



Question 1 (6 marks)



Question 1a (4 marks)

Aaron works on a food truck. Every morning, he prepares sandwiches and pizzas to sell. The following information provides guidance for the preparation of the sandwiches and pizzas.

x represents the number of sandwiches

y represents the number of pizzas

In the table:

- **Write down** the missing constraint in context
- **Identify** the correct inequality signs to complete the inequalities.

In the graph:

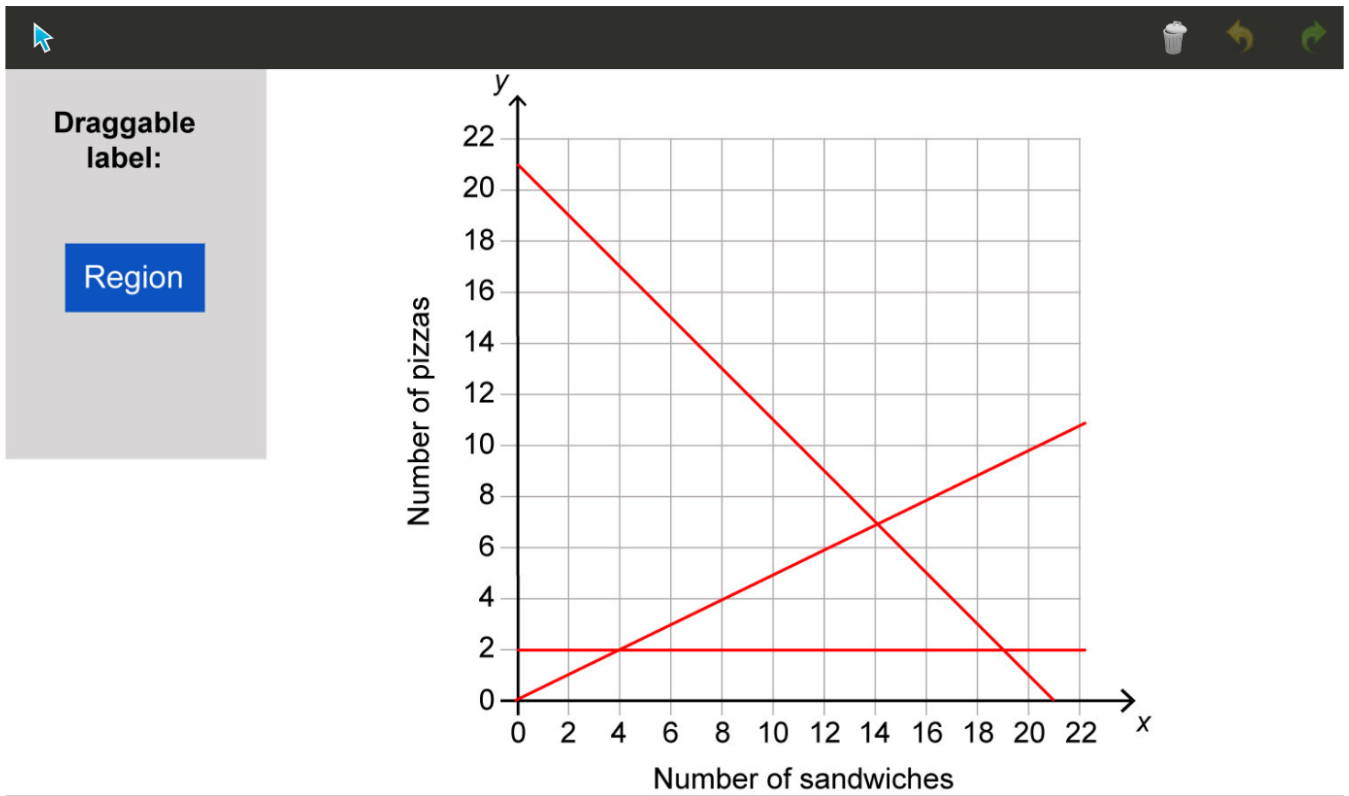
- **Identify** the region that satisfies all **three** constraints.

In the graph:

- **Identify** the region that satisfies all **three** constraints.

Draggable inequalities:		Inequalities	Constraint in context
\geq	$>$	$y \geq 2$	
\leq	$<$	$x + y \square 21$	A maximum of 21 sandwiches and pizzas combined
		$x \square 2y$	At least twice as many sandwiches as pizzas

Drag and drop the 'Region' label to the correct location.





Question 1b (1 mark)

Write down the minimum number of sandwiches that satisfies the given constraints.

B *I* ↵ ⇨ x_2 x^2 $\frac{1}{2} =$ \vdash $:=$ Ω \vee
✓ 📷 Styles \vee



Question 1c (1 mark)

Write down the maximum number of pizzas that satisfies the given constraints.

B *I* ↵ ⇨ x_2 x^2 $\frac{1}{2} =$ \vdash $:=$ Ω \vee
✓ 📷 Styles \vee



Question 3 (6 marks)

A student conducts a musical experiment by tapping a spoon on a row of identical glasses.



To produce various tones, each glass is filled with a different amount of water such that:

- the amount of water in the glasses follows an arithmetic sequence with general term U_n
- the first three glasses contain 430 ml, 385 ml and 340 ml of water.



Question 3a (1 mark)

Determine the common difference for the arithmetic sequence.

B *I* ↶ ↷ \times_2 \times^2 \doteq ∇ \doteq ∇ Ω ∇
✓ 📷 Styles ▾



Question 3b (2 marks)

Determine the amount of water in the 7th glass.

B *I* ↶ ↷ \times_2 \times^2 \doteq ∇ \doteq ∇ Ω ∇
✓ 📷 Styles ▾





Question 3c (3 marks)

By solving $Un = 0$, **find** the maximum number of glasses to conduct the experiment.

B *I* ↵ ↶ ↷ ×₂ ×² := ∇ ∴ ∇ Ω ∇ √ Styles ∇



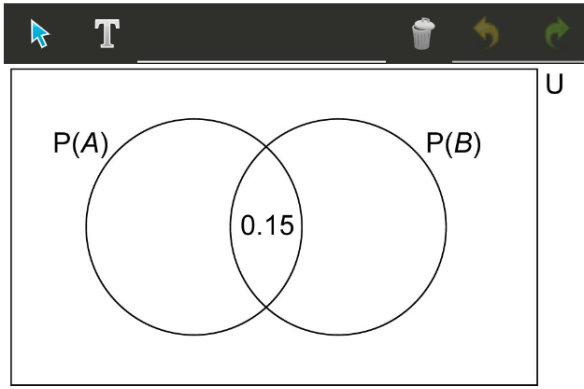


Question 4 (6 marks)



The following Venn diagram shows the probabilities of events A and B , such that:

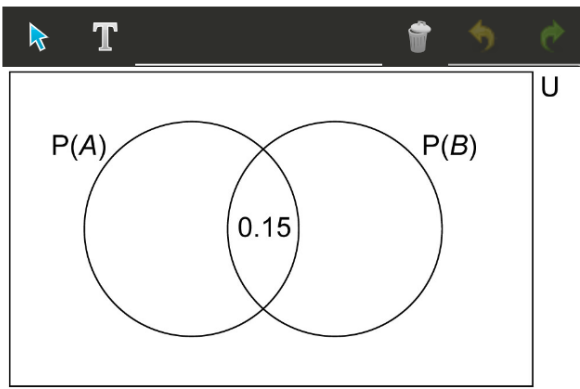
- A and B are independent events
- $P(A) = 0.25$
- $P(A \cap B) = 0.15$



Question 4b (2 marks)

Hence, **determine** $P(B \cap A')$.

B *I* ↵ ⇨ x_2 x^2 $\frac{1}{2}$ \vdots \vdots Ω \vdots
✓ 📄 Styles \vdots



Question 4c (2 marks)

Determine $P(A \cup B)'$.

B *I* \leftrightarrow \rightarrow \times_2 \times^2 $\frac{1}{2}$ \div $:=$ \vee Ω \vee
 \checkmark Styles \vee



Question 5d (3 marks)

Identify the correct transformations that maps $f(x)$ onto $g(x)$.

Select the correct option from the drop-down menu and insert a unit value in the box.

Transformation 1	<input type="text" value="Select"/>	By factor <input type="text"/>
Transformation 2	<input type="text" value="Select"/>	By <input type="text"/> units
Transformation 3	<input type="text" value="Select"/>	By <input type="text"/> units





Question 5d (3 marks)

Identify the correct transformations that maps $f(x)$ onto $g(x)$.

Select the correct option from the drop-down menu and insert a unit value in the box.

Transformation 1	<div style="border: 1px solid #ccc; padding: 2px;"><div style="border: 1px solid #ccc; padding: 2px; display: flex; justify-content: space-between;">Select▼</div><div style="background-color: #e0e0e0; padding: 2px; display: flex; justify-content: space-between;">Select▼</div><div style="padding: 2px; display: flex; justify-content: space-between;">Stretched vertically▼</div><div style="padding: 2px; display: flex; justify-content: space-between;">Stretched horizontally▼</div><div style="border: 1px solid #ccc; padding: 2px; display: flex; justify-content: space-between;">Select▼</div></div>	By factor <input style="width: 80px;" type="text"/>
Transformation 2	<div style="border: 1px solid #ccc; padding: 2px;"><div style="border: 1px solid #ccc; padding: 2px; display: flex; justify-content: space-between;">Select▼</div><div style="background-color: #e0e0e0; padding: 2px; display: flex; justify-content: space-between;">Select▼</div><div style="padding: 2px; display: flex; justify-content: space-between;">Stretched vertically▼</div><div style="padding: 2px; display: flex; justify-content: space-between;">Stretched horizontally▼</div><div style="border: 1px solid #ccc; padding: 2px; display: flex; justify-content: space-between;">Select▼</div></div>	By <input style="width: 80px;" type="text"/> units
Transformation 3	<div style="border: 1px solid #ccc; padding: 2px;"><div style="border: 1px solid #ccc; padding: 2px; display: flex; justify-content: space-between;">Select▼</div></div>	By <input style="width: 80px;" type="text"/> units





Question 5d (3 marks)

Identify the correct transformations that maps $f(x)$ onto $g(x)$.

Select the correct option from the drop-down menu and insert a unit value in the box.

Transformation 1	<input type="text" value="Select"/>	By factor <input type="text"/>
Transformation 2	<input type="text" value="Select"/> <input type="text" value="Select"/> <input type="text" value="Translation to the right"/> <input type="text" value="Translation to the left"/>	By <input type="text"/> units
Transformation 3	<input type="text" value="Select"/>	By <input type="text"/> units





Question 5d (3 marks)

Identify the correct transformations that maps $f(x)$ onto $g(x)$.

Select the correct option from the drop-down menu and insert a unit value in the box.

Transformation 1	<input type="text" value="Select"/>	By factor <input type="text"/>
Transformation 2	<input type="text" value="Select"/>	By <input type="text"/> units
Transformation 3	<input type="text" value="Select"/> <input type="text" value="Select"/> <input type="text" value="Translation up"/> <input type="text" value="Translation down"/>	By <input type="text"/> units





Question 6 (15 marks)



In this question you will make calculations for tidal energy.

Renewable energy technology has advanced by making use of changing coastal tides to provide clean and reliable energy.

There are some physical requirements needed in order to utilise energy from tides. It is essential to have a large tidal range.

The tidal range is the difference in height of the low tide and the high tide.

The tidal range may change slightly during stormy weather and during the full and new moon phase.

Another physical requirement is a suitable location to create a large tidal lagoon. A tidal lagoon is a lake that holds water at high tide. For financial and ecological reasons, the best location for a tidal lagoon is where the coastline forms a bay.

Tidal energy is dependent on the tidal range and the area of the lagoon seabed.

In this question you will make calculations for the Energy and tidal range for two different lagoon designs.



Question 6b (3 marks)

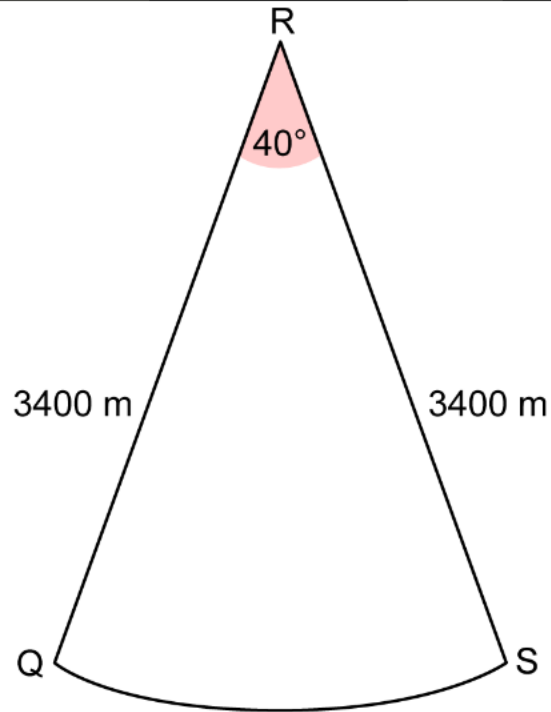
The sector QRS has the dimensions indicated on the diagram.

Diagram not to scale

Design S

Show that the area of the sector QRS is $4\,040\,000\text{ m}^2$ correct to three significant figures.

B *I* ↵ ↶ ↷ ×₂ ×² $\frac{1}{2}$ = √ ∴ ∵ ∞ ∇





Question 6c (3 marks)

The energy (E), produced by a tidal lagoon, is given by the following formula

$$E = \frac{1}{700} Ad^2$$

Where:

E = Tidal energy (kilo Watt hours, kWh)

A = Area of the lagoon seabed (square metres, m^2)

d = Tidal range (metres, m)

Information for Design S

$$E = 1\,500\,000 \text{ kWh}$$

$$A = 4\,040\,000 \text{ m}^2$$

Calculate the value of d .

B *I* ↶ ↷ ×₂ ×² $\frac{1}{2}$ = √ ∴ ∞ ∨
✓ 📱 Styles ∨



Question 6e (2 marks)

Due to a storm, d increases by 10%. **Determine** the percentage increase of E .

B *I* ↶ ↷ U \times_2 \times^2 $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{4}$ $\frac{1}{5}$ $\frac{1}{6}$ $\frac{1}{7}$ $\frac{1}{8}$ $\frac{1}{9}$ $\frac{1}{10}$ Ω $\sqrt{\quad}$ $\sqrt[3]{\quad}$ Styles \downarrow



Question 7 (20 marks)

The warehouse uses two different robots to move items.



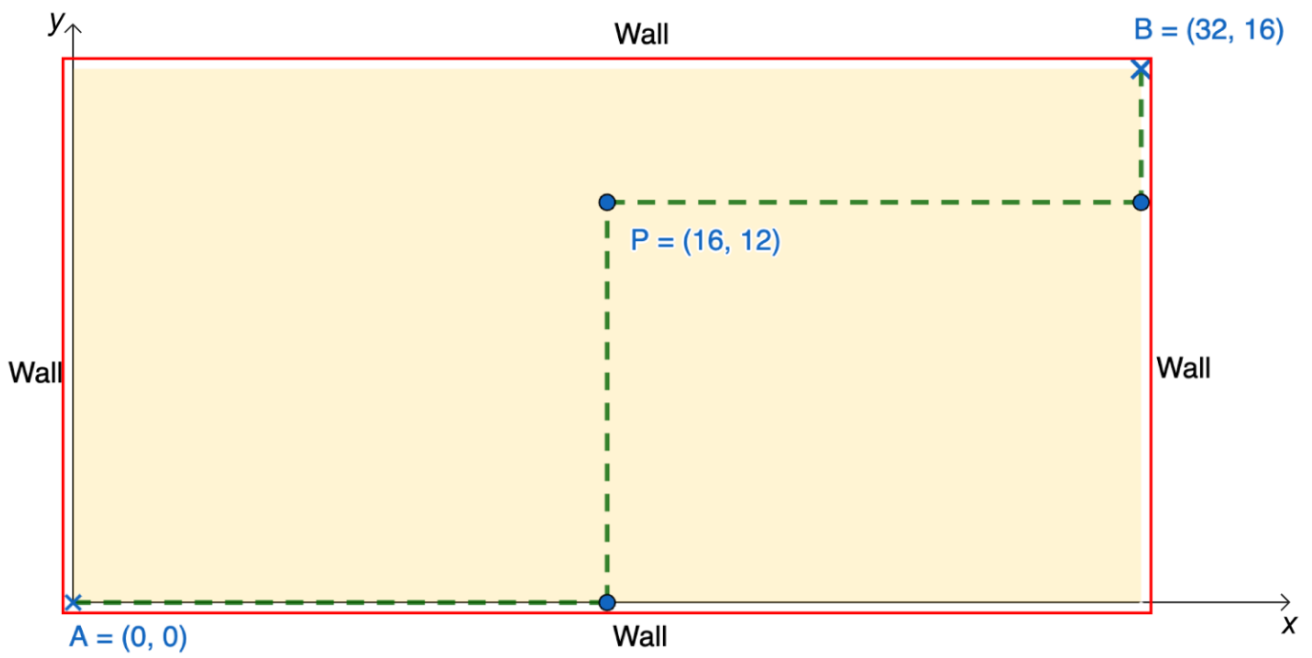


Question 7a (1 mark)

The working area of the warehouse has a length of 32 m and a width of 16 m shown in the following diagram.


All robots are designed to start at point A, move to pick up an item at point P, then move to drop off the item at point B.

Robot 1 can only move parallel to the walls of the warehouse as shown in the diagram. Robot 1 is instructed to pick up an item at point P(16,12).



Let D_1 be the distance travelled by Robot 1 from starting point A to drop-off point B.

Determine the value of D_1 .

B *I* ↶ ↷ \times_2 \times^2 $\frac{\square}{\square}$ $\frac{\square}{\square}$ Ω $\sqrt{\quad}$  Styles \downarrow



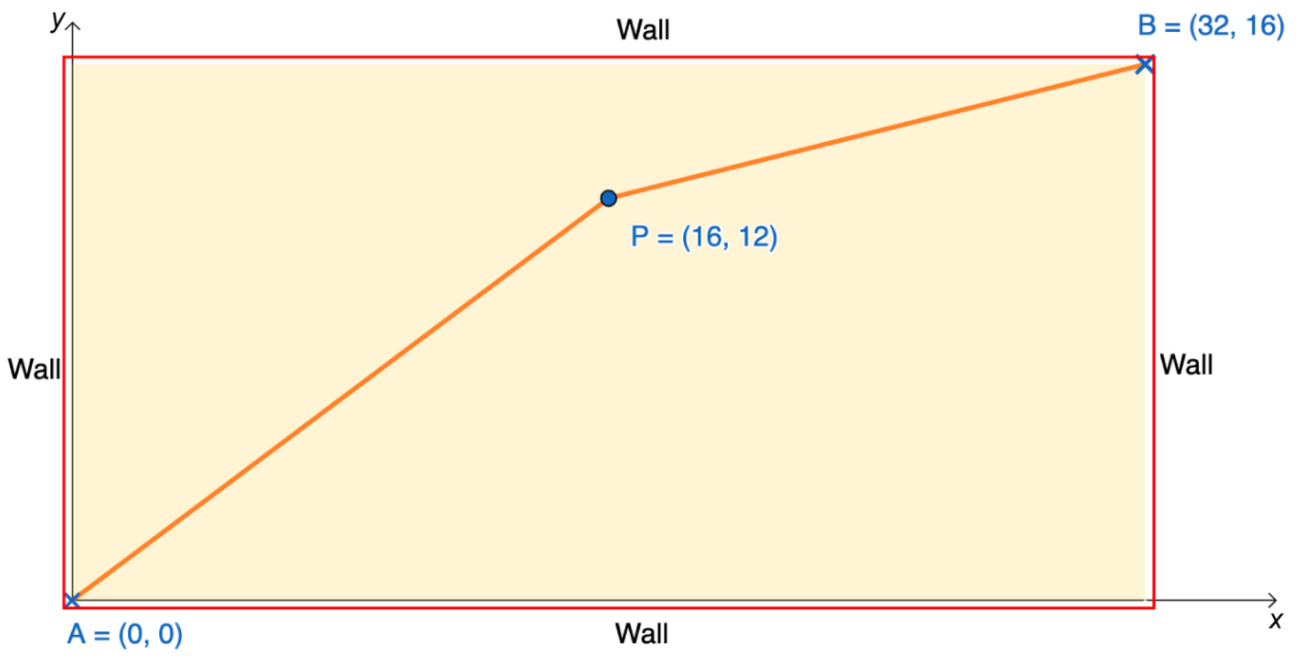


Question 7b (4 marks)

Robot 2 can move directly from one point to another as shown in the diagram.

Robot 2 is instructed to pick up an item, at the same point, P(16,12). It moves on the path from

A to P using equation $y = \frac{3}{4}x$.

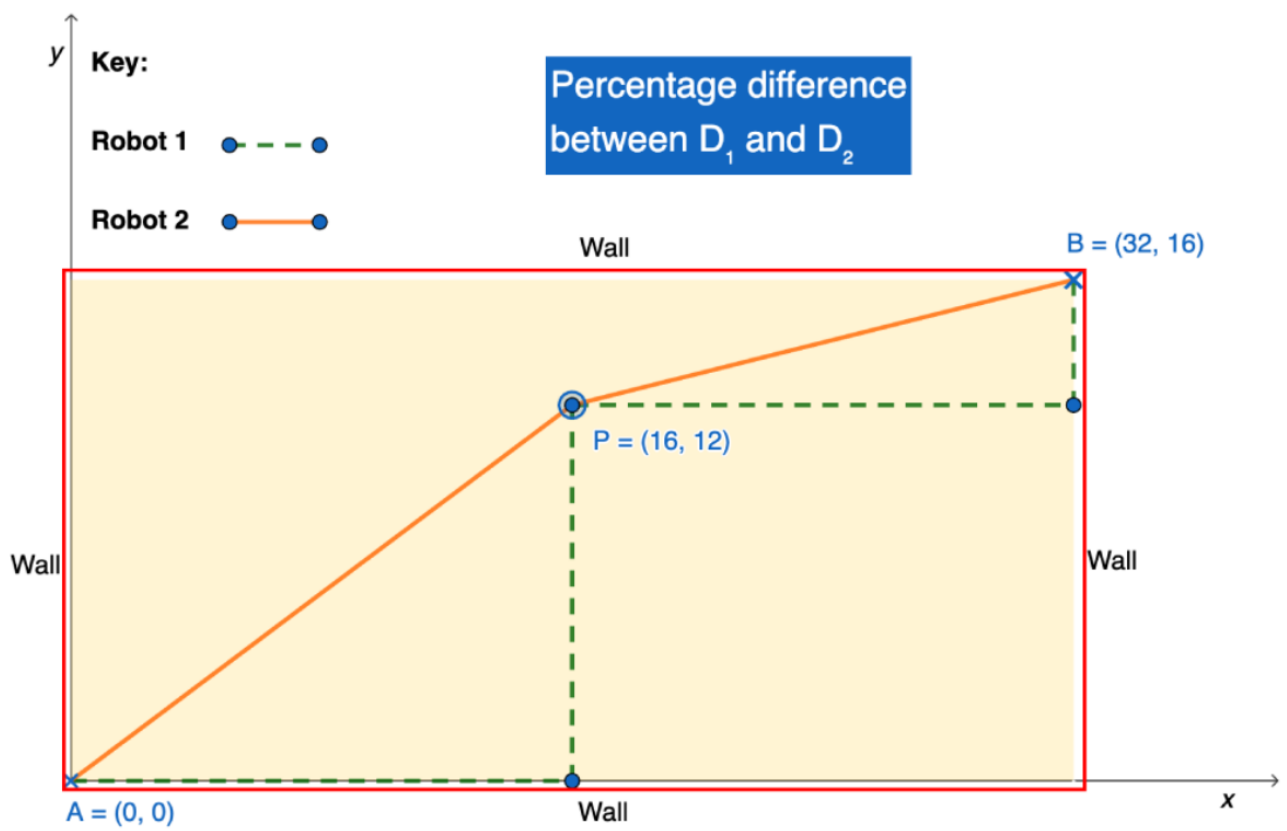




Question 7d (2 marks)

Let K be the percentage difference of D_1 and D_2 , such that:

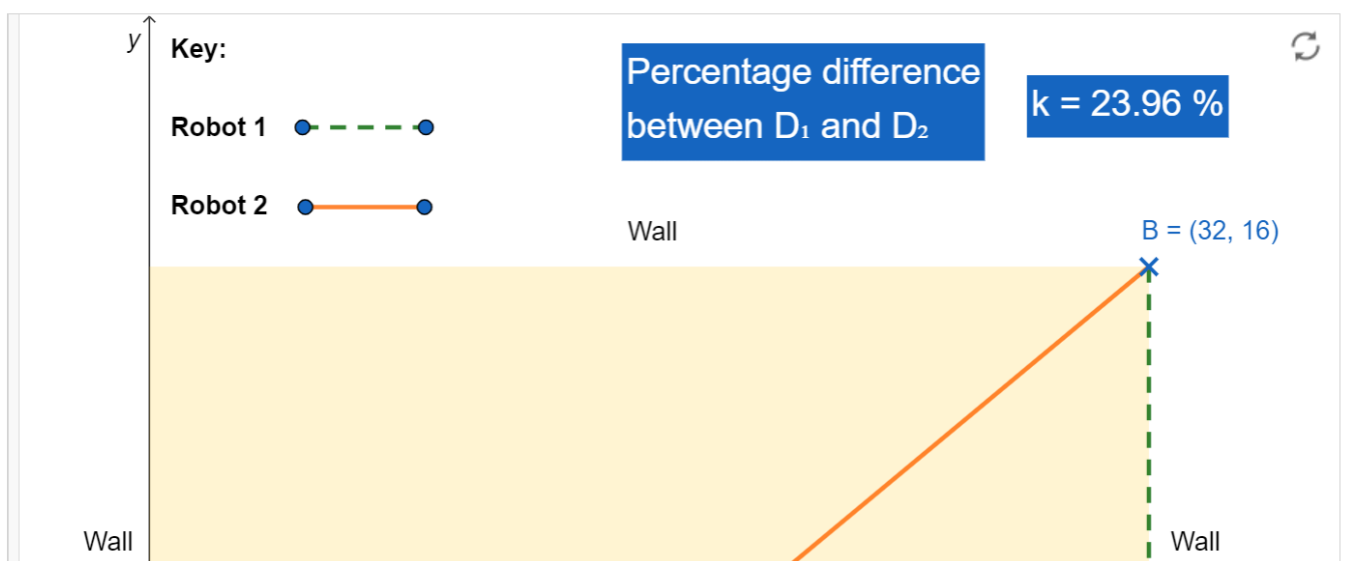
$$K = \frac{|D_2 - D_1|}{D_1} \times 100$$



The following simulation is provided for part (e).

This media is interactive

Drag the point P to reveal the value of K at different positions.





Question 7e (10 marks)

Additional information about the robots.

	Robot 1	Robot 2
Price (USD)	1000	1200
Speed (m/sec)	0.75	0.5

$$\text{distance} = \text{speed} \times \text{time}$$

The warehouse manager wants to buy another robot. **Analyse** the information given to recommend the appropriate robot type to buy. In your answer, you should:

- state **three** relevant factors
- show calculations for the minimum and maximum value of K
- show calculations for the minimum time needed for Robot 1 and Robot 2
- justify your recommendation for whether to buy Robot 1 or Robot 2.



Question 8 (30 marks)

A structure is created using cubes. In this question you will investigate the number of cubes in the structures.

Interact with the stage control to reveal the structure and number of cubes (C).

Stage control



Stage 1: $C = 1$



Interact with the stage control to reveal the structure and number of cubes (C).

Stage control



Stage 2: $C = 4$

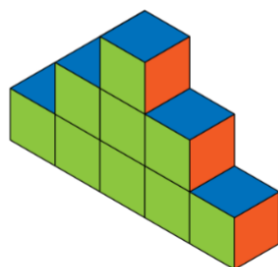


Interact with the stage control to reveal the structure and number of cubes (C).

Stage control



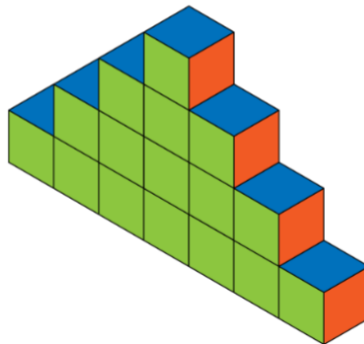
Stage 3: $C = 9$



Stage control



Stage 4: $C = 16$



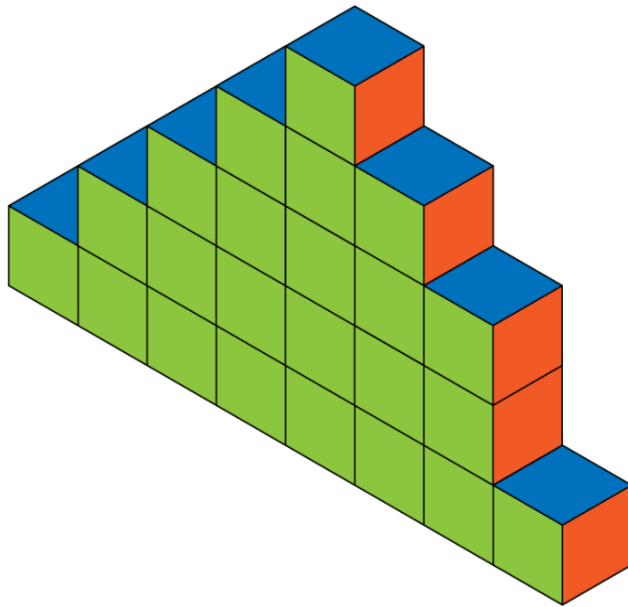


Question 8a (1 mark)

Construct Stage 5 by completing the structure on the canvas.



Draggable cubes:



✓ Complete Answer



Question 8b (1 mark)

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

Stage number (n)	Number of cubes (C)
1	1
2	4
3	9
4	16
5	
6	

Reset



Question 8c (2 marks)

Describe, in words, **two** patterns in the table for the number of cubes (C).

B *I* ↶ ↷ U \times_2 \times^2 $\frac{1}{2} =$ \div $:=$ Ω \downarrow
✓ 📄 Styles \downarrow





Question 8b (1 mark)

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

Stage number (n)	Number of cubes (C)
1	1
2	4
3	9
4	16
5	
6	

Reset



Question 8d (2 marks)

Write down, in simplest form, a general rule for C in terms of n .

B *I* \leftarrow \rightarrow \times_2 \times^2 $\frac{1}{2} =$ \div $:=$ \vee Ω \vee
 $\sqrt{\quad}$ Styles \vee





Question 8f (1 mark)

You will now investigate the total number of cubes in a new structure.

Interact with the stage control to reveal the structure and number of cubes (V).

Stage control



Stage 1: $V = 5$

3D view



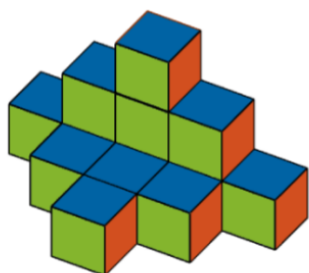
Plan view



Stage control



3D view



Stage 2: $V = 13$

Plan view

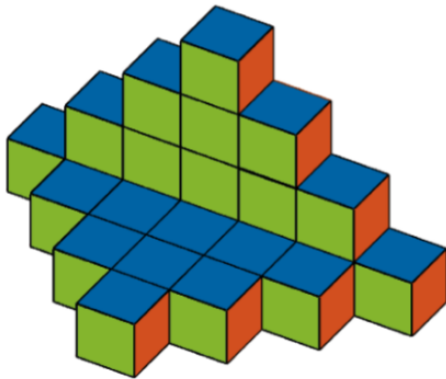


Stage control



Stage 3: $V = 25$

3D view



Plan view





Question 8g (20 marks)

Investigate the values in the table to find a relationship for the number of cubes (V) 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 **two** patterns in the table for the number of cubes (V)
- write down, in simplest form, a general rule for V in terms of n
- test and verify your general rule for V
- justify your general rule for V .



Stage number (n)	Number of cubes (V)	
1	5	
2	13	
3	25	
4	41	
5		
6		

Reset



B *I* ↶ ↷ U x_2 x^2 \int ∇ \equiv ∇ Ω ∇

✓ Styles ∇