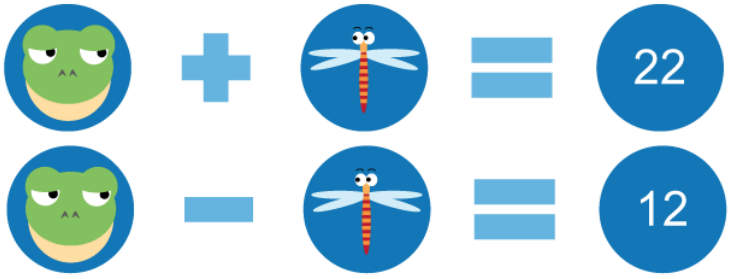
X′ =

Question 1c (2 marks)

Using your answer from part (b), **determine** the difference D in terms of *a* and *c*.

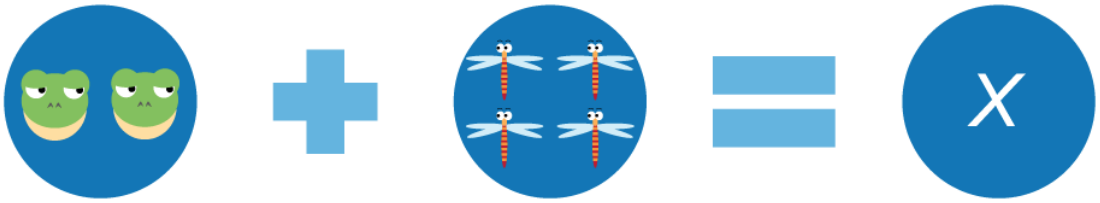
B I U x_2 x^2 Ω Σ Styles

Question 2 (6 marks)



©

Find the value of *X* for the following expression.



B I U x_2 x^2 Ω Σ Styles

Question 3a (4 marks)

To raise money for their graduation party, senior students organize a cookie and muffin sale.

x represents the number of cookies and y represents the number of muffins. The amount of cookies and muffins sold are represented by the shaded region in the diagram below.

Using the information provided in the diagram below:

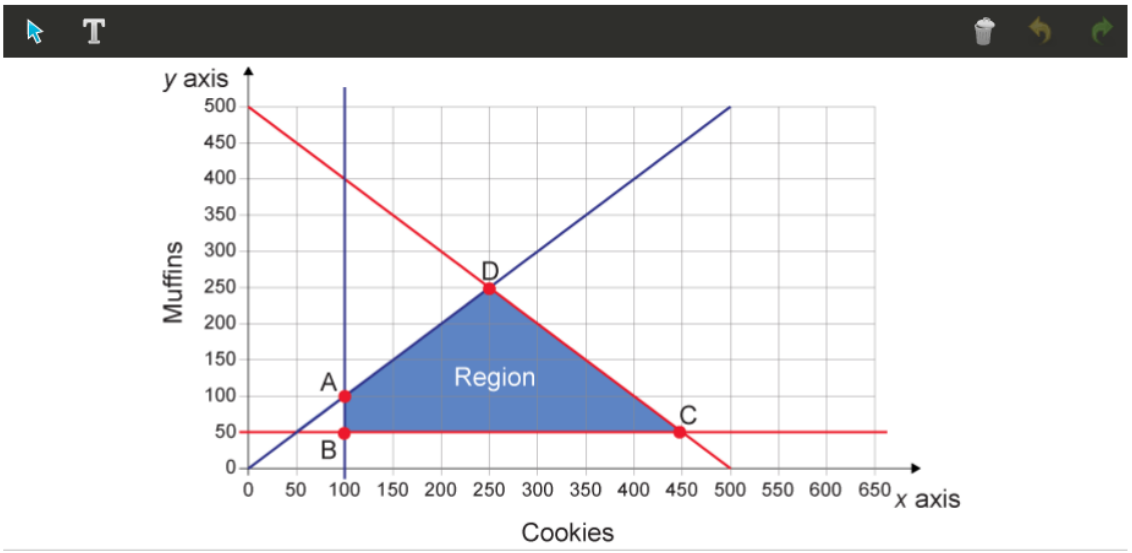
- **Identify** the shaded region by completing the inequalities below.
- The first constraint is that they cannot sell more than a total of 500 cookies and muffins. **State** the other three constraints in the spaces provided.

Draggable inequalities: ≥ ≤

Inequalities	Constraints
$x + y \leq 500$	Total number of cookies and muffins cannot exceed 500
x ☐ 100	
y ☐ 50	
y ☐ x	

Diagram

Diagram



Question 3b (1 mark)

The profit P, in Canadian dollars (CAD), for the cookies and muffins sale is calculated using the formula $P = x + 1.5y$.

Interpret the meaning of the coefficients of x and y in the profit formula above.

Question 3c (2 marks)

The table below shows the profit at the vertices A, B and D.

Vertices (x, y)	$P = x + 1.5y$ (CAD)
A (100, 100)	250
B (100, 50)	175
C	
D (250, 250)	625

Determine the missing profit at vertex C.

Question 3d (1 mark)

Write down the number of cookies and the number of muffins that the students must sell in order to maximize their profit.

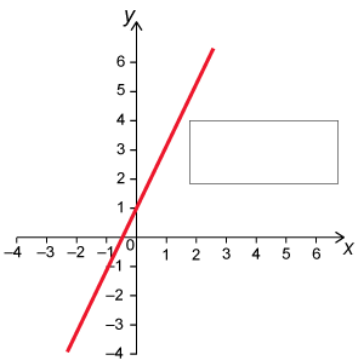
Number of cookies:

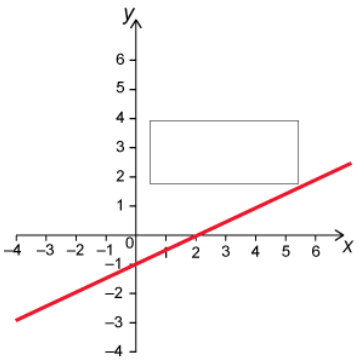
Number of muffins:

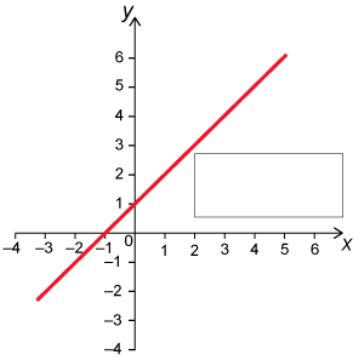
Question 4a (2 marks)

Select the line equations and place them with the corresponding graphs.

Draggable: $y = x + 1$ $y = 2x + 1$ $y = \frac{1}{2}x - 1$

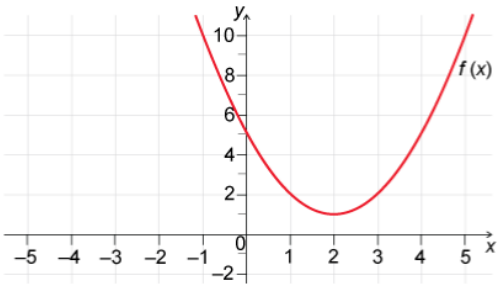




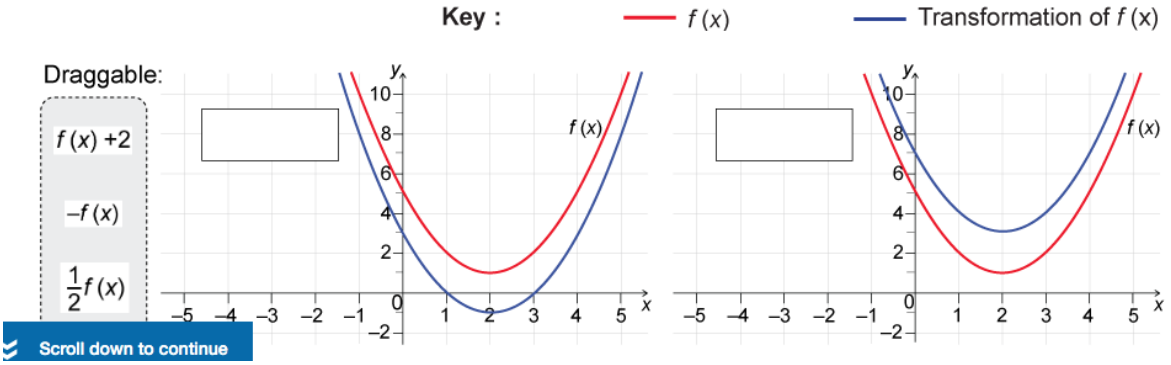


Question 4b (4 marks)

The graph below represents the function $f(x)$. Transformations of $f(x)$ are shown in the following graphs.

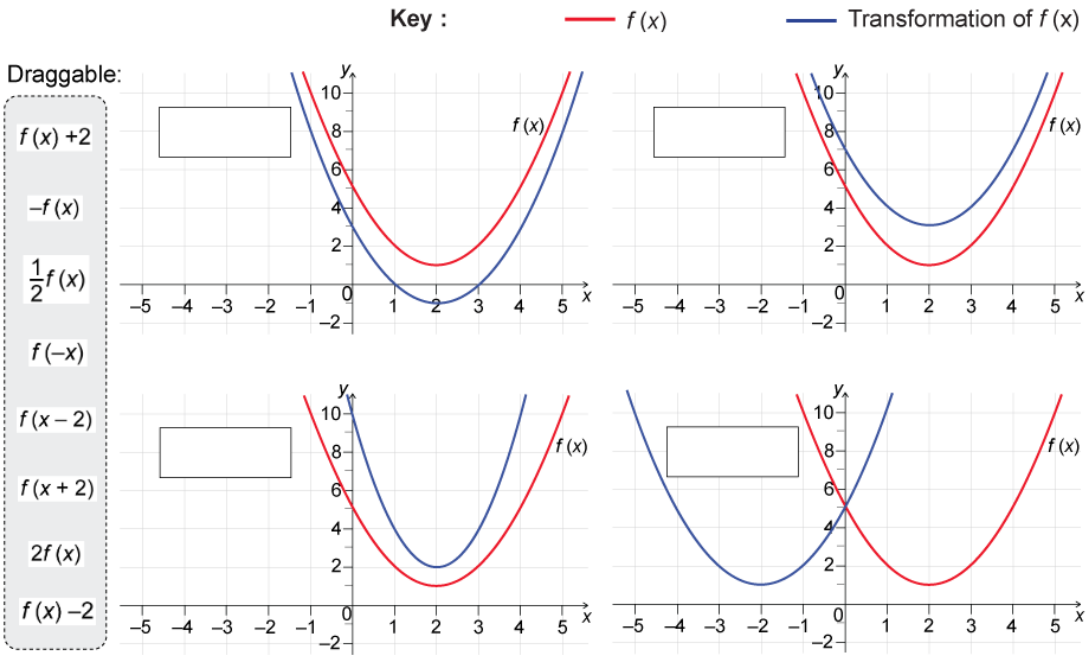


Select the equations and place them with the corresponding graphs.



Scroll down to continue

Select the equations and place them with the corresponding graphs.

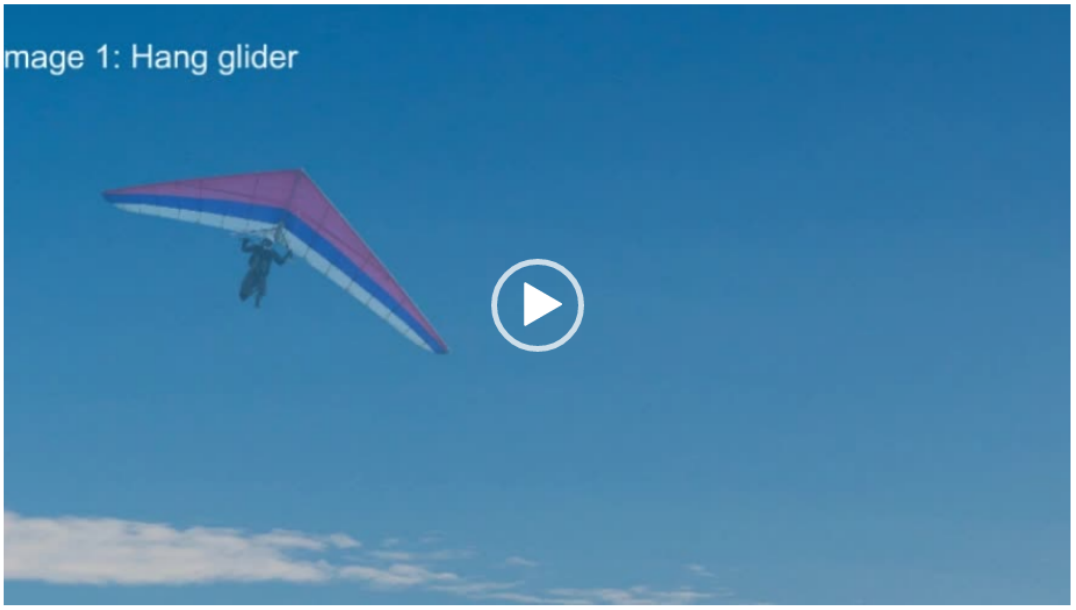


Question 5 (8 marks)

Students are planning to construct a kite which will be a scaled model of the wings of a hang glider.

This media contains no audio

Diagram not to scale

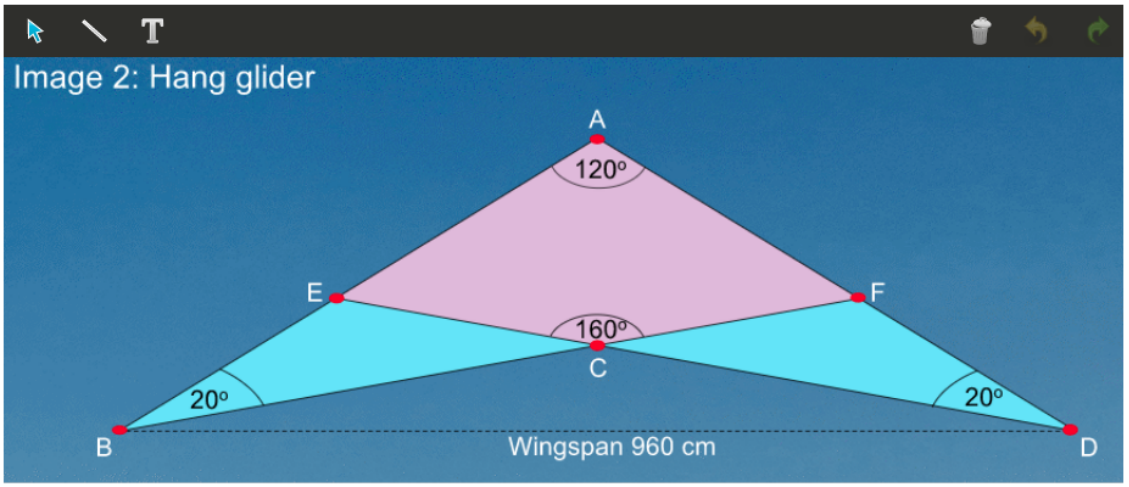


Question 5a (2 marks)

The hang glider is a quadrilateral with the following properties:

Sides	Angles
AB = AD	ABC = ADC = 20°
BC = DC	ECF = 160°
BD = 960 cm	BAD = 120°

Diagram not to scale



Question 5a (2 marks)

Show that the triangles BCE and DCF are congruent.

Question 5b (3 marks)

Calculate the length of AB for the hang glider.

Question 5c (1 mark)

The hang glider and kite are similar shapes, where B′D′ is 120 cm. **Determine** the scale factor of enlargement.

Diagram not to scale

Image 2: Hang glider

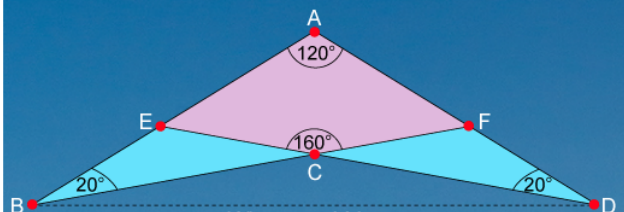
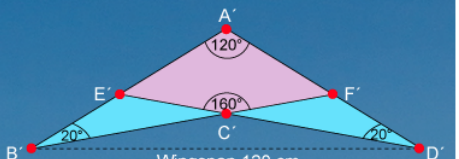


Image 4: Kite



Question 5d (2 marks)

The area of the hang glider is 92 395 cm^2.

Determine the area of the kite.

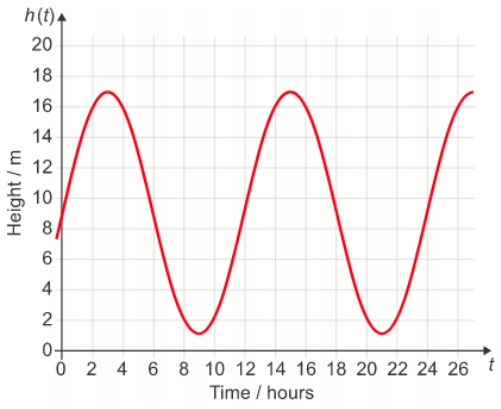
Question 6 (10 marks)

The following video illustrates how tidal range can be modelled over time by a sine function.

©

Below is the sine curve modelling the tide in Saint-Malo on a day in November 2017.

$h(t)$ is the height in metres (m) of water in the harbour and t is the number of hours after midnight.



Question 6a (2 marks)

Determine the tidal range which is the difference between the height of the low and high tides in the harbour.

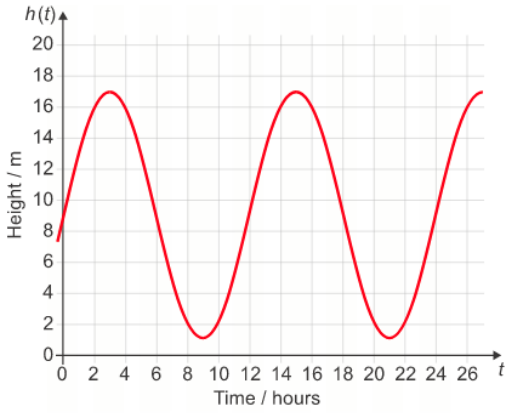
B I U x_2 x^2 Ω Σ Styles

Question 6b (2 marks)

The period can be measured as the time difference between two consecutive high tides. **Determine** the period of this tide.

Below is the sine curve modelling the tide in Saint-Malo on a day in November 2017.

$h(t)$ is the height in metres (m) of water in the harbour and t is the number of hours after midnight.



Question 6c (2 marks)

Using the graph, **estimate** at what times, during the first 12 hours after midnight, the height of the water is 2 m.

B I U x_2 x^2 Ω Σ Styles

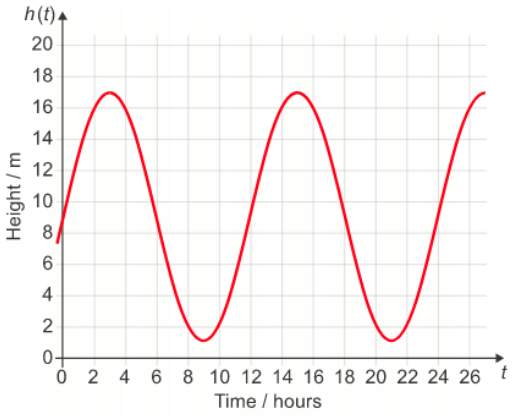
Question 6d (2 marks)

The behaviour of this tide can be modelled by the function $h(t) = a\sin(30t) + c$.

Using the graph characteristics, **justify** that $a = 8$ and $c = 9$.

Below is the sine curve modelling the tide in Saint-Malo on a day in November 2017.

$h(t)$ is the height in metres (m) of water in the harbour and t is the number of hours after midnight.



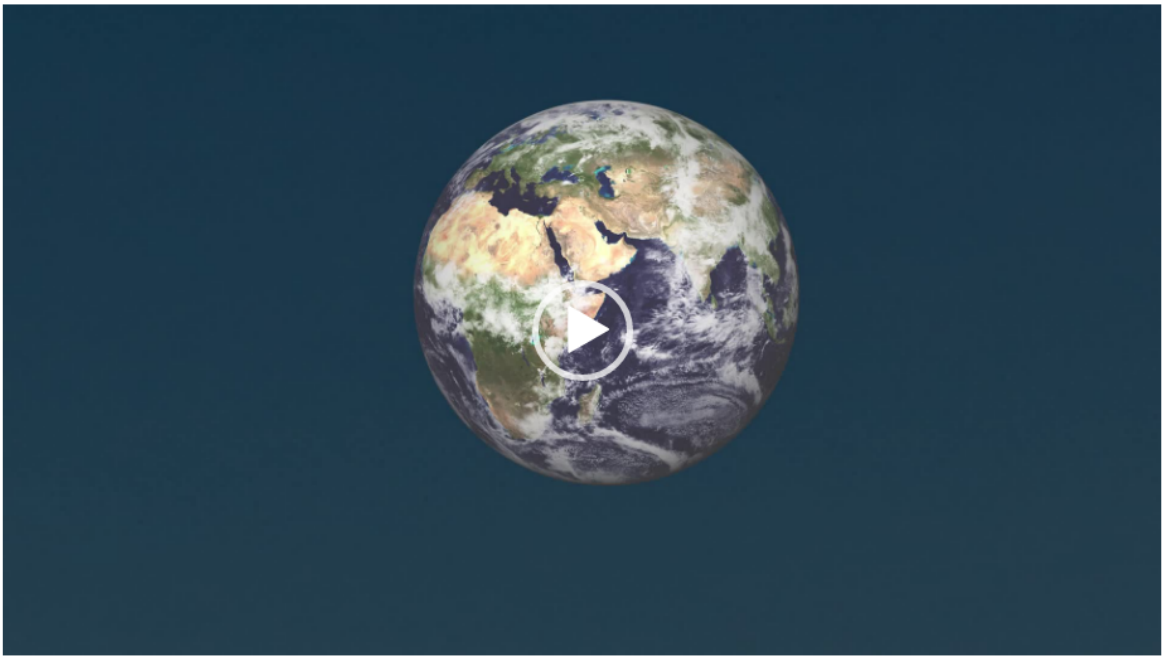
Question 6e (2 marks)

By substituting into the equation $h(t) = 8\sin(30t) + 9$, **calculate** the height in metres of water in the harbour at 17:00.

B I U x_2 x^2 Ω Σ Styles

Question 7 (23 marks)

The following video shows how mathematics can be used to make predictions for population growth over time and space.



©

Use the table in Tab 1 below to answer questions (a), (b) and (c).

Tab 1 Tab 2

The table below shows the age distribution of the population of Australia (percentage to nearest 1 %, data correct as at 2015).

Age (A)	Percentage
$0 < A \leq 20$	23
$20 < A \leq 40$	32
$40 < A \leq 60$	27
$60 < A \leq 80$	17
$80 < A \leq 100$	1

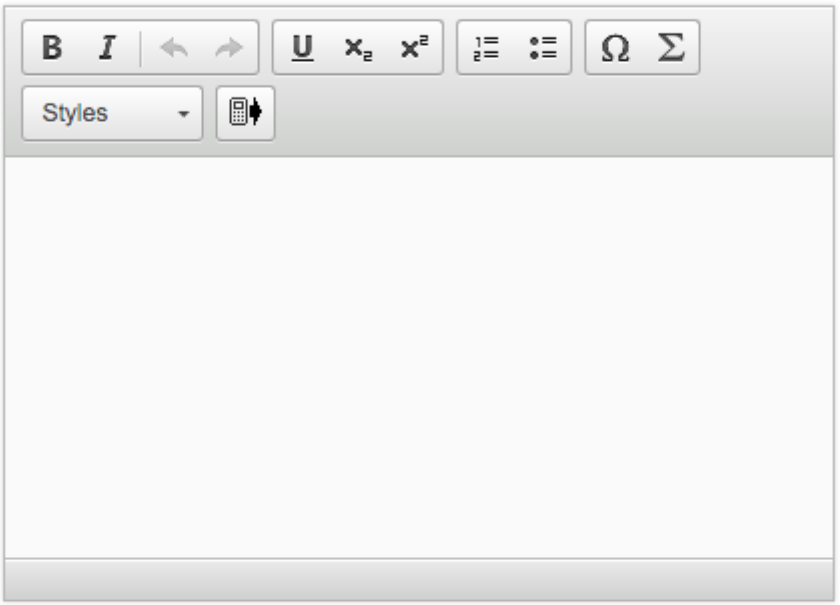
Tab 1 | Tab 2

The table below shows the country of birth of immigrants to Australia (data correct as at 2015, top ten countries only).

Country of birth	Number of immigrants
United Kingdom	1 207 000
New Zealand	611 400
China	481 800
India	432 700
Philippines	236 400
Vietnam	230 200
Italy	198 200
South Africa	178 700
Malaysia	156 500
Germany	125 900

Question 7a (1 mark)

Write down the modal class for the age distribution in Australia.

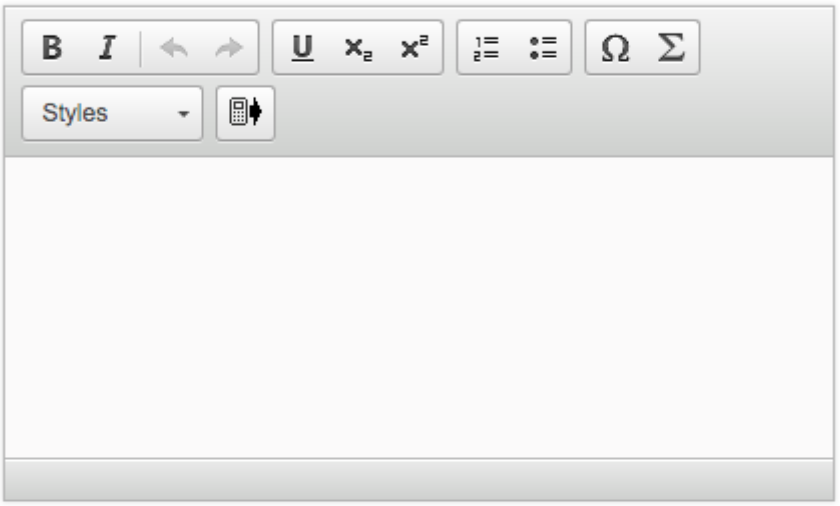


Question 7b (4 marks)

Show that the estimated mean age is 38.2

Question 7c (2 marks)

A person was selected at random from the population of Australia in 2015. **Determine** the probability that this person was over 60 years old.



Question 7d (2 marks)

The total population of Australia in 2015 was estimated to be 23 858 000 to the nearest 1000. Using the data in Tab 2, **show that** 5 % of the Australian population were immigrants from the United Kingdom (UK), to the nearest percent.

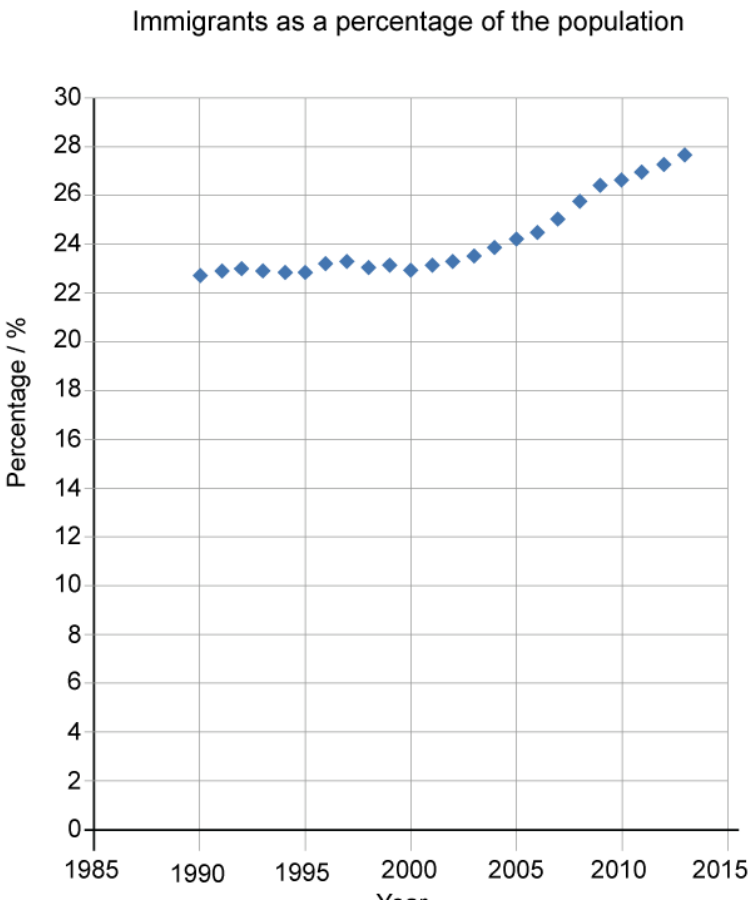
Question 7e (2 marks)

A person was selected at random from the population of Australia in 2015. **Determine** the probability that this person was an immigrant from the UK over 60 years old.

The graph below shows immigrants as a percentage of the population of Australia from 1990 to 2013.

Draw a line of best fit on the graph.

Draggable:



Scroll down to continue

Question 7g (10 marks)

©

Analyse the information provided to comment on this news headline.

In your answer, you should:

- identify the factors to be considered when making your prediction
- estimate in what year the percentage of immigrant population in Australia will exceed 50 %
- use a suitable degree of accuracy for your results
- justify whether the year you estimated makes sense in the context of the problem
- comment on the news headline.

Tab 1 Tab 2

The table below shows the age distribution of the population of Australia (percentage to nearest 1 %, data correct as at 2015).

Age (A)	Percentage
$0 < A \leq 20$	23
$20 < A \leq 40$	32
$40 < A \leq 60$	27
$60 < A \leq 80$	17
$80 < A \leq 100$	1

Tab 1 | Tab 2

The table below shows the country of birth of immigrants to Australia (data correct as at 2015, top ten countries only).

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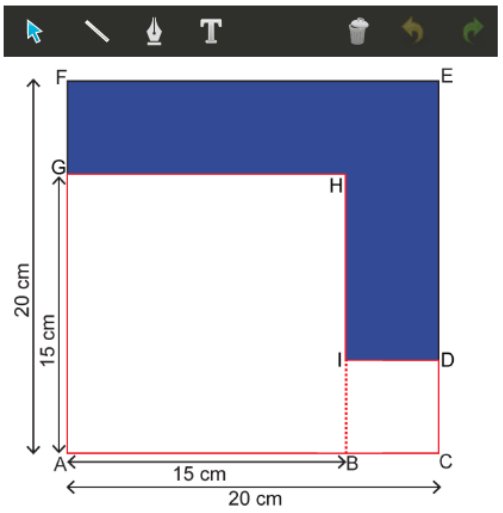
India	432 700
Philippines	236 400
Vietnam	230 200
Italy	198 200
South Africa	178 700
Malaysia	156 500
Germany	125 900

Question 8a (2 marks)

The diagram below shows squares ACEF, ABHG and BCDI.

Diagram not to scale

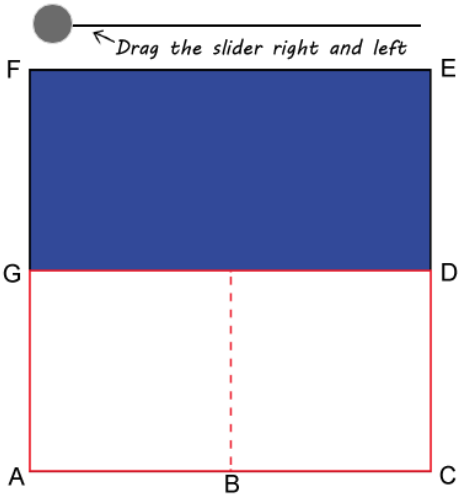


The large square shown has side AC = 20 cm. AB has length 15 cm.

Show that the perimeter of the shaded shape is 70 cm.

B I U Styles Ω Σ

On the simulator below, use the slider to change the length of AB and see the corresponding length of the perimeter of the shaded shape when AC is 20 cm.



Length of AB	Perimeter of shaded shape / cm
10	60

Question 8b (1 mark)

Write down the missing values in the table when the length of AB is L = 14 cm.

Length of AC, in cm	Length of AB (L) in cm	Length of BC in cm	Perimeter of shaded shape (P) in cm
20	10	10	60
20	11	9	62
20	12	8	64
20	13	7	66
20	14		
20	15	5	70
20			

Reset

Question 8c (1 mark)

Write down, in words, a pattern from the table for the perimeter (P).

B I U x_2 x^2 Ω Σ Styles

Question 8d (2 marks)

Determine a general rule for (P), the perimeter of the shaded shape, in terms of (L), the length of AB.

Question 8e (3 marks)

Verify your general rule.

Question 8f (3 marks)

Traditional shoemakers used a tool as shown below.

Click on "Start" to illustrate the shapes studied by ancient Greeks based on the shoemaker tool.

Start

Diagram not to scale

Traditional shoemakers tool

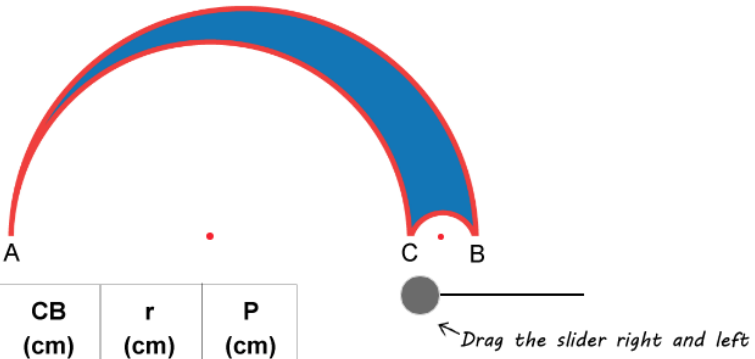
The diameter AB is 100 cm. The radius of semi-circle AC is 30 cm and radius of semi-circle CB is 20 cm.

Show that the perimeter of the shaded shape is 100π.

Question 8g (20 marks)

On the simulator below, use the slider to change the diameter CB and see the corresponding length of the perimeter of the shaded shape.

Key:
D: diameter of the semi-circle AB
R: radius of the semi-circle AC, which is 30 cm
r: radius of the semi-circle CB
P: perimeter of the shaded shape



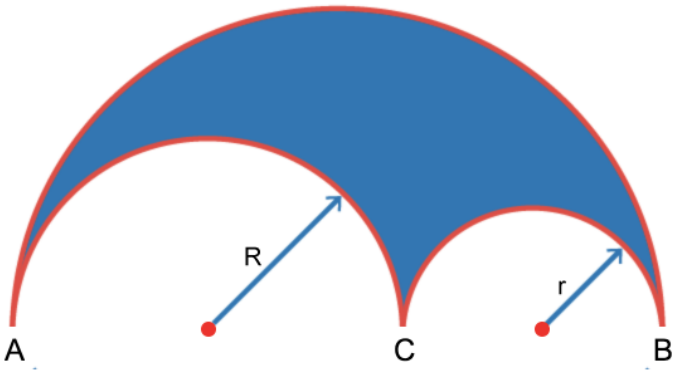
AC (cm)	R (cm)	CB (cm)	r (cm)	P (cm)
60	30	10	5	70 π

Investigate the relationship between the radius (r) of semi-circle CB and the perimeter (P) of the shaded shape when radius of semi-circle AC is 30 cm. You may use the simulator above. In your answer, you should:

- predict more values for P
- write down, in words, any patterns you see for P
- find a general rule for the perimeter of the shaded shape (P) in terms of (r)
- test your general rule
- prove or verify and justify your general rule
- ensure that you communicate the above appropriately.

To support your investigation, you may record data in the table below.

R	r	P
30	5	70 π
30	10	80 π
30	15	90 π
30	20	100 π
30	25	☐ π
30	30	☐ π
30	☐	☐ π
30	☐	☐ π
☐	☐	☐ π
☐	☐	☐ π



2018 November Maths eAssessment

Question 1 (4 marks)

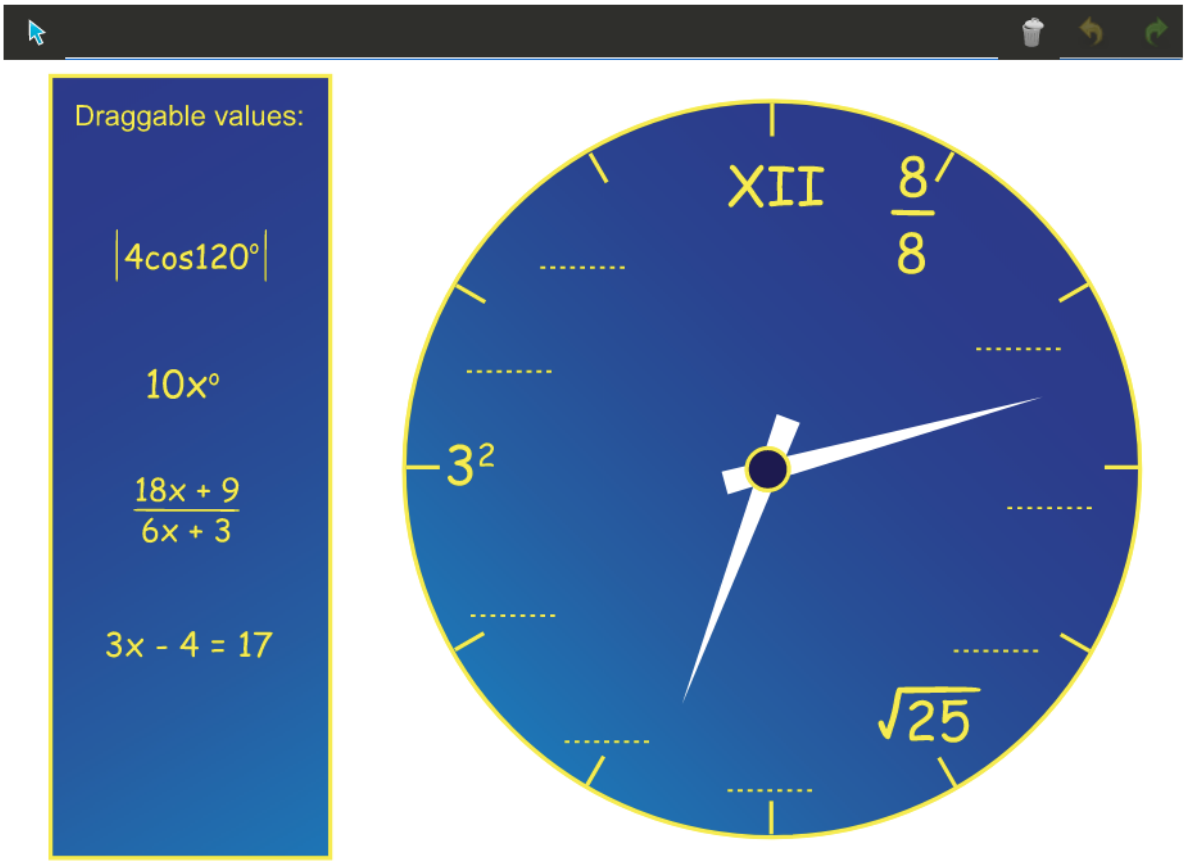
Below is an example of a mathematical wall clock.

©

In the process of designing a new mathematical wall clock, four values have been inserted in the correct place on Diagram 1 below and there are four more values that need to be placed on the diagram.

Label the mathematical clock by placing the values in the correct places.

Diagram 1



Question 2 (5 marks)

A group consisting of 120 students from MYP year 1 and MYP year 5 chose their favourite free-time activity from the following list: playing sport, gaming, and interacting on social media.

Their choices have been organized in the table below.

Favourite activity / Year group	Playing sport	Gaming	Interacting on social media	Total
MYP year 1	46	16	10	72
MYP year 5	8	16	24	48
Total	54	32	34	120

Question 2a (1 mark)

A student is selected at random from MYP year 5. **Write down** the probability that this student chose gaming as their favourite activity.

Question 2b (2 marks)

Examine the following statement:

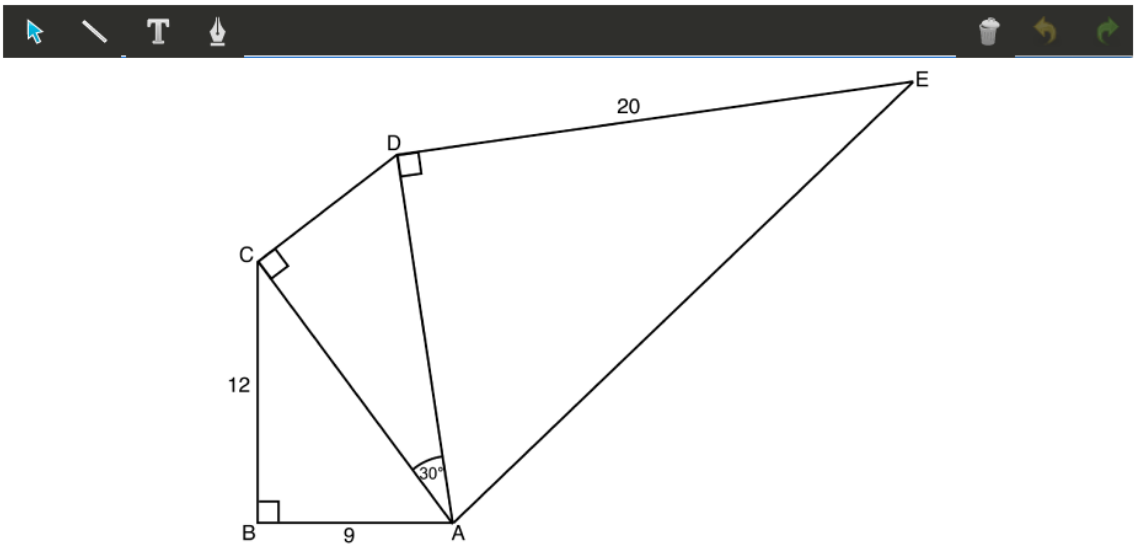
"MYP year 1 and MYP year 5 students are equally likely to choose gaming as their favourite activity."

Question 2c (2 marks)

A student is selected at random from the whole group. **Determine** the probability that this student did not choose playing sport as their favourite activity.

Question 3a (2 marks)

In the diagram below, angles ABC, ACD and ADE are 90°. The lengths AB, BC, and DE are 9 cm, 12 cm and 20 cm respectively.



Determine the length of AC.

Question 3b (3 marks)

Hence, **show that** the length of AD is $10\sqrt{3}$ cm.

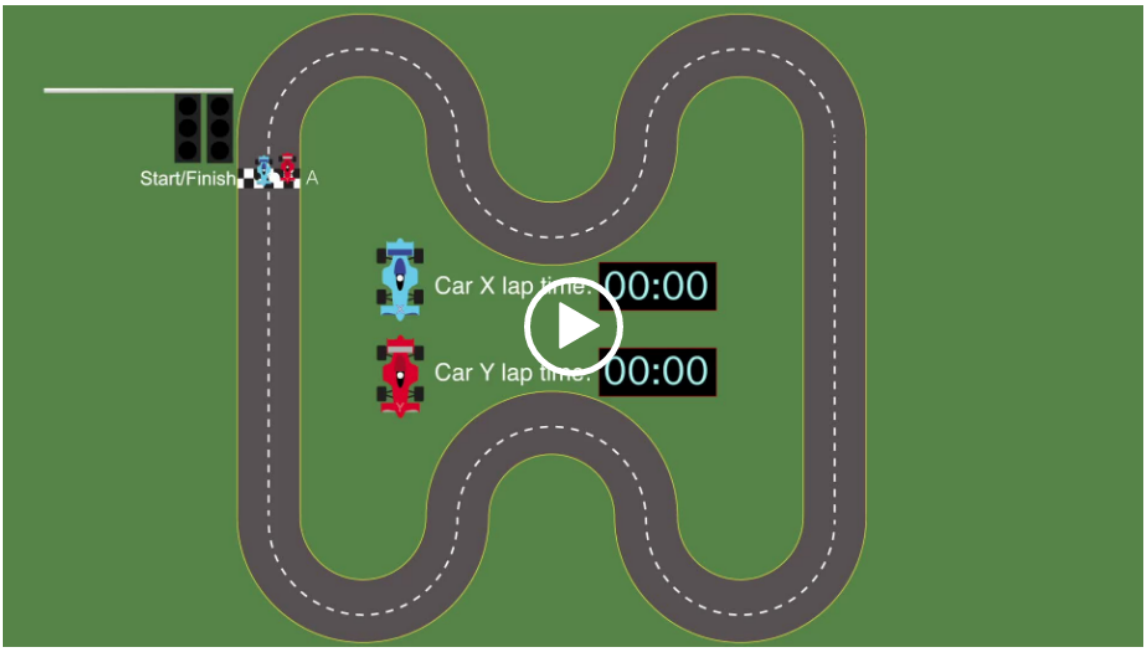
Question 3c (3 marks)

Find the angle DAE to the nearest degree.

Question 4a (2 marks)

The animation shows racing cars completing laps around a racing track. Car X and car Y start the race at the same time from the starting point A.

This media contains no audio

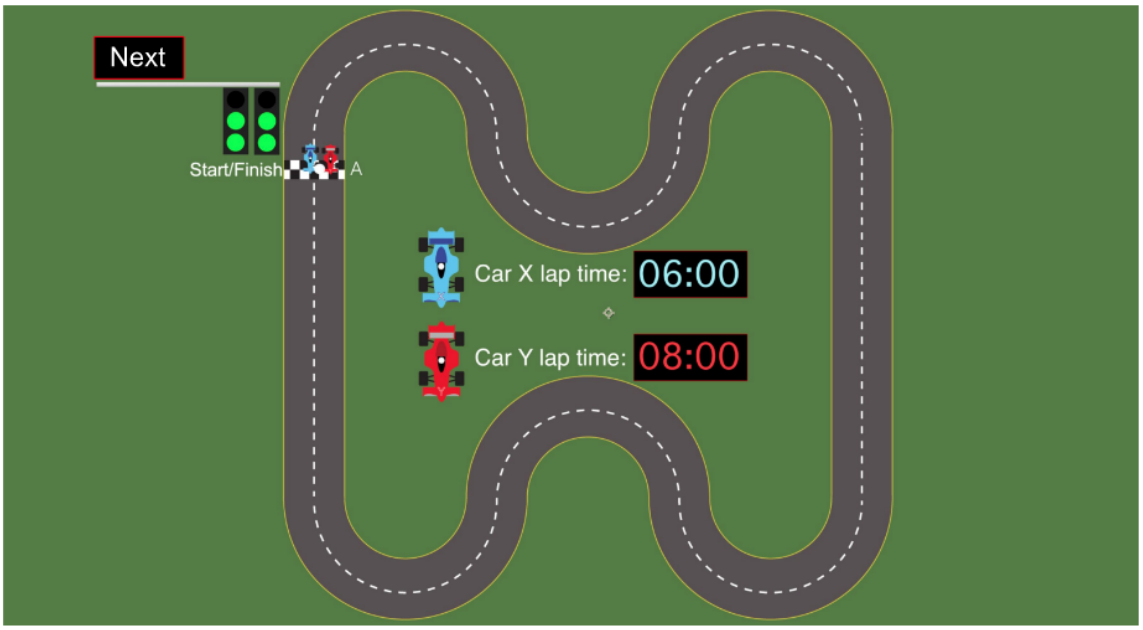


Car X completes one lap in 6 minutes and car Y completes one lap in 8 minutes.

Determine after how many minutes the two cars will meet again at the starting point A.

Question 4b (5 marks)

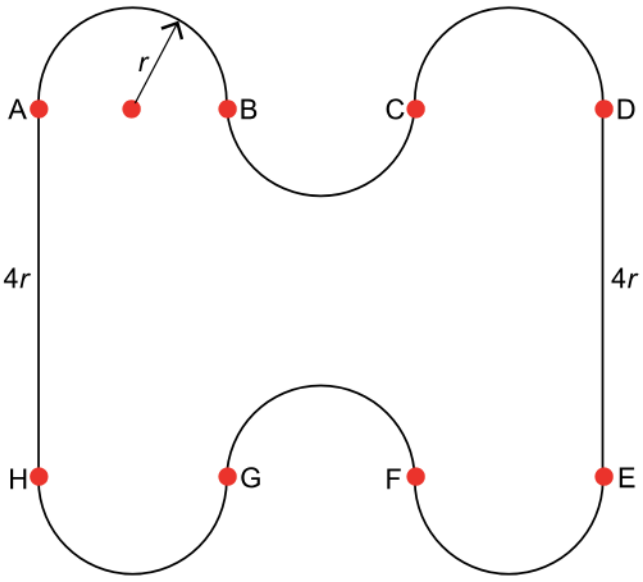
This media is interactive



The racing track from the animation can be modelled by Diagram 1 below. There are six semi-circles with radius r and two straight line sections of length $4r$.

Given that the total length of the track is 15 km, **show that** the radius r of the semi-circle is 560 m to the nearest 10 metres.

Diagram 1



Question 4c (3 marks)

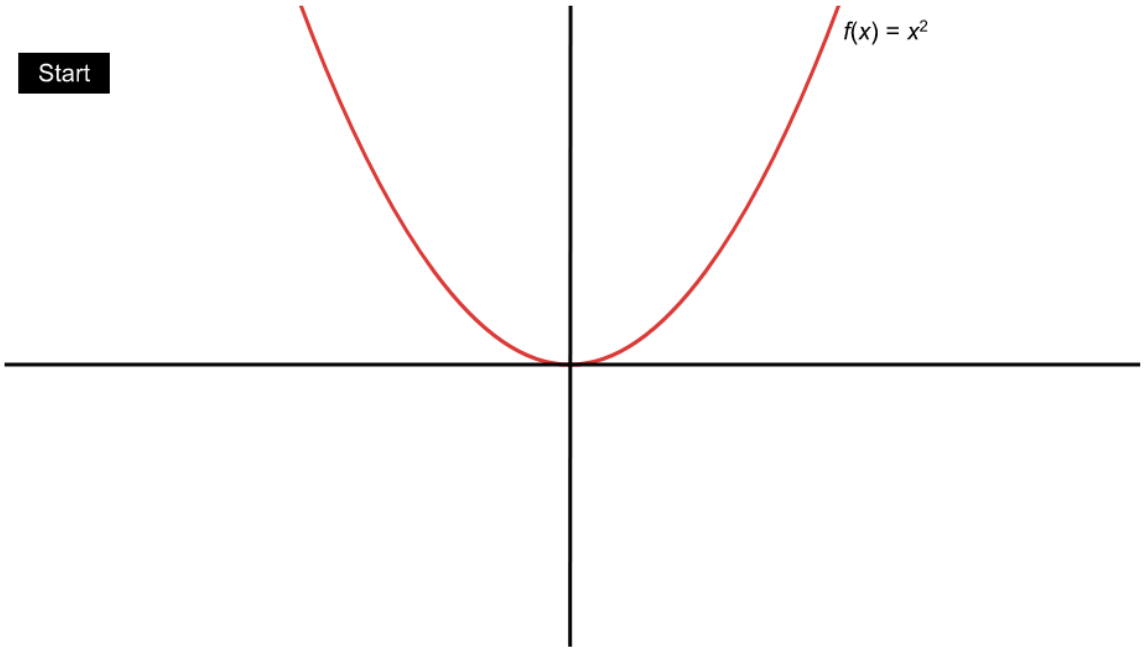
Diagram 2

The layout of the race track has inspired a company to create a logo in a similar shape. Diagram 2 is an example of the use of the logo. **Find** the area of the logo when r is 5 mm.

B I U x_2 x^2 Ω Σ Styles

This media is interactive

Start

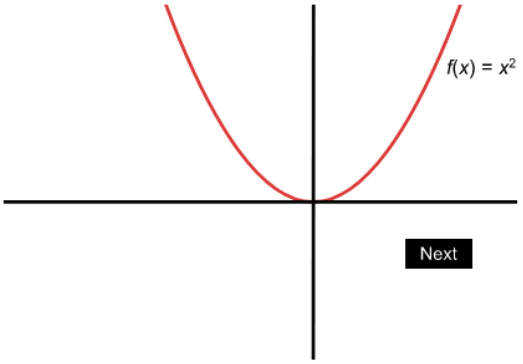


©

Given that $f(x) = x^2$ and $g(x) = -4(x + 2)^2 + 1$, **identify** the stages that transform $f(x)$ onto $g(x)$.

Question 5a (4 marks)

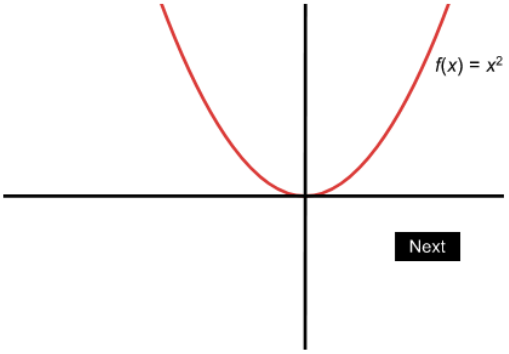
This media is interactive



Transformation 1:

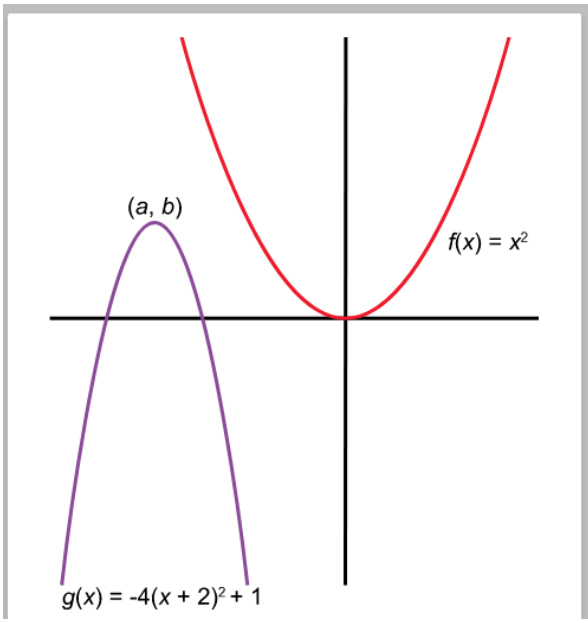
Transformation 2:

This media is interactive



Transformation 3:

Transformation 4:



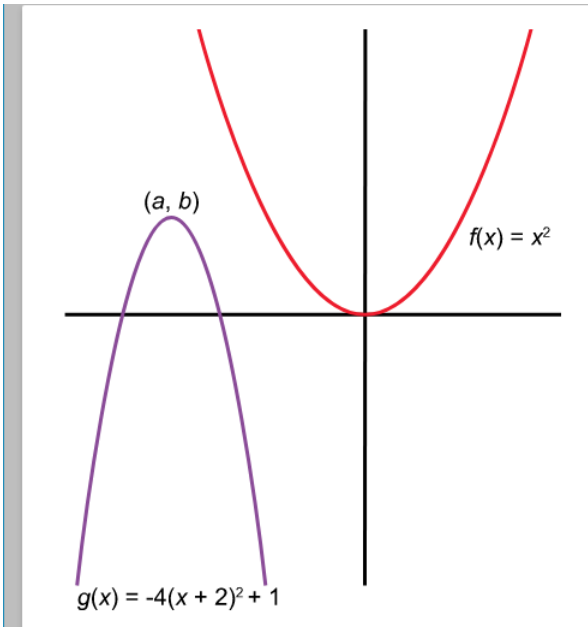
Question 5b (1 mark)

Write down the values of a and b of the function $g(x)$.

$a =$ $b =$

Question 5c (4 marks)

Given that $x = \frac{-3}{2}$ is one solution for $g(x) = 0$, **find** the value of the other solution.



Question 5b (1 mark)

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$a =$ $b =$

Question 5c (4 marks)

Given that $x = \frac{-3}{2}$ is one solution for $g(x) = 0$, **find** the value of the other solution.

Video | Script

There are many health benefits of exercise, whether it is getting active through fun activities or doing more serious structured workouts, exercise helps you stay fit and healthy.

Exercise has many other benefits. Exercise is not just good for the body, but it is also good for your mind and general feeling of well-being.

Studies have shown that exercising is a great self-esteem booster that can help you feel good about yourself all day long. You may feel more relaxed and less stressed.

In this question, you will review an exercise programme for a sixteen-year-old student. You will be provided with information about maximum heart rate. Heart rate is measured in beats per minute, otherwise called bpm. An effective exercise programme is reached when the heart rate is at least eighty percent of the maximum heart rate and a safe exercise programme is achieved when the heart rate is below the maximum heart rate.

The information provided in the question will help you review an exercise programme.

The maximum heart rate (H) in beats per minute (bpm) is calculated in terms of age, (a) in years, using the formula $H = 208 - 0.7a$

A safe exercise is one that stays below the maximum heart rate.

Question 6a (1 mark)

Show that the maximum heart rate of a 16-year-old is 197 bpm to the nearest beat.

Question 6b (2 marks)

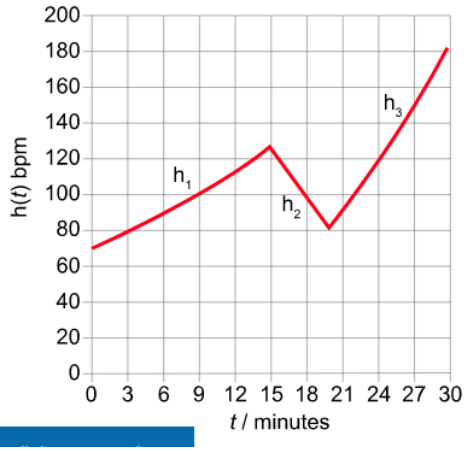
Research has shown that physical exercise is most effective when the heart rate reaches 80 % of the maximum heart rate and this should be maintained for 15 minutes.

Determine the heart rate of a 16-year-old for the most effective physical exercise. Give your answer in bpm to the nearest beat.

The heart rate of a 16-year-old student was monitored whilst doing 30 minutes of exercise.

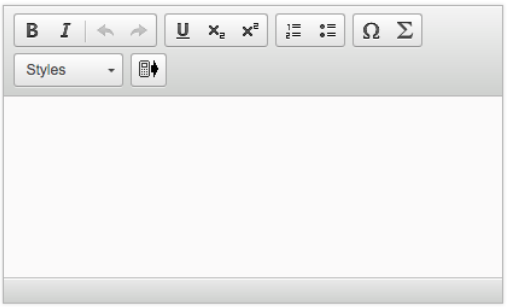
The changes in heart rate during the exercise are modelled by the function shown below, where t is the elapsed time from the beginning of the exercise, in minutes and h(t) is the heart rate, in bpm.

t	h(t)	
$0 \le t \le 15$	$h(t) = 70 \times (1.04)^t$	h_1
$15 \le t \le 20$	h(t) Heart rate decreases every minute by 9 beats per minute.	h_2
$20 \le t \le 30$	$h(t) = 0.2025t^2$	h_3



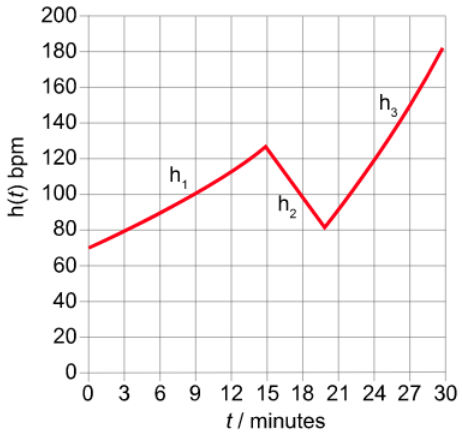
Question 6c (1 mark)

Write down the number of times the heart rate was 100 bpm during the 30 minutes of exercise.



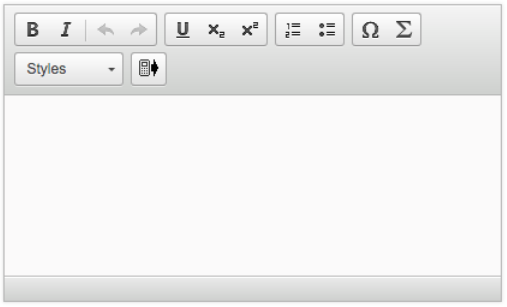
Question 6d (3 marks)

t	h(t)	
$0 \le t \le 15$	$h(t) = 70 \times (1.04)^t$	h_1
$15 \le t \le 20$	h(t) Heart rate decreases every minute by 9 beats per minute.	h_2
$20 \le t \le 30$	$h(t) = 0.2025t^2$	h_3



Question 6d (3 marks)

Calculate the heart rate after 11 minutes of training. Give your answer to the nearest beat.



Question 6e (3 marks)

Based on the behaviour of the graph, **discuss** the effectiveness and safety of this 30 minute exercise.

Question 7 (23 marks)

Video | Script

A balanced diet and regular exercise contribute to a healthy lifestyle. The intake of nutrients and energy comes from the food and drink consumed. The output of energy is achieved by every day activities and the amount of exercise we take. A healthy lifestyle has the appropriate balance of nutrients and energy.

Human beings need a certain amount of nutrients and energy for their bodies to function well.

The nutrients can be divided into three main categories: proteins, fats and carbohydrates. This pie chart shows an example of a recommended division of nutrients.

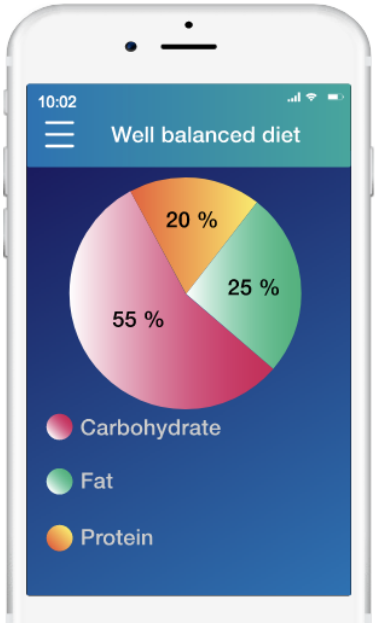
When nutrients and energy are balanced our bodies perform at their best and an imbalance of nutrients and energy can lead to poor performance.

In this question, you will examine how to balance different factors to help lead a healthy lifestyle.

Question 7a (2 marks)

This media is interactive

Hover over the pie chart sectors for details



A 180 gram (g) steak provides the correct amount of protein and fat. **Determine**, in grams, the amount of carbohydrates to be included with the steak for a balanced meal.

Styles

Question 7b (3 marks)

Daily average energy intake for children aged 13–18 years		
Age in years	Energy intake in kiloJoules (KJ)	
	Boys	Girls
13	10 100	9 300
14	11 000	9 800
15	11 800	10 000
16	12 400	10 100
17	12 900	10 300
18	13 200	10 300

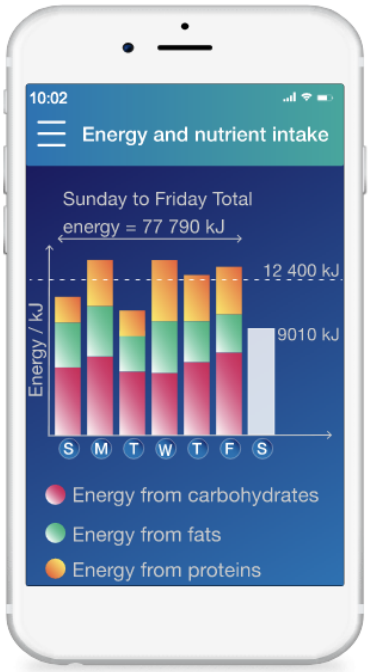
Gerry is a 16-year-old boy. He wants to divide his daily intake of energy over three meals in the following ratio:

Breakfast		Mid-day meal		Evening meal
2	:	3	:	4

Find the total amount of energy, in kJ, Gerry should have for his mid-day meal and evening meal to the nearest kJ.

Question 7c (2 marks)

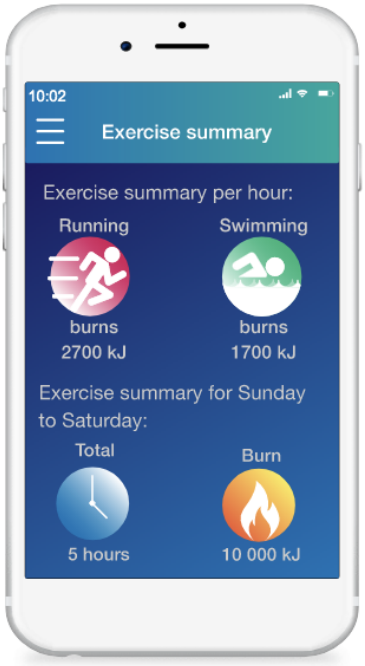
The bar chart shows Gerry's energy and nutrient intake over six days, Sunday to Friday. The total intake of energy is 77 790 kJ. He knows that the average intake per day should be 12 400 kJ.



Show that he should intake only 9010 kJ on Saturday the last day of the week.

Styles

Gerry wants to make healthy lifestyle choices. In the infographic below you can see his exercise summary.



Scroll down to continue

Question 7d (2 marks)

An equation relating the number of hours running (r) and the number of hours swimming (s) can be written as $r + s = 5$. Based on the information in the infographic, **write down** another equation relating r and s.

Question 7e (4 marks)

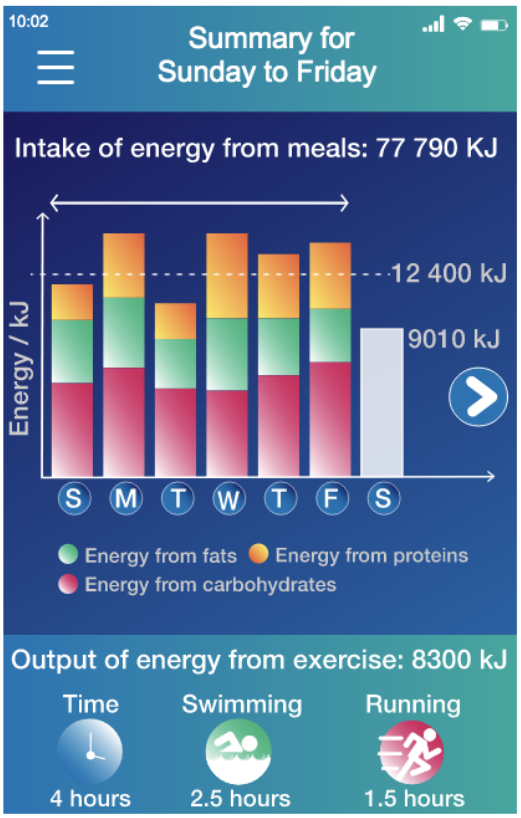
Hence, **find** the number of hours of running (r) and number of hours of swimming (s) that will allow Gerry to achieve his goal of burning exactly 10 000 kJ.

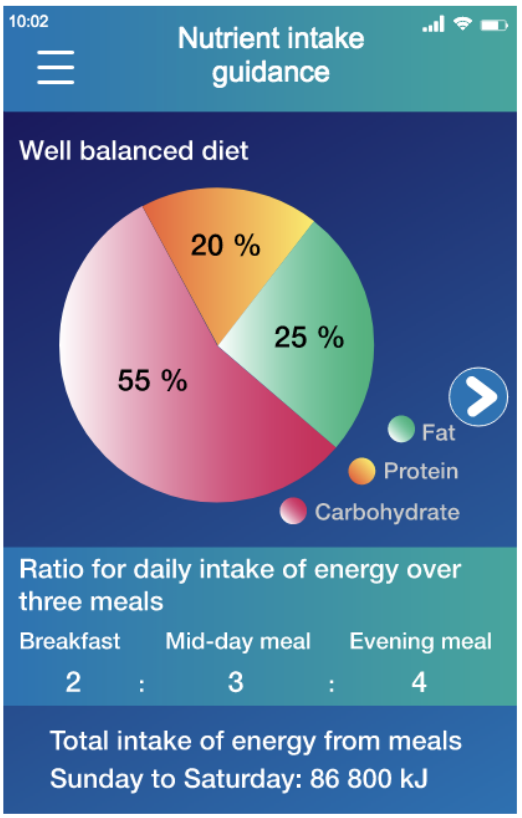
Question 7f (10 marks)

Gerry has decided to use a mobile application (app) to record his activities on a weekly basis. He is on the final day, Saturday, of his first week. He has already had his breakfast and mid-day meal and has taken no exercise today. He hopes to complete the week having achieved his healthy lifestyle goal.

This media is interactive

To toggle between pages in the App, use the buttons.





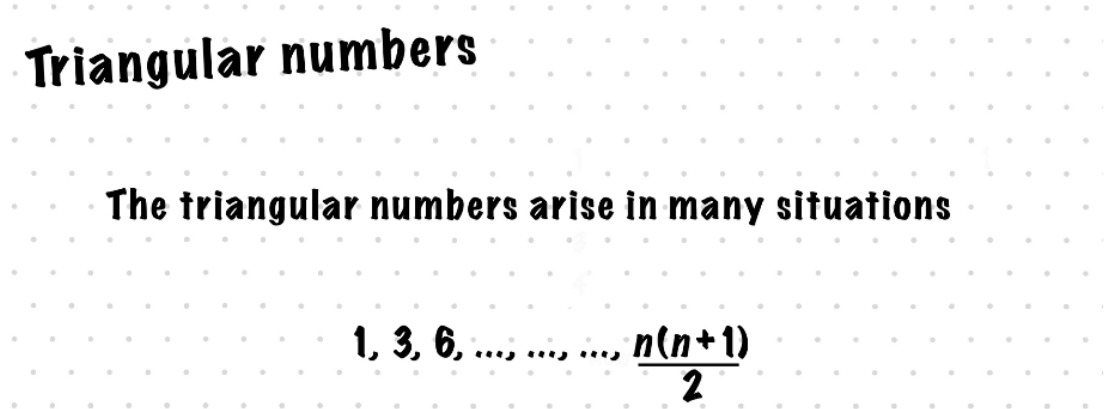
Evaluate Gerry's progress towards a healthy lifestyle. Use the information provided in the mobile app. In your answer, you should:

- identify four factors to be considered for a healthy lifestyle
- calculate the remaining nutrition and energy for Saturday
- justify the degree of accuracy of your results
- suggest advice for Gerry on his approach to a healthy lifestyle
- explain how the advice makes sense for a healthy lifestyle.

Question 8 (31 marks)

The following animation shows patterns in triangular numbers.

This media contains no audio



Question 8 (31 marks)

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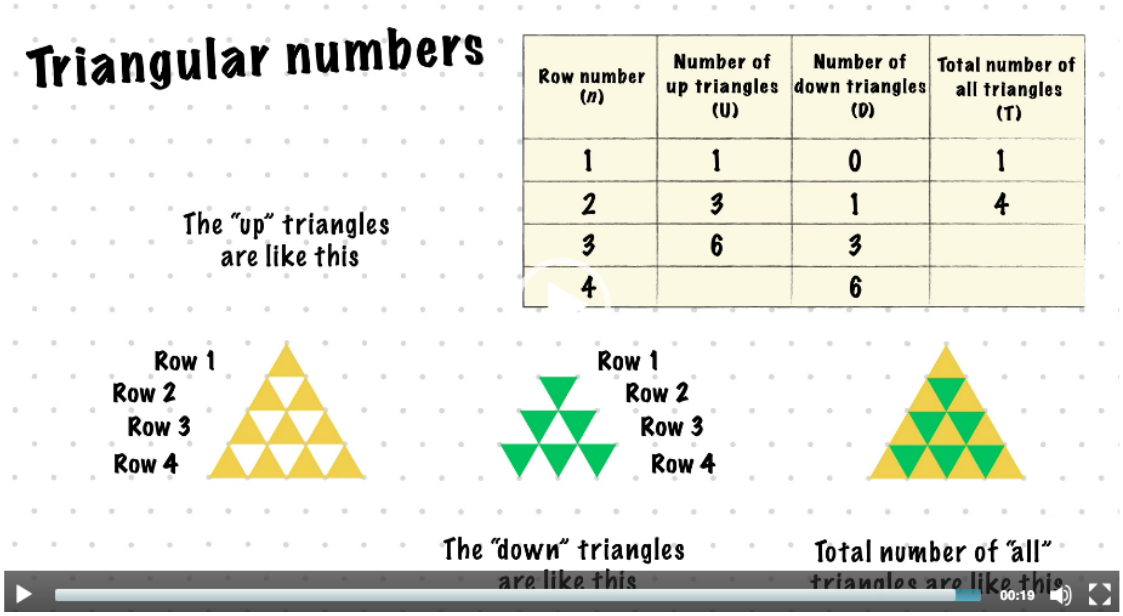
This media contains no audio



Row number (n)	Number of up triangles (U)	Number of down triangles (D)	Total number of all triangles (T)
1	1	0	1
2	3	1	4
3	6	3	
4		6	

Below is an example of the Up triangles and the Down triangles.

©

Question 8a (2 marks)

The table below is populated with some of the results.

Write down the missing values in the table up to row 5.

Row number (*n*)	Number of up triangles (U)	Number of down triangles (D)	Total number of all triangles (T)
1	1	0	1
2	3	1	4
3	6	3	
4		6	
5			

Reset

Question 8b (3 marks)

Describe in words three patterns you see in the table.

B I U x_2 x^2 Ω Σ Styles

Question 8c (1 mark)

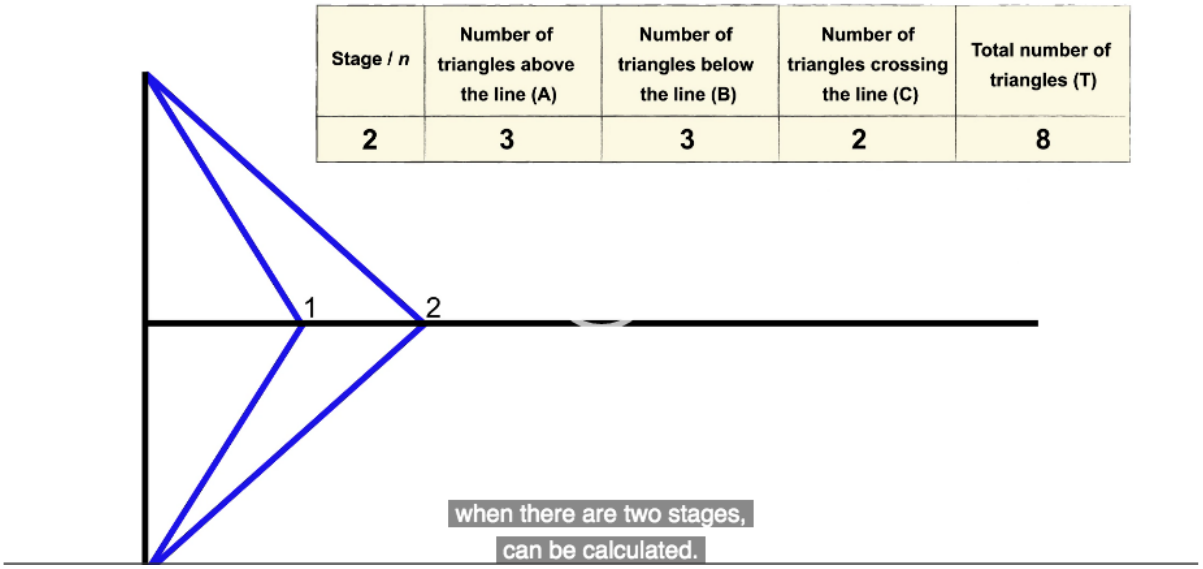
Write down a general rule for T in terms of *n*.

Question 8d (3 marks)

Verify your general rule for T.

Video | Script

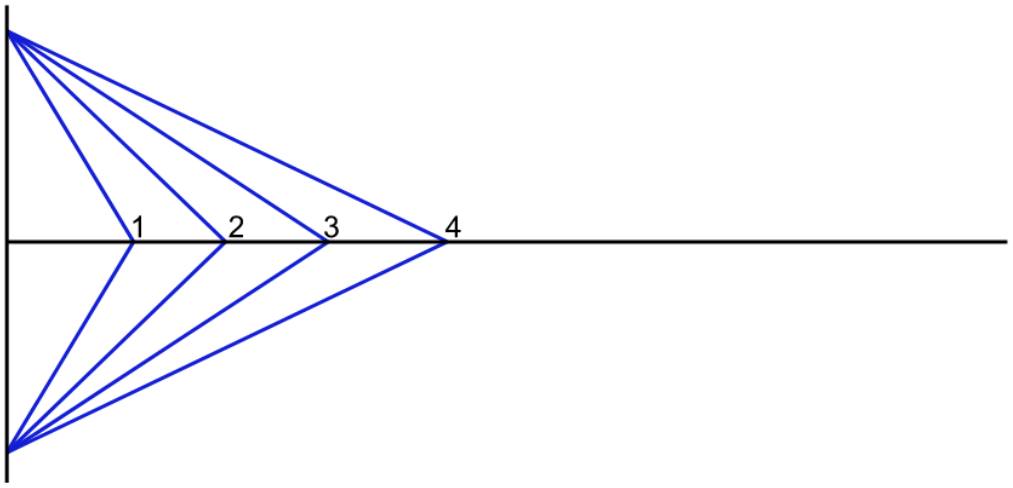
The following video shows a systematic method for counting triangles from a diagram.



Question 8e (22 marks)

Investigate the values in the table to find a relationship for T in terms of n. In your answer, you should:

- predict more values and record these in the table below
- describe in words any patterns for columns C and T
- find a general rule for T in terms of n
- test your general rule for T
- prove or verify and justify your general rule for T
- ensure that you communicate all your working appropriately.

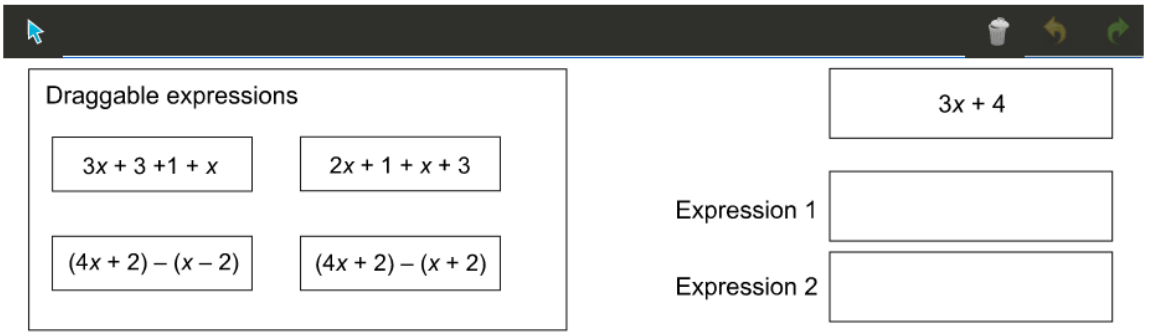


Stage (n)	Number of triangles above the line (A)	Number of triangles below the line (B)	Number of triangles crossing the line (C)	Total number of triangles (T)	
1	1	1	1	3	
2	3	3	2	8	
3	6	6	3	15	
4	10				
5					
6					

2019 May Maths eAssessment

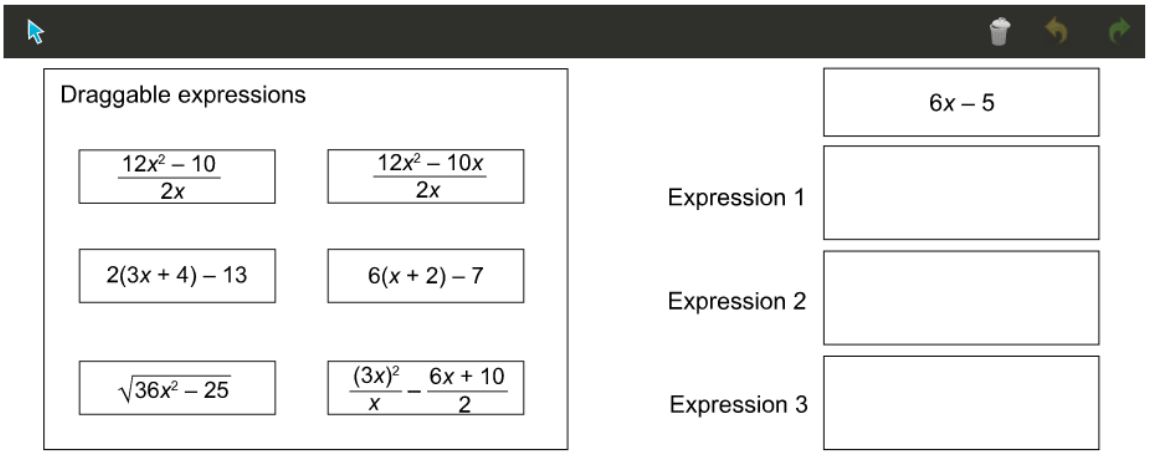
Question 1a (2 marks)

Identify the **two** expressions that simplify to $3x + 4$. Drag and drop the two expressions to the allocated space below.



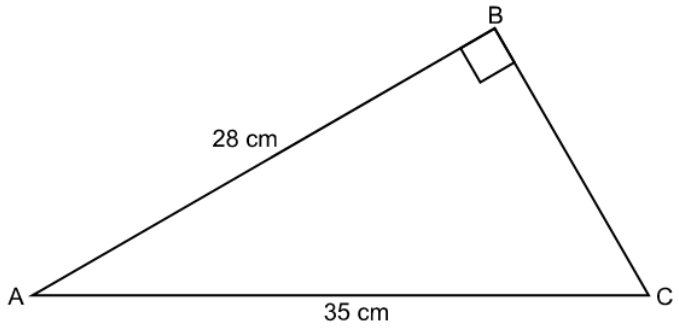
Question 1b (3 marks)

Identify the **three** expressions that simplify to $6x - 5$. Drag and drop the three expressions to the allocated space below.



Question 2a (3 marks)

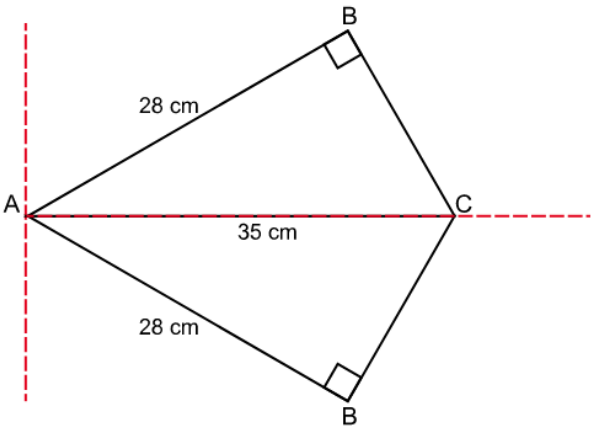
Calculate the length of side BC.



Question 2b (1 mark)

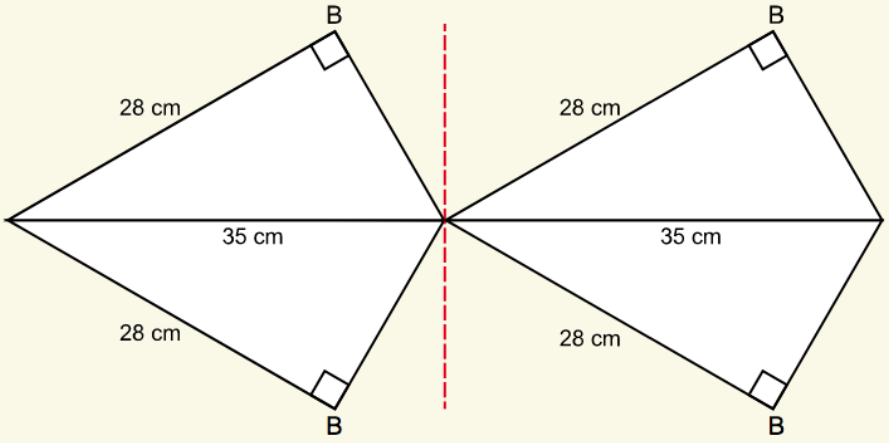
Triangle ABC is reflected in the horizontal line AC as shown in **Diagram 1**. The shape in **Diagram 1** is reflected in the vertical line passing through point A.

Diagram 1

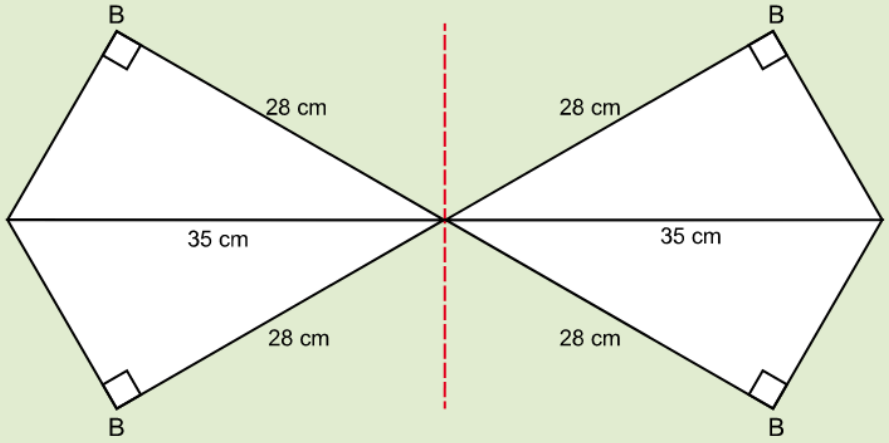


Select the figure which shows the final shape after this reflection.

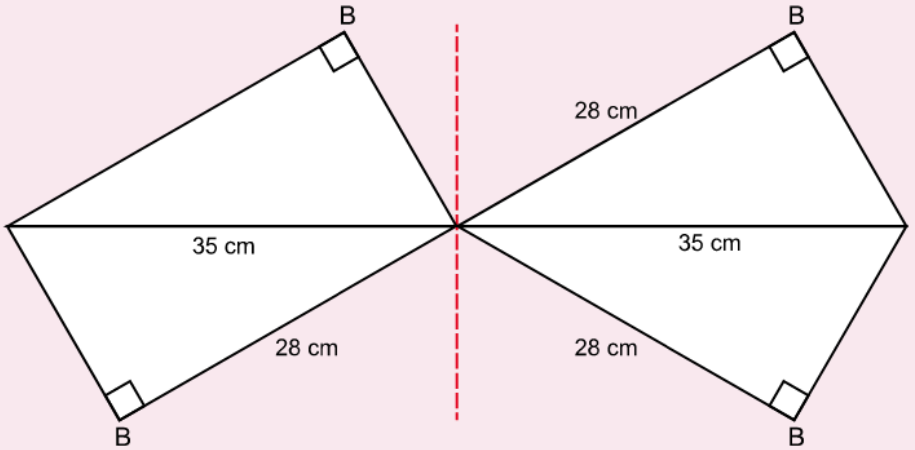
Option A



Option B



Option C



Question 2c (2 marks)

Determine the perimeter of the final shape formed after the reflections.

Question 3a (2 marks)

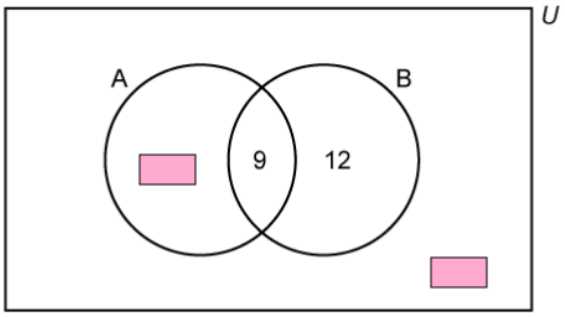
In a group of 60 students:

22 study Extended mathematics
21 study Physics
26 study neither.

In the Venn diagram below

Set A represents the number of students who study Extended mathematics
Set B represents the number of students who study Physics.

Determine the missing values and complete the Venn diagram below.



Question 3b (1 mark)

Describe the region $A \cap B$ in context.

The school decides to participate in a competition. The participants must be studying **both** Extended mathematics and Physics.

Question 3c (2 marks)

One student is selected at random from the group. **Determine** the probability that this student can participate in the competition.

Question 3d (3 marks)

Three students are selected at random from the group. **Find** the probability that they can participate in the competition.

Question 3e (2 marks)

Comment on the practicality of selecting students for the competition randomly.

©

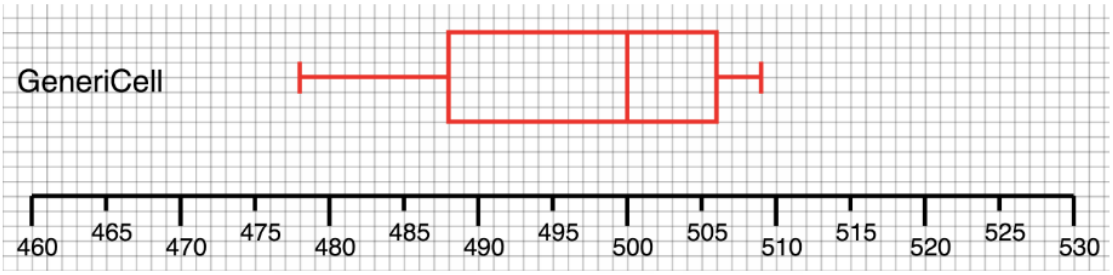
The students have conducted an experiment in their maths class to test the claims of the advertisements. In the experiment, students have tested nine batteries from GeneriCell and measured the lifetime of the batteries. The results are shown in **Table 1** to the nearest minute. A higher number indicates that the battery has a longer lifetime.

Table 1

Lifetime (in minutes) of the nine batteries from GeneriCell								
478	478	498	500	500	501	505	507	509

Below is a box-and-whisker plot representing the data found in **Table 1**. You can hover over the box-and-whisker plot to reveal the values.

Box-and-whisker plot to show "Lifetime (in minutes) for the nine batteries from GeneriCell"



Question 4a (1 mark)

Using the box-and-whisker plot, **write down** the percentage of batteries with a lifetime between 488 and 506 minutes from GeneriCell.

Question 4b (3 marks)

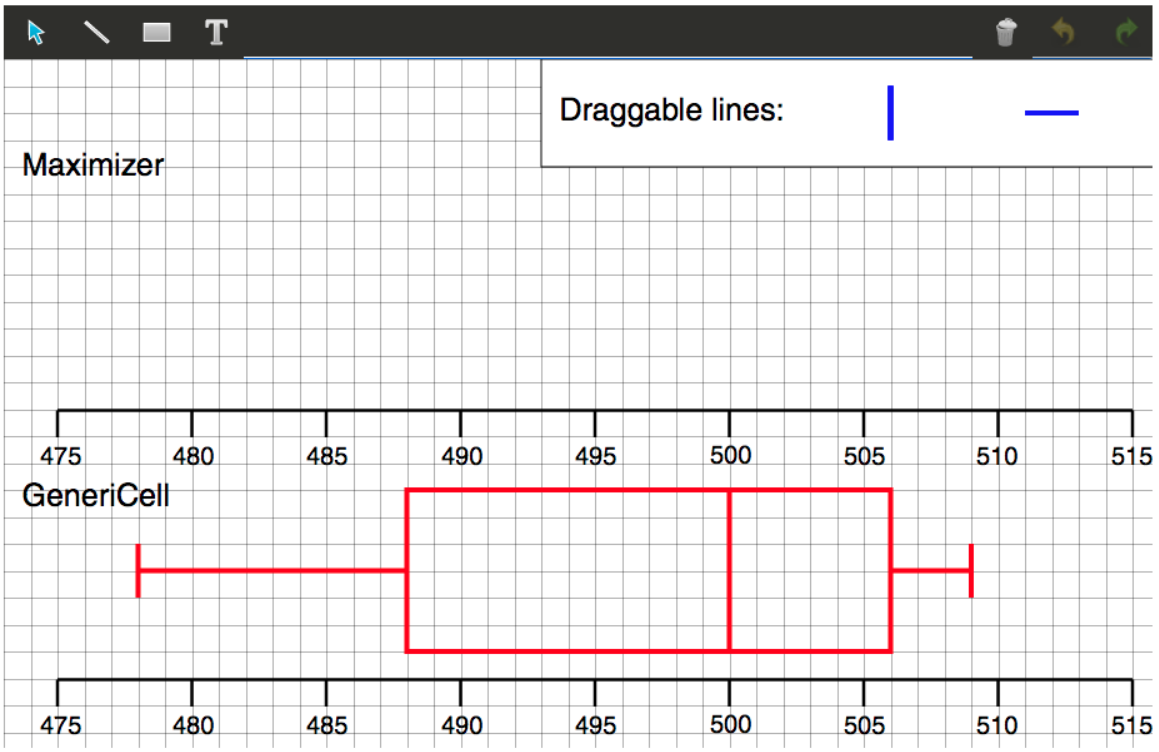
The experiment is repeated for the Maximizer brand. The times are recorded in **Table 2** to the nearest minute.

Table 2

Lifetime (in minutes) of the nine batteries from Maximizer								
478	491	497	498	502	502	502	504	509

On the canvas provided, **draw** a box-and-whisker plot to summarize the data given in **Table 2** for Maximizer. The draggable lines can be resized as required.

Lifetime (in minutes) of the nine batteries from both brands



Question 4c (2 marks)

Using your box-and-whisker plots:

Identify **one** reason that supports GeneriCell in their advertisement claim and **one** reason that supports Maximizer in their advertisement claim.

GeneriCell

Maximizer

Question 5a (3 marks)

The equation, $x + \frac{1}{2}x = 6^2$ can be described in words as

"The sum of a number and its half is the same as the square of six."

Calculate the value of the number.

Question 5b (4 marks)

In another case,

"The sum of a number and its square is the same as 56".

Find all possible values of the number.

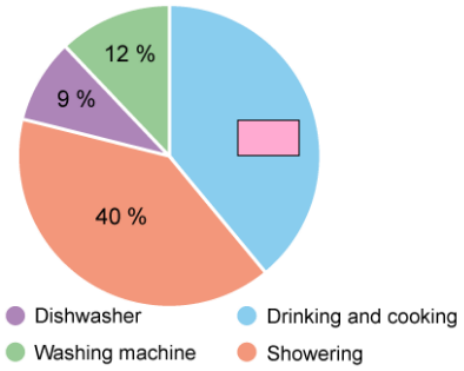
Question 6 (14 marks)

In this question, you will make calculations for changes that individuals can make to save water on a daily basis.

Question 6a (1 mark)

Write down the missing percentage for drinking and cooking on the pie chart.

Daily percentage of water usage per person



Question 6b (2 marks)

It is estimated that the daily water usage per person is 120 litres.

Determine the amount of water used for showering.

Question 6c (2 marks)

A regular shower has a flow rate of 8 Litres (L) per minute.

Using your answer from part (b), **determine** the duration of a regular shower.

Question 6d (2 marks)

In a water-saving condition the flow rate of a shower can be reduced to be 5 L per minute. Given that the duration of the shower does not change:

Determine the amount of water used for showering in a water-saving condition.

Question 6e (3 marks)

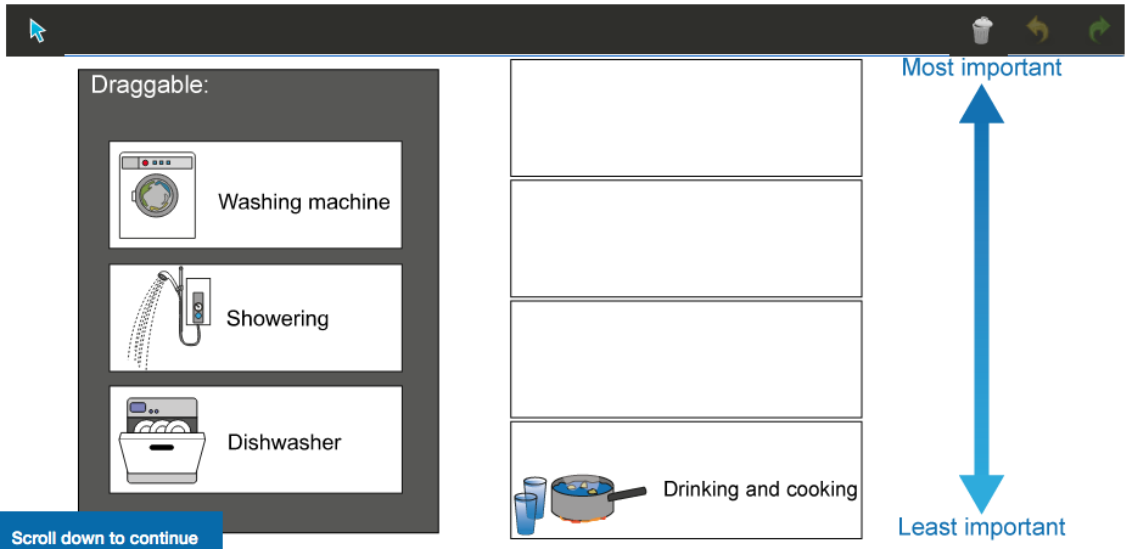
The amount of water used by the washing machine is 14.4 L. The eco-setting for washing machines reduces water by 5 %.

Calculate the amount of water used by the washing machine in the eco-setting.

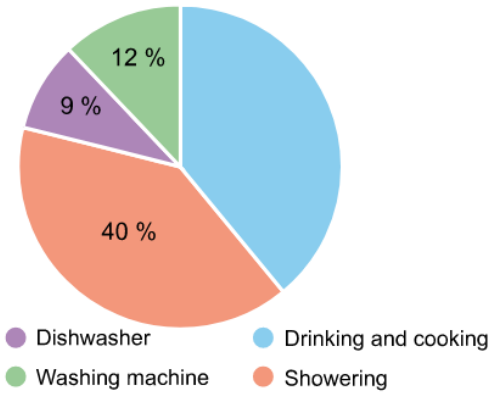
Question 6f (1 mark)

Water activity	Water-saving condition
Drinking and cooking	No change
Dishwasher	Eco setting: saves 5 % of water
Washing machine	Eco setting: saves 5 % of water
Showering	Flow rate: 5 litres of water per minute

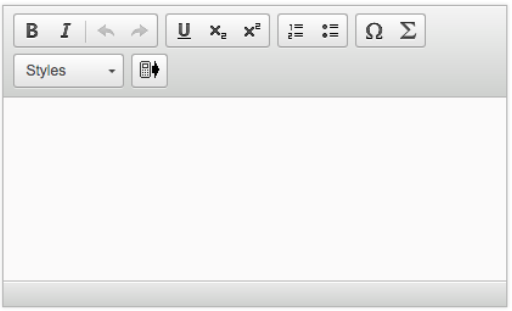
Suggest the order of activities in which it is most important to save water. Drag and drop the activities in the appropriate order.



Question 6g (3 marks)

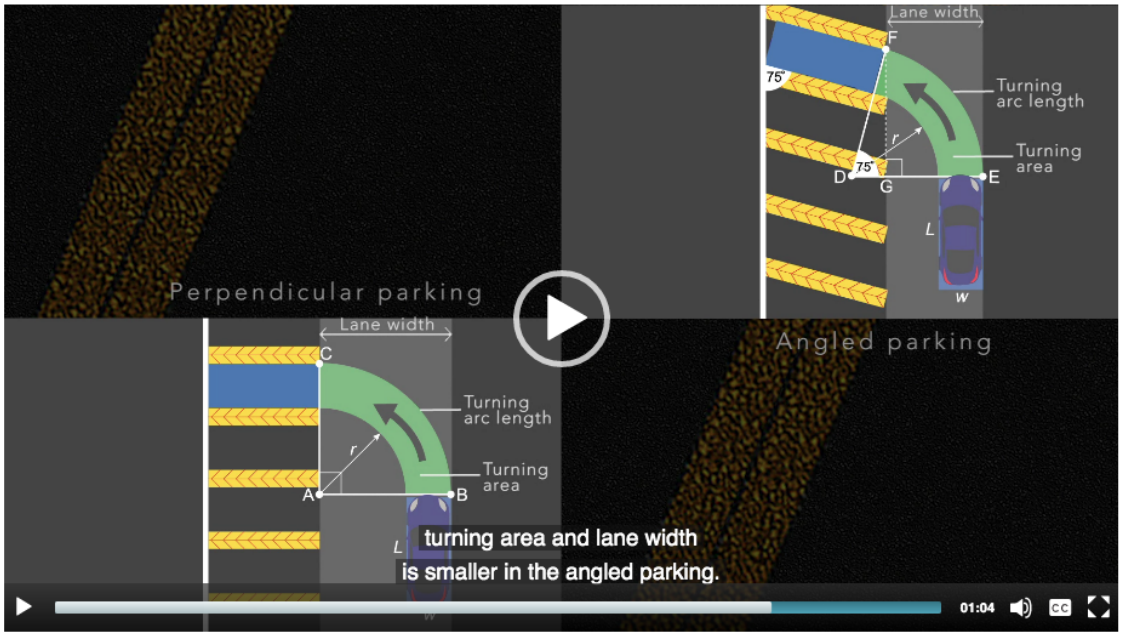


Justify your chosen order in part (f). You should refer to your answers from previous parts.



Question 7a (1 mark)

The following video explains the factors that are important to consider in car park design.



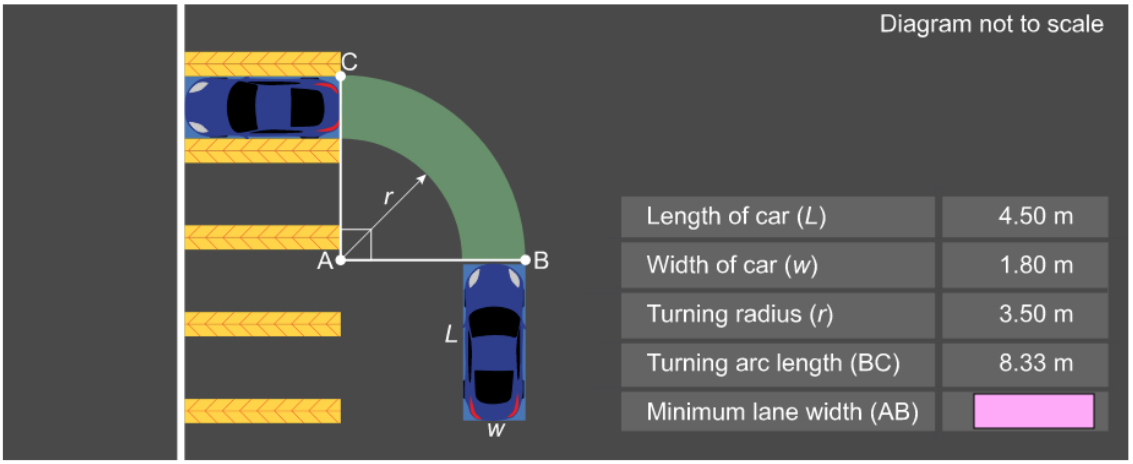
Perpendicular parking scenario

The car park is designed to fit cars with maximum dimensions, as shown in the table. AB and AC are equal.

The perpendicular parking scenario is modelled in **Diagram 1** below.

Determine the value of the minimum lane width AB, needed for cars to enter and leave perpendicular parking spaces. Write your answer in the table in **Diagram 1**.

Diagram 1



Length of car (L)	4.50 m
Width of car (w)	1.80 m
Turning radius (r)	3.50 m
Turning arc length (BC)	8.33 m
Minimum lane width (AB)	

Angled parking scenario

The car park is designed to fit cars with maximum dimensions as shown in the table. DE and DF are equal. FG is perpendicular to DE.

The angled parking scenario is modelled in **Diagram 2** below.

Given that DE is equal to AB from part (a).

Diagram 2

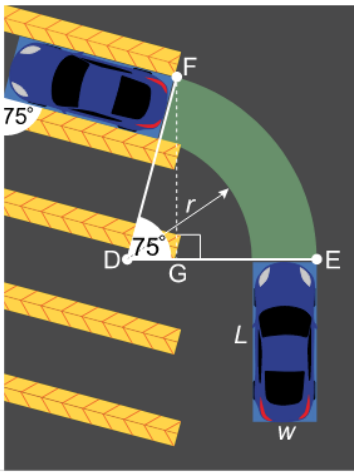


Diagram not to scale

Length of car (L)	4.50 m
Width of car (w)	1.80 m
Turning radius (r)	3.50 m
Turning arc length (EF)	?

Question 7b (3 marks)

Calculate the turning arc length EF.

Question 7c (4 marks)

Find the value of DG to the nearest one decimal place.

Question 7d (1 mark)

Hence, **determine** the value of the minimum lane width EG, needed for cars to enter and leave angled parking spaces.

Question 7e (10 marks)

You are the designer in a planning department, below is your brief for a car park design.

Purpose:

Design a car park to maximize the number of parking spaces in order to make the best use of the land as a resource.

Conditions:

Use **either** perpendicular parking **or** angled parking **but not both.**

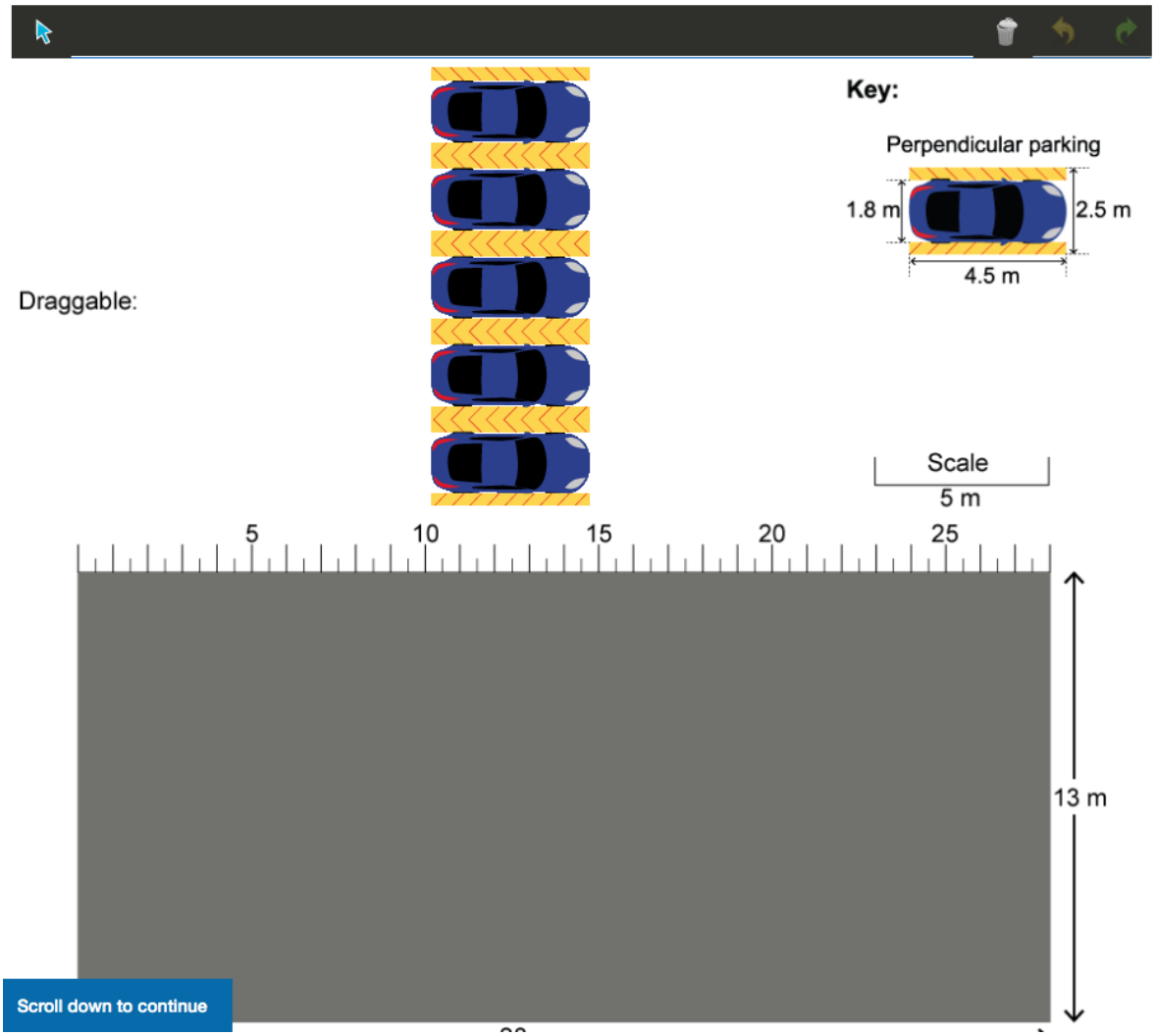
Use 5.5 m as minimum lane width for the perpendicular parking

Use 4.0 m as minimum lane width for the angled parking

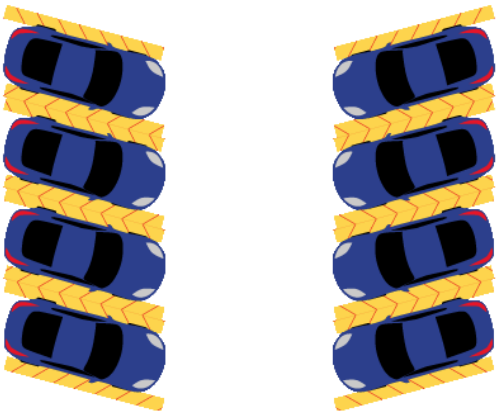
Design a layout for the car park with the dimensions provided in the diagram.

In your answer, you should:

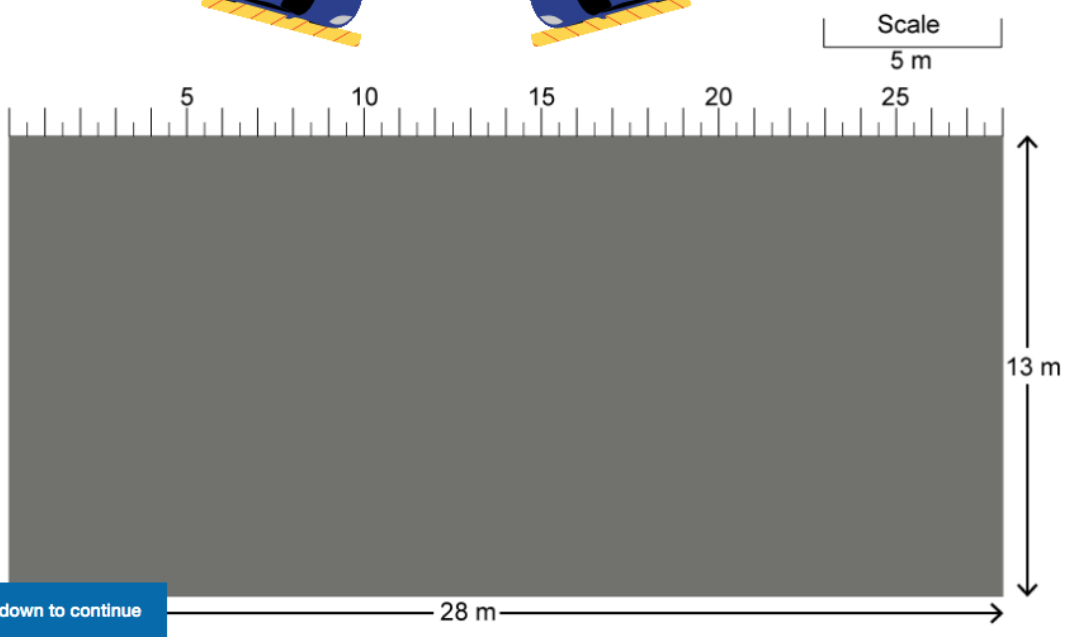
- identify the relevant factors you considered in your design
- justify with calculations that your design is making the best use of the available width of the car park
- justify the degree of accuracy of your design
- illustrate the design on **one** of the diagrams below.


Key:
Perpendicular parking
1.8 m
2.5 m
4.5 m
Draggable:
Scale
5 m
5
10
15
20
25
13 m
Scroll down to continue

Draggable:

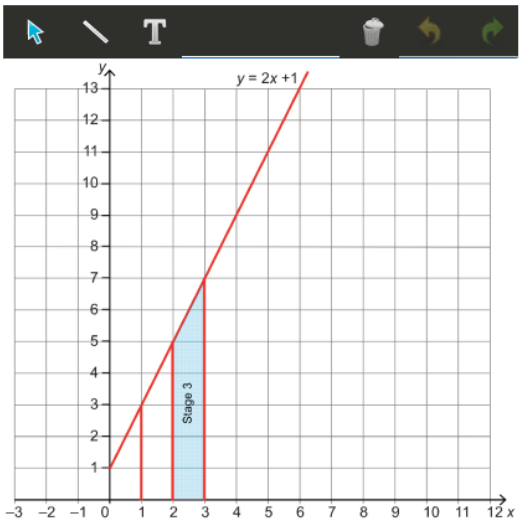


Key:



Scroll down to continue

Question 8a (2 marks)



For stage 3, **show that** the area of the trapezium is 6 units squared.

B I U Styles

Question 8b (1 mark)

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

Stage (n)	Area of trapezium (A)
1	2
2	4
3	6
4	8
5	
6	

Reset

Question 8c (2 marks)

Describe in words **two** patterns you see in the table for A.

B I U x_2 x^2 Ω Σ Styles

Question 8d (2 marks)

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

B I U x_2 x^2 Ω Σ Styles

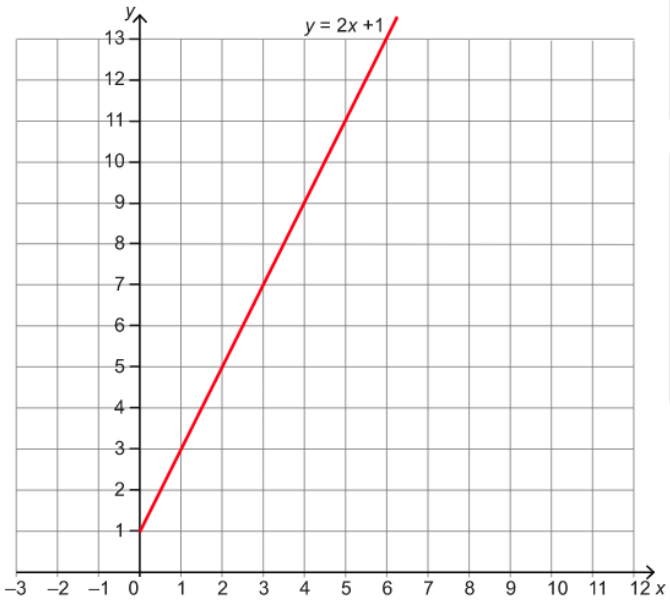
Question 8e (3 marks)

Verify your general rule for A.

Question 8f (23 marks)

Using the same line, you will now look at how different trapeziums are formed. Drag the Stage slider to see how these different trapeziums can be formed.

This media is interactive



Stage control

Stage:

Stage (n)	Area of trapezium (T)

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

- predict more values and record these in the table
- describe in words **two** patterns for column T
- find a general rule for T in terms of n
- test your general rule for T
- prove or verify and justify your general rule for T
- ensure that you communicate all your working appropriately.

Stage (n)	Area of trapezium (T)	
1	2	
2	6	
3	12	
4	20	
5		
6		
7		

Reset

B I U x_2 x^2 Ω Σ

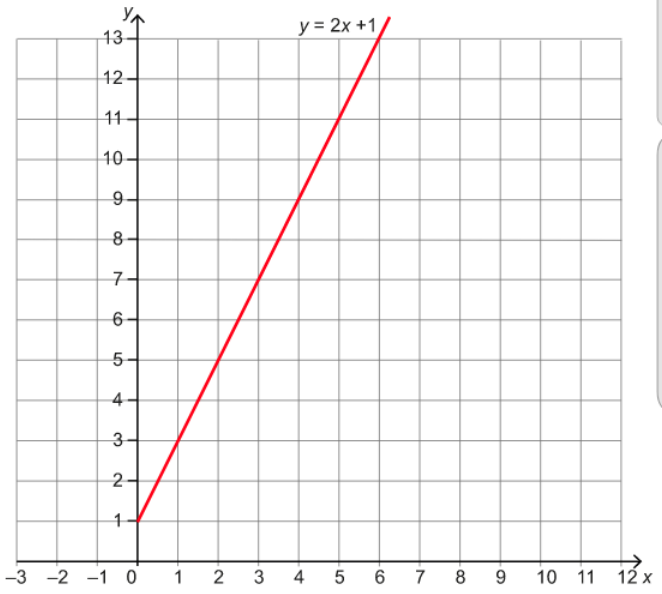
Styles

Question 8 (33 marks)

The line $y = 2x + 1$ is shown on the coordinate axes below. Vertical line segments can be added between the line and the x axis, one unit apart horizontally. In this question, you will investigate areas of different trapeziums formed.

Drag the stage slider to see how trapeziums can be formed.

This media is interactive



Stage control

Stage:

Stage (n)	Area of trapezium (A)

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Question 1a (2 marks)

Select the line equations and place them with the corresponding lines.

Draggable equations:

$y - x = 6$

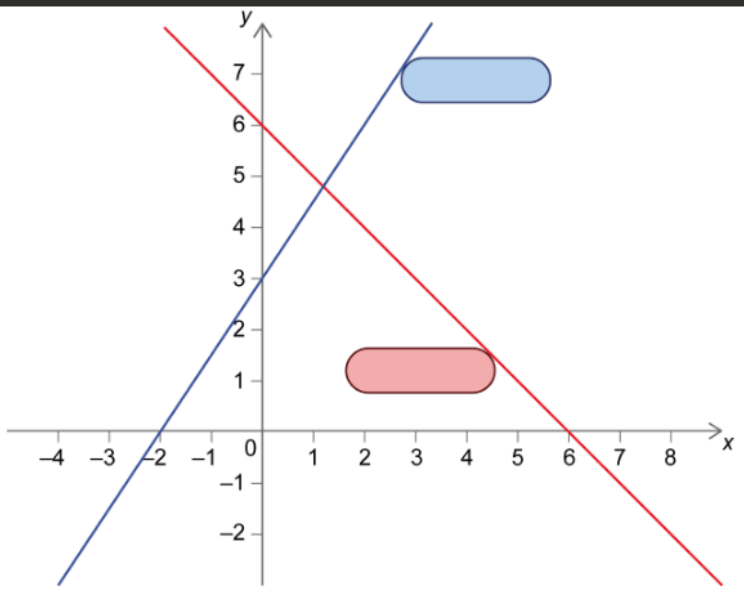
$y = x + 3$

$y + x = 6$

$2y - 3x = 6$

$2y + 3x = 6$

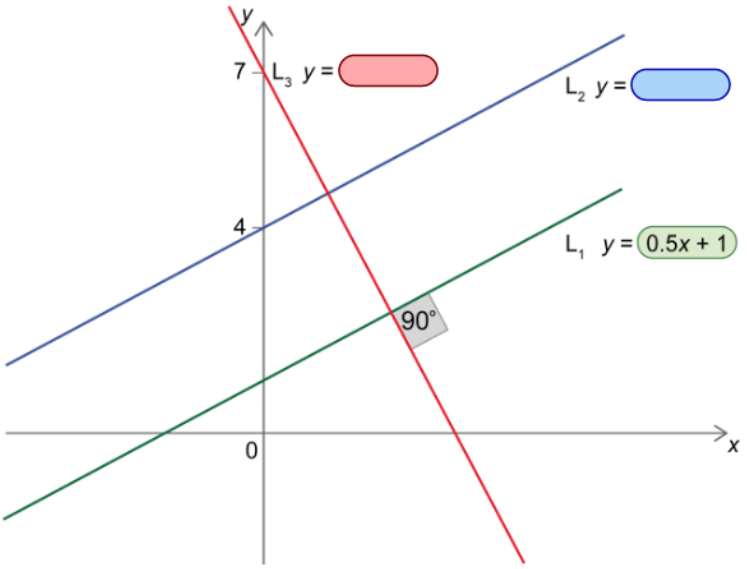
$3y - 2x = 6$



Not Started **Question 1b** (2 marks)

Line L_3 is perpendicular to both L_1 and L_2

Write down the equation of the lines L_2 and L_3.

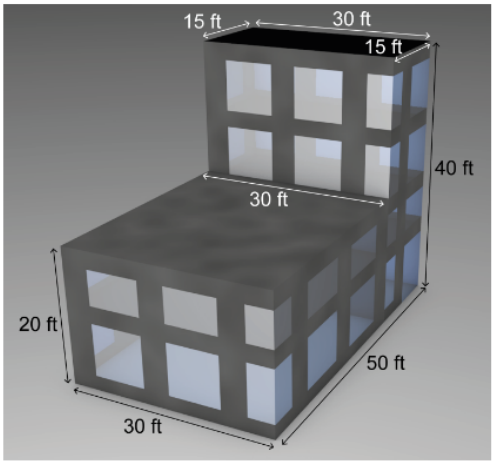


Question 2 (8 marks)

Below is a 3D diagram for an office building. The dimensions are in feet (ft).

Question 2a (3 marks)

Dimensions are in feet (ft)



Calculate the volume of the office building in cubic feet.

B I U x_2 x^2 Ω Σ Styles

Question 2b (3 marks)

The number of employees in the office building each day is given in the table below.

	Working days				
Day	Monday	Tuesday	Wednesday	Thursday	Friday
Number of employees	105	70	90	75	60

Find the mean number of employees in the office building during the working days.

Question 2c (2 marks)

To control the temperature in the office building, a central air-conditioning unit is needed.

The power (P) of the air-conditioning unit is measured in horsepower (hp) and can be found using the following formula:

$$P = \frac{(6V + 500N)}{9000}$$

Where:

V is the volume in cubic feet.
N is the mean number of employees during the working days.

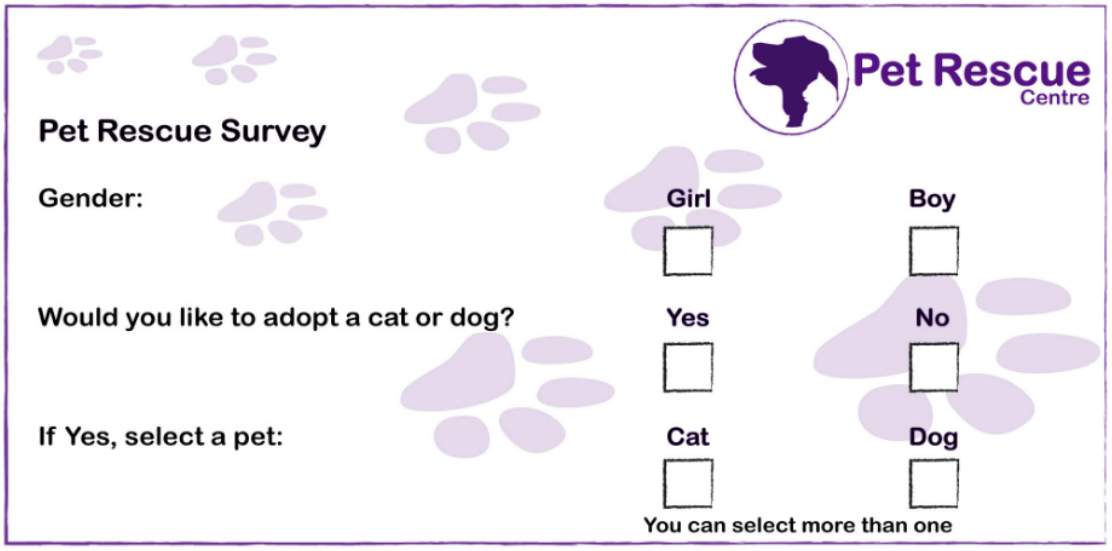
Using your answers from part (a) and part (b), **determine** the value of P needed for controlling the temperature in this office building.

Question 3a (1 mark)

Izumi is a volunteer at a pet rescue centre which has cats and dogs for adoption. At the next school festival, she will try to convince students to adopt a pet from the pet rescue centre.

Izumi decides to run a survey in her school before the festival.

She asked the following questions:

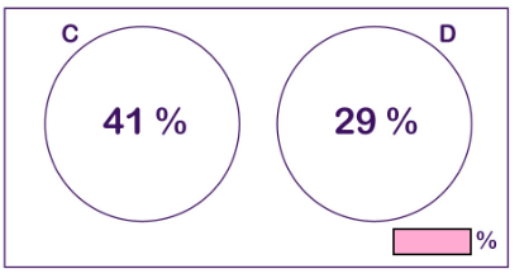


©

The image and Venn diagram show the survey results for the girls.

Event C represents: Would like to adopt a cat
Event D represents: Would like to adopt a dog
No girl selected both cat and dog.

Determine the percentage of girls who would not like to adopt a pet. Write your answer on the Venn diagram.

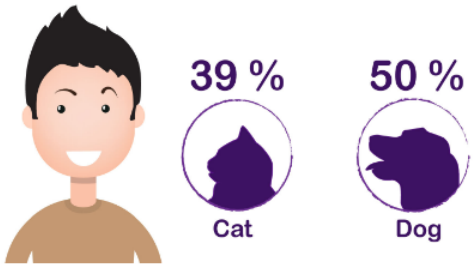


Question 3b (1 mark)

Events C and D are mutually exclusive. **State** how this is represented in the Venn diagram.

Question 3c (1 mark)

The image shows the survey results for the boys.



©

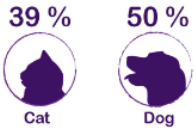
31 % of the boys answered they would not like to adopt a pet. Based on the percentages provided, **state** how it can be concluded that some boys selected both cat and dog.

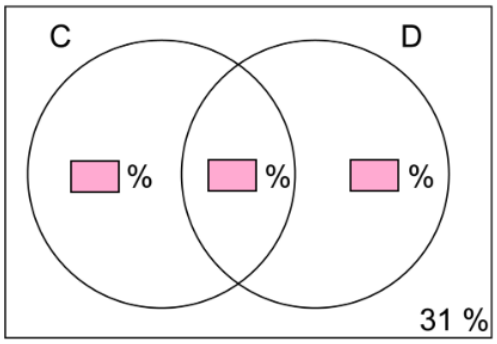
Question 3d (4 marks)

Izumi draws the following Venn diagram to summarize the survey results for the boys.

Event C represents: Would like to adopt a cat

Event D represents: Would like to adopt a dog

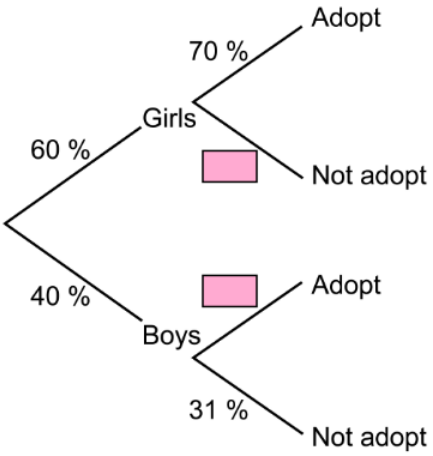




Find the missing values and complete the Venn diagram.

B I U x_2 x^2 Ω Σ Styles

Question 3e (3 marks)



On the festival day, 60 % of the students are girls and 40 % are boys. **Calculate** the probability that a student at the festival will adopt a pet from the pet rescue centre.

B I U x_2 x^2 Ω Σ Styles

Question 4 (8 marks)

The image shows a jar containing 50 cent coins and $1 coins.

The ratio of the 50 cent coins to the $1 coins is 5 : 7.

©

Question 4a (1 mark)

The number of $1 coins in the jar is 140. **Show that** the number of 50 cent coins is 100.

B I U x_2 x^2 Ω Σ Styles

Question 4b (2 marks)

Hence, **determine** the total value of the coins in the jar.

Question 4c (5 marks)

Another jar contains 50 cent coins, $1 coins and $2 coins.

The number of 50 cent coins, $1 coins and $2 coins are in the ratio 2 : 4 : 3.

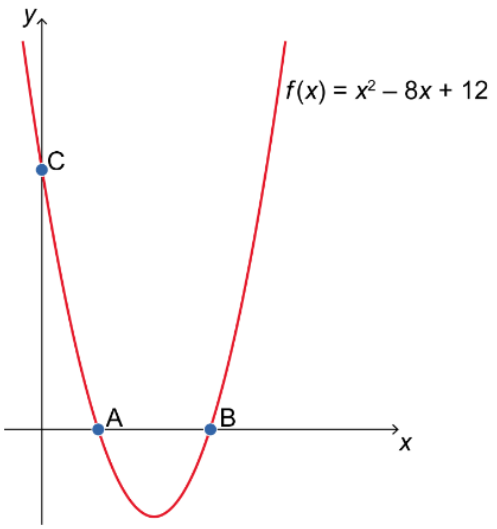
©

The number of the three types of coins are in the ratio 2 : 4 : 3, respectively. The total value of the coins is $1760. **Find** the total number of coins in the jar.

B I U x_2 x^2 Ω Σ Styles

Question 5 (6 marks)

The following diagram shows part of the graph of a quadratic function $f(x) = x^2 - 8x + 12$

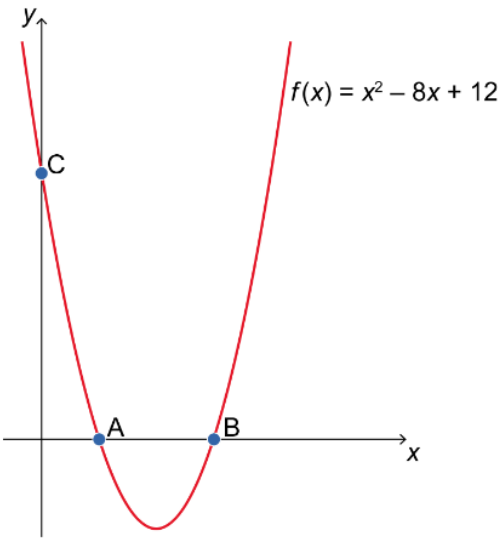


Question 5a (1 mark)

Write down the coordinates of point C.

Question 5b (4 marks)

Find the coordinates of points A and B.



Question 5c (1 mark)

The function f is reflected on the y-axis

Write down the coordinates of point B after the reflection.

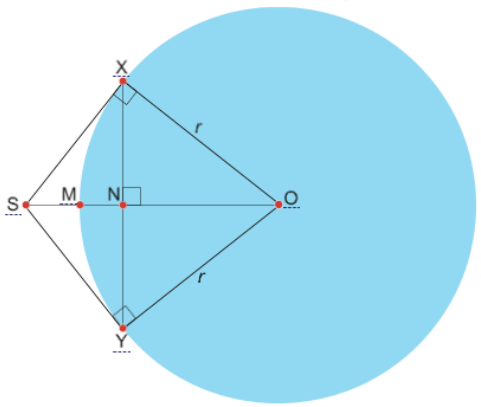
Question 6 (15 marks)

The following video introduces how we are able to observe the Earth from the International Space Station.

This media is interactive

Hover over the letters to reveal the label.

Diagram not to scale



Key: radius (r) = 6372 km

©

Question 6a (1 mark)

SX and SY are tangents to the circle. Given that angle XSY is 140°, **show that** angle XOY is 40°.

Question 6b (2 marks)

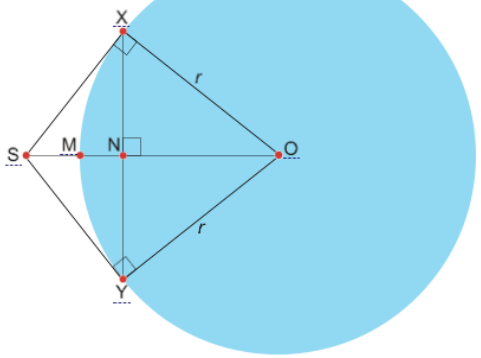
The radius of the Earth is r = 6372 km

Determine the length of the minor arc XY.

This media is interactive

Hover over the letters to reveal the label.

Diagram not to scale



Key: radius (r) = 6372 km

©

Question 6c (5 marks)

OS is perpendicular to the chord XY. **Find** the length of ON to the nearest km.

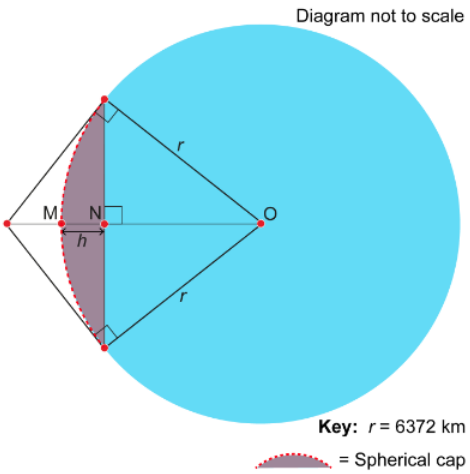
Question 6d (1 mark)

Hence, **determine** the length of MN.

Not Started

Question 6e (3 marks)

This media is interactive



©

The surface area (A) of the spherical cap is $A = 2\pi rh$ where

r is the radius of the Earth,

h is the height of the spherical cap (MN)

Calculate the surface area (A) of the spherical cap. Give your answer in standard form correct to two significant figures.

B I U x_2 x^2 Ω Σ Styles

Question 6f (3 marks)

Hence, **find** the percentage of Earth the International Space Station can see at any one time.

Not Started

Question 7 (19 marks)

The following video describes how different fuels for vehicles can impact emissions on communities and environments.

Cost in £	Vehicle A (electric-powered)	Vehicle B (petrol-powered)
Vehicle	?	18 000
Fuel per mile	0.035	0.085
Annual fuel	?	1190

Question 7a (3 marks)

Vehicle A is advertised to buy for £31 250. As part of a government incentive the vehicle cost is reduced by 20 %.

Calculate the vehicle cost after the government incentive for vehicle A.

Question 7b (2 marks)

A person drives 14 000 miles on average per year.

Determine the annual fuel cost of vehicle A.

Question 7c (2 marks)

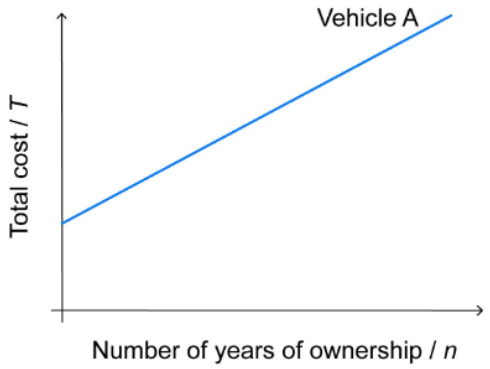
Cost in £	Vehicle B (petrol-powered)
Vehicle	18 000
Fuel per mile	0.085
Annual fuel	1190

The total cost (T) of owning a vehicle is the sum of the vehicle price and the annual fuel cost.

Show that the total cost (T) of owning vehicle B after 7 years is £26 330.

Question 7d (2 marks)

The following graph shows the linear relationship for the total cost, T, of owning Vehicle A for n years, driving 14 000 miles per year.



©

Write down a linear equation for the total cost, T, of owning vehicle A for n years.

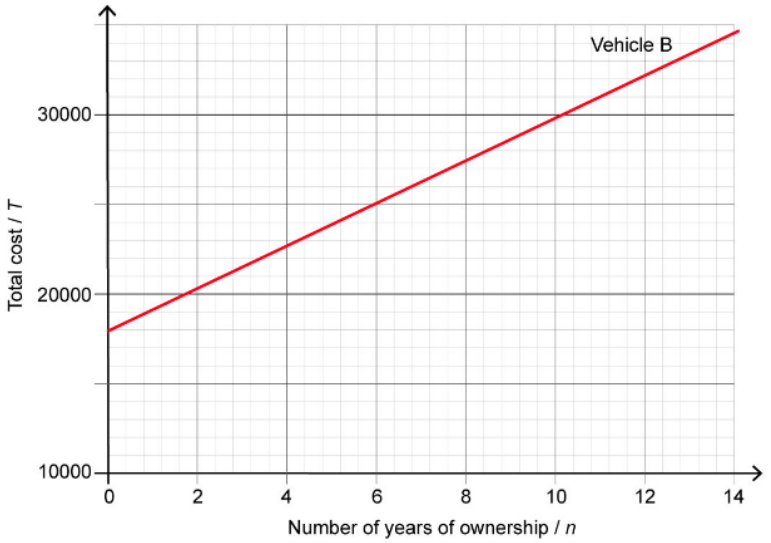
B I U x_2 x^2 Ω Σ Styles

Question 7e (10 marks)

Discuss whether vehicle A or vehicle B is a better buy. Use the information provided in the table and your answers from parts (a) to (d). In your answer, you should:

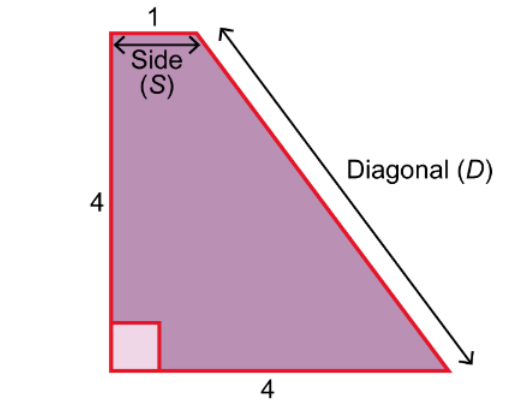
- identify **three** relevant factors to consider when deciding whether to buy vehicle A or vehicle B
- draw a graph that describes the linear relationship for the total cost (T) of owning vehicle A for n years
- determine after how many years the total cost of owning vehicle A is equal to vehicle B
- justify whether vehicle A or vehicle B is a better buy and how this may impact communities and the environment
- comment on the accuracy of the total cost for owning the different vehicles.

Draggable points:



Question 8a (3 marks)

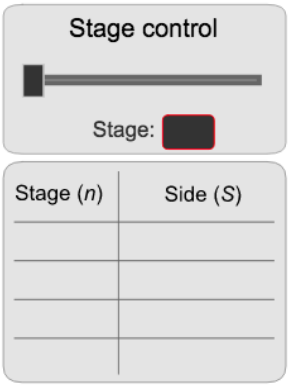
In this task you will investigate sides and perimeters of trapeziums.



Show that the diagonal of the trapezium is 5 units.

Styles

Drag the stage slider to see how trapeziums are produced.



Question 8b (1 mark)

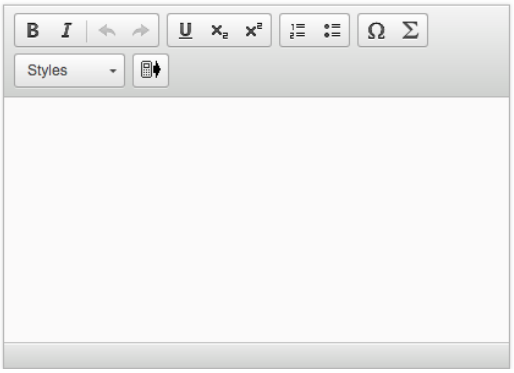
Write down the missing values in the table up to row 6.

Stage (n)	Side (S)
1	1
2	4
3	7
4	10
5	
6	

Reset

Question 8c (1 mark)

Describe in words **one** pattern you see in the table for S.



Question 8b (1 mark)

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

Stage (n)	Side (S)
1	1
2	4
3	7
4	10
5	
6	

Reset

Question 8d (2 marks)

Determine a general rule for S in terms of n.

B I U x_2 x^2 Ω Σ Styles

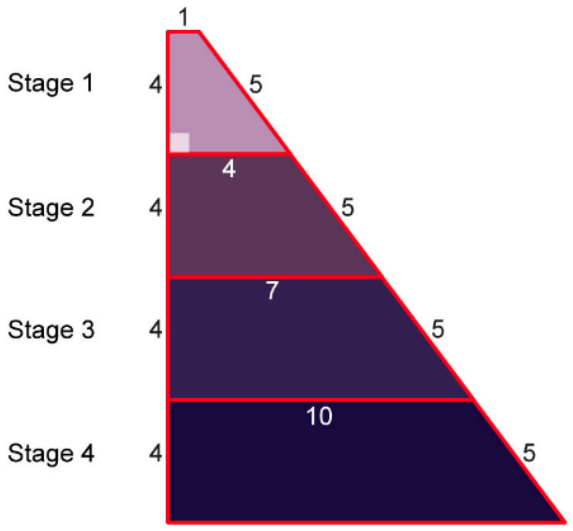
Question 8e (3 marks)

Verify your general rule for S.

B I U x_2 x^2 Ω Σ Styles

Question 8f (20 marks)

The diagram below shows the trapeziums formed in each stage.



©

Stage (n)	Side (S)	Perimeter (P)
1	1	14
2	4	20
3	7	26
4	10	32
5		
6		

Reset

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

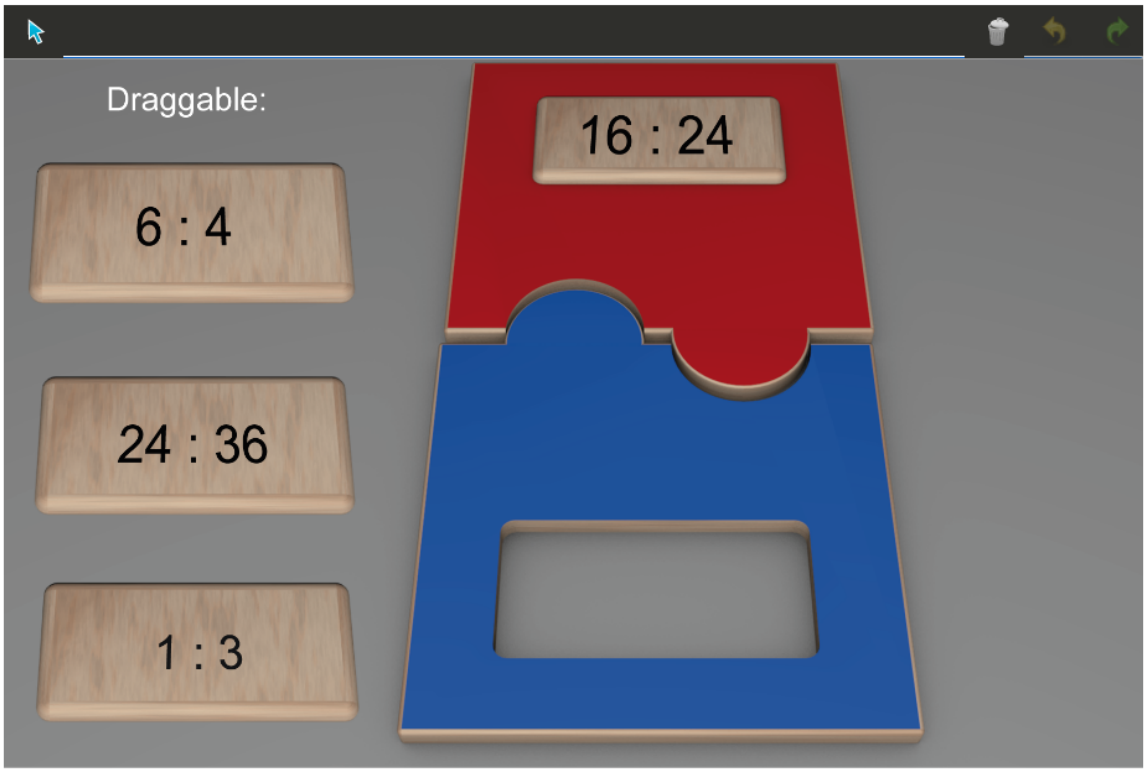
- predict more values and record these in the table
- describe in words a pattern for column P
- write down a general rule for P in terms of n
- test your general rule for P
- verify and justify your general rule for P
- ensure that you communicate all your working appropriately.

2020 November Maths eAssessment

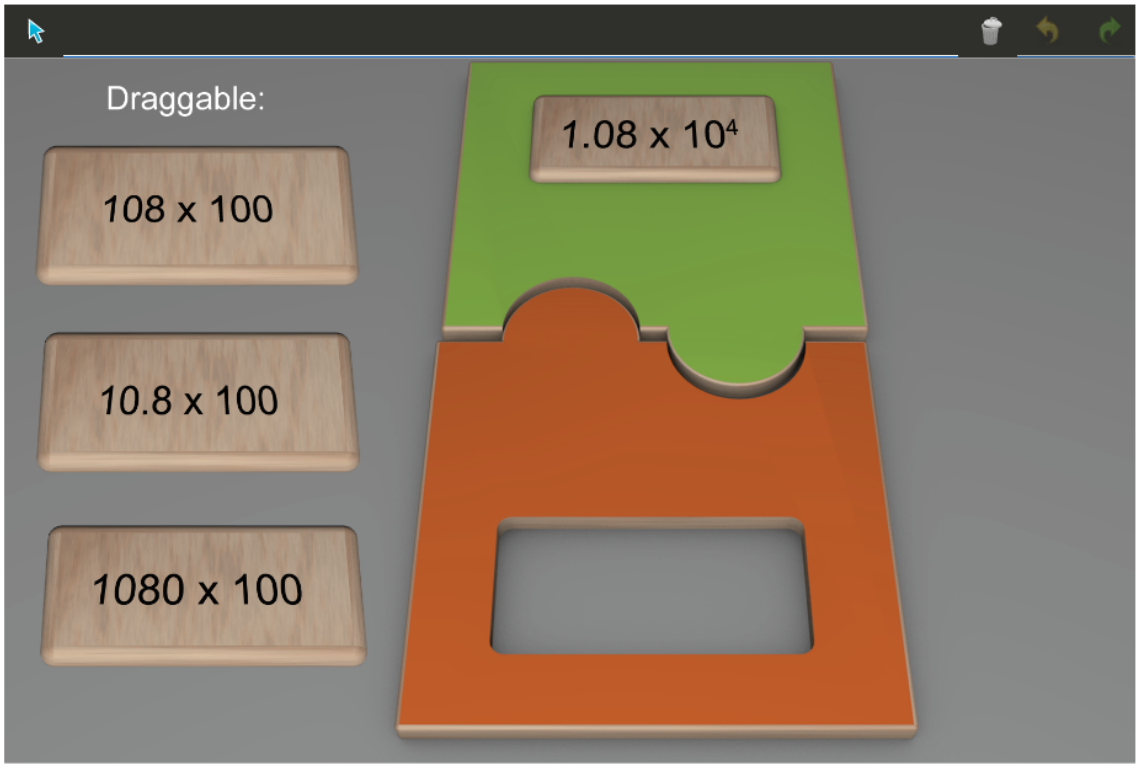
Question 1 (7 marks)

Below are seven puzzles, each with a missing section. From the draggable items, **select** the correct equivalent option to complete each puzzle.

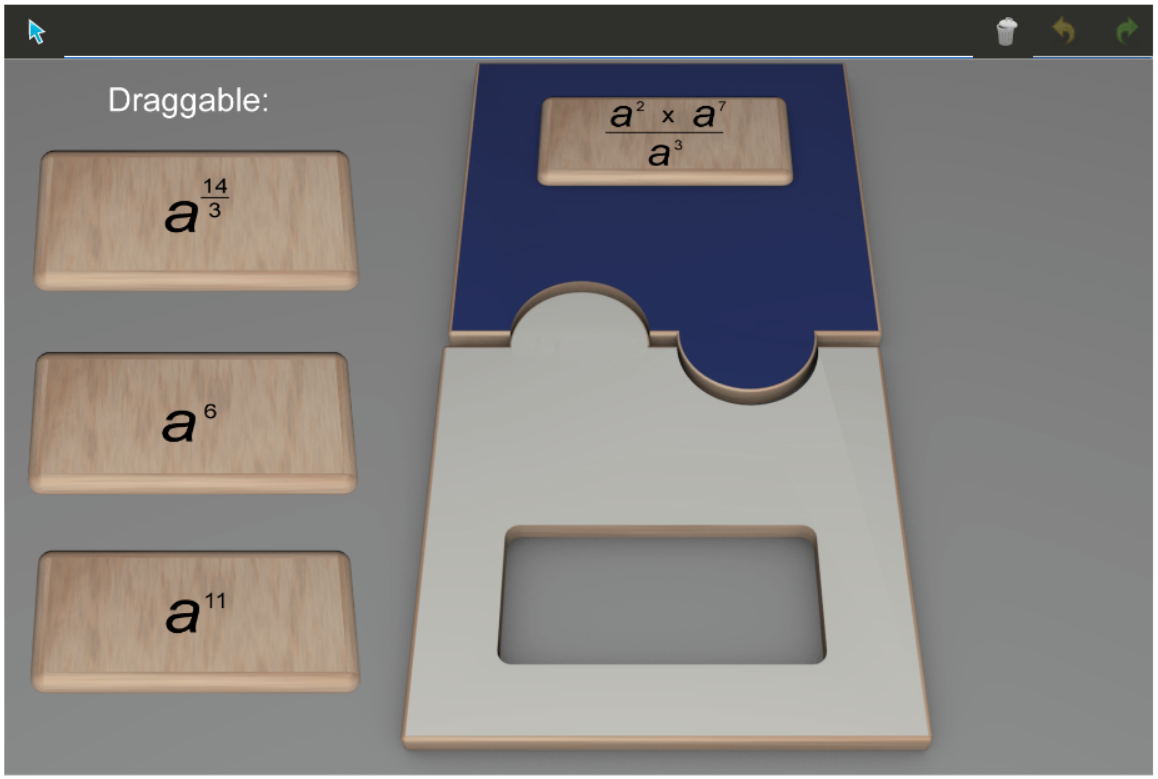
Question 1a (1 mark)



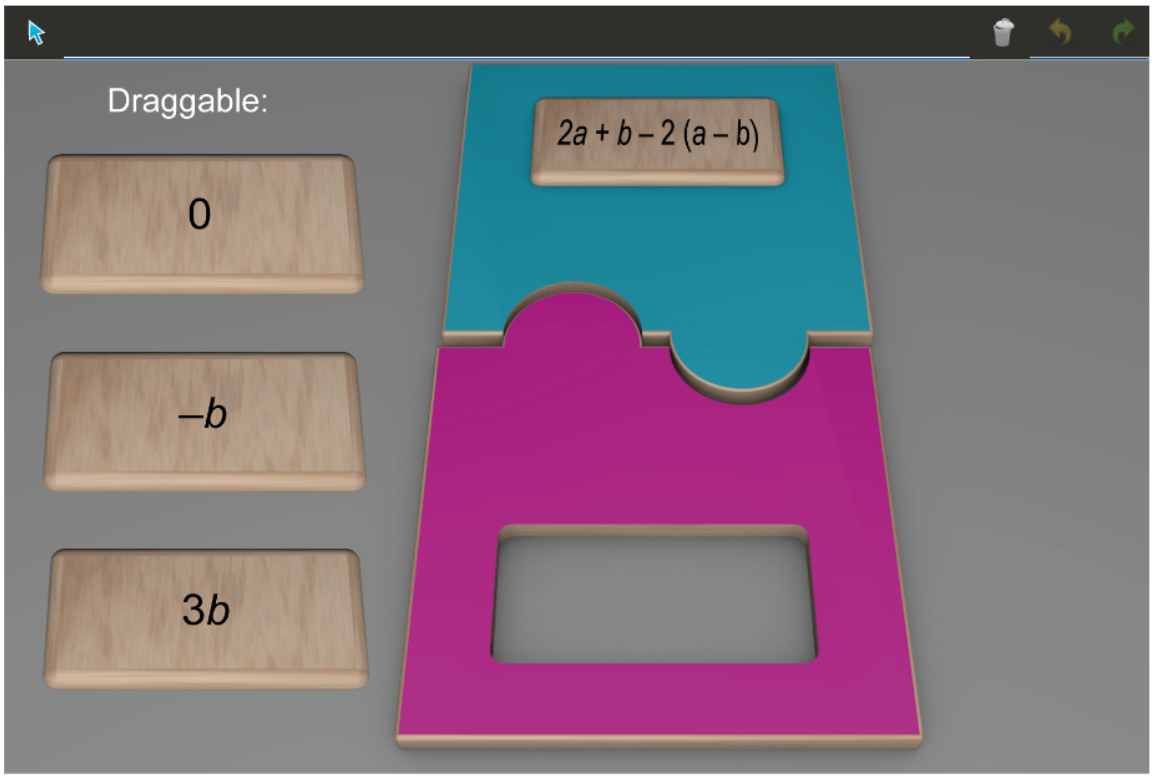
Question 1b (1 mark)



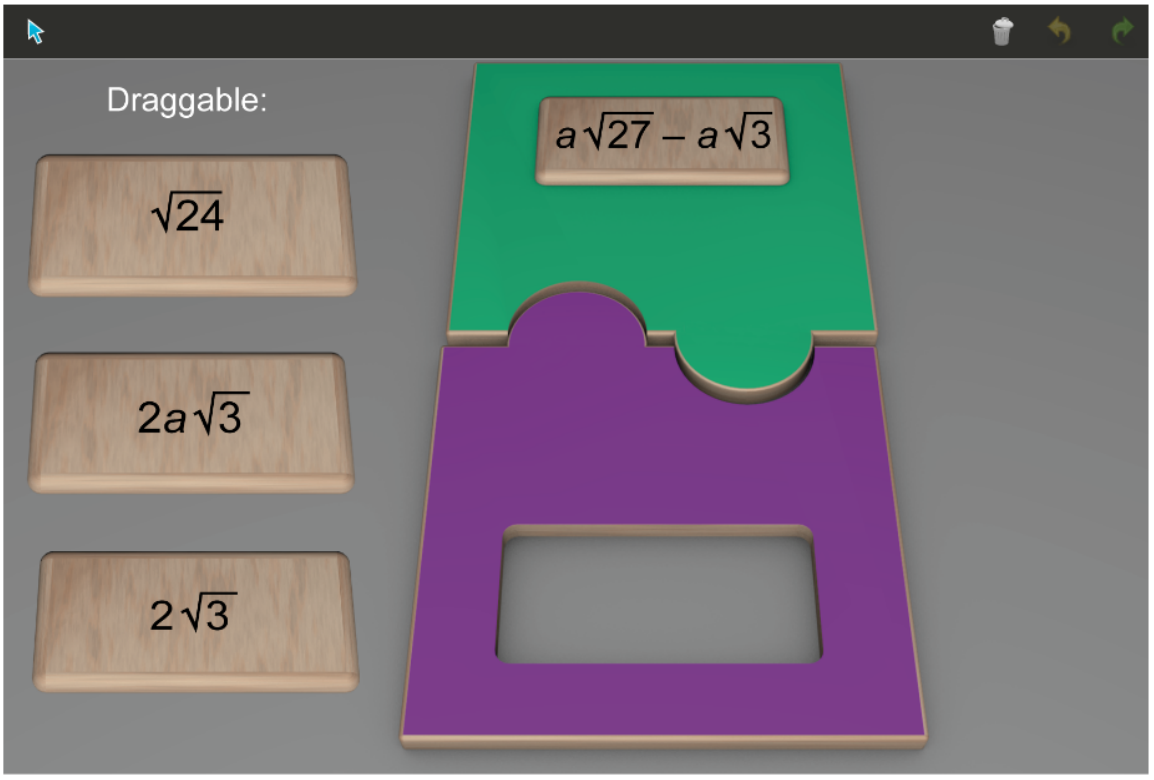
Question 1c (1 mark)



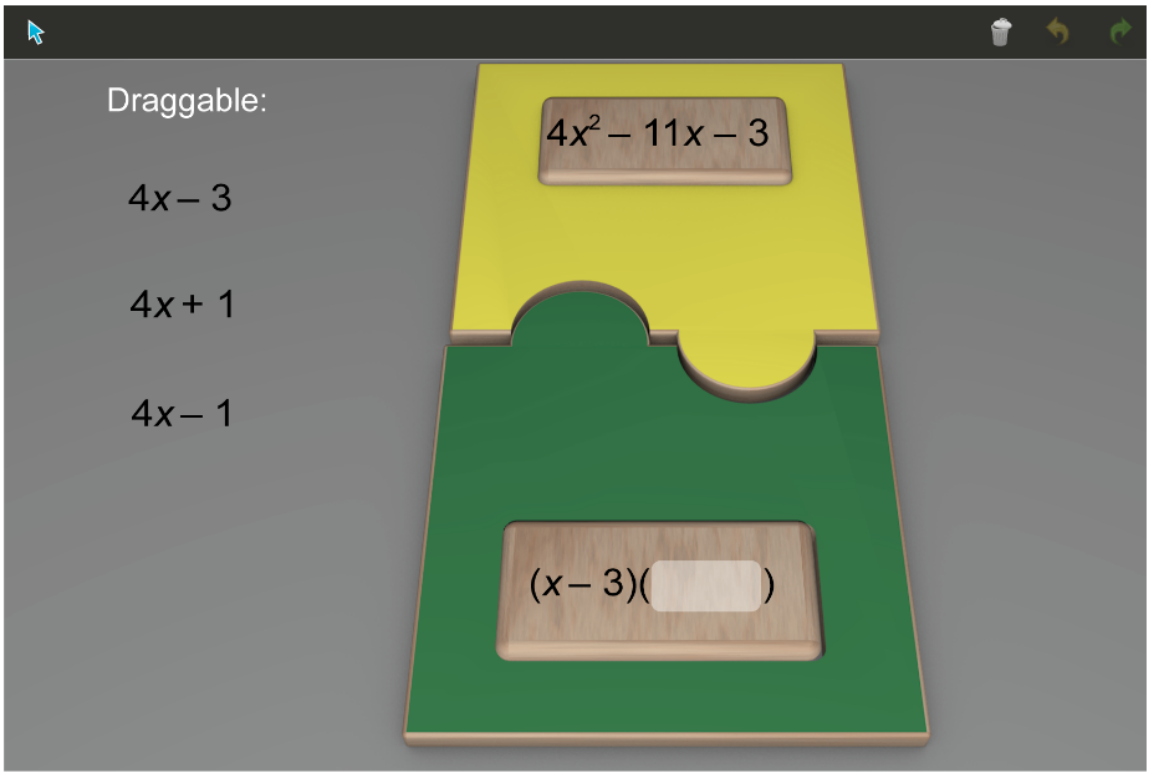
Question 1d (1 mark)



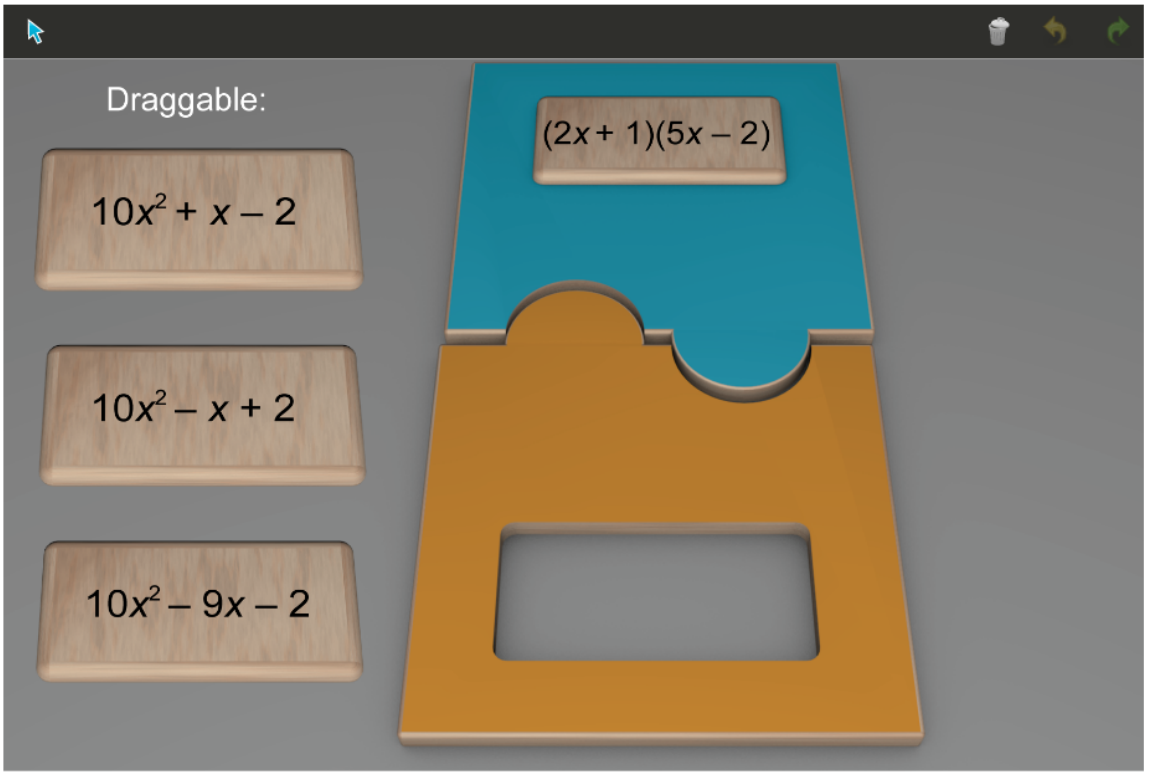
Question 1e (1 mark)



Question 1f (1 mark)



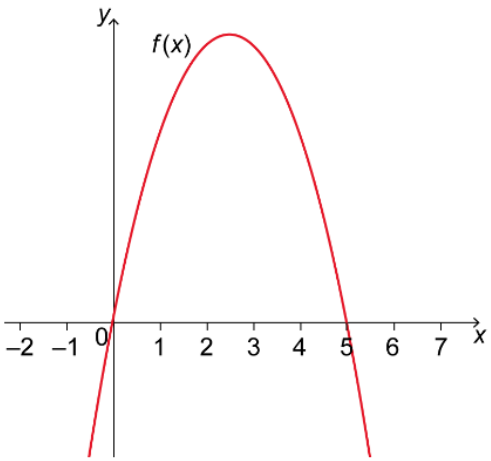
Question 1g (1 mark)



Question 2 (8 marks)

Question 2a (3 marks)

The function $f(x) = -x(x - 5)$ is shown below.

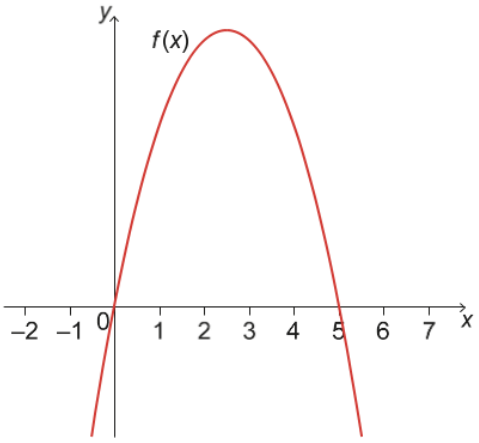


Calculate the maximum value of $f(x)$.

Styles

The function $f(x)$ is transformed to $g(x)$ by a translation of L units to the right. Press 'Next' to illustrate below.

This media is interactive



Next

Question 2b (1 mark)

Write down the value of L.

$L =$

Question 2c (2 marks)

Hence, **determine** the equation for $g(x)$.

Styles

Question 2d (1 mark)

The function $g(x)$ is transformed to $h(x)$ by a reflection in the x-axis. **Write down** the equation for $h(x)$.

Question 2e (1 mark)

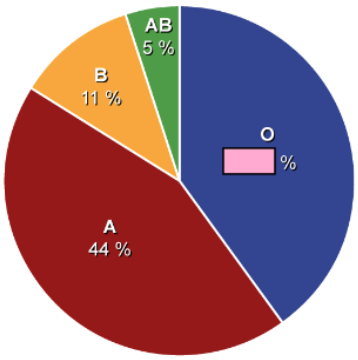
Write down the minimum value of $h(x)$.

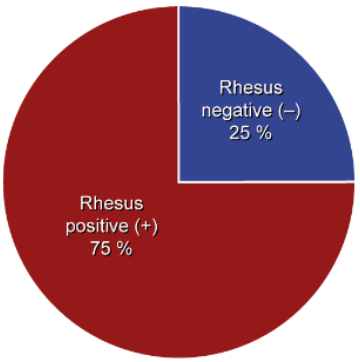
Question 3 (9 marks)

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.

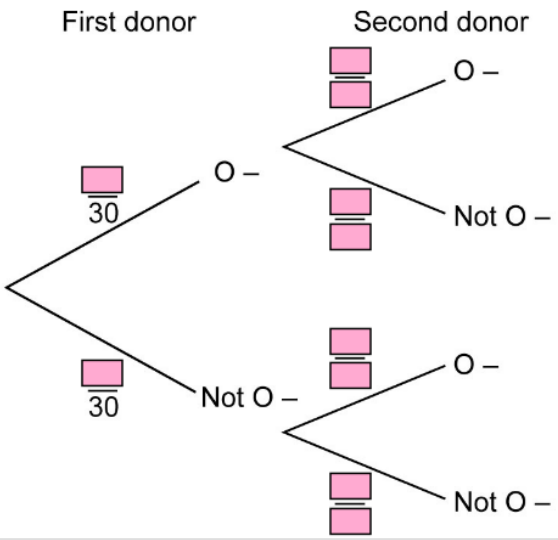
Show that the probability that a randomly selected person has blood type **O–** is 0.1.

Question 3b (1 mark)

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

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 (3 marks)

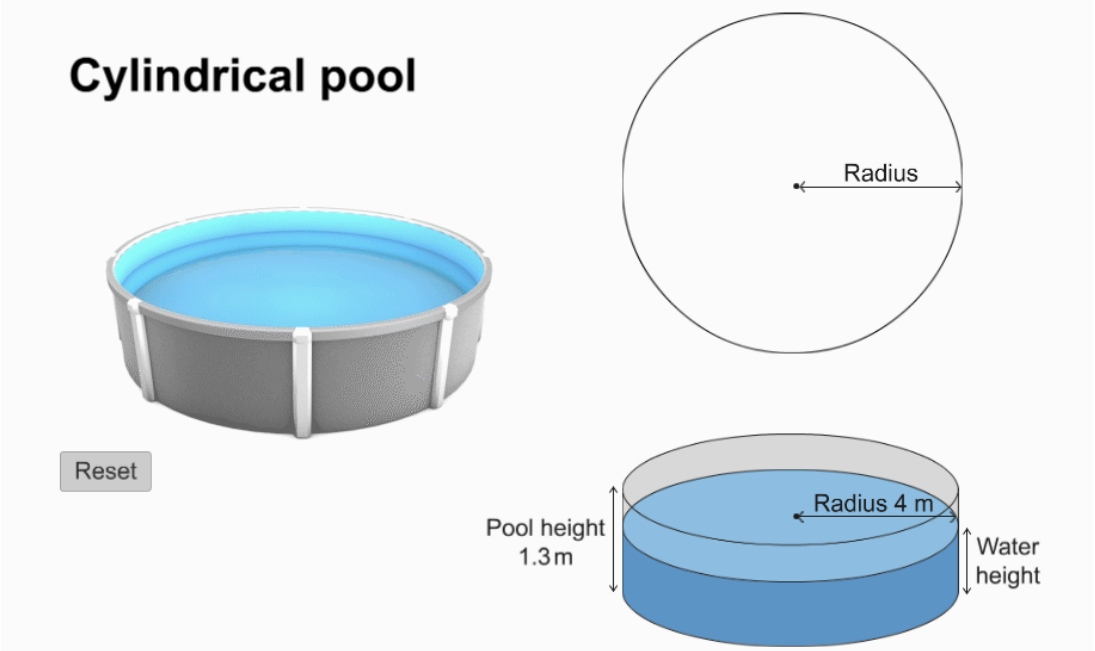
Find the probability that only one of the two donors has blood type **O–**.

Question 4 (12 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



The pool height is 1.3 metres (m) and the radius of the pool is 4 m.

Question 4a (3 marks)

To avoid overflow, the pool is filled with water to 90 % capacity. **Show that** 90 % of the capacity is 58.8 m^3, correct to three significant figures.

Question 4b (3 marks)

A pump is used to remove water from the pool. The pump removes water at a rate of 11 200 litres (L) per hour.

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

Find the time it takes for the pump to remove the 58.8 m^3 of water. Write your answer in hours and minutes, to the nearest minute.

B I U x_2 x^2 Ω Σ Styles

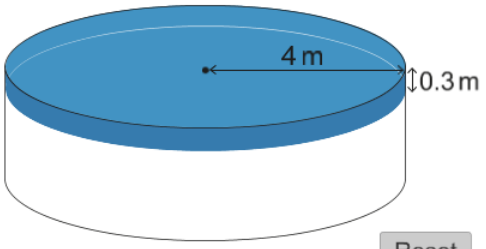
[ ] hours and [ ] minutes

Question 4c (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 Ω Σ Styles

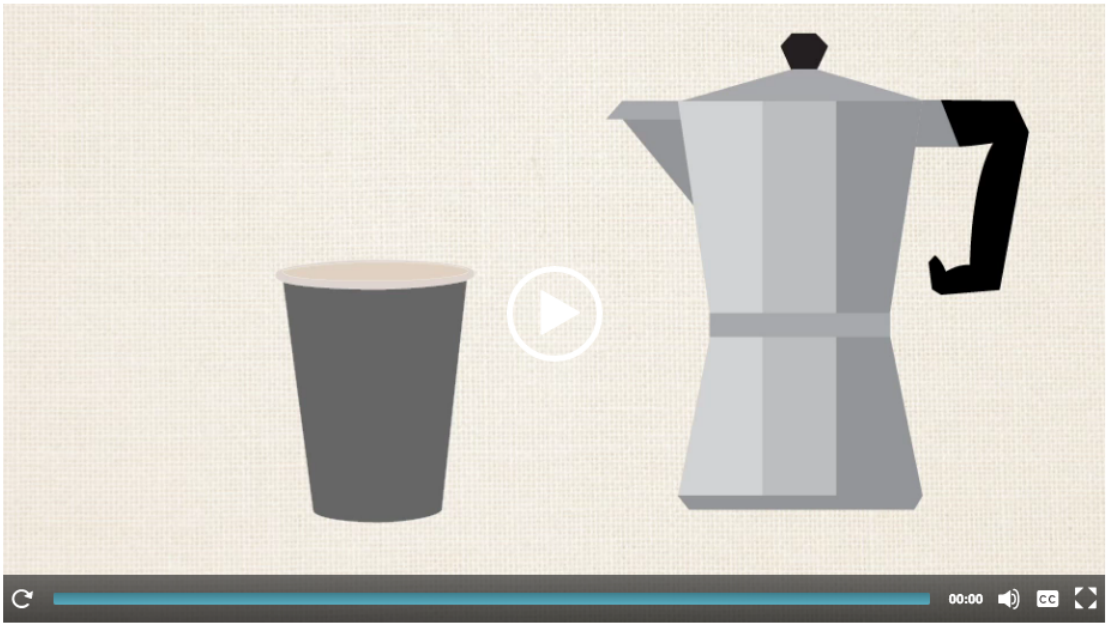
Question 4d (1 mark)

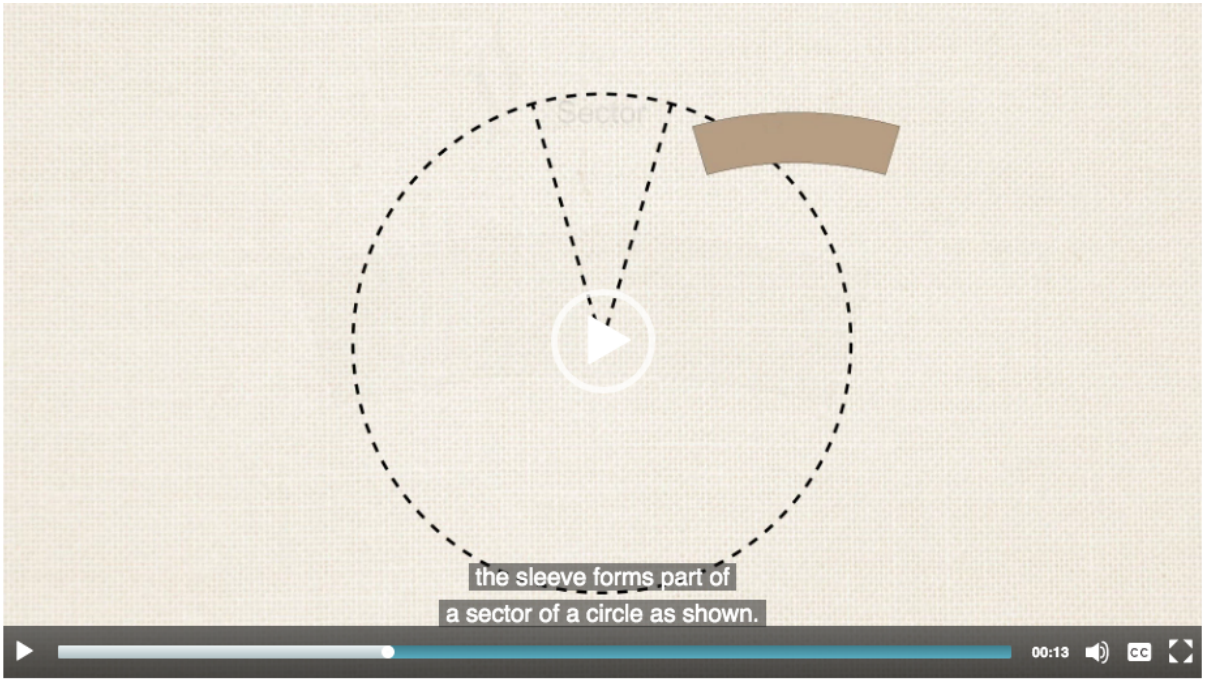
Material for the pool cover costs $3.40 per square metre. **Determine** the cost of the pool cover.

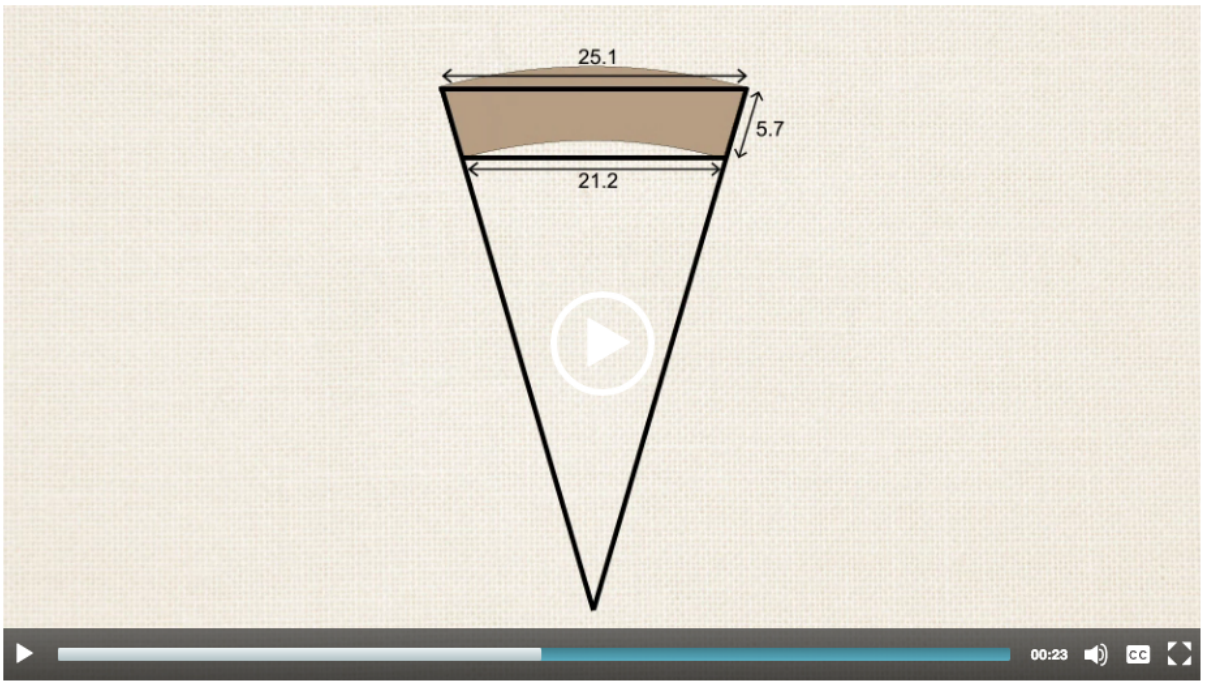
Question 5 (15 marks)

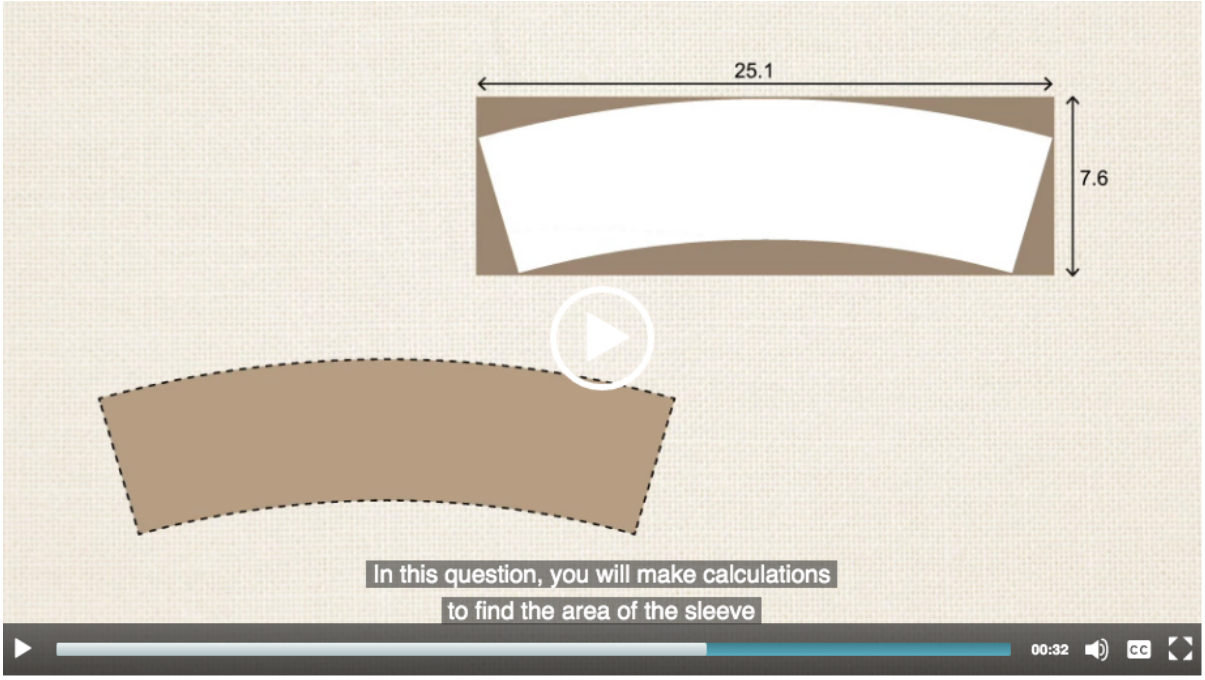
The following video explains the use of sleeves for paper cups.

Video Script




the sleeve forms part of
a sector of a circle as shown.
00:13

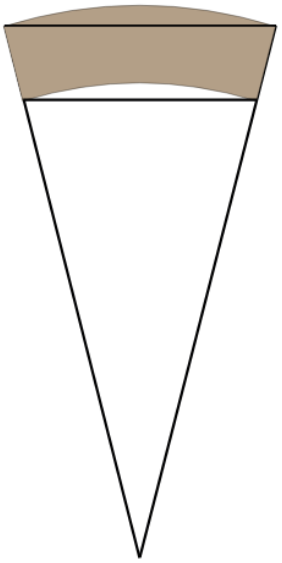

25.1
5.7
21.2
00:23



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

This media is interactive

Stage 2



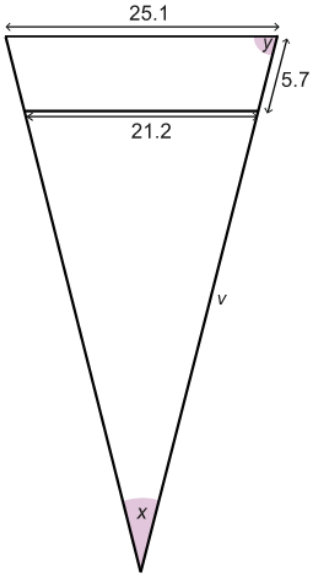
Stage control

Stage: 2

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

This media is interactive

Stage 3



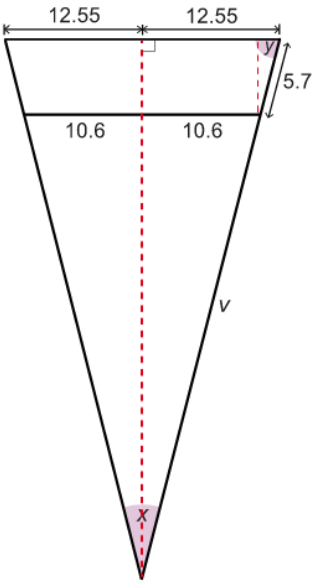
Stage control

Stage: 3

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

This media is interactive

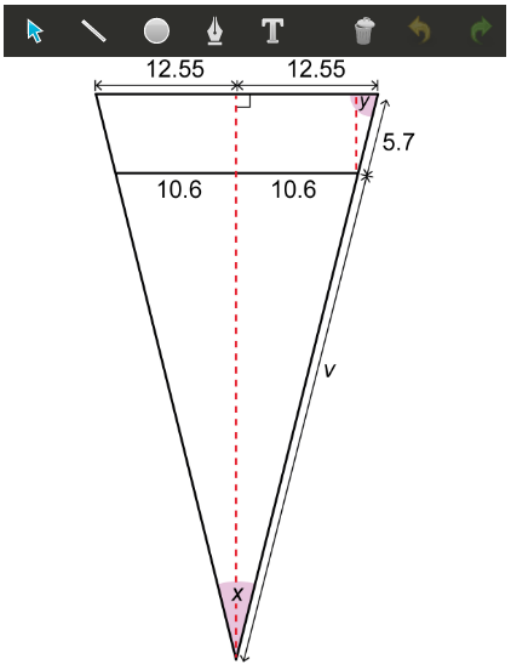
Stage 4



Stage control

Stage: 4

Question 5a (3 marks)



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

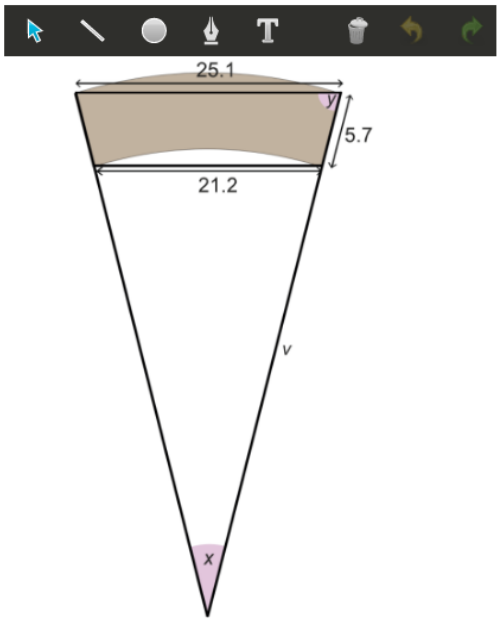
Question 5b (2 marks)

Hence, **determine** the value of angle x, to the nearest degree.

Question 5c (3 marks)

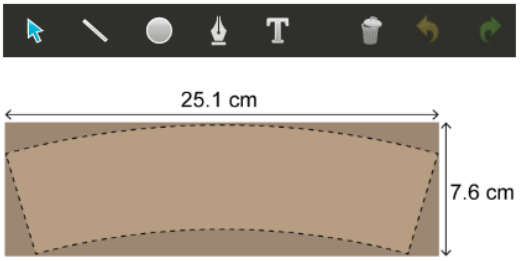
Calculate the value of v.

Question 5d (4 marks)



Find the area of the sleeve.

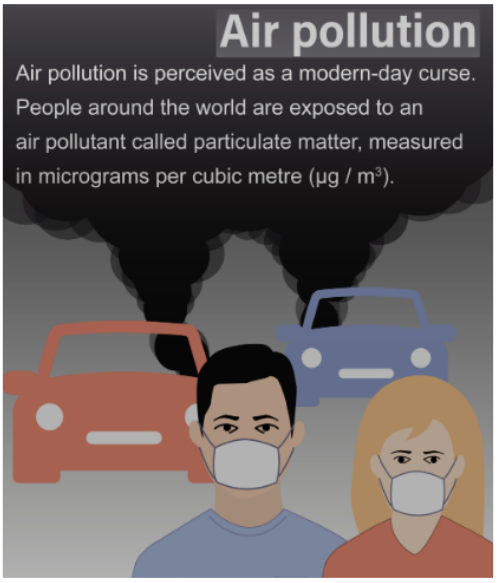
Question 5e (3 marks)



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.



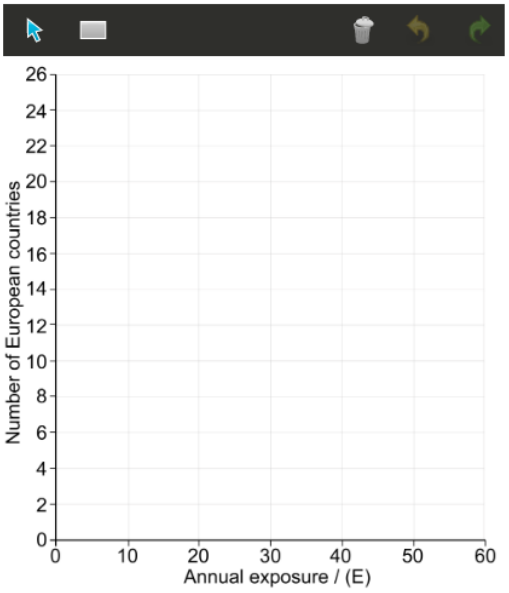
Question 6a (2 marks)

Annual exposure to particulate matter across Europe in 1990.

Annual exposure (E) to particulate matter in µg / 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.

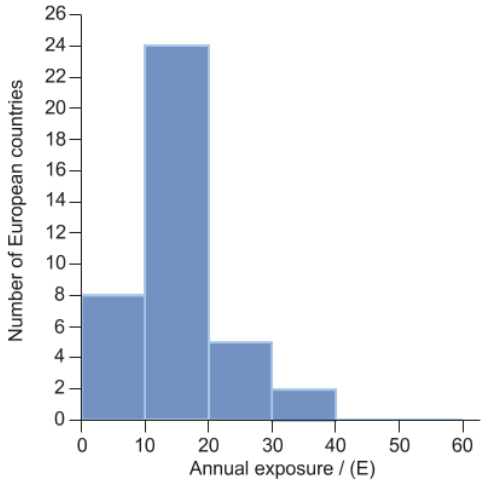
Particulate matter for 1990



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

Particulate matter for 2016

This media is interactive



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.

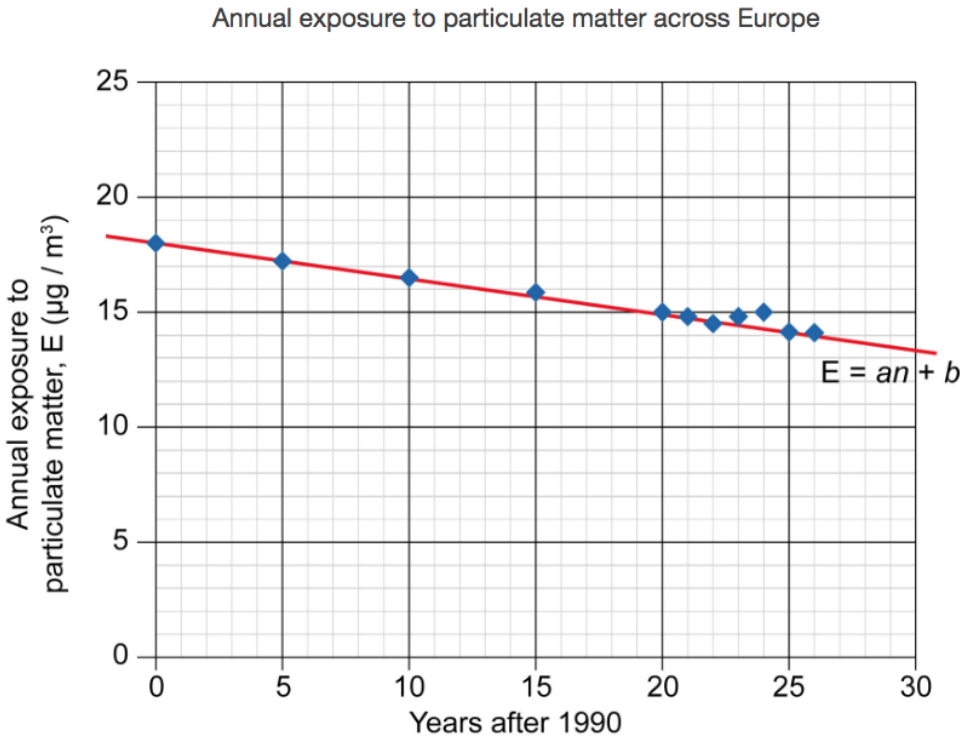
Question 6c (4 marks)

Using the histogram for 2016, **show that** an estimate for the mean of E in 2016 is 15.3 μg / m^3 to the nearest one decimal place.

Question 6d (2 marks)

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

Graph 1



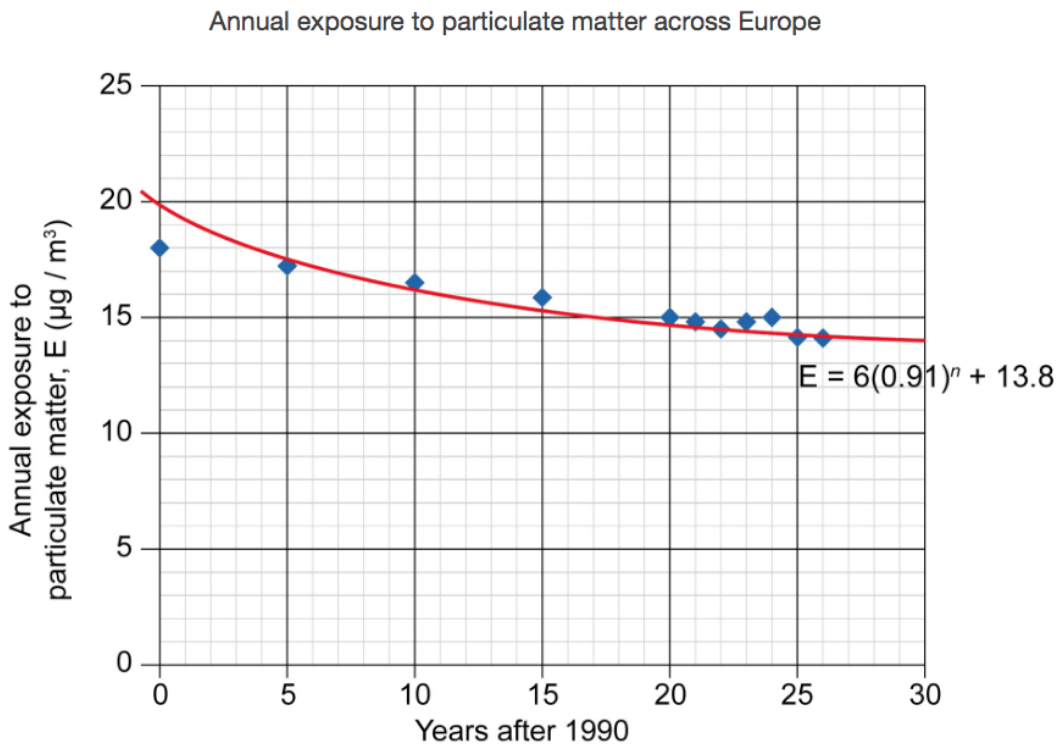
The equation of the line of best fit can be written as E = $an + b$, where E is the annual exposure to particulate matter and n is the number of years after 1990.

Determine the values of a and b.

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



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 µg / 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 (30 marks)

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

Question 7a (1 mark)

The square below has a side length of 3 units.

©

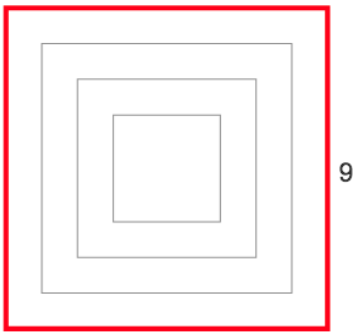
Show that the perimeter of the square is 12 units.

B I U x_2 x^2 Ω Σ Styles

Drag the slider to see how the square is enlarged in different stages.

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.

Stage number (n)	Perimeter of square (P)
1	12
2	20
3	28
4	36
5	
6	

Question 7c (2 marks)

Describe in words two patterns in the table for the perimeter of square (P).

B I U x_2 x^2 Ω Σ Styles

Question 7d (2 marks)

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

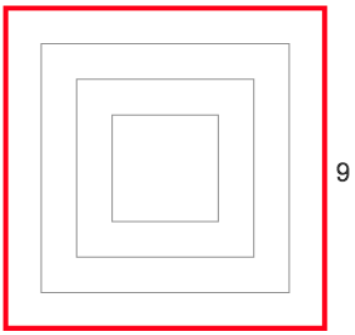
Question 7e (3 marks)

Verify your general rule for P.

Question 7f (20 marks)

This media is interactive

Stage 4



Stage control

Stage: 4

Stage number (n)	Area of square (A)	
1	9	
2	25	
3	49	
4	81	
5		
6		

Reset

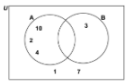
Investigate the values in the table to find a relationship for the area of each square (A) in terms of n. In your answer, you should:

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

2019 May Maths eAssessment

1 (8 marks)
2 (6 marks)
3 (8 marks)
4 (7 marks)
5 (7 marks)
6 (15 marks)
7 (19 marks)
8 (30 marks)

Question 1 (8 marks)



Knowing and understanding

In this task (questions 1 to 5), you will interact with different aspects of **form** using a variety of related concepts. This task focuses on **criterion A** (Knowing and understanding) and **criterion C** (Communication).

Use a Venn diagram to find probabilities.

Question 2 (6 marks)

Complete an addition and a multiplication grid.

Question 3 (8 marks)

Find the intersection of a line and a parabola.

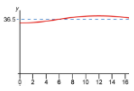
Question 4 (7 marks)

Use percentages to find the amount earned by creators of videos.

Question 5 (7 marks)

Find missing values in a sphere and cone.

Question 6 (15 marks)



Applying mathematics in real-life contexts

In this task (questions 6 and 7), you will use **relationships** to apply mathematics within the global context of **identities and relationships**. This task focuses on **criterion D** (Applying mathematics in real-life contexts) and **criterion C** (Communication).

Examine the relationship between body temperature and time.

Question 7 (19 marks)

Explore relationships between sleep and reaction times.

Question 8 (30 marks)

Investigating patterns

In this task (question 8), you will use **logic** to investigate the creation of trapeziums contained in a parabola. You will be assessed using **criterion B** (Investigating patterns) and **criterion C** (Communication).

Describe patterns and find general rules for trapeziums contained in a parabola.

Question 1 (8 marks)

The elements of the universal set ***U*** are {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}.

Consider two subsets of ***U***

Set A contains the multiples of 2.

Set B contains the multiples of 3.

Question 1a (1 mark)

Organize the given numbers in the Venn diagram. Drag the numbers to the correct place.

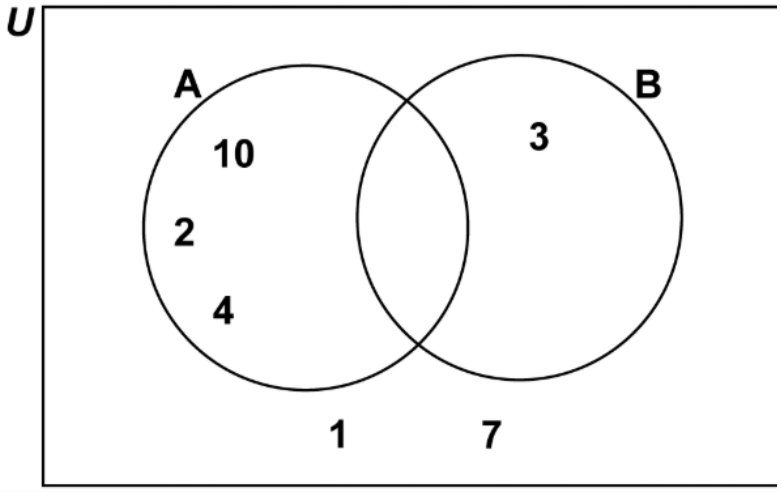
Draggable numbers:

5

6

8

9



Question 1b (2 marks)

Describe the region A ∩ B' in context.

Styles

Question 1c (2 marks)

Two numbers are selected at random from ***U***. **Determine** the probability that they are both elements of A ∩ B'.

Styles

Question 1d (3 marks)

Two numbers are selected at random from ***U***. **Calculate** the probability that only one is an element of A ∩ B'.

Styles

Question 2 (6 marks)

Question 2a (3 marks)

The table below shows an example of a completed addition grid.

Addition grid	+	4	5
	3	7	8
	10	14	15

In the addition grid below, **write down** the missing values, in a simplified exact form.

Addition grid	+	$\sqrt{5}$	
	$\sqrt{20}$		$\sqrt{5}$
	$\sqrt{45}$		$2\sqrt{5}$

Question 2b (3 marks)

The table below shows an example of a completed multiplication grid.

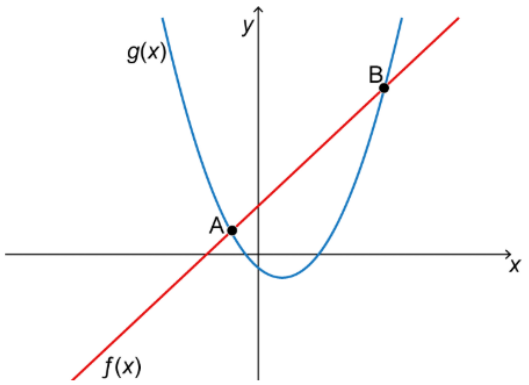
Multiplication grid	×	4	5
	3	12	15
	10	40	50

In the multiplication grid below, **write down** the missing values, in a simplified index form.

Multiplication grid	×	2b	
	$\frac{7}{2}a$		$14a^2b^{-2}$
			$12a^5b^{-1}$

Question 3 (8 marks)

In the graph below, the function $f(x) = 2x + 4$ intersects $g(x) = (x - 1)^2 - 2$ at points A and B.



©

Question 3a (2 marks)

Show that when the two graphs intersect, $x^2 - 4x - 5 = 0$.

Question 3b (4 marks)

Hence, **find** the coordinates (x, y) of points A and B.

Question 3c (2 marks)

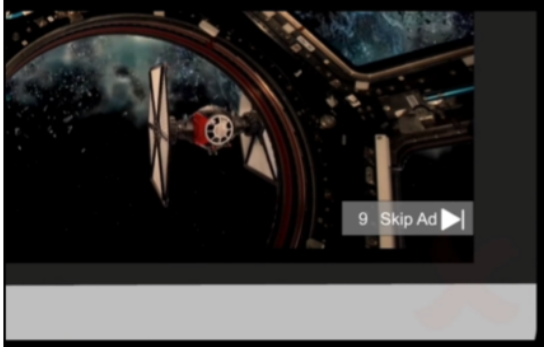
Determine the distance AB.

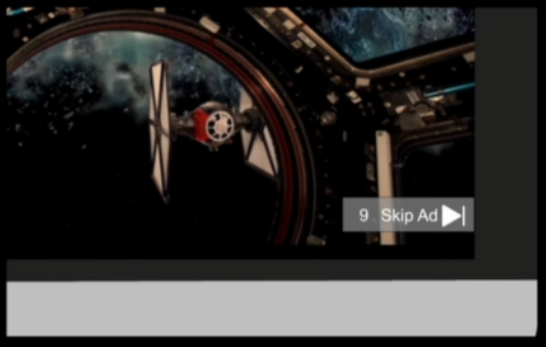
Question 4 (7 marks)

Some creators make videos that are very popular and viewed by many people on video-sharing platforms.

Advertisers pay the creators to have their advertisement included in the video.

Some viewers prefer to **skip** advertisements and some prefer to watch the **full view**.

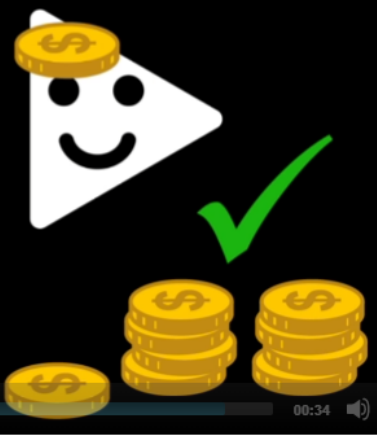


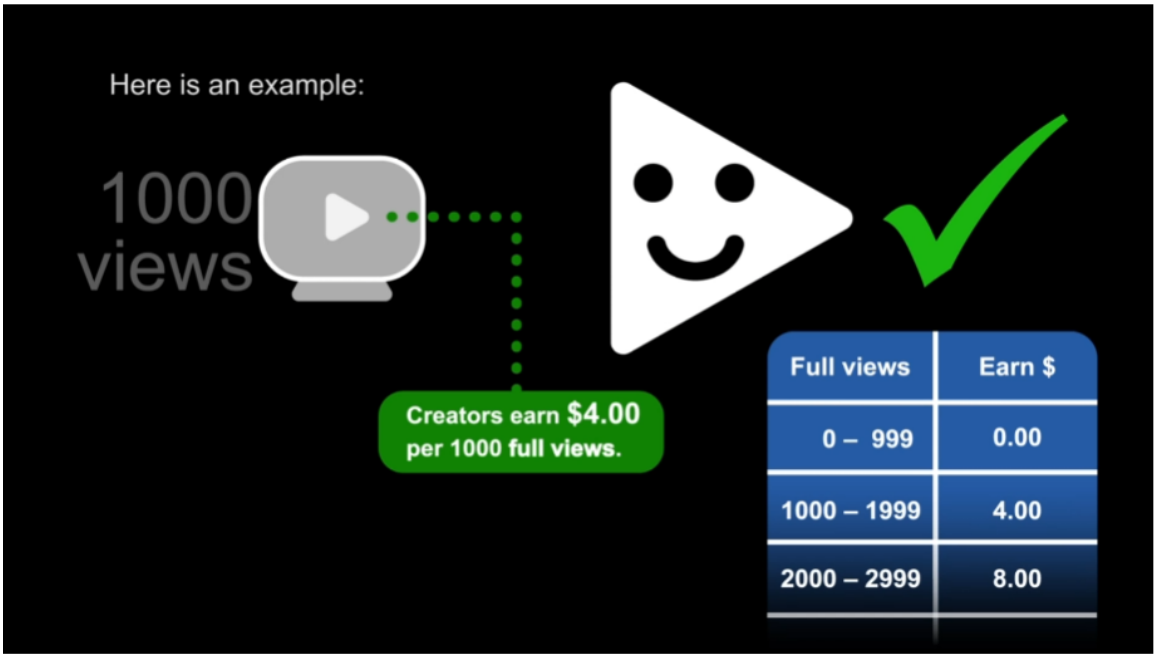


A **full view** is only counted if the viewer watches the whole advertisement.

Skip advertisment

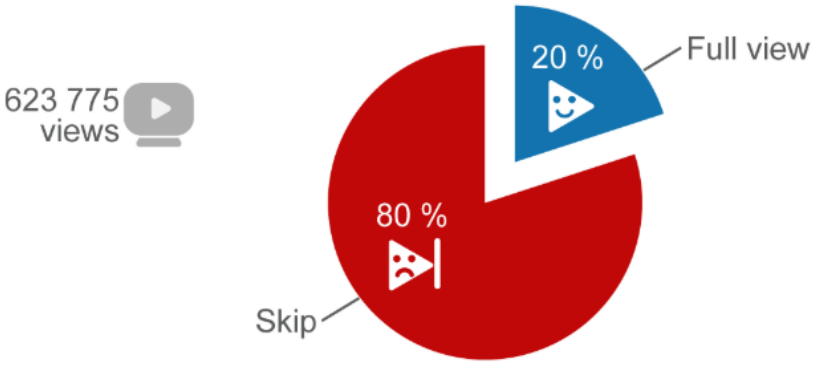
Full view





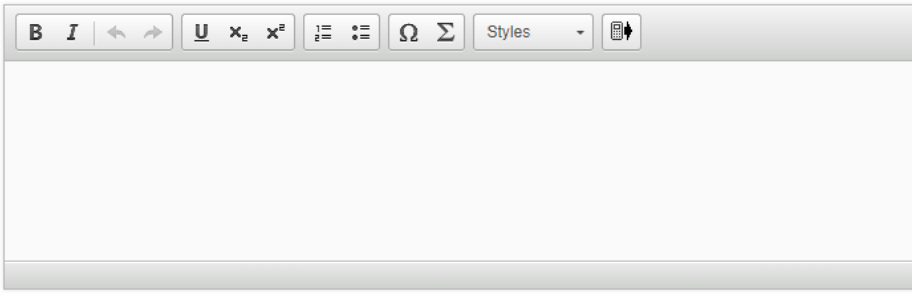
A creator uploaded a video and received 623 775 views.

The pie chart shows the views of the advertisements.

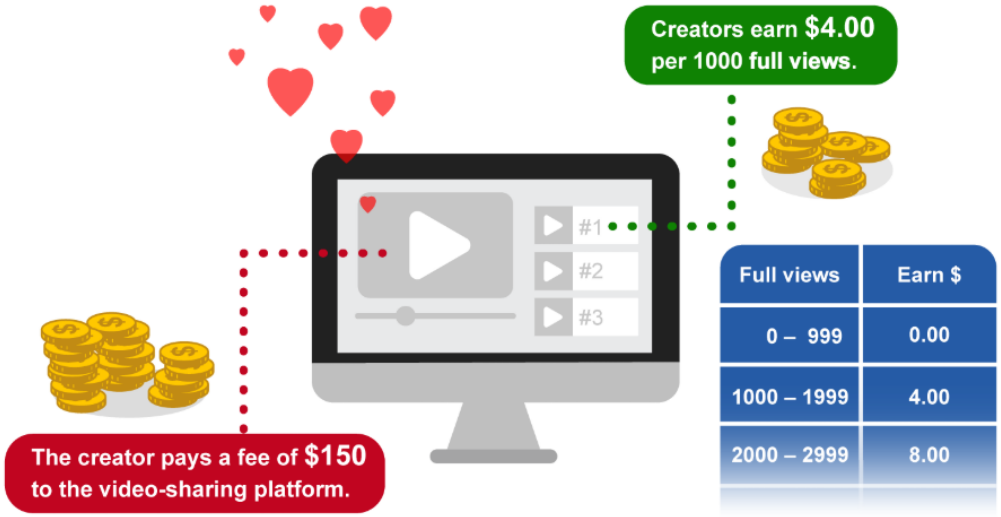


Question 4a (1 mark)

Determine the number of full views.



Question 4b (3 marks)

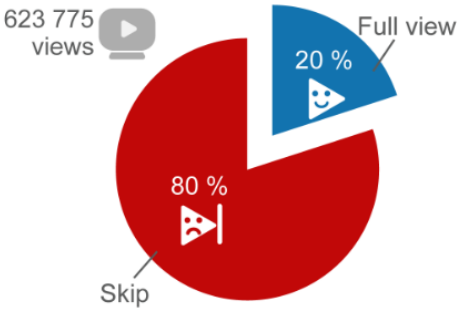


Full views	Earn $
0 – 999	0.00
1000 – 1999	4.00
2000 – 2999	8.00

©

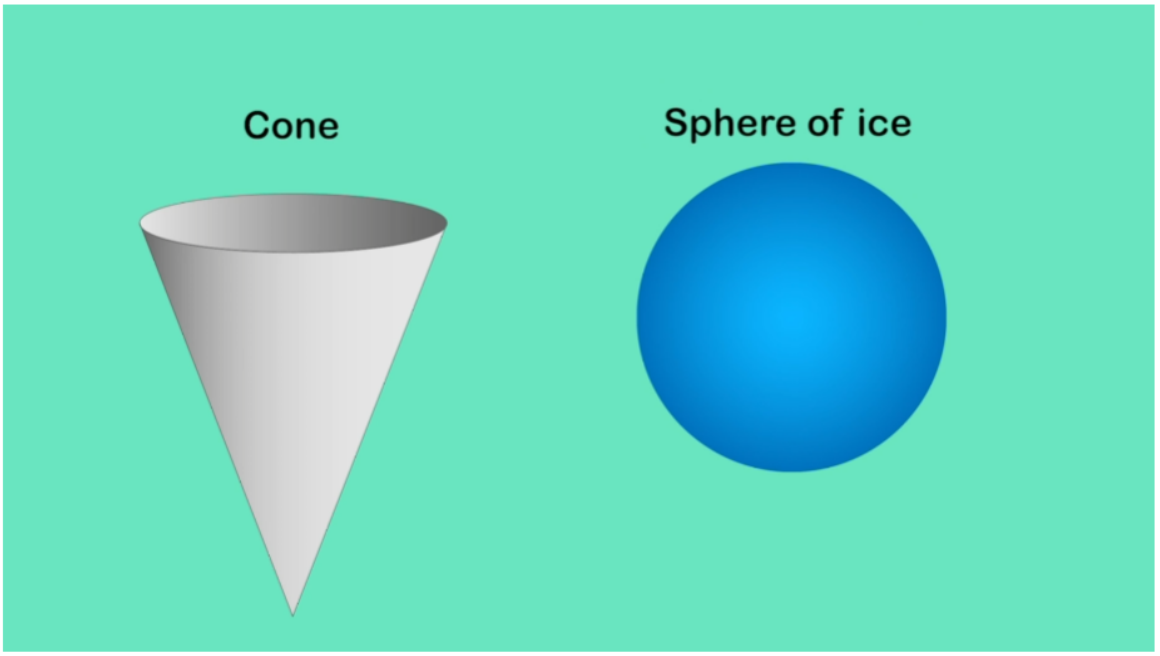
Calculate the profit made by the creator.

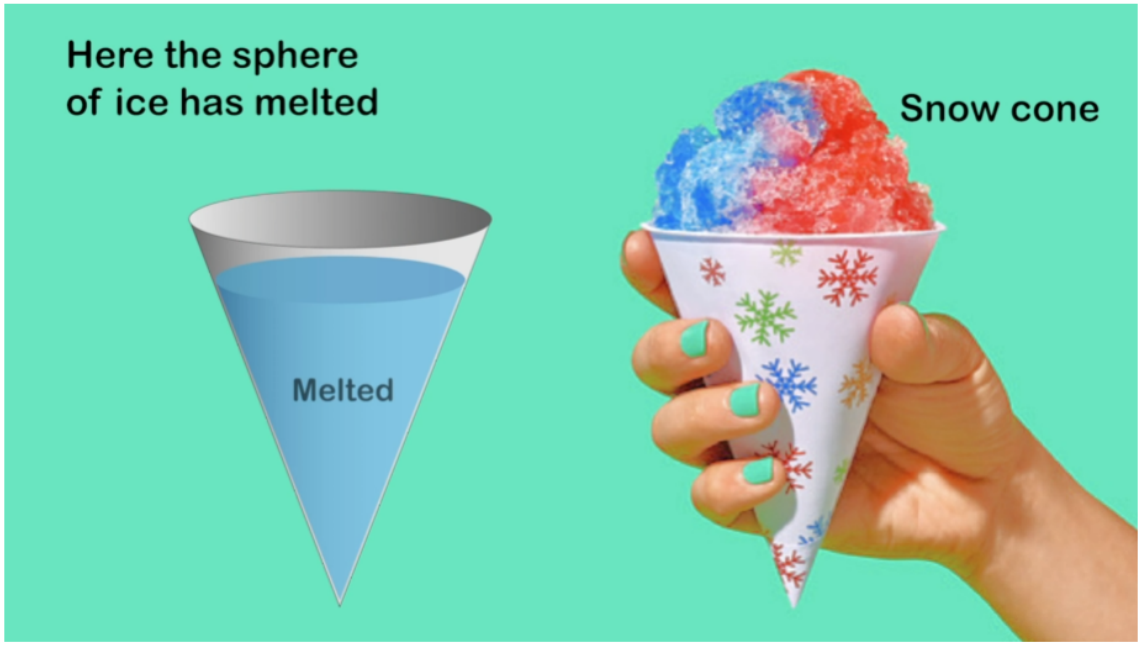
Question 4c (3 marks)



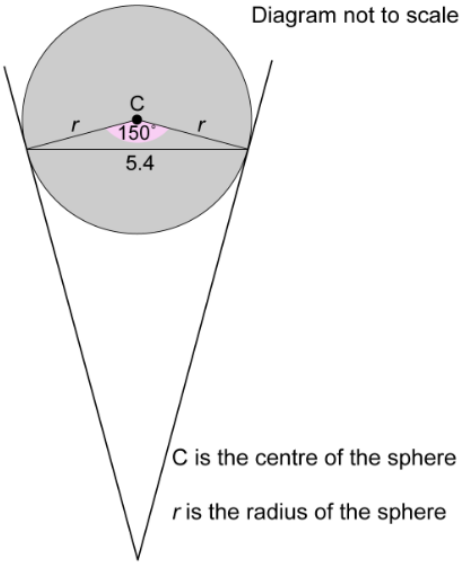
For this video, **find** the minimum number of views required, to make a profit of $500.

Question 5 (7 marks)





Question 5a (3 marks)



Show that $r = 2.80$ cm, correct to **three** significant figures.

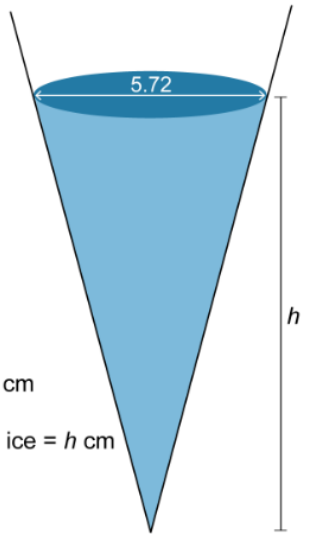
B I U x_2 x^2 Ω Σ

Styles

The whole sphere of ice melted in the cone, as shown in the diagram below.

Question 5b (4 marks)

Diagram not to scale



Diameter = 5.72 cm

Height of melted ice = h cm

Find the value of h.

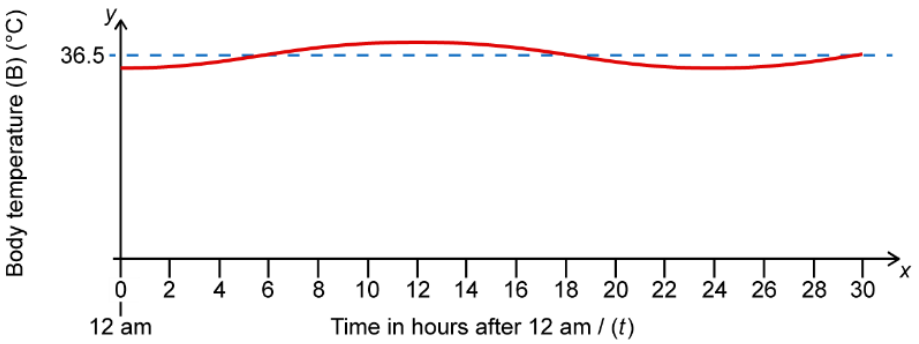
Question 6 (15 marks)

Body temperature changes during the day. The graph below shows a cosine curve modelling the body temperature for Ingrid.

B is the temperature in degrees Celsius (°C)

t is the time in hours after midnight.

This media is interactive



©

Ingrid knows it is best to sleep for 8 to 10 hours when her body temperature is 36.5 °C or below.

Question 6a (1 mark)

Suggest a sleeping schedule for Ingrid.

Sleep time: : Select

Wake up time: : Select

During the day, Ingrid's body temperature (B) can be modelled using the equation

$$B = -0.5\cos 15t + 36.5$$

where t is the time in hours after 12 am. Angles are in degrees.

Scroll down to continue

During the day, Ingrid's body temperature (B) can be modelled using the equation

$$B = -0.5\cos 15t + 36.5$$

where t is the time in hours after 12 am. Angles are in degrees.

Question 6b (2 marks)

Write down the time when Ingrid's body temperature is at a maximum and a minimum.

Maximum: : Select

Minimum: : Select

Question 6c (2 marks)

Write down the amplitude and period.

Amplitude:

Period:

Question 6d (2 marks)

Determine the values of the maximum and minimum temperatures.

Maximum: °C

Minimum: °C

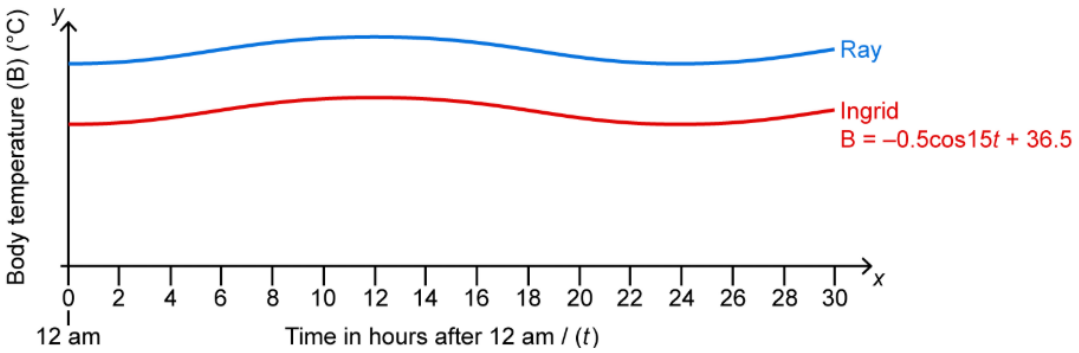
Question 6e (3 marks)

Calculate Ingrid's body temperature at 7:15 am, to the nearest **one** decimal place.

B I U x_2 x^2 Ω Σ

Styles

Ray's body temperature is 0.25 °C higher than Ingrid's. The graph below shows two cosine curves modelling the body temperatures for Ingrid and Ray.



Question 6f (1 mark)

Write down the equation modelling Ray's body temperature.

Question 6g (4 marks)

Hence, **calculate** the first time when Ray's body temperature will reach 36.5 °C

Question 7 (19 marks)

In this question you will predict the reaction times of sprinters based on previously acquired data and their sleep pattern.

Video | Script

Sprinters competing in a 100 metre race should ensure they are well rested before competitions.

Studies have shown that a good sleeping habit can improve reaction time.

The start of the race is one of the most important factors for an overall fast time. Sprinters need to react as quickly as possible to the start signal.

In this question you will explore the reaction times of sprinters with different sleeping habits and how this affects their probability of winning a race.

These sprinters take a test that records their reaction time. The table below shows the results.

©

Reaction time in seconds (s)	0.75	0.76	0.77	0.78	0.79	0.80
Number of sprinters	4	3	5	6	1	1

Question 7a (2 marks)

Write down the mode and median reaction times.

Mode: _____ seconds

Median: _____ seconds

Question 7b (2 marks)

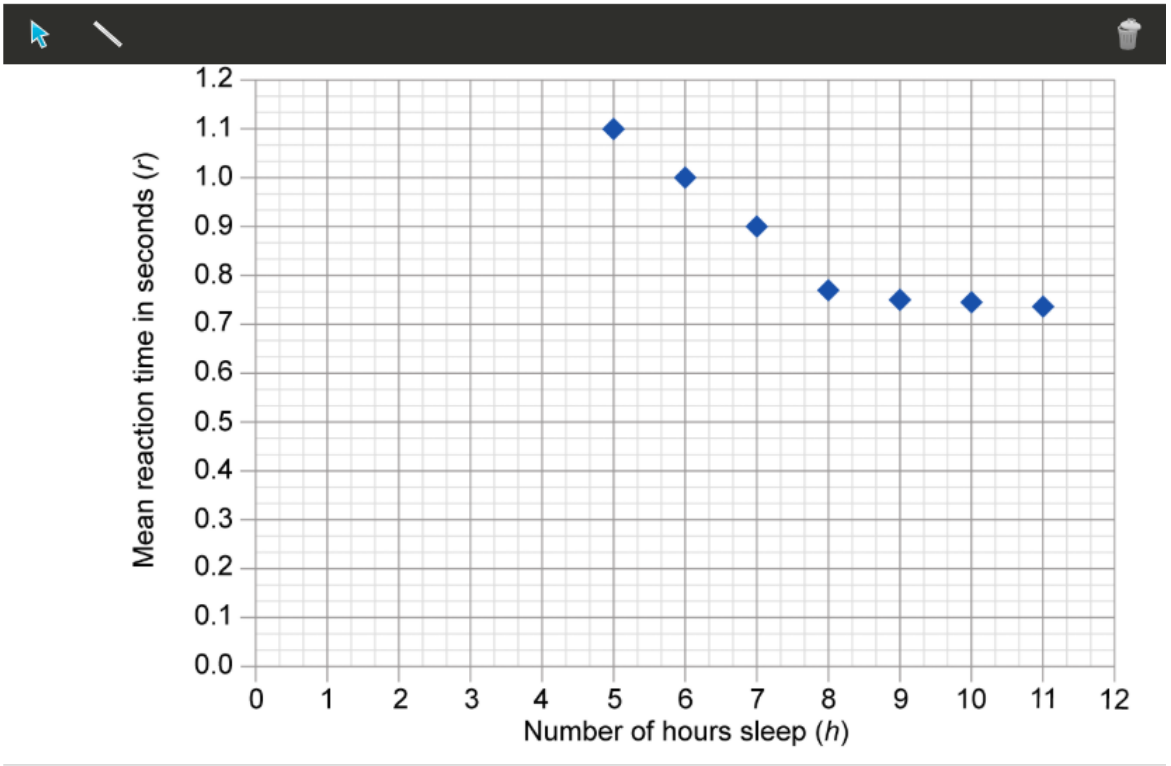
Show that the mean reaction time is 0.77 s, for this group of sprinters.

B I U x_2 x^2 Ω Σ Styles

Groups of sprinters with different sleeping habits take the same test. The graph below shows the mean reaction time of each group.

Question 7c (2 marks)

Draw a line of best fit.



Question 7d (2 marks)

Using your line of best fit from (c), **write down** the value of r for $h = 4$ hours and $h = 7.5$ hours.

$h = 4$ hours $r =$ _____ seconds

$h = 7.5$ hours $r =$ _____ seconds

Question 7e (3 marks)

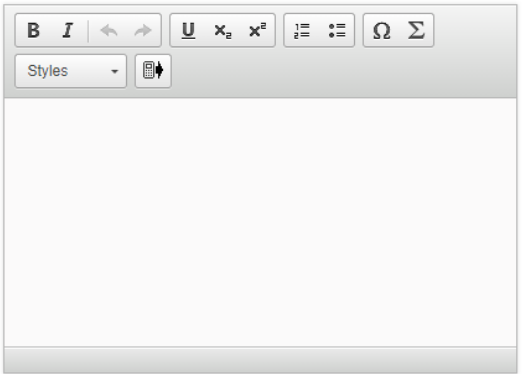
$w = 24\,(100)^{-r}$

Where:

w is the probability of winning a race.

r is the mean reaction time in seconds.

Calculate the value of w when $r = 0.77$ s. Give your answer correct to **two** significant figures.



Question 7f (8 marks)

Explore the probability of winning a race for sprinters with different sleeping habits. In your answer you must:

- identify the **two** relevant factors affecting the probability of winning
- calculate the probability of winning for sprinters with different sleeping habits
- comment on the relationship between the probability of winning and sleeping habits
- justify the accuracy of your findings.

$w = 24\,(100)^{-r}$

Where:

w is the probability of winning a race.

r is the mean reaction time in seconds.

h	4	7.5	8	
r			0.77	
w				

B I U x_2 x^2 Ω Σ Styles

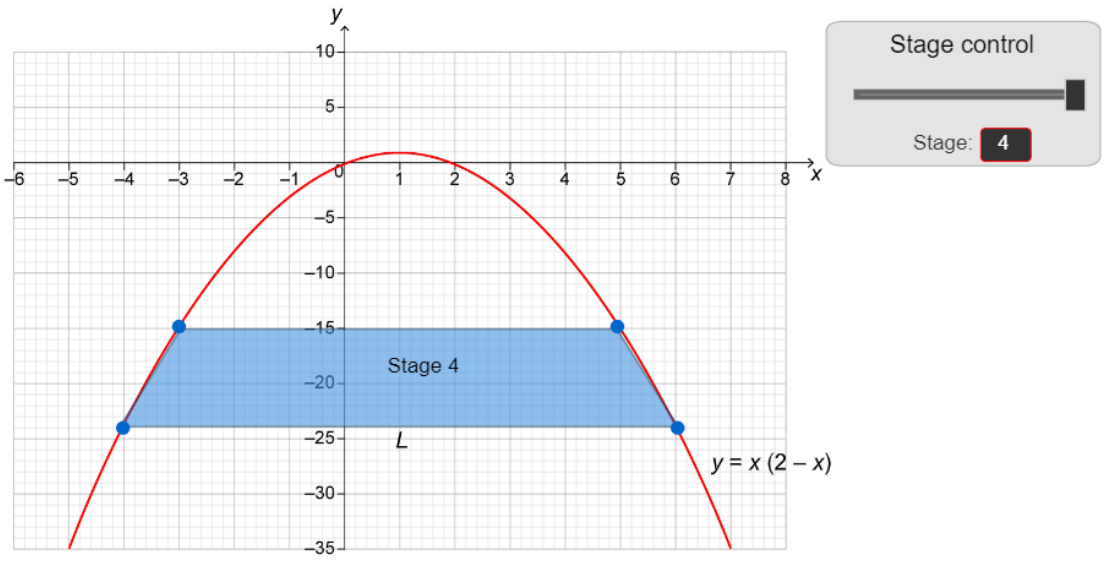
Question 8 (30 marks)

In this question, you will investigate areas of trapeziums.

The parabola $y = x\,(2 - x)$ is shown in the graph below. Different sized isosceles trapeziums are drawn inside the parabola.

Drag the slider to see how the trapeziums are formed.

This media is interactive



Question 8a (1 mark)

Write down the missing values in the table.

Stage (n)	Longer base of trapezium (L)
1	4
2	6
3	8
4	10
5	
6	

Reset

Question 8b (2 marks)

Describe, in words, **two** patterns for L.

B I U x_2 x^2 Ω Σ Styles

Question 8c (2 marks)

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

B I U x_2 x^2 Ω Σ Styles

Question 8a (1 mark)

Write down the missing values in the table.

Stage (n)	Longer base of trapezium (L)
1	4
2	6
3	8
4	10
5	
6	

Reset

Question 8d (3 marks)

Verify your general rule for L.

B I U x_2 x^2 Ω Σ Styles

Question 8e (22 marks)

Investigate the values in the table to find a relationship for the area (A) of trapeziums in terms of n. In your answer, you should:

- predict more values and record these in the table
- describe in words **one** pattern for column A
- determine a general rule for A in terms of n
- test your general rule for A
- verify and justify your general rule for A
- ensure that you communicate all your working appropriately.

n	Longer base of trapezium (L)	Smaller base of trapezium (S)	Height (H)	Area (A)	
1	4	2	3	9	
2	6	4	5	25	
3	8	6	7	49	
4	10	8	9	81	
5					
6					

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Question 1 (4 marks)

For each puzzle, **select** the correct puzzle piece with equivalent values, from the draggable options, and place it in the space provided.

Question 1a (1 mark)

Draggable puzzle pieces:

0.24 km
5.15 m 0.042 m

0.24 km
51.5 cm 42 000 m

2400 cm

Diagram not to scale

240 m
Place equivalent puzzle piece here
515 mm 42 km

Scroll down to continue

1 (4 marks)
- Question 1a
- Question 1b
- Question 1c
- Question 1d

2 (9 marks)
3 (10 marks)
4 (11 marks)
5 (14 marks)
6 (20 marks)
7 (32 marks)

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Question 1b (1 mark)

Reading Time

Draggable puzzle pieces:

2.3×10^{7}
0.0015 4×10^{-2}

2.3×10^{7}
1500 4×10^{-2}

2.3×10^{-7}
1500 4×10^{2}

Diagram not to scale

23 000 000
Place equivalent puzzle piece here
1.5×10^{3} 0.04

Scroll down to continue

1 (4 marks)
- Question 1a
- Question 1b
- Question 1c
- Question 1d

2 (9 marks)
3 (10 marks)
4 (11 marks)
5 (14 marks)
6 (20 marks)
7 (32 marks)

Draggable puzzle pieces:

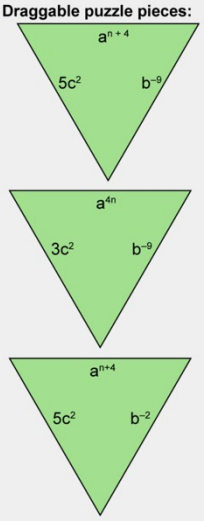
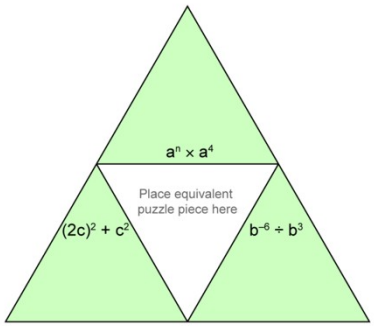


Diagram not to scale



Scroll down to continue

Question 1d (1 mark)

Draggable puzzle pieces:

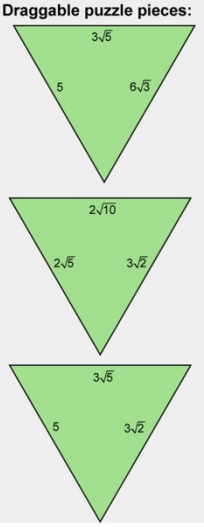
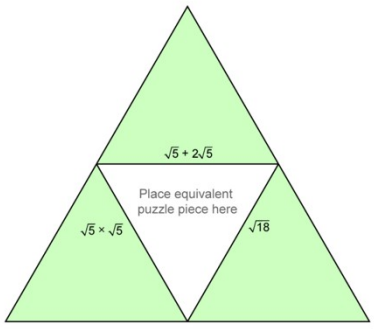


Diagram not to scale



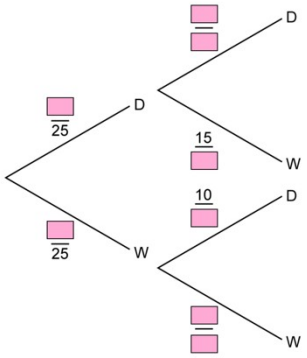
Scroll down to continue

Question 2 (9 marks)

A bag contains 10 dark chocolates (D) and 15 white chocolates (W). Two chocolates are selected at random from the bag and not replaced.

Question 2a (2 marks)

Write down the missing values on the tree diagram below.



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Question 2b (2 marks)

Determine the probability that exactly two dark chocolates are selected.

Question 2c (2 marks)

Hence, **determine** the probability that at least one white chocolate is selected.

Question 2d (3 marks)

A third chocolate is selected at random from the bag. **Find** the probability that exactly two dark chocolates are selected out of the three.

Scroll down to continue

1 (4 marks)
2 (9 marks)
Question 2a
Question 2b
Question 2c
Question 2d
3 (10 marks)
4 (11 marks)
5 (14 marks)
6 (20 marks)
7 (32 marks)

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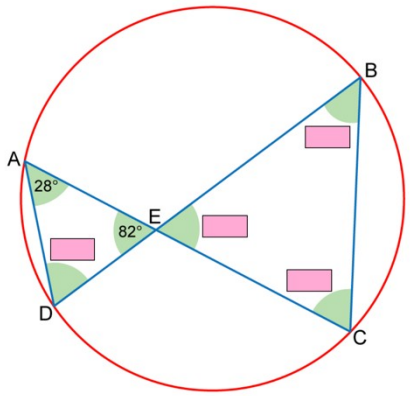
Question 3 (10 marks)

Question 3a (2 marks)

Points A, B, C and D lie on the circumference of a circle and the chords AC and BD intersect at point E.

Diagram not to scale

Determine the missing angles in the diagram below.



Scroll down to continue

1 (4 marks)
2 (9 marks)
3 (10 marks)
Question 3a
Question 3b
Question 3c
Question 3d
4 (11 marks)
5 (14 marks)
6 (20 marks)
7 (32 marks)

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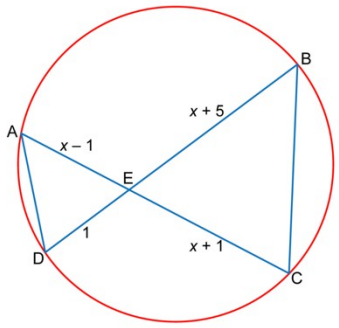
Diagram not to scale



Question 3b (1 mark)

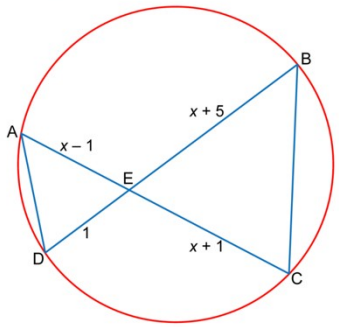
Triangle AED is similar to triangle BEC.
State the reason.

Question 3c (4 marks)

Hence, form and solve a quadratic equation to **show that** $x = 3$.

Scroll down to continue

1 (4 marks)
2 (9 marks)
3 (10 marks)
Question 3a
Question 3b
Question 3c
Question 3d
4 (11 marks)
5 (14 marks)
6 (20 marks)
7 (32 marks)



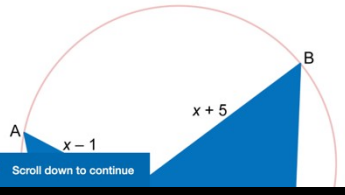
Question 3c (4 marks)

Hence, form and solve a quadratic equation to **show that** $x = 3$.

Question 3d (3 marks)

Triangle AED is similar to triangle BEC.

$x = 3$



Scroll down to continue

Given that AD = 2.1 cm, **calculate** the perimeter of the shaded shape.

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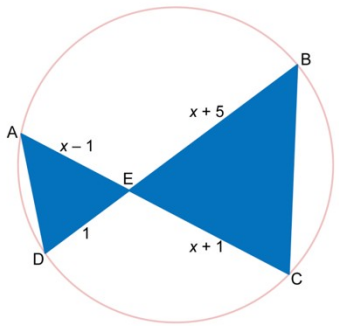
Question 3d (3 marks)

Triangle AED is similar to triangle BEC.

$x = 3$



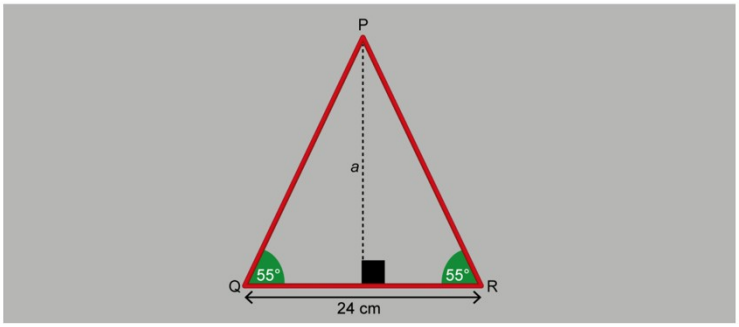
Given that AD = 2.1 cm, **calculate** the perimeter of the shaded shape.

1 (4 marks)
2 (9 marks)
3 (10 marks)
Question 3a
Question 3b
Question 3c
Question 3d
4 (11 marks)
5 (14 marks)
6 (20 marks)
7 (32 marks)

Question 4 (11 marks)

The diagram below shows an isosceles triangle with the dimensions indicated on the diagram.

Diagram not to scale



Question 4a (3 marks)

Show that the value of *a* is 17.1 cm correct to 3 significant figures.

Scroll down to continue

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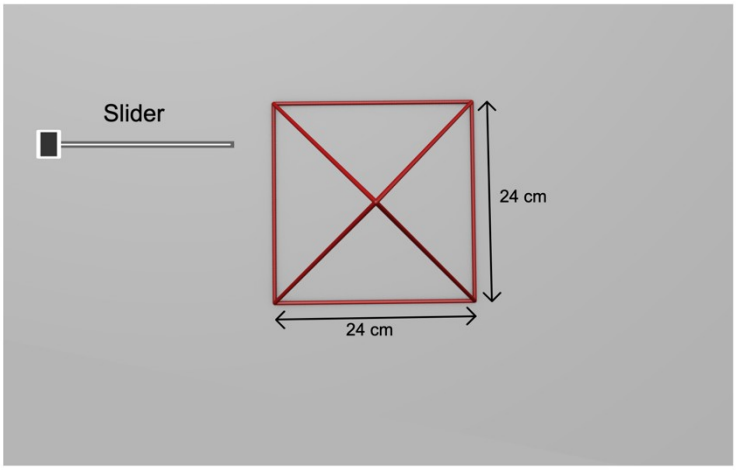
The isosceles triangle PQR above, is used to form the four faces of the square-based pyramid shown in the diagram below.

Interact with the slider to see different faces of the pyramid

Diagram not to scale



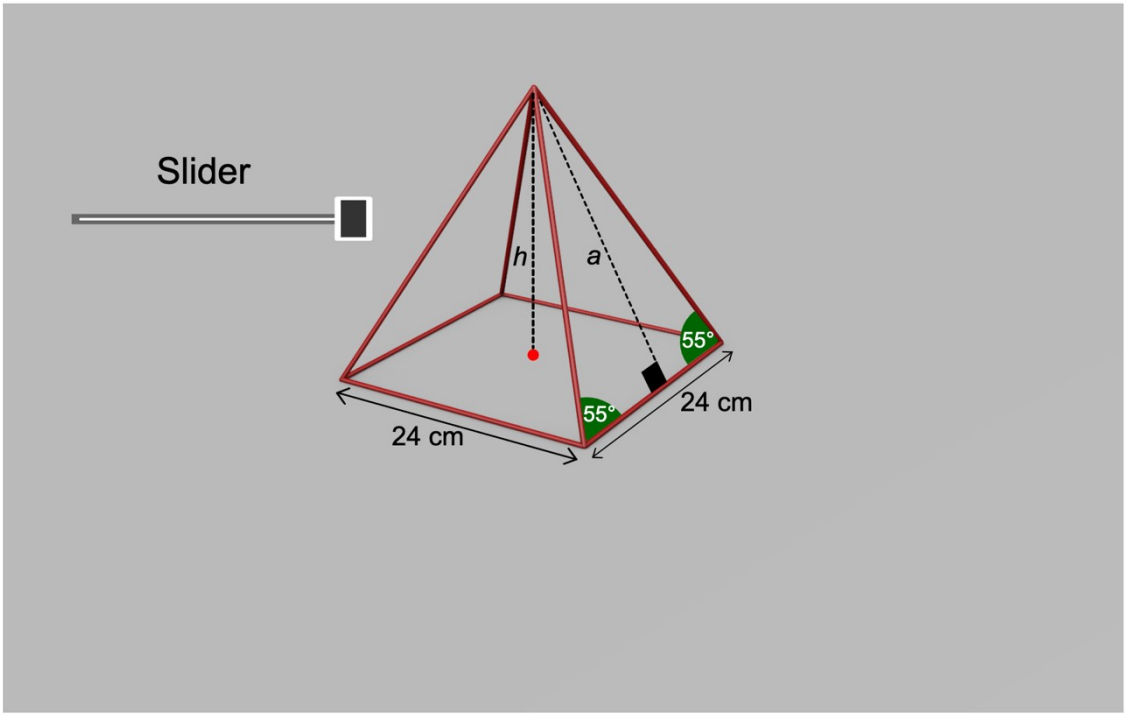
Scroll down to continue

1 (4 marks)
2 (9 marks)
3 (10 marks)
4 (11 marks)
Question 4a
Question 4b
Question 4c
Question 4d
5 (14 marks)
6 (20 marks)
7 (32 marks)

The isosceles triangle PQR above, is used to form the four faces of the square-based pyramid shown in the diagram below.

Interact with the slider to see different faces of the pyramid

Diagram not to scale



Question 4b (2 marks)

Determine the value of the height h.

Question 4c (3 marks)

Calculate the volume of the pyramid.
Give your answer to the nearest integer.

Question 4d (3 marks)

Question 4d (3 marks)

A larger pyramid is created by increasing all of the dimensions by 10 %.

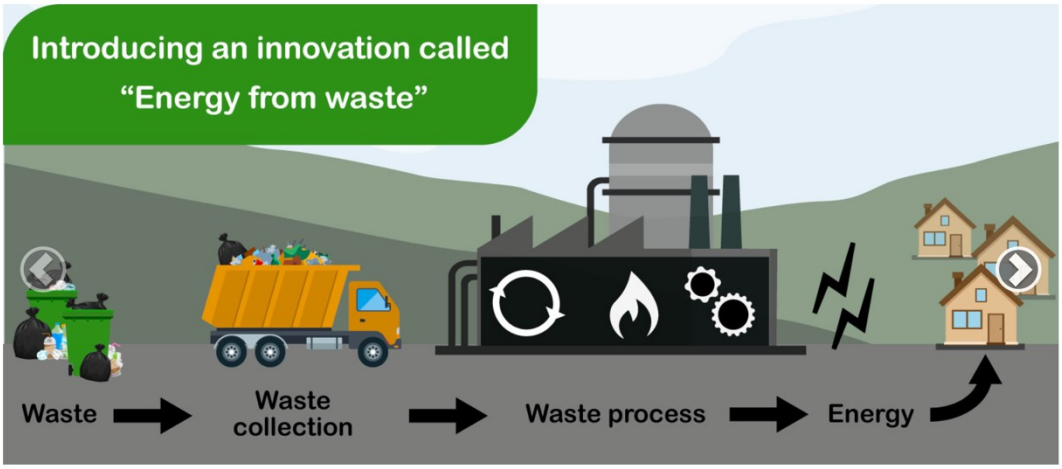
Find the percentage increase of the volume.

Question 5a (1 mark)

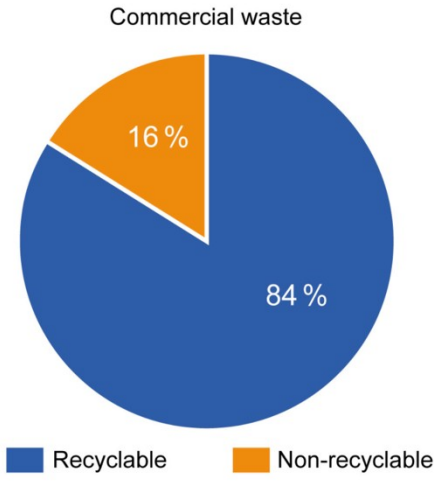
Question 5 (14 marks)

The following infographic shows how an organization produces energy from non-recyclable waste.

Question 5a (1 mark)



The pie chart below shows the type of commercial waste received by the organization in one month.



The total weight of commercial waste received was 4500 tonnes (t). **Determine** the weight of **non-recyclable** commercial waste.

B I U Styles Ω Σ

Question 5b (2 marks)

In the same month, the weight of **non-recyclable** waste received from the different categories was in the ratio of:

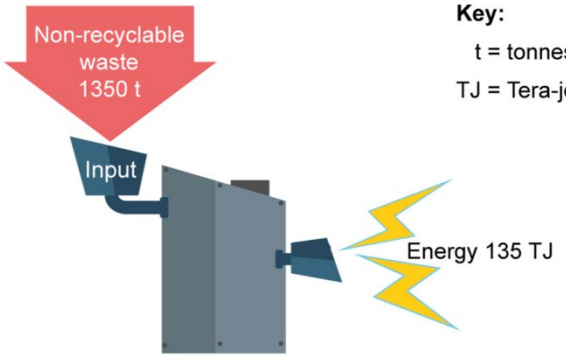
Domestic	:	Commercial	:	Industrial
15	:	8	:	3

Determine the weight of non-recyclable **industrial** waste.

Question 5c (4 marks)

Energy is generated from the non-recyclable waste from each category. The image below shows the data for domestic waste.

Domestic



Key:

t = tonnes

TJ = Tera-joules = 1×10^{12} Joules

Determine the missing values in the table.

		Weight, tonnes (t)	Production ratio Energy per tonne (TJ/t)	Energy, Tera-joules (TJ)
Category	**Domestic**	1350	r =	135
	Commercial	Answer from (a)	r =	
	ial	Answer from (b)	2r =	

Scroll down to continue

	Industrial	Answer from (b)	2r =	

Total energy produced by the organization this month

Question 5d (4 marks)

A town has 68 420 homes. The table shows the energy (E) used by the town in the year 2022.

Number of months	2	4	2	1	3
Energy (TJ)	$850 < E \leq 870$	$870 < E \leq 890$	$890 < E \leq 910$	$910 < E \leq 930$	$930 < E \leq 950$

Show that the estimate of the mean value of energy used per month by the town is 900 TJ, to the nearest 10 TJ.

Question 5e (3 marks)

Given that every month:

- 900 TJ of energy can provide power for 68 420 homes
- the organization produces a total energy of **your answer from part (c)**.

Find the maximum number of homes that can be powered by the organization every month.

B I U x_2 x^2 Ω Σ Styles

The following video explains how carbon markets aim to reduce carbon emissions for industrial organizations.

Video | Script

There are many global initiatives for the reduction of gas emissions that contribute to climate change.

A key initiative for industrial organizations is the annual carbon emissions and carbon markets.

The government gives organizations an annual limit for the amount of carbon emissions they can produce.

Every year the annual limit for carbon emissions is reduced.

If an organization goes over their limit, they must buy more carbon units from the carbon market.

If they are under their limit, they can sell unused carbon units to the carbon market.

In order for organizations to stay within their limit they must invest in technology such as filters, renewable energy, carbon capture schemes and other innovations.

If they make good investment decisions, they may further reduce their emissions which means they can sell their surplus carbon units to the carbon market.

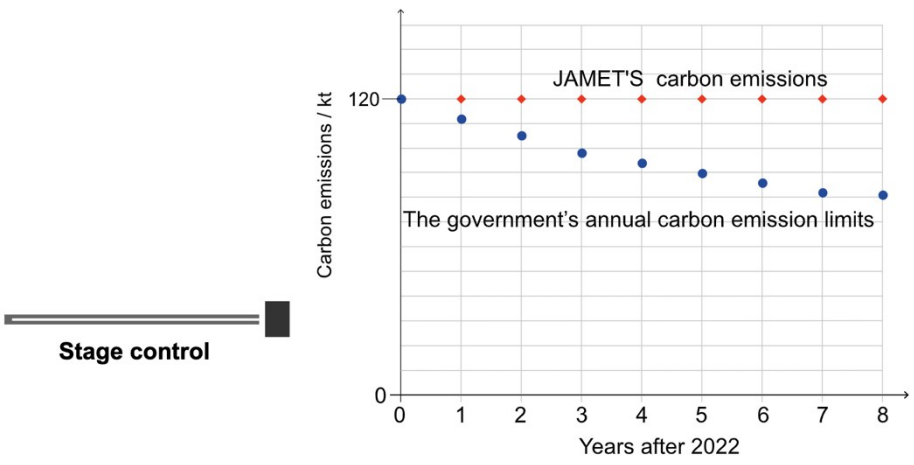
Organizations must consider the following costs:

- buying carbon units
- selling carbon units
- investment in technology to reduce emissions.

In this question you will analyse a financial scenario for an organization that needs to review its carbon emissions.

JAMET is an industrial organization that needs to review their carbon emissions. Based on historical data JAMET estimates that they will emit approximately 120 thousand tonnes (kt) every year.

The government has set a carbon emission limit for JAMET for the next few years in order to reach a reduced target by 2030. Drag the slider to see the emission data.



The government's annual carbon emission limits for JAMET can be modelled by the following equation.

equation.

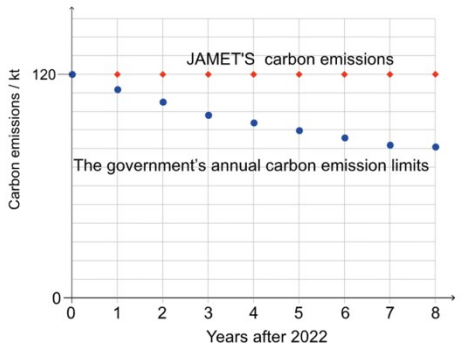
$$E = a(10 - n)^2 + 80,\ 0 \leq n \leq 8$$

Where

E annual carbon emission limit in kt (thousand tonnes)

n number of years after 2022, where n is an integer

a constant



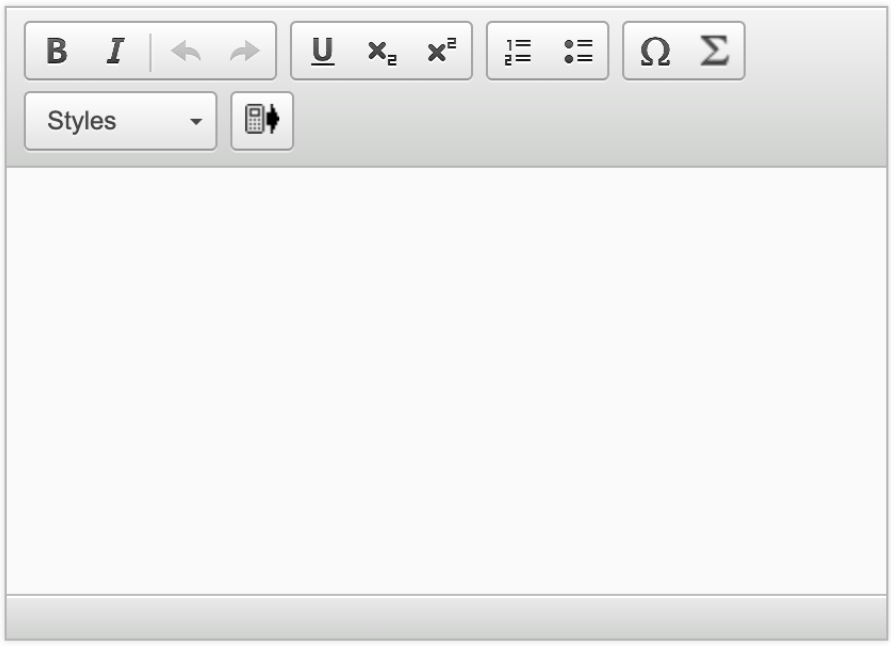
Question 6a (2 marks)

Show that $a = 0.4$.

B I U Styles Ω Σ

Question 6b (2 marks)

Hence, **determine** the annual carbon emission limit set by the government for JAMET in 2024.



Question 6c (2 marks)

If JAMET does not invest in technology, their carbon emissions will be **above** the limit set by the government. So, they will have to buy additional carbon units on the carbon market.

The cost of carbon units is $60 000 per thousand tonnes (kt)

Determine the cost of the carbon units that JAMET will have to buy in 2024.

Question 6c (2 marks)

If JAMET does not invest in technology, their carbon emissions will be **above** the limit set by the government. So, they will have to buy additional carbon units on the carbon market.

The cost of carbon units is $60 000 per thousand tonnes (kt)

Determine the cost of the carbon units that JAMET will have to buy in 2024.

B I U x_2 x^2 Ω Σ Styles

The government's annual carbon emission limits for JAMET can be modelled by the following equation.

$E = a(10 - n)^2 + 80,\ 0 \leq n \leq 8$

Where

E annual carbon emission limit in kt

n number of years after 2022, where n is an integer

a constant

Calculate the number of years that the carbon emissions are below the limit set by the government.

B I U x_2 x^2 Ω Σ Styles

Question 6e (10 marks)

Question 6d (4 marks)

JAMET has installed filters which reduced their annual carbon emissions to 90 kt. Installing filters will ensure that JAMET does not have to buy carbon units for a number of years.

The government's annual carbon emission limits for JAMET can be modelled by the following equation.

$E = a(10 - n)^2 + 80,\ 0 \leq n \leq 8$

Where

E annual carbon emission limit in kt

n number of years after 2022, where n is an integer

a constant

Calculate the number of years that the carbon emissions are below the limit set by the government.

B I U x_2 x^2 Ω Σ Styles

Question 6e (10 marks)

Question 6e (10 marks)

HAMJO is another organization reviewing its carbon emissions.

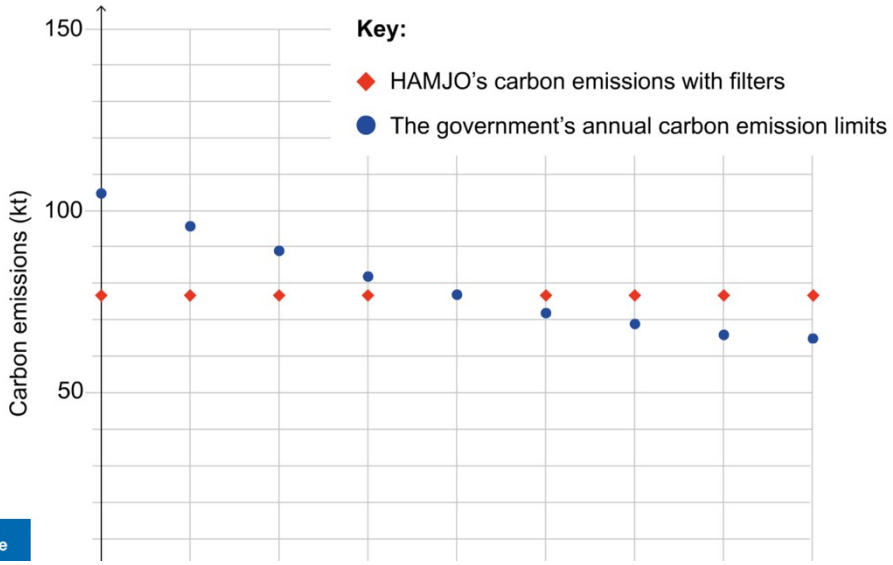
If HAMJO does not install filters in the next 8 years:

- they must buy a total of 222 kt of carbon units.

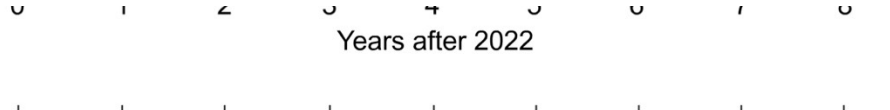
If HAMJO does install filters:

- it will cost 14 million dollars to install filters
- their carbon emissions reduce to 77 kt per year.

The interactive graph below illustrates the data they have to make a decision. Interact with the points on the graph to complete the table.



Scroll down to continue



Year	2022	2023	2024	2025	2026	2027	2028	2029	2030
Difference in carbon emissions (kt)	28	19.5			0	4.5	8		
Value of difference in carbon emissions ($ million)	1.68					0.27			
Buy or sell	sell	sell	sell	sell		buy	buy	buy	buy

Carbon units are approximately $60 000 per kt to buy or sell.

HAMJO needs to know if installing filters will help the organization save money. **Analyse** the data to make a recommendation to the organization. In your answer you should provide:

- **three** relevant factors
- calculations for selling and buying carbon units, with and without filters
- recommendations for whether to install filters
- a justification for the degree of accuracy in the context of the question.

Three relevant factors.

Scroll down to continue

Calculations, recommendations and justification.

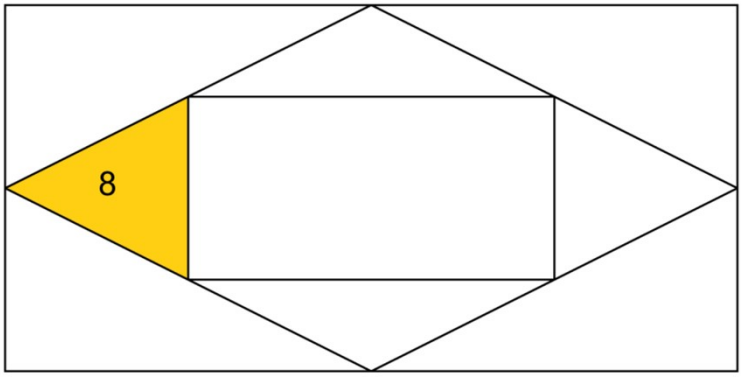
Question 7 (32 marks)

In part (a) to (d) you will investigate the number of triangles formed in each stage.

Click on each stage to see how the number of triangles (T) increases.

Stage 1 | Stage 2 | Stage 3 | Stage 4

Stage number (n)	Number of triangles (T)
1	0
2	8



Question 7a (1 mark)

Question 7b (2 marks)

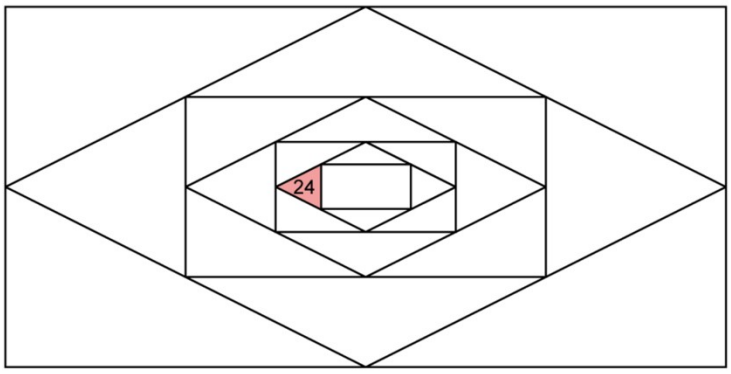
Question 7 (32 marks)

In part (a) to (d) you will investigate the number of triangles formed in each stage.

Click on each stage to see how the number of triangles (T) increases.

Stage 1 | Stage 2 | Stage 3 | Stage 4

Stage number (n)	Number of triangles (T)
1	0
2	8
3	16
4	24



Question 7a (1 mark)

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

Stage number (n)	Number of triangles (T)
1	0
2	8
3	16
4	24
5	
6	

Reset

Question 7b (2 marks)

Describe, in words, two patterns in the table for the number of triangles (T).

Styles

Question 7c (2 marks)

Write down, in simplest form, a general rule for T in terms of n.

B I U x_2 x^2 Ω Σ

Styles

Question 7d (3 marks)

Verify your general rule for T.

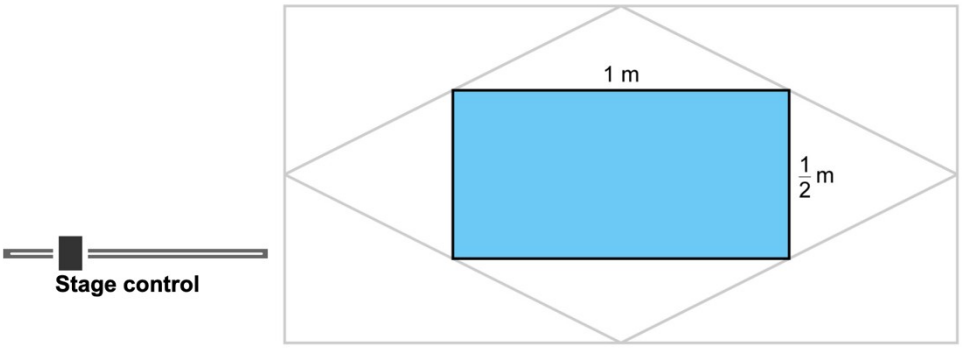
B I U x_2 x^2 Ω Σ

Styles

The simulation below shows how smaller rectangles are formed. Each time the dimensions of the rectangle are halved. The new rectangle is centred inside the previous one.

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

Stage 2:

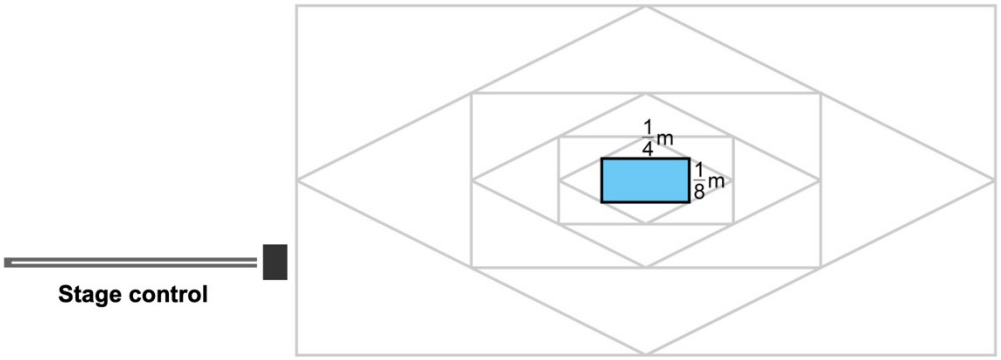


Question 7e (1 mark)

The simulation below shows how smaller rectangles are formed. Each time the dimensions of the rectangle are halved. The new rectangle is centred inside the previous one.

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

Stage 4:



Question 7e (1 mark)

Show that $\frac{1}{4} \times \frac{1}{8} = 2^{-5}$.

B I U x_2 x^2 Ω Σ Styles

Question 7f (23 marks)

Question 7f (23 marks)

Stage number (n)	Length (L)	Width (W)	Area of rectangle (A)	Area (A) in index form
1	2	1	2	2^1
2	1	$\frac{1}{2}$	$\frac{1}{2}$	2^{-1}
3	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	2^{-3}
4	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{32}$	2^{-5}
5				
6				

Reset

Investigate the values in the table to find a relationship for the area (A) of the rectangle 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 area of rectangle
- write down, in simplest form, a general rule for A in terms of n
- test and verify your general rule for A
- justify your general rule for A.

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