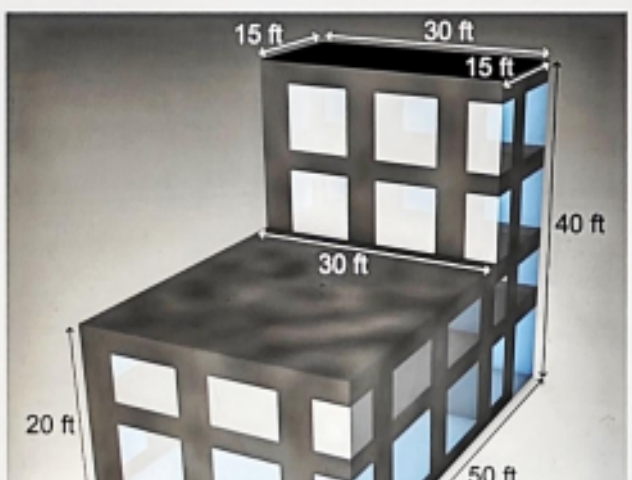
Question 1 (8 marks)

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

Question 1a (3 marks)

Dimensions are in feet (ft)



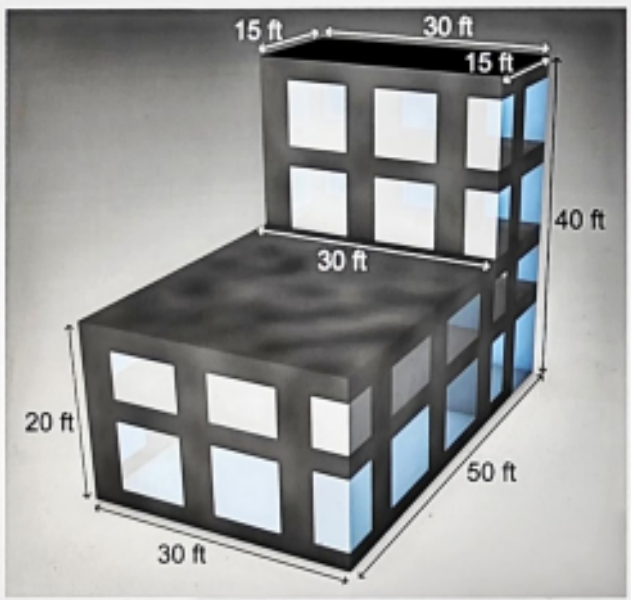
Calculate the volume of the office building in cubic feet.

B I U x_2 x^2 Ω Σ

Styles

Question 1a (3 marks)

Dimensions are in feet (ft)



Calculate the volume of the office building in cubic feet.

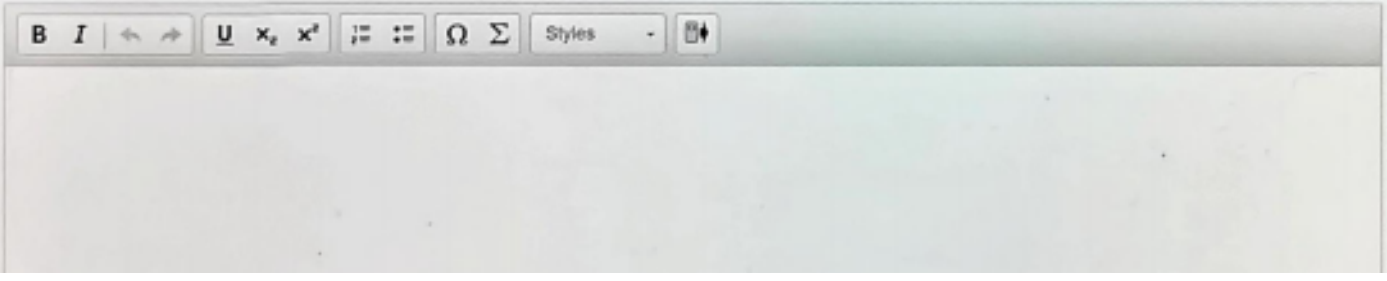
B I U x_2 x^2 Ω Σ

Styles

Question 1b (3 marks)

Given that the mean number of employees in the office building for the two-day weekend is 3 and for the whole seven-day week is 58.

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



Question 1c (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:

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

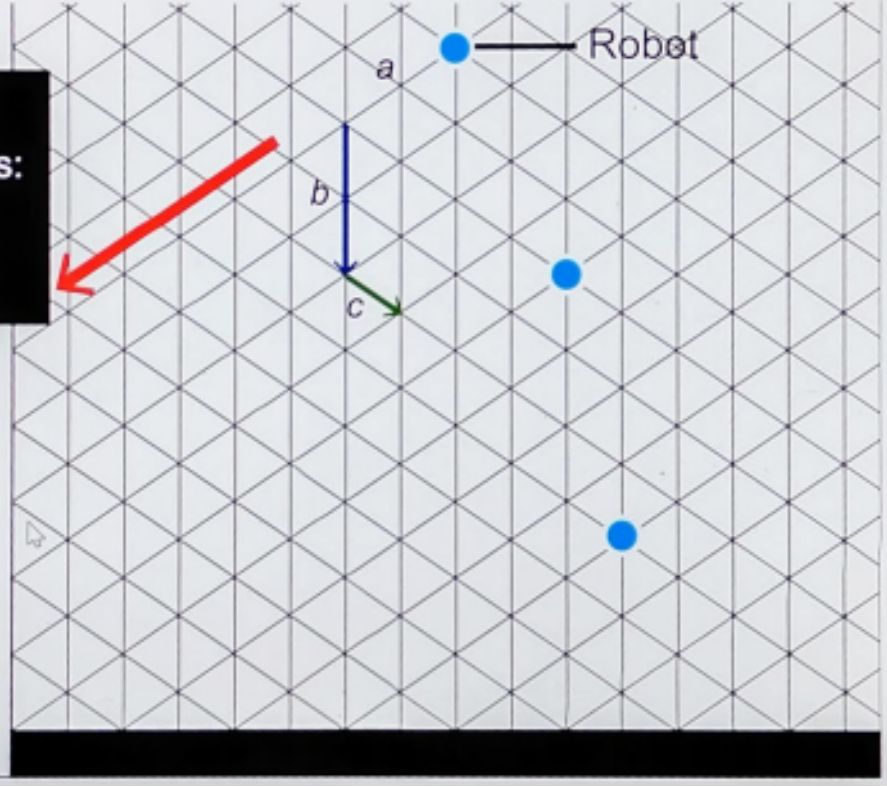
Where:

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 2 (6 marks)

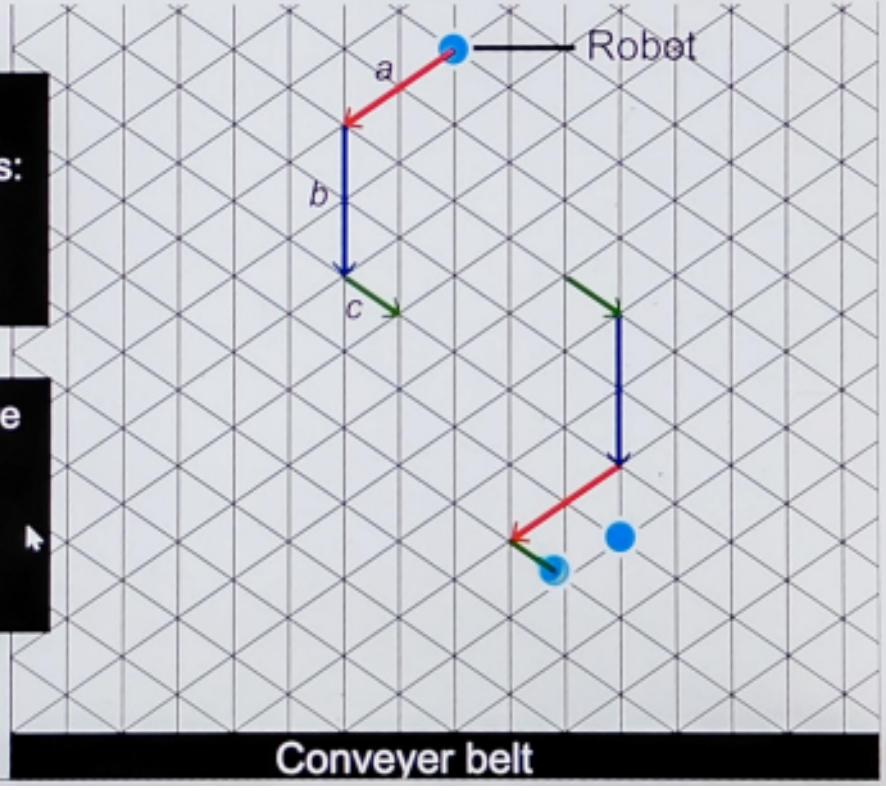
They can move according to the three following vectors: *a*, *b*, *c* to deliver the books to a moving conveyer belt.



Question 2 (6 marks)

They can move according to the three following vectors: *a*, *b*, *c* to deliver the books to a moving conveyer belt.

In this question Robots move on paths modelled by a two-dimensional isometric grid.



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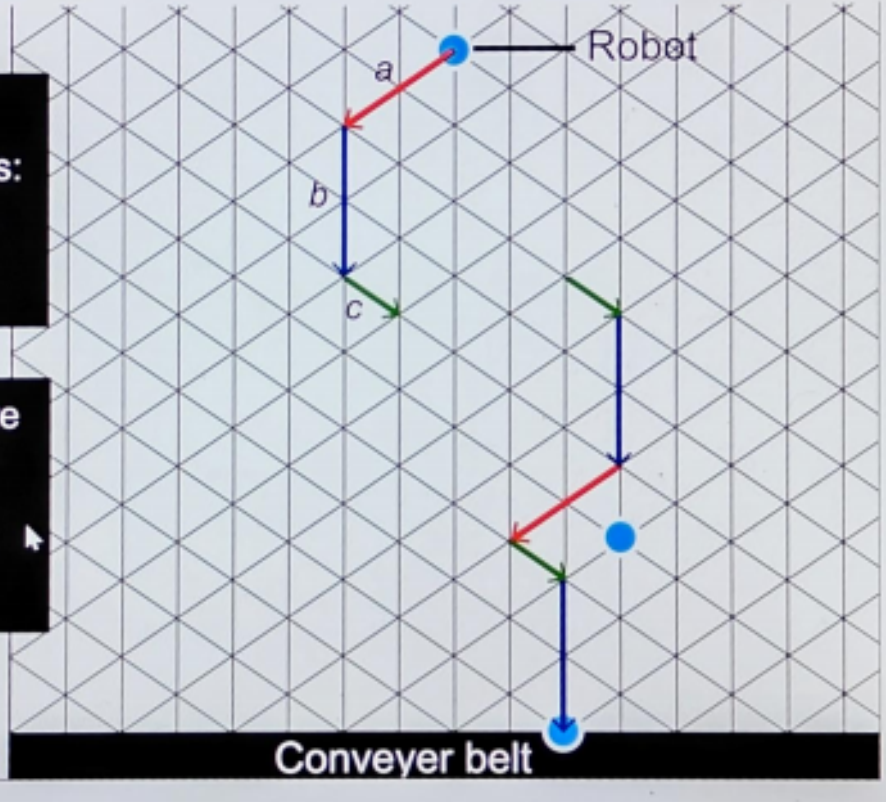
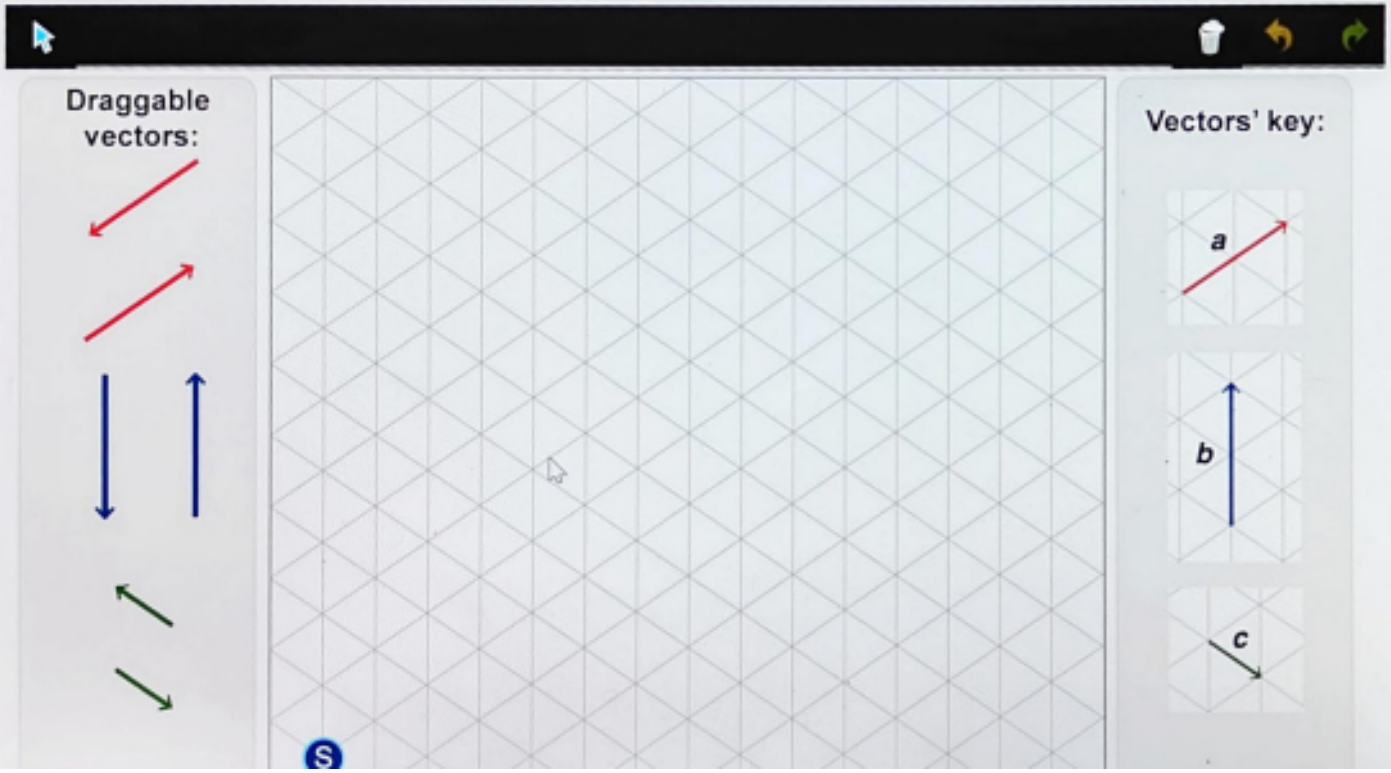
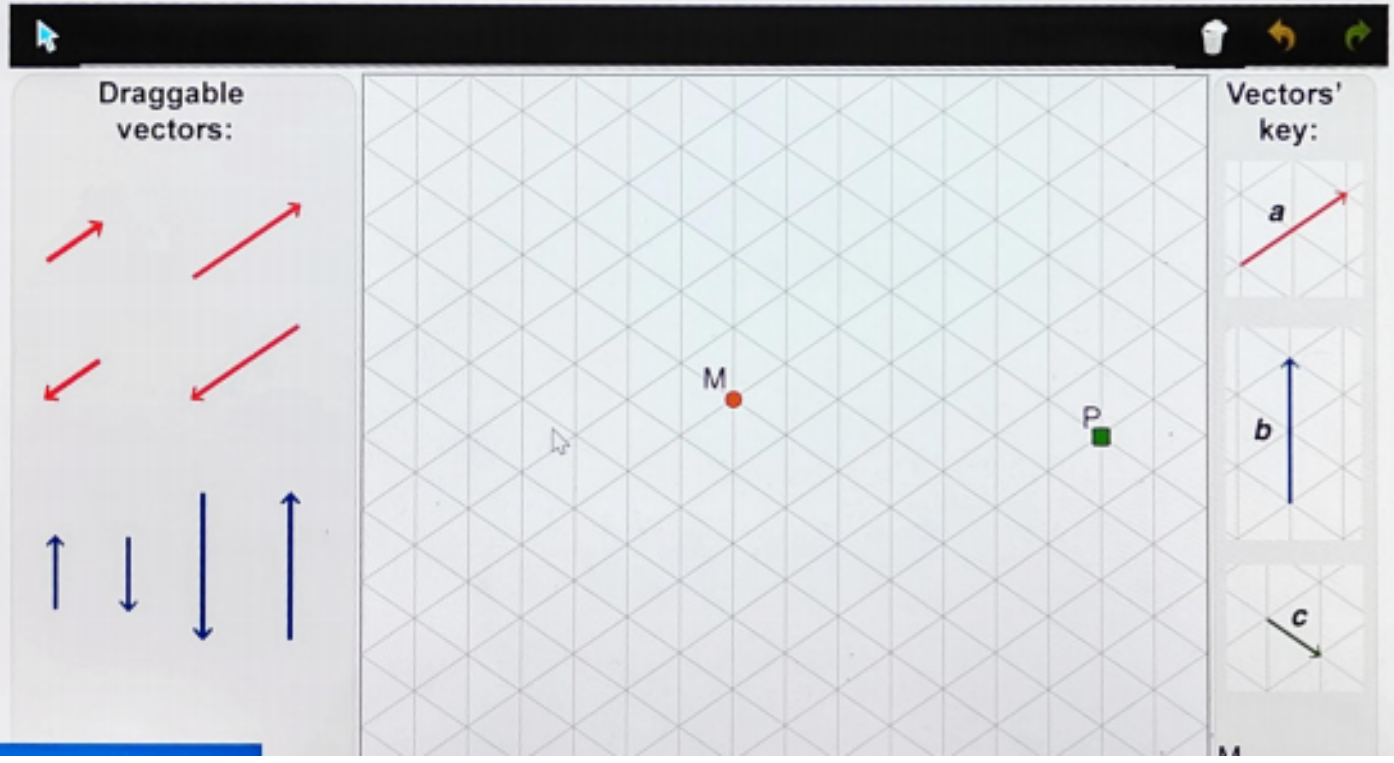


Robot 1 is at point S. It moves following the vector $3\boldsymbol{a} - \boldsymbol{c} - 2\boldsymbol{b}$. Label the grid to show the path of Robot 1.

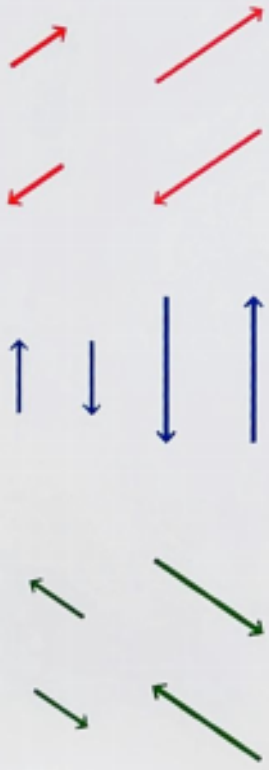


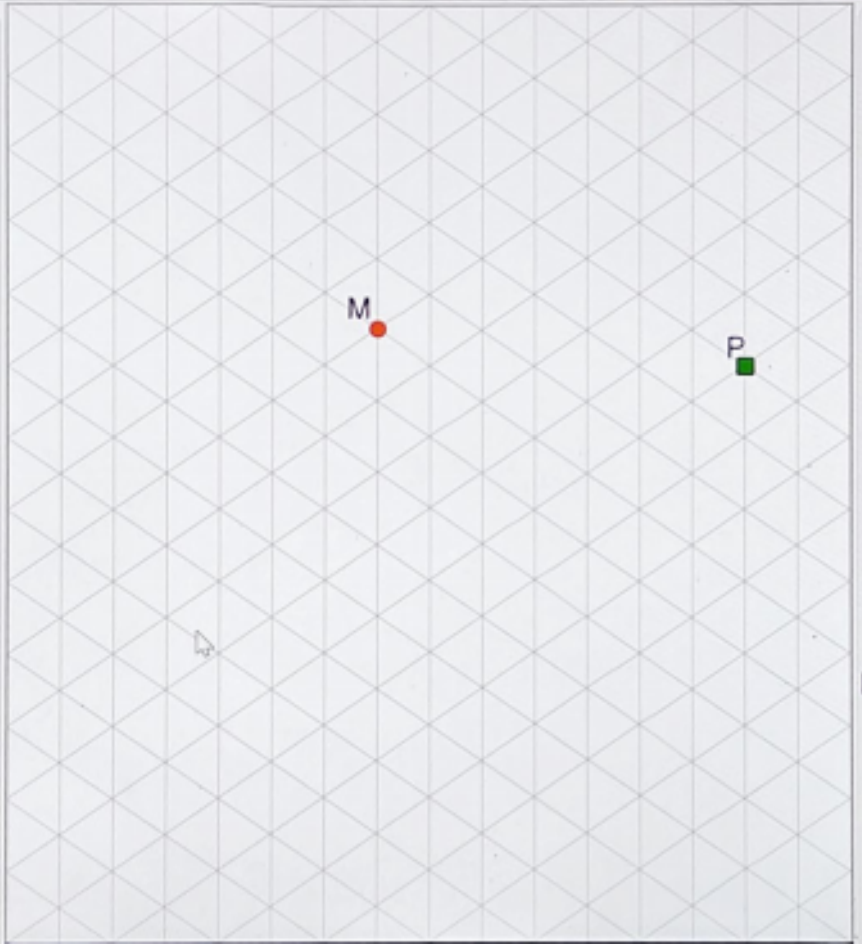
Question 2b (2 marks)

Robot 2 is at point M. It must collect books from point P and then deliver them to the conveyor belt. **Determine** the vector of path of Robot 2, in terms of ***a***, ***b*** and ***c***, in its simplest form.

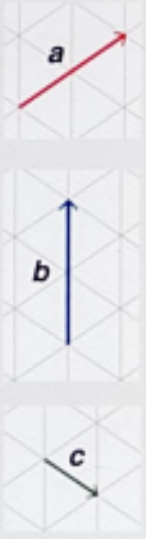


Draggable vectors:





Vectors' key:



M Robot 2

P Books

Question 2c (3 marks)

4 robots can prepare 15 orders in 3 minutes. **Calculate** how many minutes it would take 10 robots to prepare 300 orders.

B I U x_2 x^2 Ω Σ

Styles

Question 3a (1 mark)

Izumi is a volunteer at a pet rescue centre which has cats, dogs and rabbits 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:

Pet Rescue Centre

Pet Rescue Survey

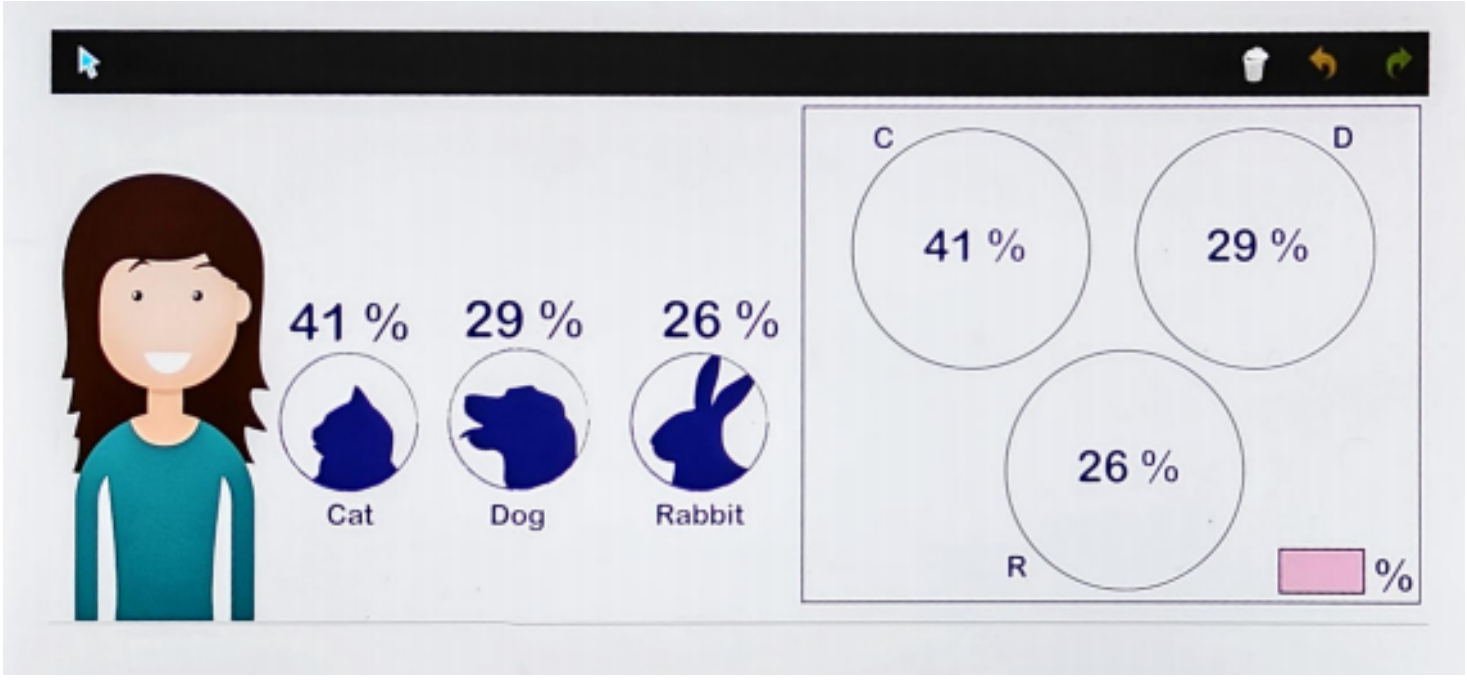
Gender:	**Girl** ☐	**Boy** ☐
Would you like to adopt a cat, dog or rabbit?	**Yes** ☐	**No** ☐
If Yes, select a pet:	**Cat**	**Dog** **Rabbit**

She asked the following questions:

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

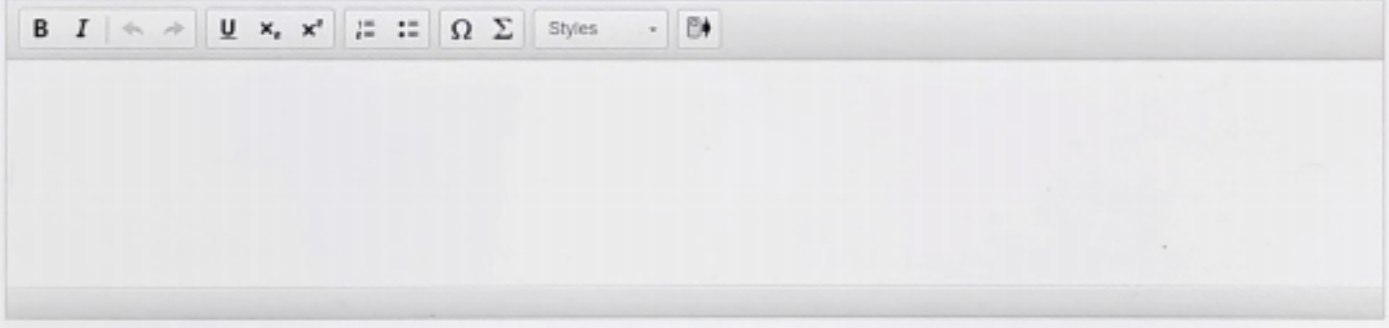
Event C represents: Would like to adopt a cat
Event D represents: Would like to adopt a dog
Event R represents: Would like to adopt a rabbit
No girl selected more than one pet.

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


41 %
29 %
26 %
Cat
Dog
Rabbit
C
D
41 %
29 %
26 %
R
%

Question 3b (1 mark)

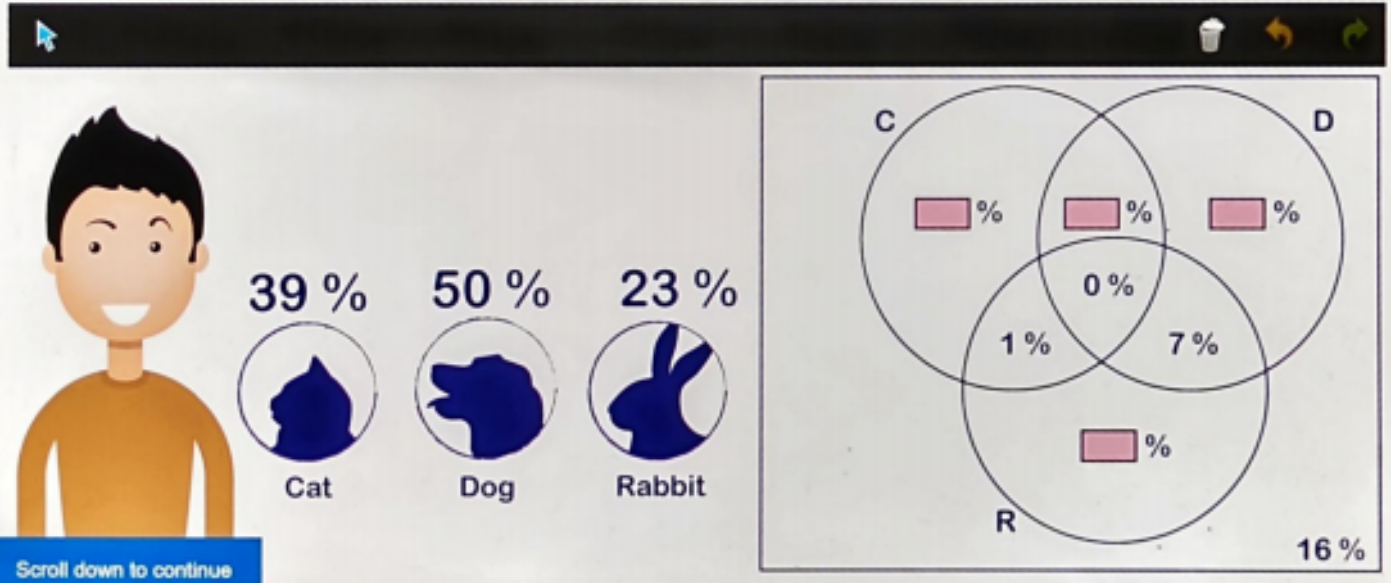
Events C, D and R are mutually exclusive. **State** how this is represented in the Venn diagram.



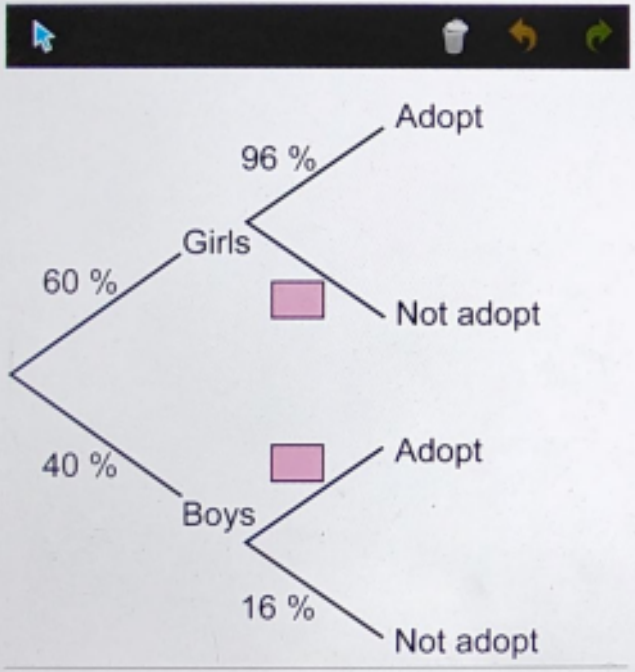
Question 3c (5 marks)

The image shows the survey results for the boys. Some boys indicated that they would like to adopt more than one type of pet. Izumi draws the following Venn diagram to summarize the survey results for the boys.

Find the missing values and complete the Venn diagram.



Question 3d (3 marks)



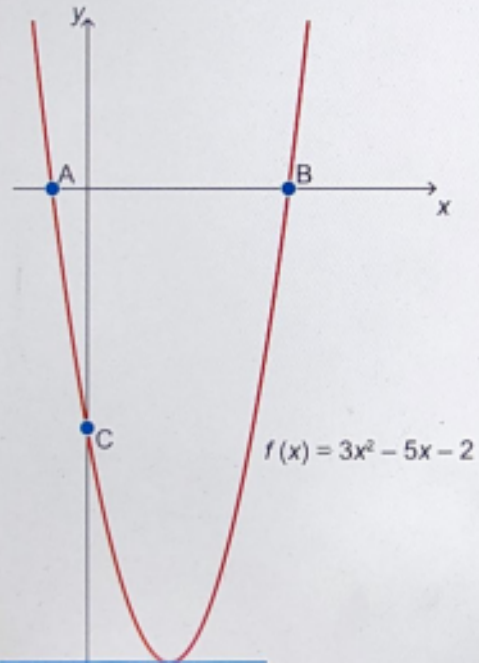
On the festival day, 60 % of the students are girls and 40 % are boys. **Calculate** the probability that a student at the festival will adopt a pet from the pet rescue centre.

B I U x_2 x^2 Ω Σ

Styles

Question 4 (6 marks)

The following diagram shows part of the graph of a quadratic function $f(x) = 3x^2 - 5x - 2$

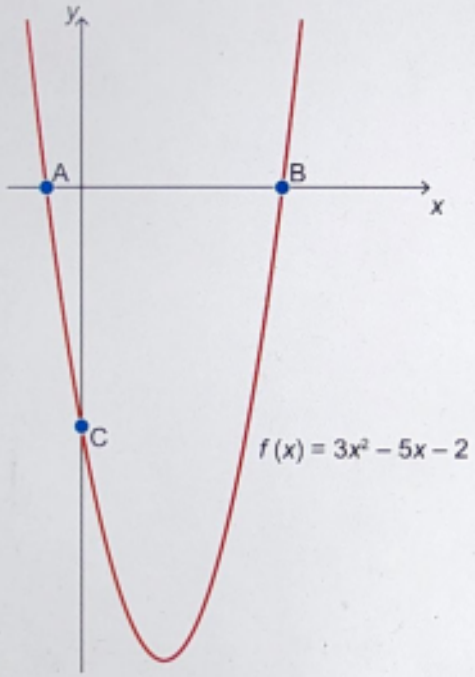


Question 4a (1 mark)

Write down the coordinates of point C.

B I U x_2 x^2 Ω Σ

Styles

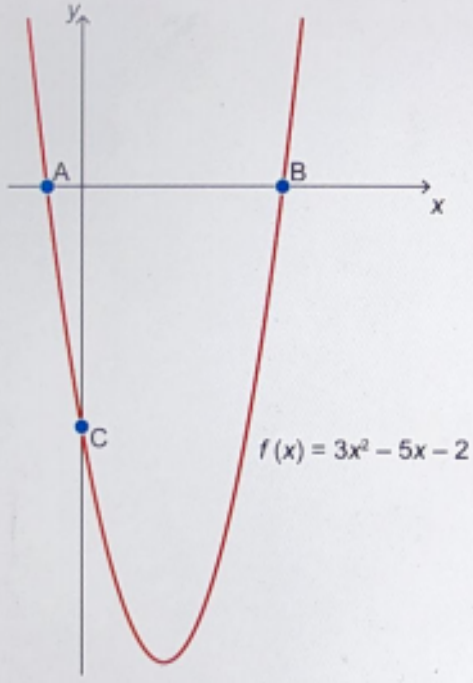


Question 4b (4 marks)

Find the coordinates of points A and B.

B I U x_2 x^2 Ω Σ

Styles



Question 4c (1 mark)

The function f is reflected on the y-axis

Write down the coordinates of point B after the reflection.

B I U x_2 x^2 Ω Σ

Styles

Question 5 (6 marks)

Question 5a (2 marks)

Given that $\log 2x = \log 12y - \log 3$, **show that** $x = 2y$.

B I | U x_2 x^2 | Ω Σ | Styles

Question 5b (4 marks)

Hence or otherwise, **solve** the simultaneous equations

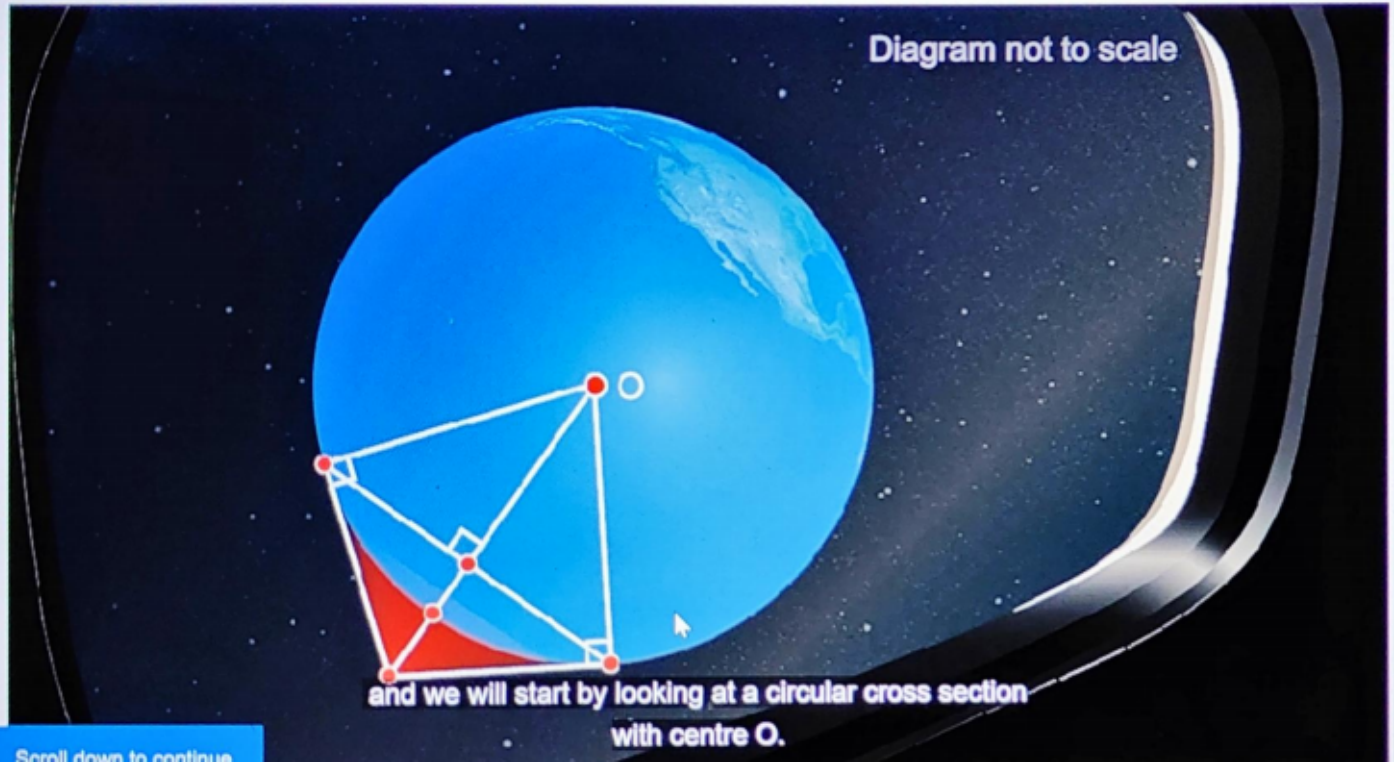
$$\log_4(3x - 2y) = 2$$

$$\log 2x = \log 12y - \log 3$$

B I U x_a x^a Ω Σ Styles

Question 6 (14 marks)

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



Scroll down to continue

Question 6 (14 marks)

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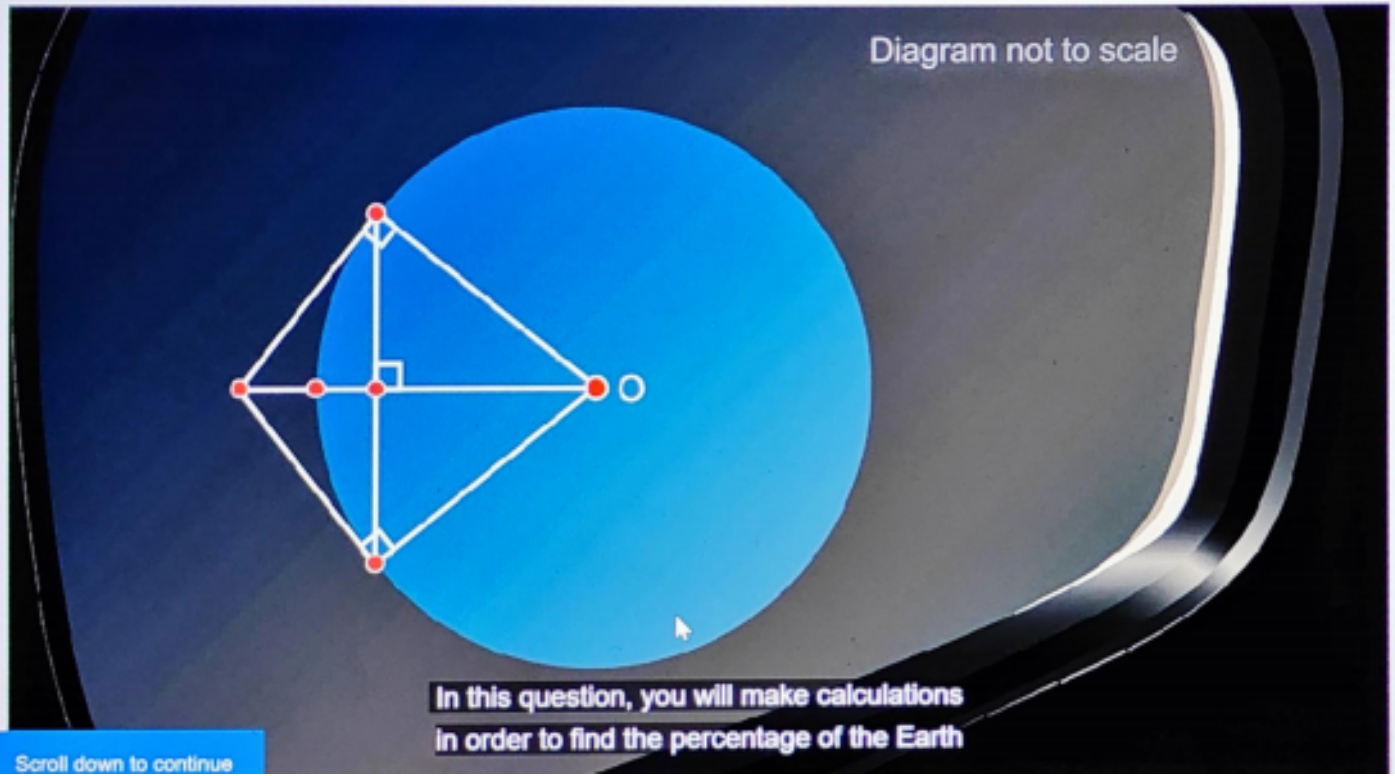

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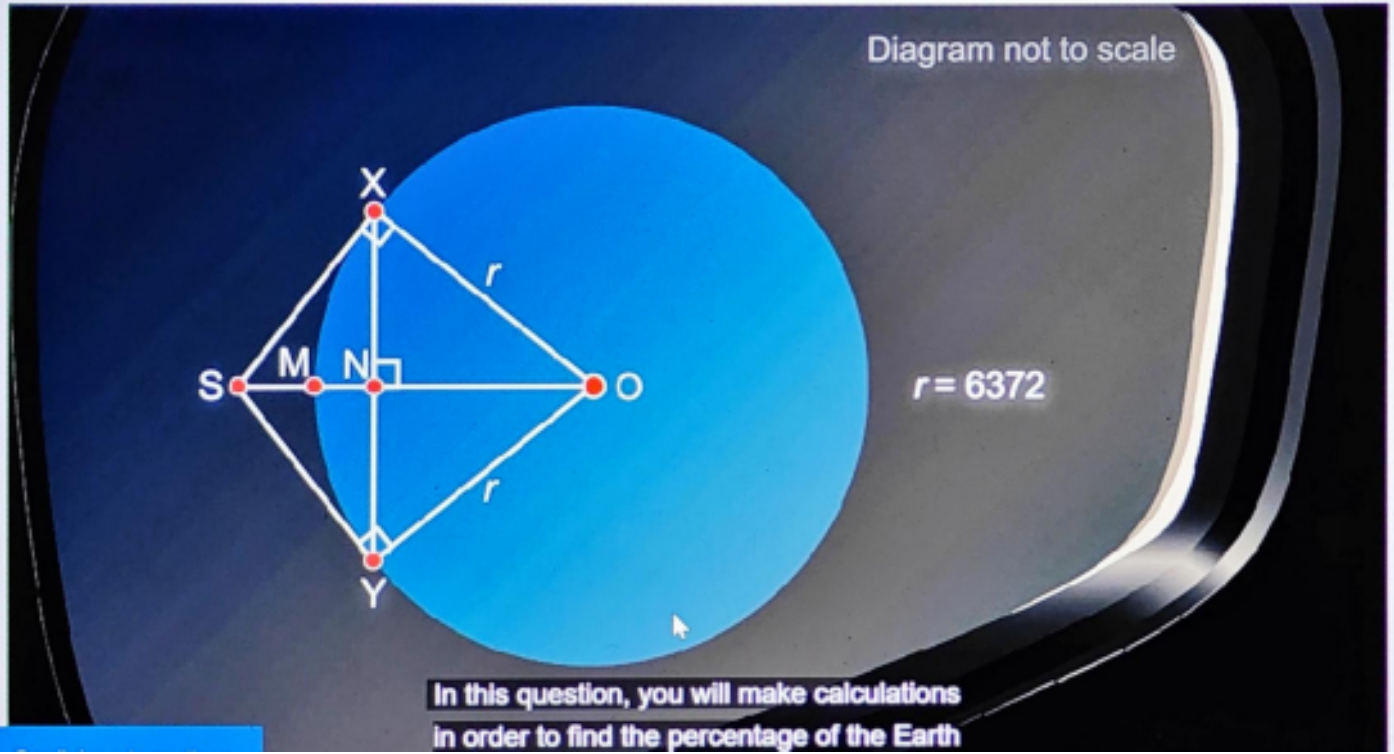
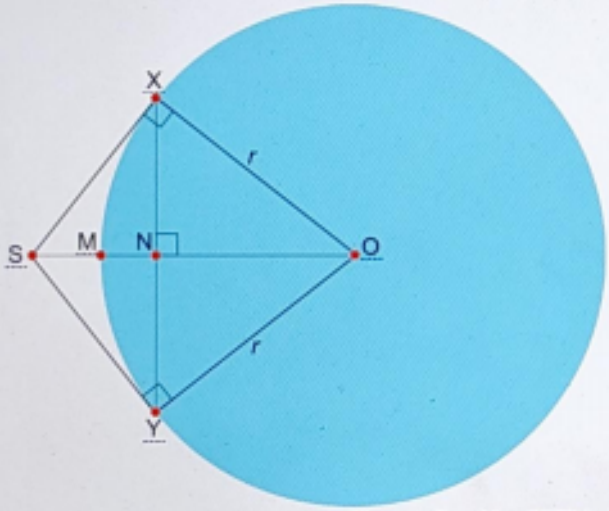


This media is interactive

Hover over the letters to reveal the label.

Diagram not to scale



Key: radius (r) = 6372 km

Question 6a (1 mark)

The radius of the Earth is $r = 6372$ km

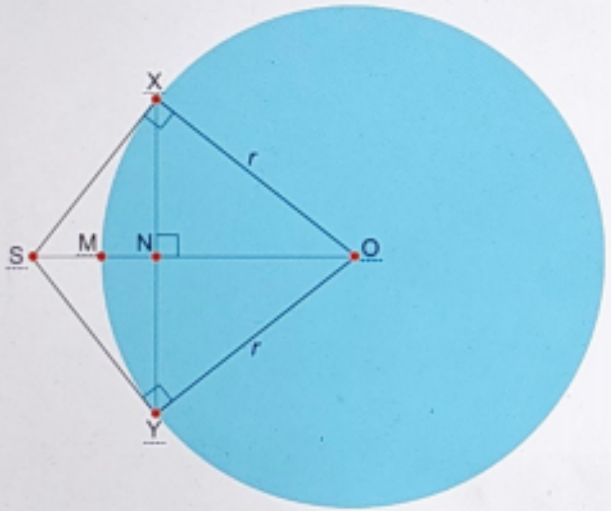
Given that MS is 400 km, **show that** OS is 6772 km.

B I U Styles

This media is interactive

Hover over the letters to reveal the label.

Diagram not to scale



Key: radius (r) = 6372 km

Question 6b (2 marks)

OS is perpendicular to the chord XY, **show that** triangle NOX is similar to triangle XOS.

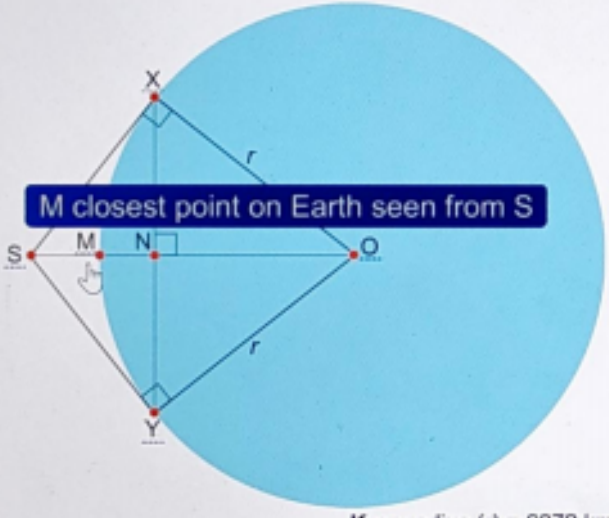
B I U x_2 x^2 Ω Σ

Styles

This media is interactive

Hover over the letters to reveal the label.

Diagram not to scale



Key: radius (r) = 6372 km

Question 6c (4 marks)

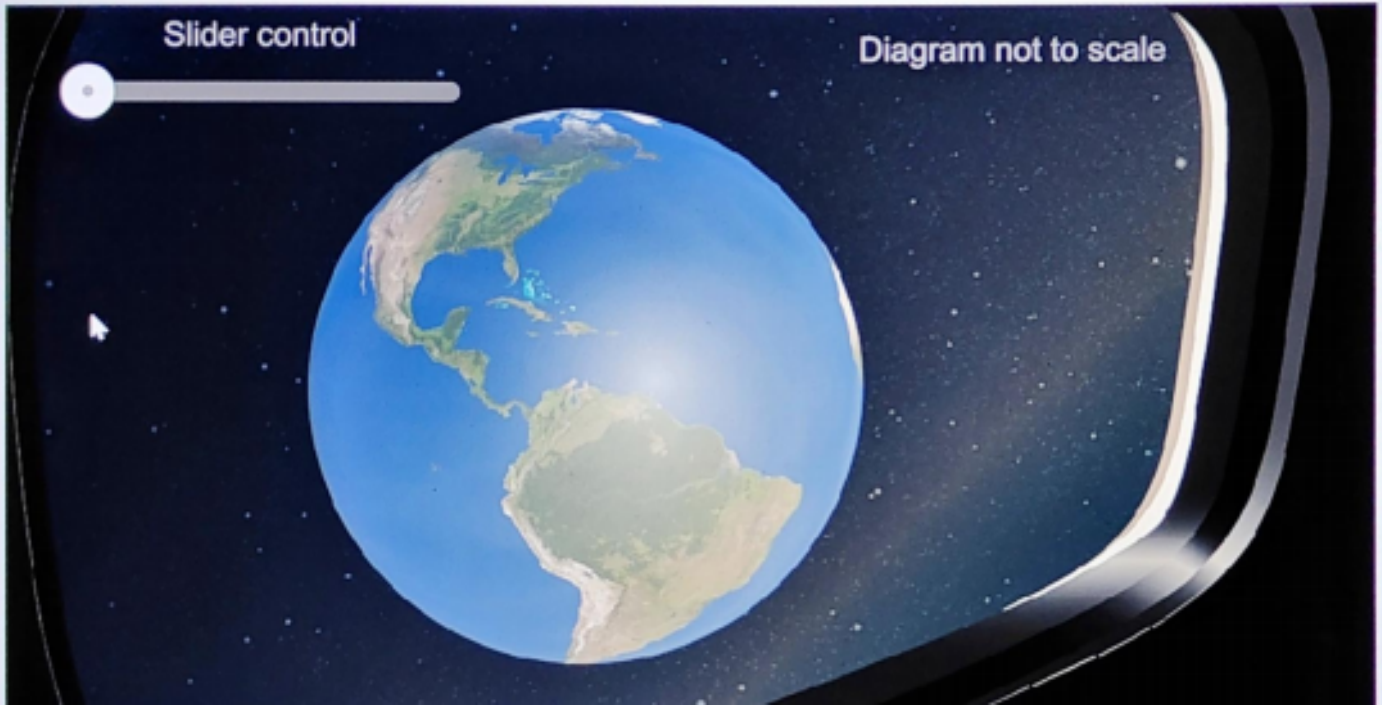
Hence, **find** the length of ON to the nearest km.

B I U x_a x^a Ω Σ

Styles

Question 6d (4 marks)

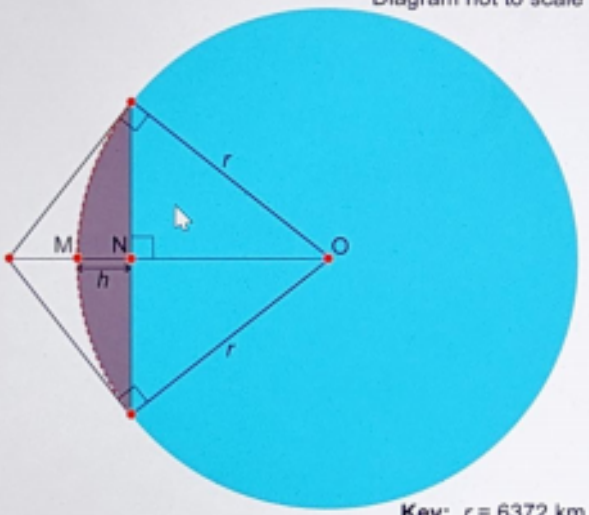
This media is interactive



Question 6d (4 marks)

This media is interactive

Diagram not to scale



Key: $r = 6372$ km

= Spherical cap

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.

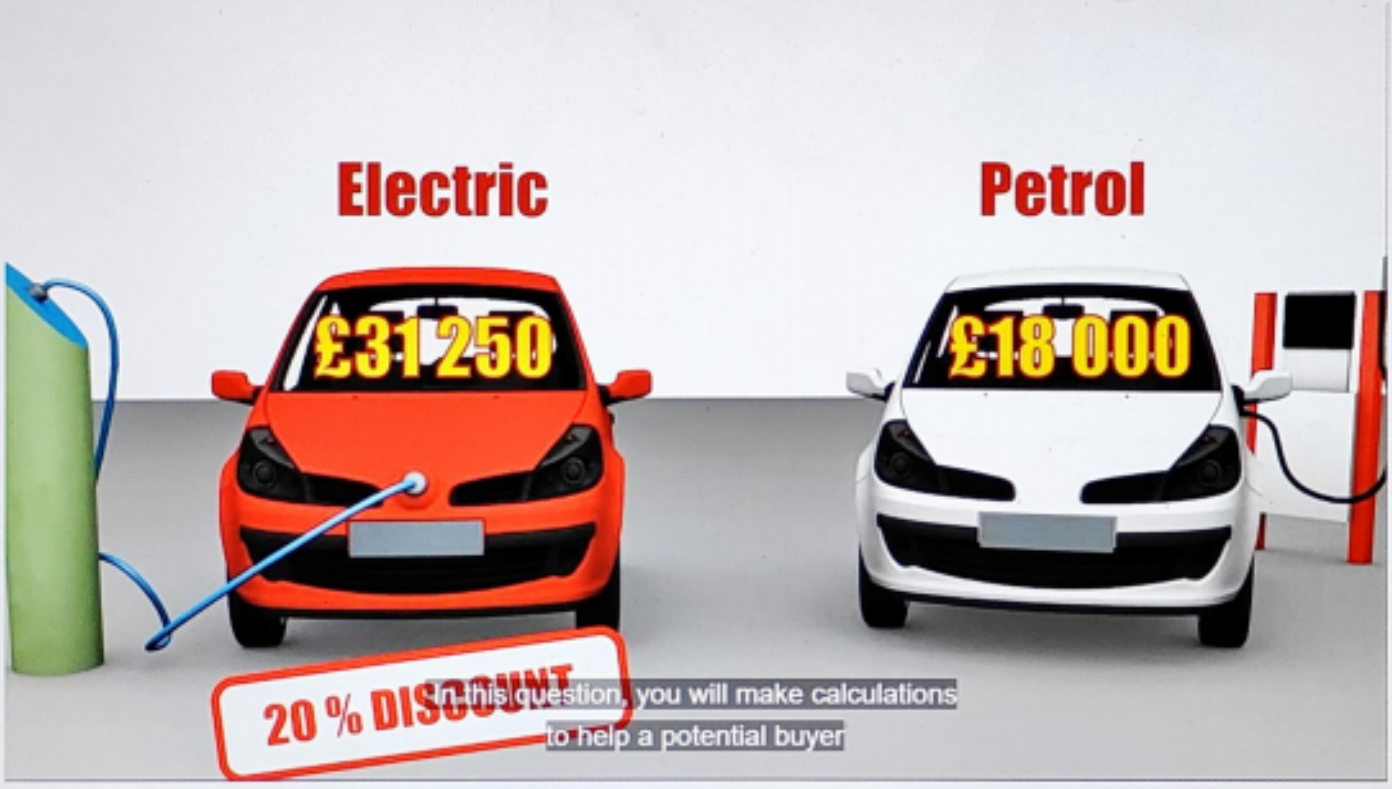
B I U x_2 x^2 Ω Σ

Styles

Question 6e (3 marks)

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

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



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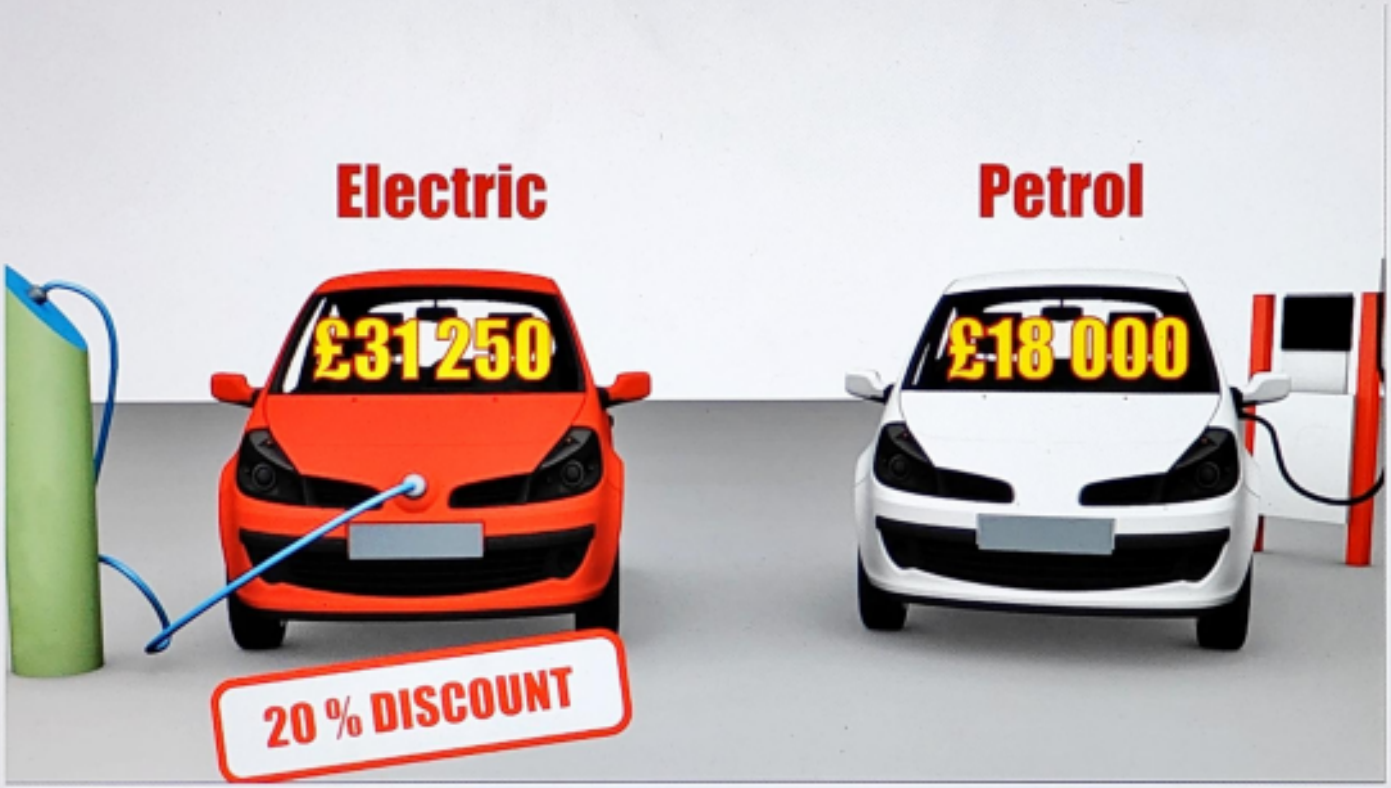


Cost in £	Vehicle A (electric-powered)	Vehicle B (petrol-powered)
Vehicle	?	18 000
Fuel per mile	0.035	0.085
Annual fuel	?	1190

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.

B I U x_2 x^2 Ω Σ Styles

Question 7b (2 marks)

A person drives 14 000 miles on average per year.

Determine the annual fuel cost of vehicle A.

B I U x_2 x^2 Ω Σ Styles

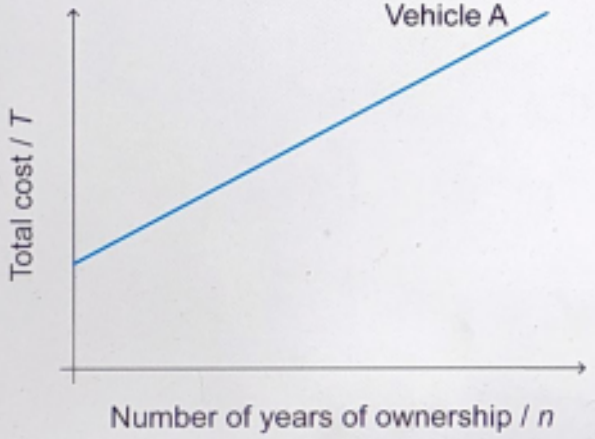
Question 7c (3 marks)

The annual fuel cost of vehicle B is £1190. **Find** the percentage savings of the annual fuel cost when purchasing vehicle A instead of vehicle B.

Question 7d (2 marks)

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

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.

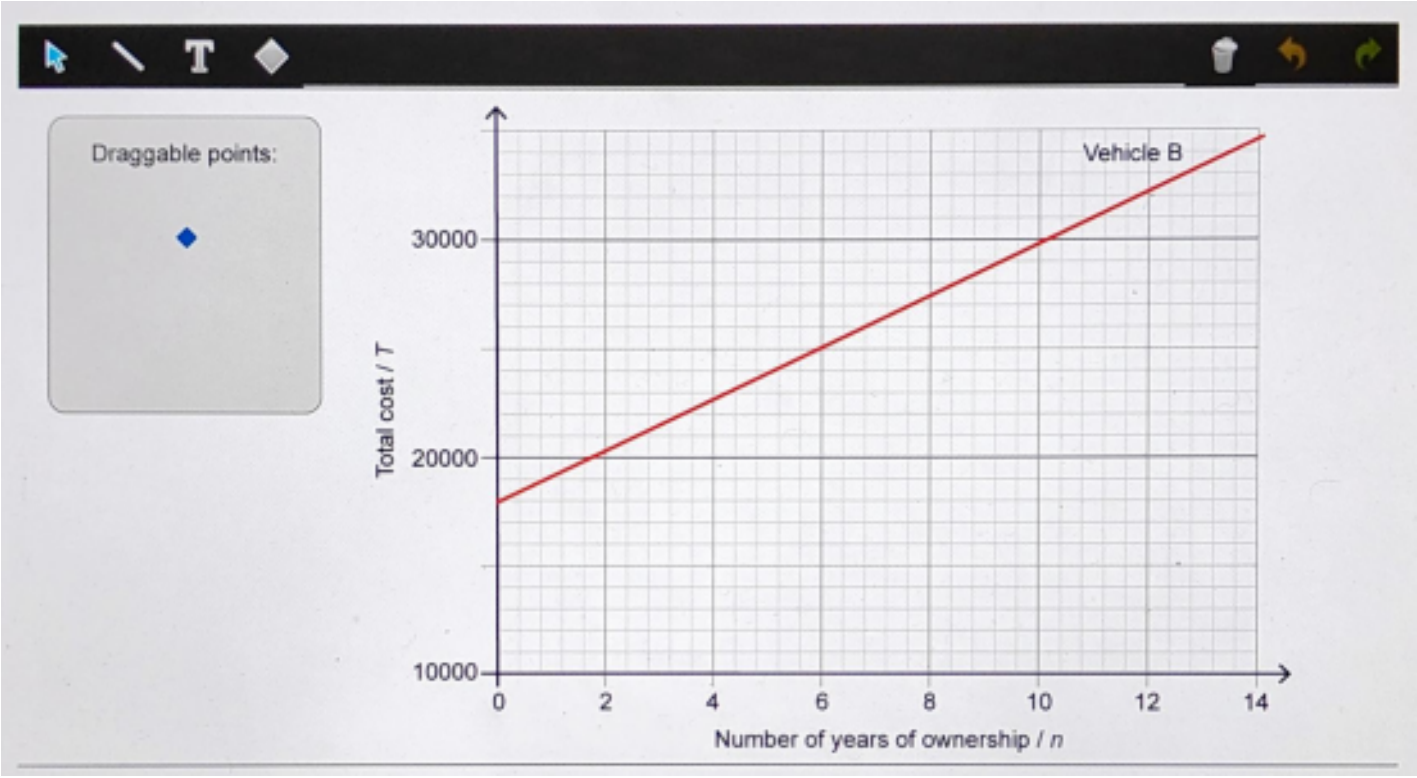
B I U x_n x^n Ω Σ

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:

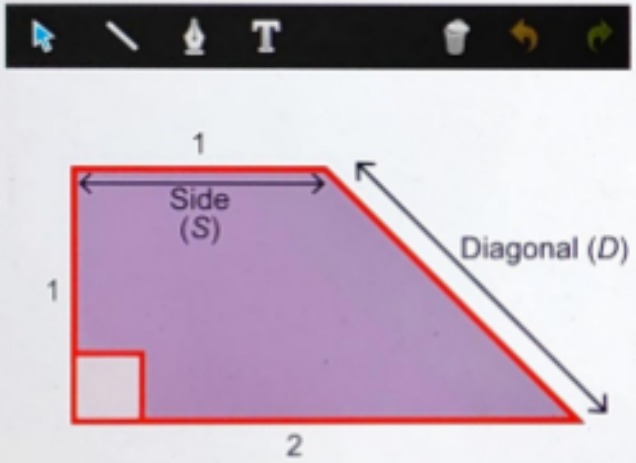
- identify **three** relevant factors to consider when deciding whether to buy vehicle A or vehicle B
- draw a graph that describes the linear relationship for the total cost (T) of owning vehicle A for n years
- determine after how many years the total cost of owning vehicle A is equal to vehicle B
- 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:
Vehicle B
30000
20000
10000
Total cost / T
0
2
4
6
8
10
12
14
Number of years of ownership / n

Question 8 (30 marks)

Question 8a (2 marks)

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

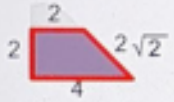


Show that the diagonal of the trapezium is $\sqrt{2}$ units.

B I U Styles Ω Σ

Use the slider to see how more trapeziums are produced.

Stage 2



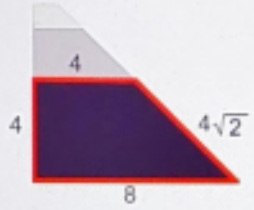
Stage control

Stage: 2

Stage (n)	Diagonal (D)
1	$\sqrt{2}$
2	$2\sqrt{2}$

Use the slider to see how more trapeziums are produced.

Stage 3

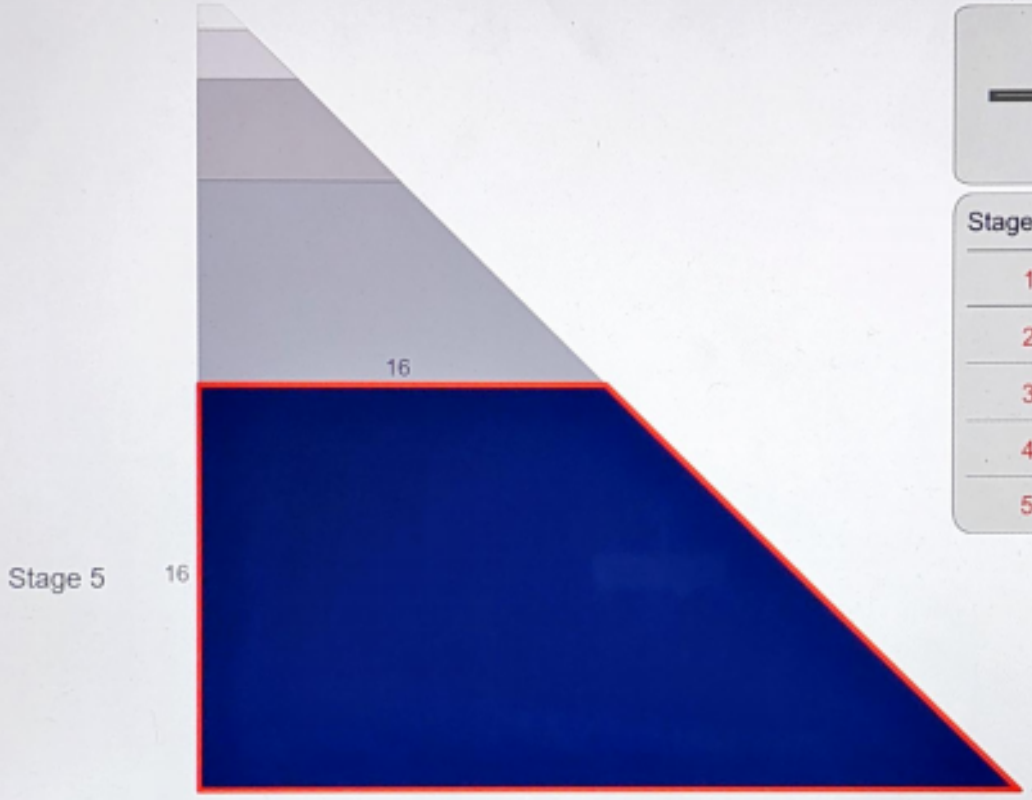


Stage control

Stage: 3

Stage (n)	Diagonal (D)
1	$\sqrt{2}$
2	$2\sqrt{2}$
3	$4\sqrt{2}$

Use the slider to see how more trapeziums are produced.



Stage control

Stage: 5

Stage (n)	Diagonal (D)
1	$\sqrt{2}$
2	$2\sqrt{2}$
3	$4\sqrt{2}$
4	$8\sqrt{2}$
5	

Question 8b (1 mark)

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

Double click inside a cell to show the equation toolbar.

Stage (n)	Diagonal (D)
1	$\sqrt{2}$
2	$2\sqrt{2}$
3	$4\sqrt{2}$
4	$8\sqrt{2}$
5	

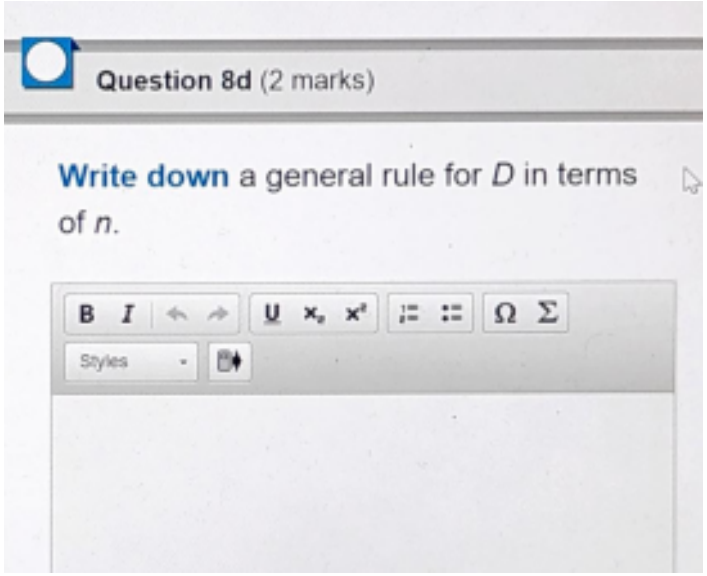
Question 8c (2 marks)

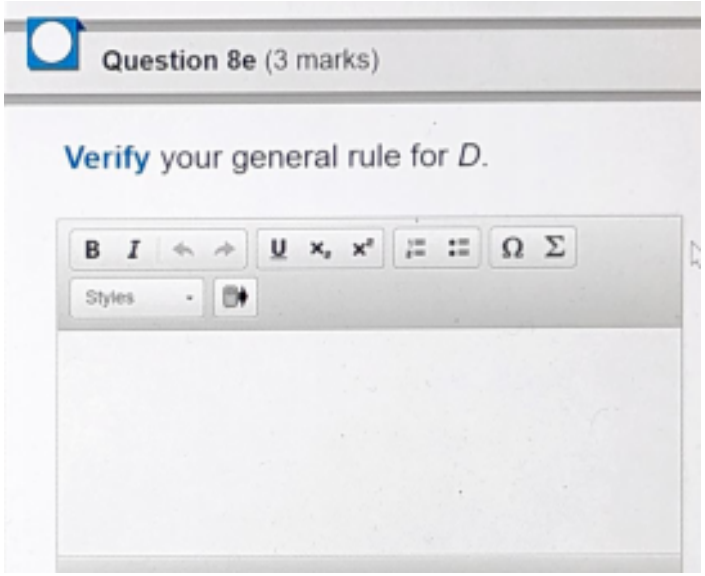
Describe in words **two** patterns you see in the table for D.

B I U x_2 x^2 Ω Σ

Styles

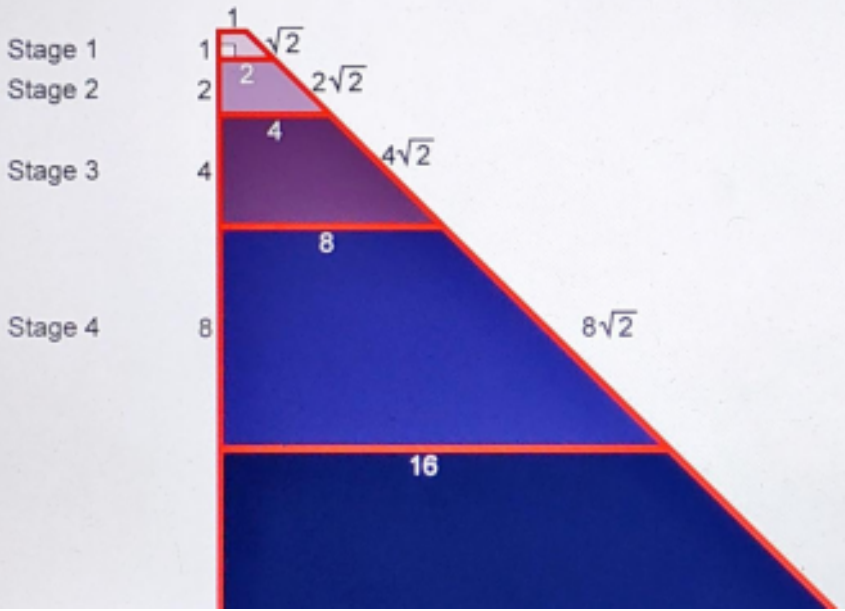
Question 8d (2 marks)

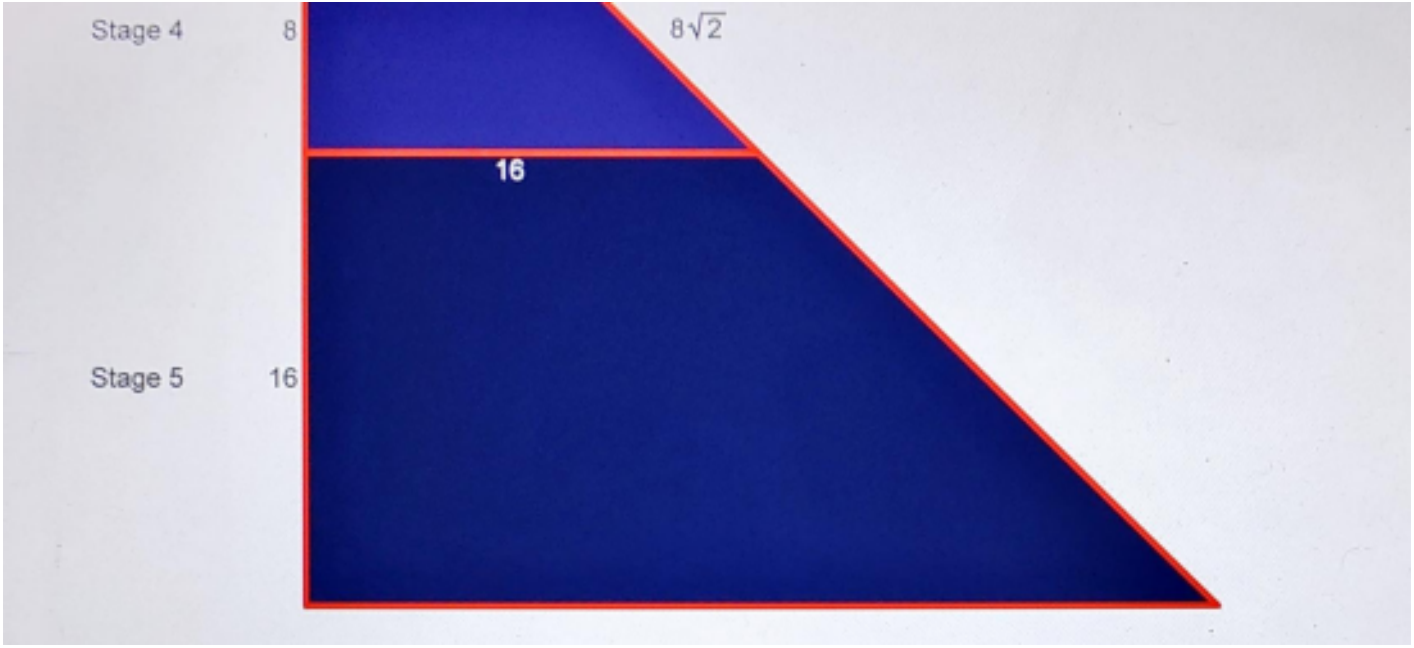

Question 8d (2 marks)
Write down a general rule for D in terms of n.
Styles


Question 8e (3 marks)
Verify your general rule for D.
Styles

Question 8f (20 marks)

The diagram below shows the trapeziums formed in each stage.




Stage 4
8
$8\sqrt{2}$
16
Stage 5
16

Double click inside a cell to show the equation toolbar.

Stage (n)	Side (S)	Diagonal (D)	Perimeter (P)
1	1	$\sqrt{2}$	$4+\sqrt{2}$
2	2	$2\sqrt{2}$	$8+2\sqrt{2}$
3	4	$4\sqrt{2}$	$16+4\sqrt{2}$
4	8	$8\sqrt{2}$	$32+8\sqrt{2}$
5			
6			

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
- find 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.