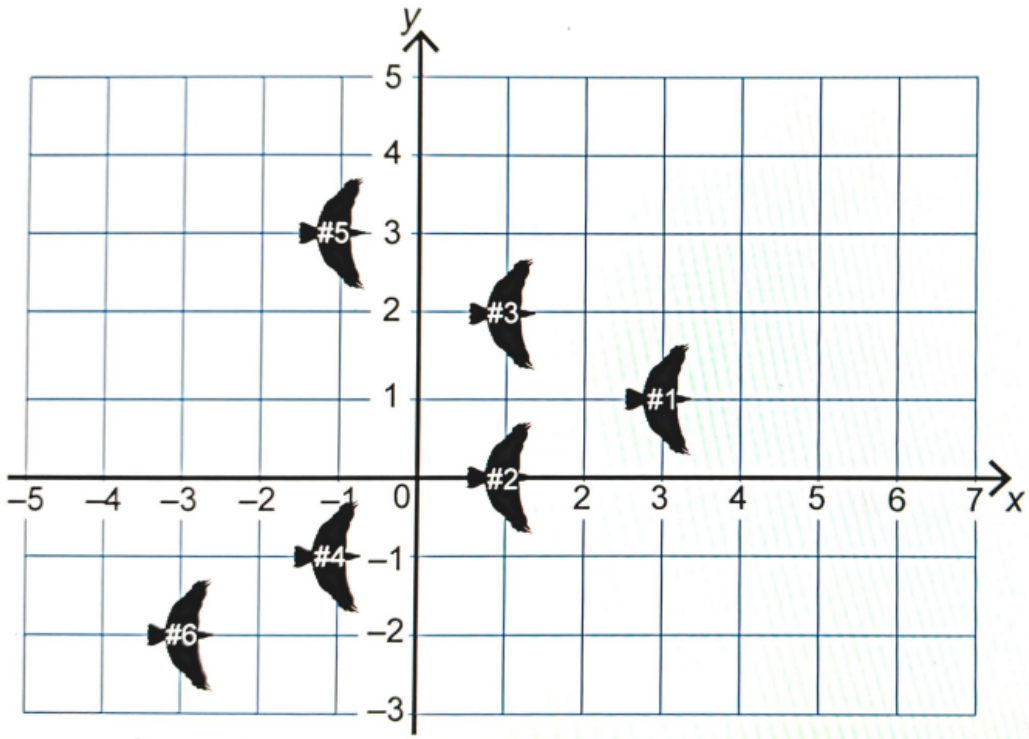
The diagram below shows a flock of birds flying.



Question 1a (1 mark)

A bird joins the flock at position (c , d). The shape formed is symmetrical. **Write down** the coordinates (c , d).

B I U x_2 x^2 Ω Σ

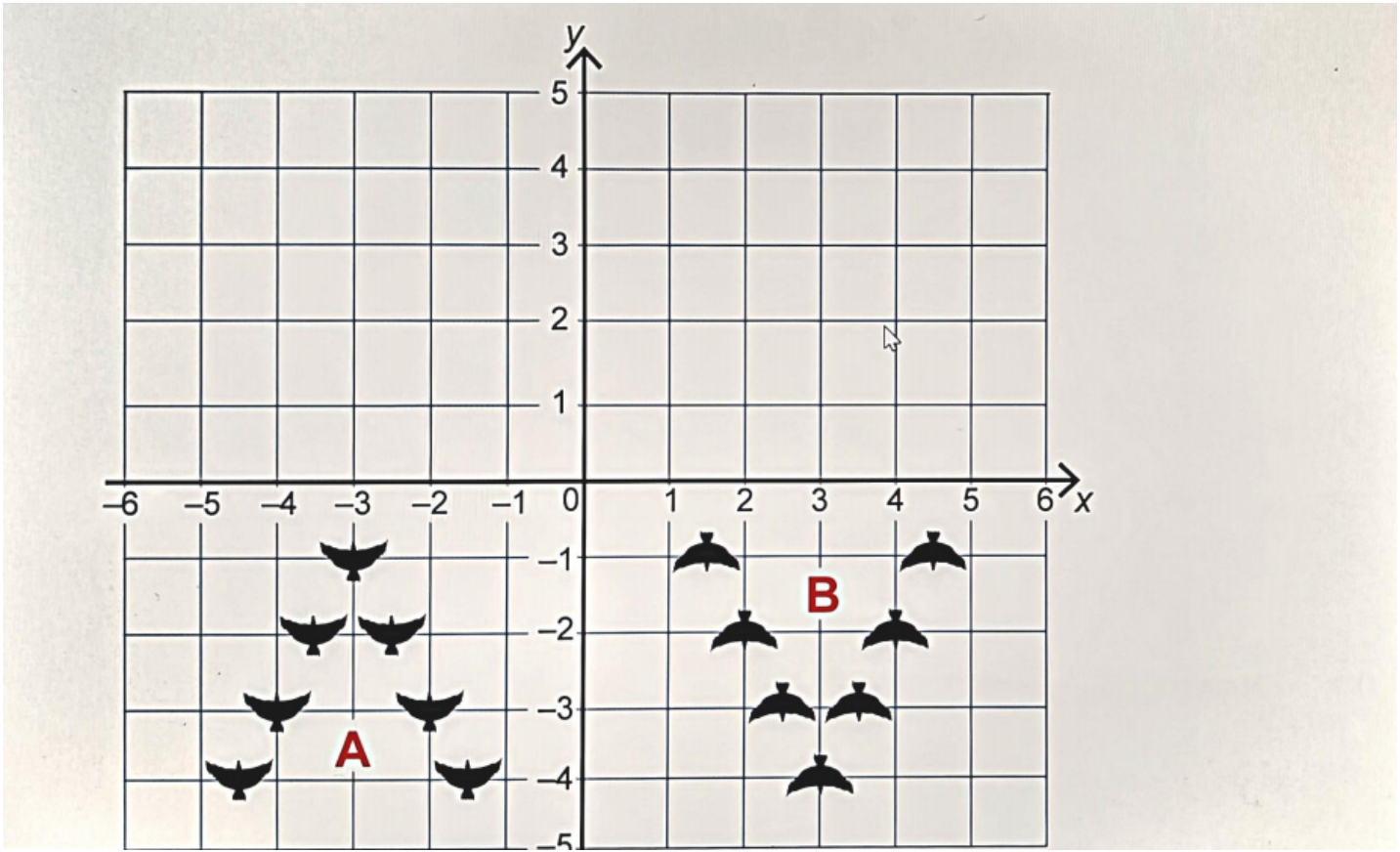
Styles

Question 1b (1 mark)

The flock of birds changes direction and rotates 90° clockwise about centre (0 , 0). **Determine** the coordinates of bird #5 after the rotation.

B I U x_2 x^2 Ω Σ

Styles

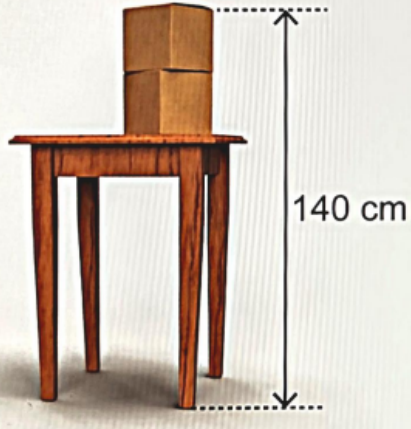

y
x
5
4
3
2
1
0
−1
−2
−3
−4
−5
−6
−5
−4
−3
−2
−1
1
2
3
4
5
6
A
B

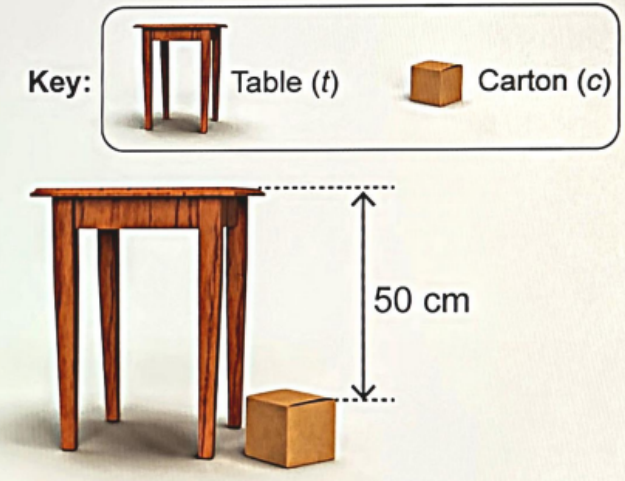
Deduce the missing information in the table.

Transformation	Type of transformation	Detail
1	Rotation	180° about (0 , 0)
2		

Using the information provided in the diagram below, **find** the height of a carton.

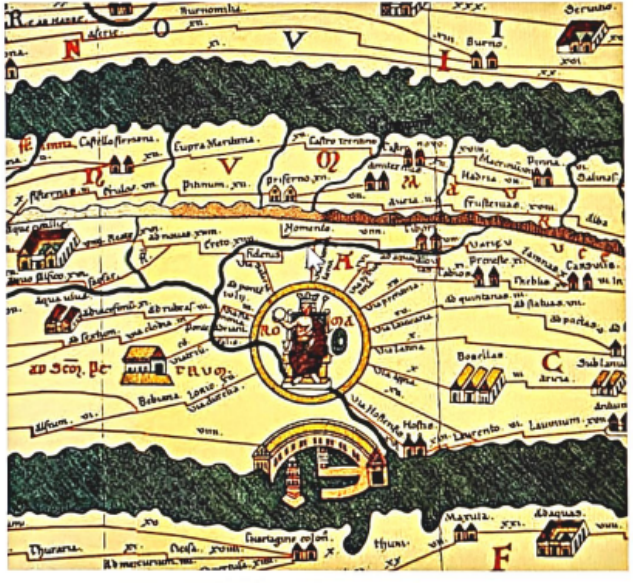
Diagram not to scale





Question 3 (12 marks)

In ancient times, Rome was the economic and cultural centre of Europe. Most big cities were linked by roads to Rome. Travellers often had to go from one city to another and choose between different roads before reaching Rome.



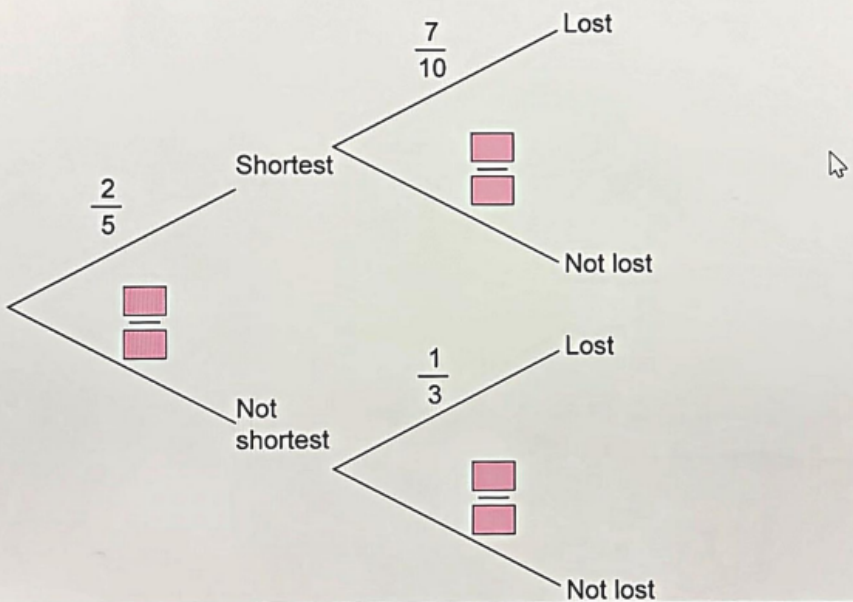
Question 3a (1 mark)

The probability that travellers choose the shortest road to Rome is $\frac{2}{5}$. **Write down** the probability that they will **not** choose the shortest road.

Question 3b (1 mark)

Travellers could get lost on the different roads. The probabilities for getting lost are illustrated in the tree diagram below.

Write down the missing probabilities in the tree diagram.



Question 3c (2 marks)

Determine the probability of choosing the shortest road and not getting lost.

B I | U x_2 x^2 Ω Σ

Styles

Question 3d (3 marks)

Find the probability that a traveller will not get lost.

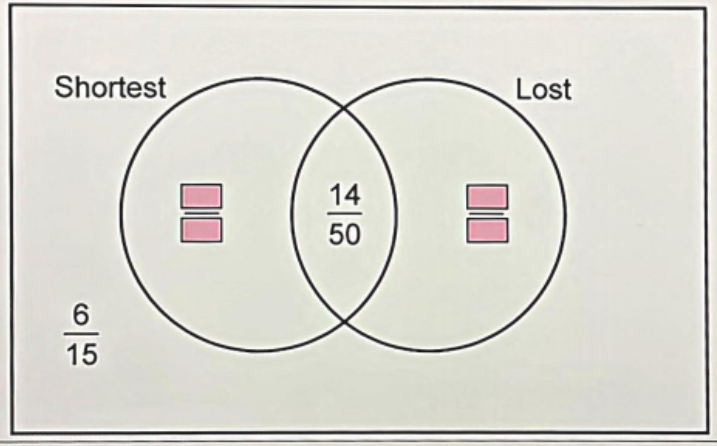
B I | U x_2 x^2 Ω Σ

Styles

Question 3e (3 marks)

The probabilities from the tree diagram can be presented in a Venn diagram.

Using your previous answers, **determine** the missing values in the Venn diagram below.



Question 3f (2 marks)

A traveller went to Rome on **three** occasions. **Determine** the probability that, on all **three** occasions the traveller did not choose the shortest road **and** did not get lost.

B I | U x_2 x^2 Ω Σ Styles

Question 4a (4 marks)

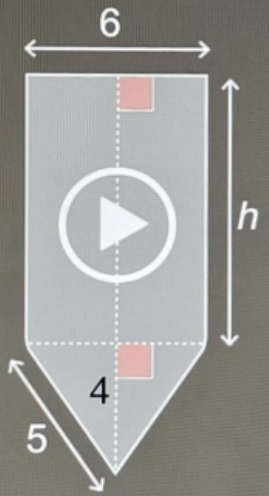
This **open** silo is made of a cylinder and a cone. The dimensions are shown in the diagram below. All units are in metres (m).

The surface area of the silo is $63\pi\ m^2$

Show that the total volume of this silo is $84\pi\ m^3$

This media contains no audio

Diagram not to scale

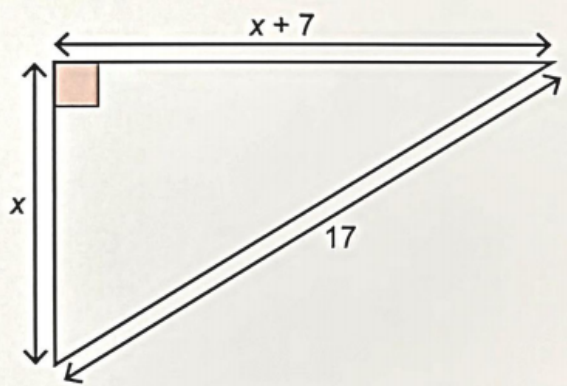


Question 4b (3 marks)

The silo is filled by pumps. One pump can fill the silo at a rate of 10 m^3 per hour. **Find** the number of pumps needed to fill the silo in less than 8 hours.

Question 5 (6 marks)

Diagram not to scale



Question 5a (4 marks)

Find the value of x.

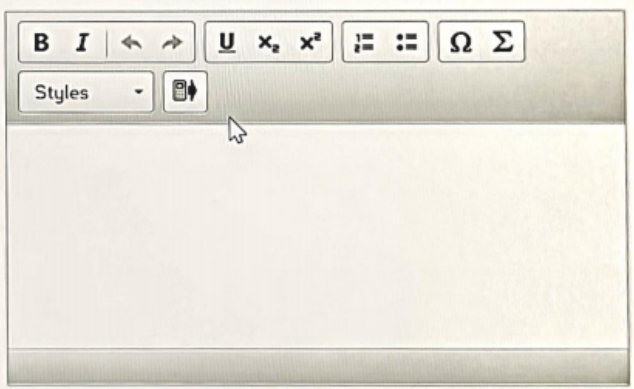
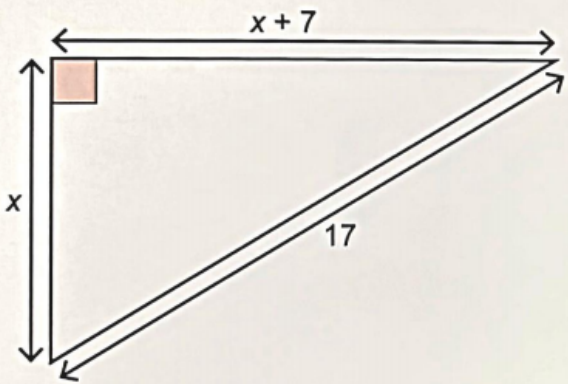


Diagram not to scale



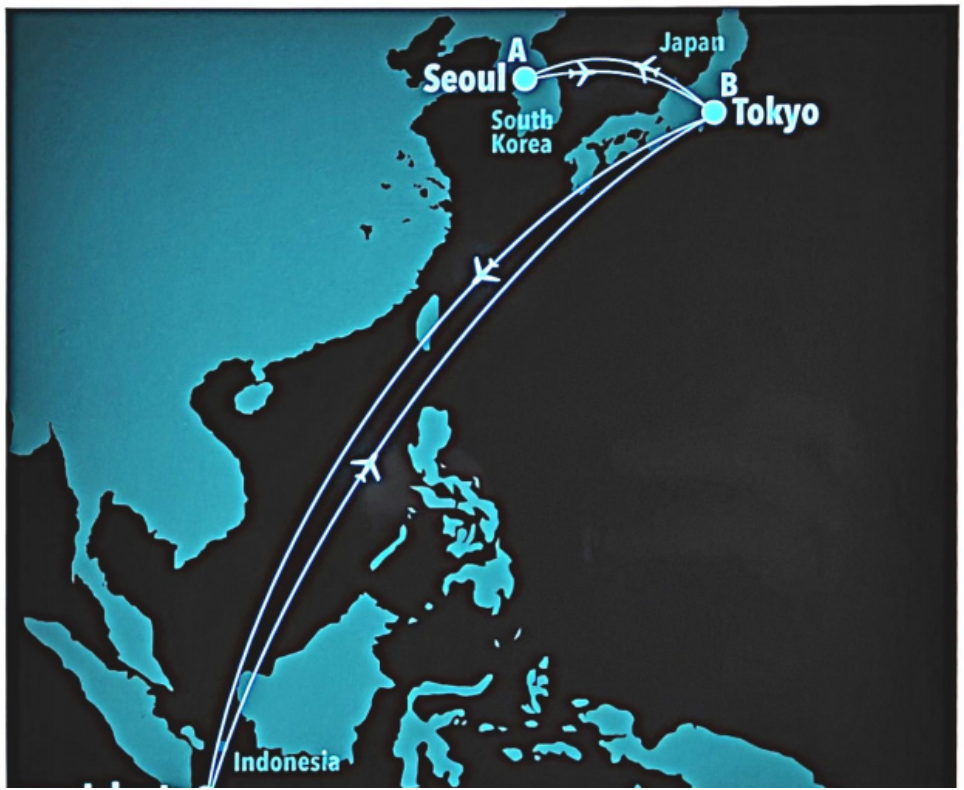
Question 5b (2 marks)

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

B I U x_2 x^2 Ω Σ

Styles

Several flights take place between Seoul, Tokyo and Jakarta each day. Airplanes cross each other in the sky several times a day.



Origin	Destination	Departure time	Flight time / minutes	Distance / km	Average speed km/h
Seoul	Tokyo	07:00	140		500
Tokyo	Jakarta	11:00		5760	900

Question 6a (2 marks)

Show that the distance between Seoul and Tokyo is 1170 km, correct to three significant figures.

B I U x_2 x^2 Ω Σ Styles

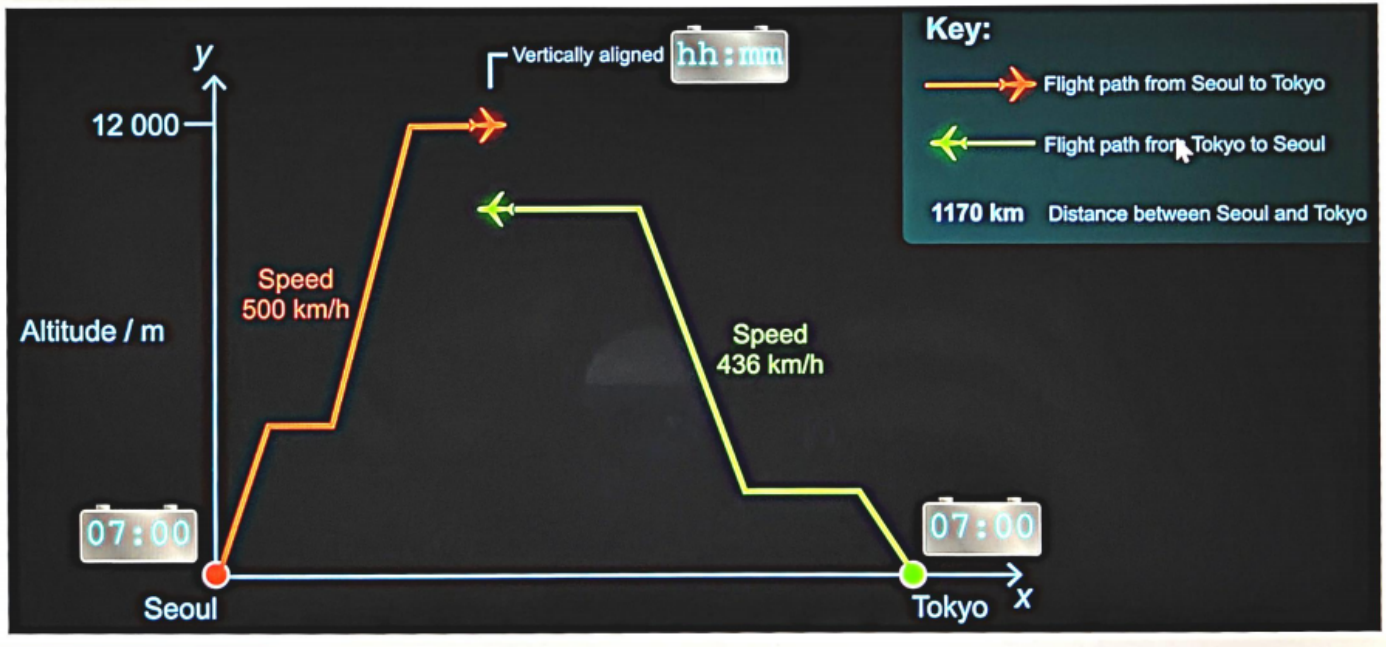
Question 6b (2 marks)

Determine the flight time from Tokyo to Jakarta. Give your answer in minutes.

B I U x_2 x^2 Ω Σ Styles

Question 6c (5 marks)

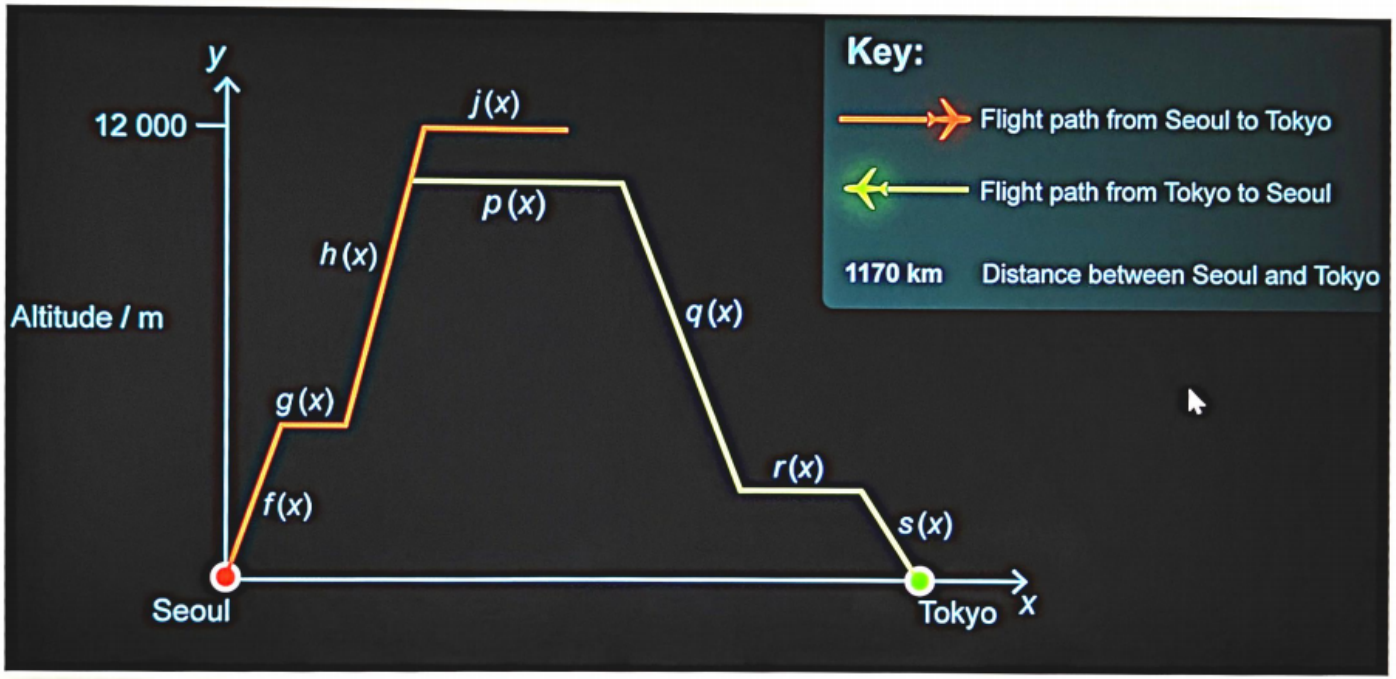
An airplane departs from Seoul to Tokyo at 07:00 with an average speed of 500 km/h. At the same time, another airplane departs from Tokyo to Seoul with an average speed of 436 km/h.



©

Calculate the time at which they will be vertically aligned. Give your answer to the nearest minute.

B I U x_2 x^2 Ω Σ Styles



©

To avoid collision, the minimum vertical distance between two airplanes must be 300 metres. The path $f(x)$ and $h(x)$ are parallel.

	Function	Domain
f	$f(x) = 60x$	$0 \leq x \leq 40$
g	$g(x) = 2400$	$40 \leq x \leq 80$
h		$80 \leq x \leq 240$
j	$j(x) = 12\,000$	$240 \leq x \leq 700$

	Function	Domain
p	$p(x)$	$233 \leq x \leq 700$
q	$q(x) = -40x + 39\,580$	$700 \leq x \leq 951$
r	$r(x) = 1540$	$951 \leq x \leq 1100$
s	$s(x) = -22x + 25\,740$	$1100 \leq x \leq 1170$

Question 6d (3 marks)

Find the equation of $h(x)$.

B I U x_2 x^2 Ω Σ Styles

Question 6e (3 marks)

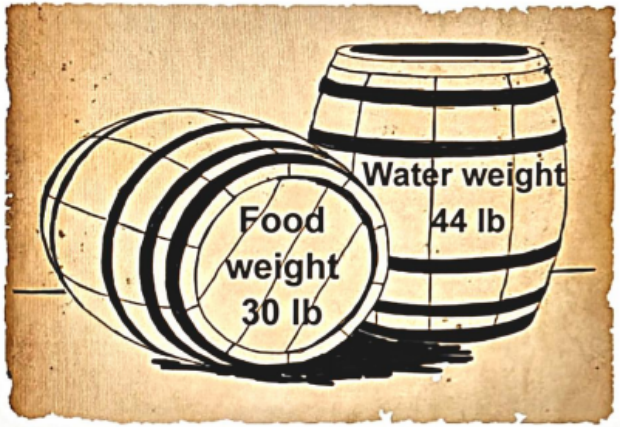
Deduce that the airplanes are at a safe vertical distance apart.

B I U x_2 x^2 Ω Σ Styles

Two families travelled from Missouri to Santa Fe.

Family Fry chose the Cimarron route.

Since the Cimarron route is a desert, family Fry had to carry a supply of food and water for their trip.



©

They had the following constraints:

- The total weight of the supplies was **not more** than 1200 lb
- They needed **at least** 7 water barrels
- The number of water barrels was **at most** twice the number of food barrels.

Select the **three** inequalities that satisfy the constraints above.

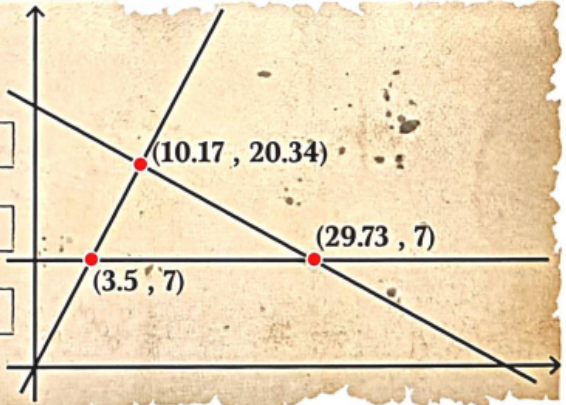
Identify the region that satisfies the constraints above by dragging the "Region" icon into the correct place on the graph.

f represents the number of food barrels and w represents the number of water barrels.

Draggable items:

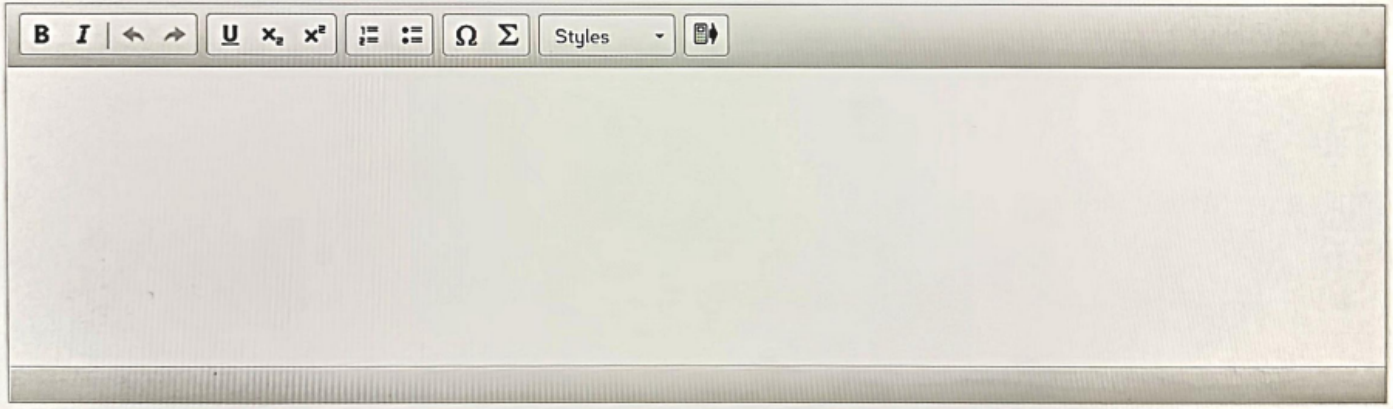
- $w \leq 7$
- $w \geq 7$
- $30f + 44w \geq 1200$
- $30f + 44w \leq 1200$
- $w \geq 2f$
- $w \leq 2f$
- Region

Constraints



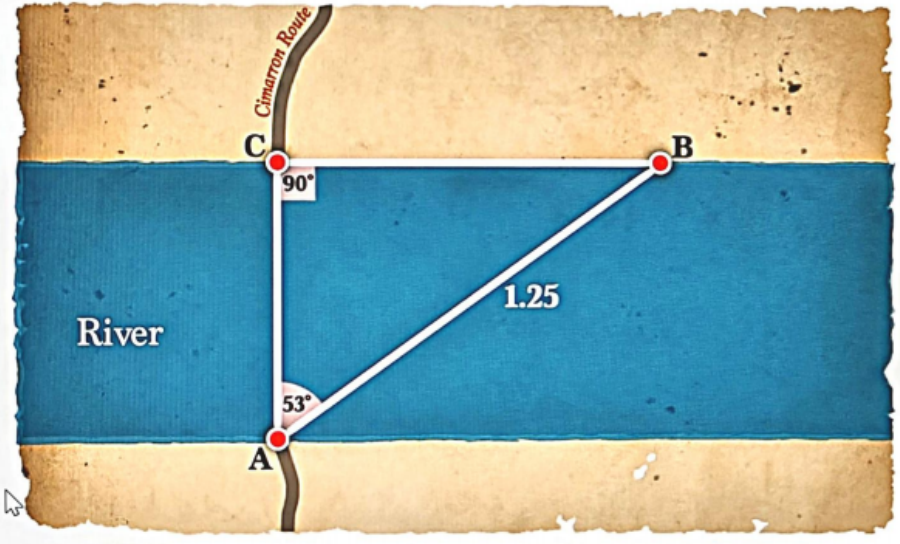
Question 7b (3 marks)

Using the information in the graph above, **find** the maximum weight of food and water the wagon can carry.



To access the Cimarron route (C), the family had to cross the Mississippi river from A. The bridge across the river to the Cimarron route from A to C was broken so the family had to cross the river to B.

Diagram not to scale



Question 7c (3 marks)

Calculate the distance from B to C.

B I U x_2 x^2 Ω Σ

Styles

Question 7d (1 mark)

Hence, **determine** how far the family travelled to get from A to the start of the Cimarron route.

B I U x_2 x^2 Ω Σ

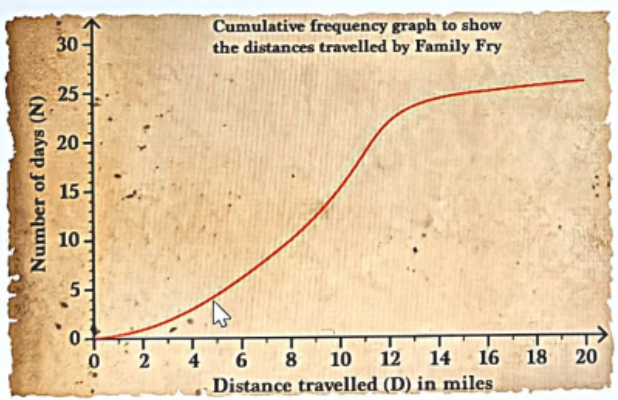
Styles

Question 7e (10 marks)

Family Fry chose the Cimarron route. A summary of their journey is illustrated in the cumulative frequency graph below, however some of the data has been lost.

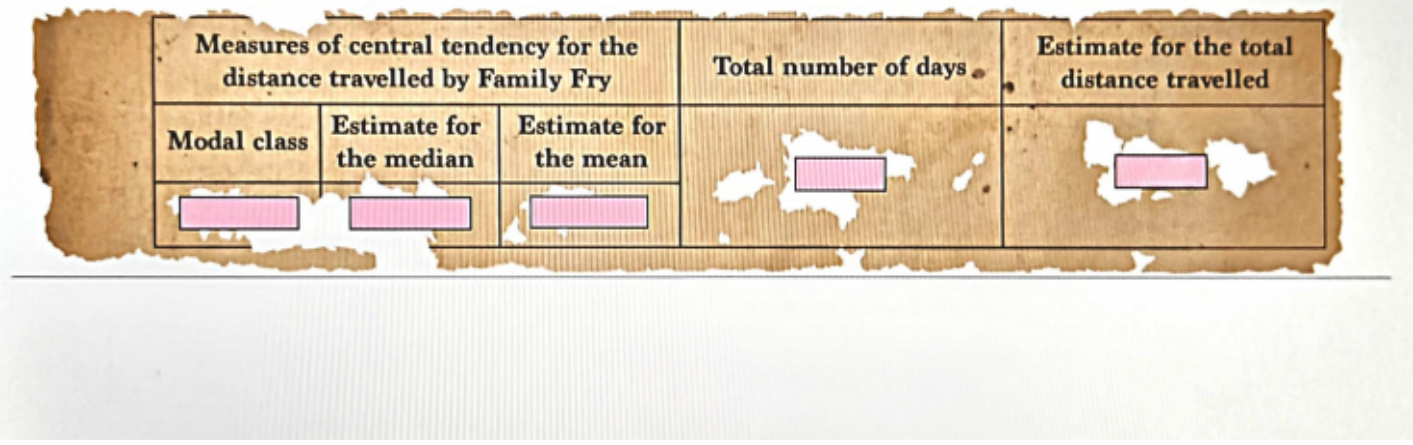
Cimarron route

This media is interactive



Scroll down to continue

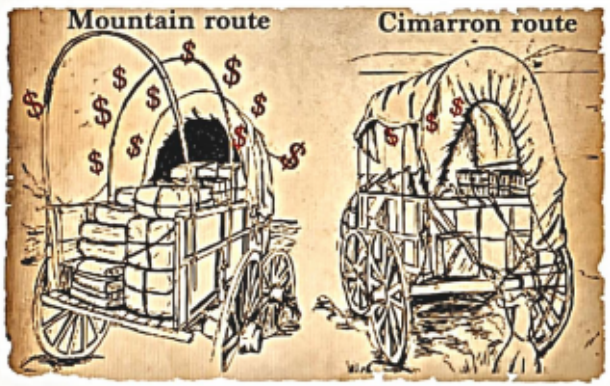
Distance travelled (D) in miles	Number of days (N)
$0 \leq D < 4$	3
$4 \leq D < 8$	
$8 \leq D < 12$	12
$12 \leq D < 16$	3
$16 \leq D < 20$	1



Measures of central tendency for the distance travelled by Family Fry			Total number of days	Estimate for the total distance travelled
Modal class	Estimate for the median	Estimate for the mean		

Scroll through the images to reveal more information on the two routes.

A lot
of trading goods to sell



Not a lot
of trading goods to sell

Scroll through the images to reveal more information on the two routes.

Family Kane chose the Mountain route. A summary of their journey is illustrated in the table below.

Mountain Route

Measures of central tendency for the distance travelled by Family Kane			Total number of days	Estimate for the total distance travelled
Modal class	Estimate for the median	Estimate for the mean	39	502
$12 \leq D < 16$	13.5	12.87		

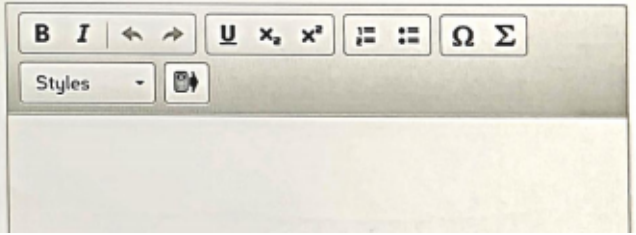
Question 8a (1 mark)

Ring (n)	Circumference of the circle (C)
1	48π
2	60π
3	72π
4	84π
5	
6	

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

Question 8b (1 mark)

Describe in words a pattern you see in the table for the circumference (C).



Ring (n)	Circumference of the circle (C)
1	48π
2	60π
3	72π
4	84π
5	
6	

Question 8c (2 marks)

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

B I U x_2 x^2 Ω Σ

Styles

Ring (n)	Circumference of the circle (C)
1	48π
2	60π
3	72π
4	84π
5	
6	

Question 8d (3 marks)

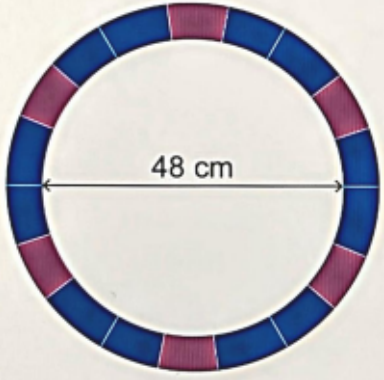
Verify your general rule for C.

B I U x_2 x^2 Ω Σ

Styles

Question 8e (3 marks)

Ring 1 includes 12 blue tiles and 6 pink tiles. Each blue tile has an arc length of $\frac{5\pi}{2}$.



For ring 1, **show that** the arc length of a pink tile is 3π cm.

B I U x_a x^a Ω Σ

Styles

Question 8f (22 marks)

There are always 12 blue tiles and the arc length of each blue tile is always $\frac{5\pi}{2}$.

Investigate the values in the table to find a relationship for the arc length (L) of the pink tile 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 L
- find a general rule for L in terms of n
- test your general rule for L
- verify and justify your general rule for L
- ensure that you communicate all your working appropriately.

Ring (n)	Circumference of the circle (C)	Number of pink tiles (P)	Arc length of the pink tile (L)		
1	48π	6	3π		
2	60π	12	$\frac{5}{2}\pi$		
3	72π	18	$\frac{7}{3}\pi$		
4	84π	24	$\frac{9}{4}\pi$		
5					
6					

Analyse the routes taken by the two families. In your answer, you should consider:

- **three** relevant factors
- measures of central tendency for each route
- the total distance and number of days for each route
- similarities and differences between the two routes
- the degree of accuracy in the context of the question.