

C300UA0-1

FRIDAY, 20 MAY 2022 – MORNING

MATHEMATICS – COMPONENT 1

NON – CALCULATOR MATHEMATICS

HIGHER TIER

2 hours 15 minutes plus your additional time allowance

THE USE OF A CALCULATOR IS NOT PERMITTED IN THIS EXAMINATION

Surname: _____

First name(s): _____

Centre Number: _____

Candidate Number: 0 _____

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	3	
2.	2	
3.	7	
4.	6	
5.	5	
6.	3	
7.	6	
8.	3	
9.	3	
10.	5	
11.	6	
12.	5	
13.	4	
14.	4	
15.	5	
16.	9	
17.	4	
18.	5	
19.	5	
20.	4	
21.	8	
22.	4	
23.	8	
24.	3	
25.	3	
Total	120	

(Turn over)

ADDITIONAL MATERIALS

An additional formulae booklet.

A ruler, a protractor and a pair of compasses may be required.

ITEMS INCLUDED WITH QUESTION PAPER

A separate Formula List.

A separate Diagram Booklet.

Model for Question 3.

The Diagram Booklet MUST be handed in to the invigilators and sent for marking.

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball – point pen, black felt tip or your usual method.

Write your name, centre number and candidate number in the spaces on the front cover.

Answer ALL the questions.

Write your answers in the spaces provided.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

The number of marks is given in brackets at the end of each question or part – question.

You are reminded of the need for good English and orderly, clear presentation in your answers.

1. In 2019,

- €1 = £0.90
- \$1.25 = £1

In 2019, a silver pencil cost €110 in Germany.

The same pencil cost \$125 in the USA.

In which country was the pencil cheaper?

Germany ☐ USA ☐

You must show all your working.

(Turn over)

6

[3 marks]

(Turn over)

2. Look at the diagram for Question 2 in the separate Diagram Booklet.

The diagram is NOT drawn to scale.

The diagram shows a parallelogram, $ABCD$ and the diagonal AC .

Tick (✓) the TWO correct statements below.

Angle ABC is not equal to angle CDA	
$AB = DC$ and $AD = BC$ and AC is a side of both triangle ABC and triangle CDA	
Triangle ABC is similar to triangle CDA with enlargement scale factor 0.5	
Triangle ABC is not congruent to triangle CDA	
Triangle ABC is congruent to triangle CDA	
AB represents the shortest distance from B to AC	

[2 marks]

(Turn over)

3. Ask for the model for Question 3.

The model is NOT made to scale.

The model represents a cone placed with its circular base on a table.

It has

- **base radius 15 cm**
- **height 30 cm**

(a) Work out the volume of this cone.

Give your answer as a multiple of π

Volume is _____ cm^3

[3 marks]

continued on the next page . . .

Question 3 continued

- 3. (b) On the 1 cm grid provided for Question 3 (b) in the separate Diagram Booklet, make an accurate scale drawing of the plan and side elevation of this cone.**

Use the ratio

actual cone : scale drawing = 5 : 1

[4 marks]

(Turn over)

4. A tank contains **225** litres of water.
A tap at the bottom is opened so that
water flows out at a constant rate of **5** litres
every minute until the tank is empty.

- (a) On the grid provided for Question 4 (a)
in the separate Diagram Booklet,
draw a line to show the volume of water
in the tank at any time after the tap has
been opened.

[4 marks]

continued on the next page . . .

(Turn over)

Question 4 continued

4. (b) How many minutes does it take for the volume of water in the tank to decrease by $33\frac{1}{3}$ % of the original volume?

[2 marks]

(Turn over)

5. Look at the diagram for Question 5 in the separate Diagram Booklet.

The diagram is an incomplete tree diagram.

The probability that Kathy cycles to work on Monday is 0.6

If she cycles to work on Monday, the probability that she cycles to work on Tuesday is 0.3

If she does NOT cycle to work on Monday, the probability that she does NOT cycle to work on Tuesday is 0.1

- (a) Complete the tree diagram.

[1 mark]

continued on the next page . . .

Question 5 continued

- 5. (b) Calculate the probability that Kathy cycles to work on both Monday and Tuesday.**

[2 marks]

continued on the next page . . .

(Turn over)

Question 5 continued

5. (c) Calculate the probability that Kathy does NOT cycle to work on either day.

[2 marks]

(Turn over)

- 6. In a factory, 6 identical machines can make 3000 erasers in 2 hours.**

How long would it take 8 of these machines to make 1000 erasers?

[illegible]

[3 marks]

(Turn over)

7. (a) Expand and simplify $(4x + 5)(2x - 1)$

[3 marks]

(b) (i) Factorise $x^2 - 10x + 21$

[2 marks]

continued on the next page . . .

(Turn over)

Question 7 (b) continued

7. (b) (ii) Use your answer to part (b) (i) to write down the solutions of the equation

$$x^2 - 10x + 21 = 0$$

$x =$ _____ or $x =$ _____

[1 mark]

(Turn over)

8. Vikram wanted to find out how many moths there were in a small woodland.

One night, Vikram captured a random sample of **12** moths and marked them.

He then released them back into the woodland.

The next night, Vikram captured a second random sample of **30** moths.

He found that **9** of the moths in the second sample had been marked.

Vikram estimated that there were **40** moths in the woodland.

- (a) Show that Vikram's estimate of the number of moths was correct.

[2 marks]

8. (b) Comment on how reliable Vikram's estimate was likely to be.

[1 mark]

(Turn over)

- ## 9. Deena sells a painting for £8690

This is 10% more than she originally paid for it.

How much did Deena pay for the painting?

[illegible]

[3 marks]

(Turn over)

- 10. (a) Write 378 as a product of its prime factors.**

Give your answer in index form.

[illegible]

index form _____

10. (b) Use prime factors to prove that 1 is the only common factor of 378 and 275

[illegible]

(Turn over)

25

[2 marks]

(Turn over)

11. (a) Look at the diagram for Question 11 (a) in the separate Diagram Booklet.

The diagram shows a coordinate grid.

The point **O** is the origin.

- (i) The points **O**, **P**, and **R** are such that

$$\mathbf{OP} = \begin{pmatrix} 1 \\ 3 \end{pmatrix} \text{ and } \mathbf{OR} = \begin{pmatrix} 5 \\ -1 \end{pmatrix}$$

Find **PR**.

You may use the grid provided to help you.

$$\mathbf{PR} = \begin{pmatrix} \\ \end{pmatrix}$$

[2 marks]

continued on the next page . . .

(Turn over)

Question 11 (a) continued

11. (a) (ii) The point Q is such that, when taken in a clockwise direction, the points O , P , Q and R form a parallelogram.

Find $\mathbf{OQ}$.

You may use the grid provided to help you.

$$\mathbf{OQ} = \begin{pmatrix} \\ \end{pmatrix}$$

[2 marks]

continued on the next page . . .

(Turn over)

Question 11 continued

- 11. (b) Look at Diagram 1 and Diagram 2 for Question 11 (b) in the separate Diagram Booklet.**

Diagram 1 is a grid showing the vectors $\mathbf{a}$ and $\mathbf{b}$.

Mitch wants to draw the vector $2\mathbf{a} + \mathbf{b}$
His diagram is shown in Diagram 2.

Make TWO criticisms of Mitch's diagram (Diagram 2).

Criticism 1 _____

continued on the next page . . .

(Turn over)

Question 11 (b) continued

Criticism 2 _____

[2 marks]

- 12. (a) Three quantities A , B and C are in the ratio**

$A : B : C$ is $13 : 7 : 2$

Given that $A - B = 48$, find the value of $A + B + C$

[illegible]

[4 marks]

continued on the next page . . .

(Turn over)

Question 12 continued

12. (b) X cars travel a TOTAL of 1000 kilometres.

Each car uses f litres of fuel.

Each car travels the same number of kilometres per litre.

Find an algebraic expression for the number of kilometres per litre travelled by each car.

_____ kilometres per litre

[1 mark]

(Turn over)

13. The table below shows the population and area of land for country X.

	Population	Area (km ²)
Country X	2.16×10^7	3000

Population density can be measured in number of people per square kilometre.

The population density of country Y is
8000 people per km²

Which country has the greater population density and by how much is it greater?

The population density of country

is greater by _____ people

per km²

[4 marks]

(Turn over)

14. Rearrange this formula to make e the subject.

$$\frac{e^3 f}{7} + 5 = d$$

[illegible]

[4 marks]

15. Look at the diagram for Question 15 in the separate Diagram Booklet.
The diagram is NOT drawn to scale.

P*, *Q*, *R* and *S are points on a circle with centre ***O***.

The line ***TU*** is a tangent to the circle at the point ***S***.

Angle ***POS*** = 130° and angle ***PQR*** = 120°

Show that $x = 55^\circ$

Give a reason for each step of your answer.

[5 marks]

16. Brian and Yvonne are gardeners.

They each have an orchard of fully – grown apple trees.

(a) Look at the table for Question 16 (a) in the separate Diagram Booklet.

The table shows information about the height, in cm, of Yvonne's 44 apple trees on 1st September.

(i) Complete the frequency density column in the table.

[2 marks]

continued on the next page . . .

(Turn over)

Question 16 (a) continued

- 16. (a) (ii) On the grid provided for Question 16 (a) (ii) in the separate Diagram Booklet, draw a histogram to illustrate the data in the table.**

[2 marks]

- (iii) Calculate an estimate of the probability that an apple tree has a height of less than 270 cm.**

[2 marks]

continued on the next page . . .

(Turn over)

Question 16 continued

- 16. (b) Look at the diagram for Question 16 (b) in the separate Diagram Booklet.**

The diagram is a histogram.

This histogram shows the heights of the apple trees in Brian's orchard on 1st September.

How many apple trees are in Brian's orchard?

[2 marks]

continued on the next page . . .

(Turn over)

Question 16 continued

16. (c) One of the gardeners says,

“I prefer to grow shorter apple trees as the fruit is easier to pick.”

Which person is this likely to be?

You must justify your answer.

[1 mark]

(Turn over)

17. Look at the diagram for Question 17 in the separate Diagram Booklet.

The diagram is NOT drawn to scale.

The diagram shows an equilateral triangle with side $2x$ cm.

The height of the triangle is h cm.

Find and simplify an expression for h in terms of x .

[4 marks]

(Turn over)

18. (a) Write $5^3 \div 5^{-4}$ as a single power of 5

[1 mark]

(b) Calculate the value of $10\,000^{\frac{3}{4}}$

[2 marks]

continued on the next page . . .

(Turn over)

Question 18 continued

18. (c) Simplify $\sqrt{49 \times 10^{2n}}$

[2 marks]

(Turn over)

19. (a) Write $\frac{1}{27}$ as a recurring decimal.

[1 mark]

continued on the next page . . .

(Turn over)

Question 19 continued

19. (b) By writing $1.2\overline{43}$ as a fraction,

calculate $1.\overset{\bullet}{2}\overset{\bullet}{4}\overset{\bullet}{3} - \frac{8}{9}$

Give your answer as a fraction.

[illegible]

[4 marks]

20. $g(x) = \frac{x}{2}$

$$h(x) = x^3$$

(a) Find $hg\left(\frac{1}{3}\right)$

[2 marks]

continued on the next page . . .

(Turn over)

Question 20 continued

20. (b) Solve $h^{-1}(x) = -2$

[illegible]

[2 marks]

(Turn over)

21. (a) (i) Look at the diagram for Question 21 (a) (i) in the separate Diagram Booklet.

The diagram shows a set of axes.

On the axes, sketch the graph of $y = \cos x$ for $-180^\circ \leq x \leq 180^\circ$

[2 marks]

- (ii) Solve $\cos x = \frac{\sqrt{3}}{2}$ for
 $-180^\circ \leq x \leq 180^\circ$

[2 marks]

continued on the next page . . .

(Turn over)

Question 21 continued

- 21. (b) Look at the diagram for Question 21 (b) in the separate Diagram Booklet.**

The diagram shows a sketch of the graph of $y = f(x)$

The point A has coordinates $(-2, 0)$ and the point B has coordinates $(0, 3)$

- (i) Look at the diagram for Question 21 (b) (i) in the separate Diagram Booklet.**

The diagram shows a set of axes.

Sketch the graph of $y = f(x) - 1$ on the axes.

You must indicate the coordinates of the new positions of the points A and B .

[2 marks]

continued on the next page . . .

(Turn over)

Question 21 (b) continued

21. (b) (ii) Look at the diagram for Question 21 (b) (ii) in the separate Diagram Booklet.

The diagram shows a set of axes.

Sketch the graph of $y = f(x - 3)$ on the axes.

You must indicate the coordinates of the new positions of the points A and B .

[2 marks]

22. A game of chance at a school fete is played with the following rules.

- **There are five identical balls numbered from 1 to 5 in a bag.**
- **A player takes two balls from the bag at random.**
- **A player wins a prize when their two balls are numbered 2 and 4**
- **At the end of each game, both balls are put back in the bag.**

(a) Olivia plays the game once.

What is the probability that she wins a prize?

[2 marks]

22. (b) Alex plays the game and stops playing when he wins.

What is the probability that he only plays the game twice?

[2 marks]

(Turn over)

23. (a) Write $7\sqrt{3}(5\sqrt{3} - 4) + \sqrt{27}$

in the form $a + b\sqrt{3}$, where a and b
are integers.

[3 marks]

continued on the next page . . .

(Turn over)

Question 23 continued

23. (b) Look at the diagram for Question 23 (b) in the separate Diagram Booklet.
The diagram is NOT drawn to scale.

In this question all lengths are in centimetres.

This shape is made from two rectangles.

The area of this shape is $33\sqrt{2} - 18$

Showing all your working, find the value of X .

Give your answer in the form $c + d\sqrt{2}$,
where c and d are integers.

(Turn over)

24. A circle has equation $x^2 + y^2 = 400$

(a) Write down the length of the radius.

[1 mark]

continued on the next page . . .

(Turn over)

Question 24 continued

- 24. (b) The points $A(12, -16)$ and B lie on the circle.**

AB is a diameter of the circle.

Find the coordinates of B .

[illegible]

[2 marks]

(Turn over)

25. A hummingbird flies at a speed of v metres per second for t seconds after it has finished feeding from a flower.

Look at the diagram for Question 25 in the separate Diagram Booklet.

The diagram is NOT drawn to scale.

The diagram shows the speed of the hummingbird for $5 \leq t \leq 15$

When $t = 5$, $v = 6$

The average acceleration of the hummingbird for $5 \leq t \leq 15$ is 0.5 m/s^2

Calculate the speed of the hummingbird when $t = 15$

You must show all your working.

[3 marks]

END OF PAPER

TOTAL 120 MARKS

(Turn over)

Question number	Additional pages, if required. Write the question number(s) in the left - hand margin.

Question number	Additional pages, if required. Write the question number(s) in the left - hand margin.

Question number	Additional pages, if required. Write the question number(s) in the left - hand margin.

C300UA0-1

FRIDAY, 20 MAY 2022 – MORNING

MATHEMATICS – COMPONENT 1

NON – CALCULATOR MATHEMATICS

HIGHER TIER

**The Diagram Booklet MUST be handed in
to the invigilators and sent for marking.**

Diagram Booklet

Surname: _____

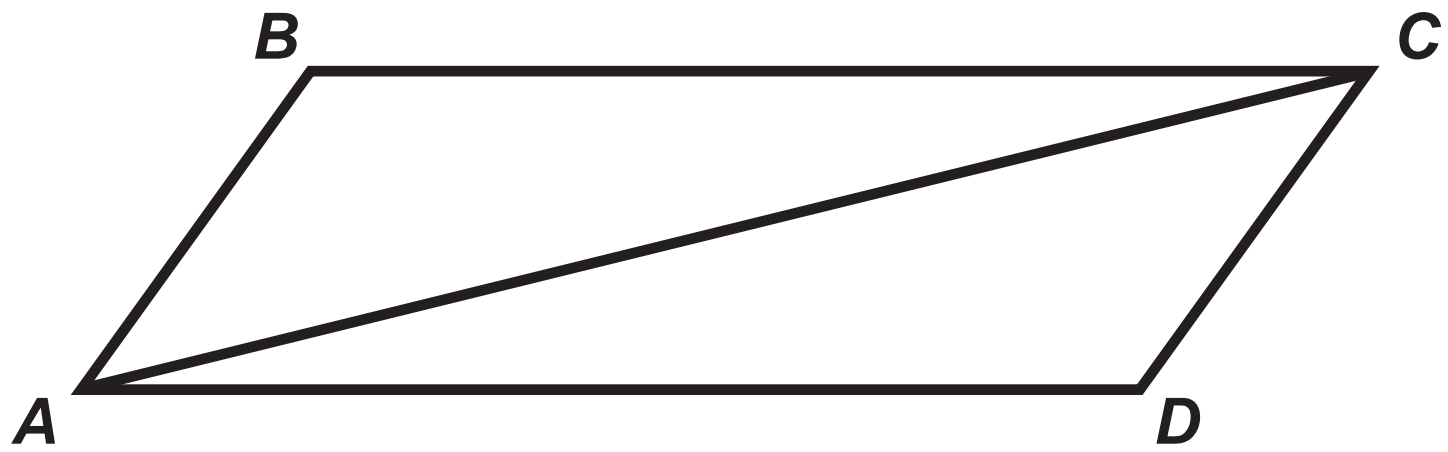
First name(s): _____

Centre Number: _____

Candidate Number: 0 _____

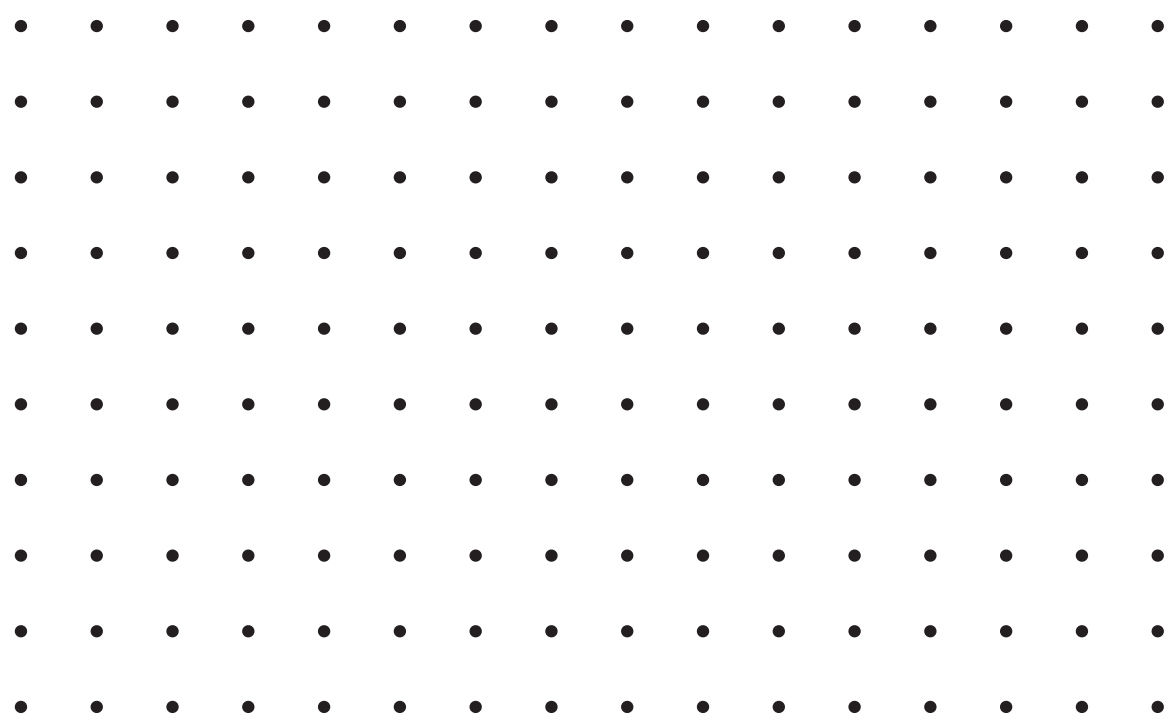
Question 2

Diagram NOT drawn to scale

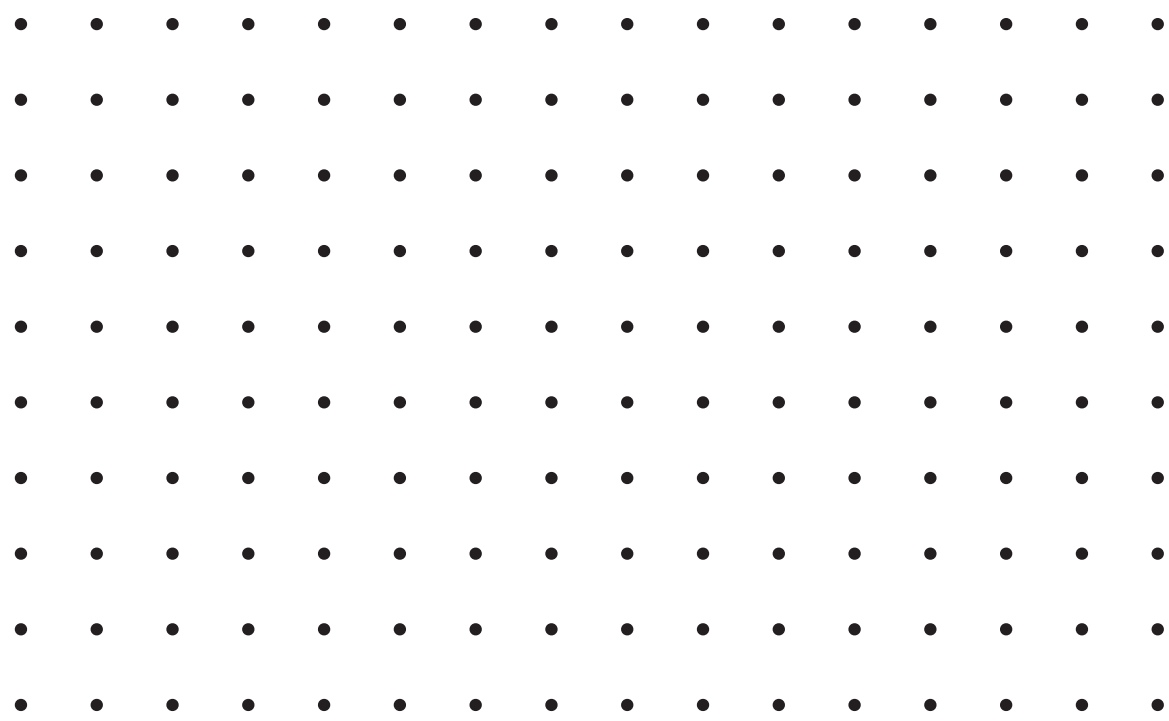


Question 3 (b)

Plan

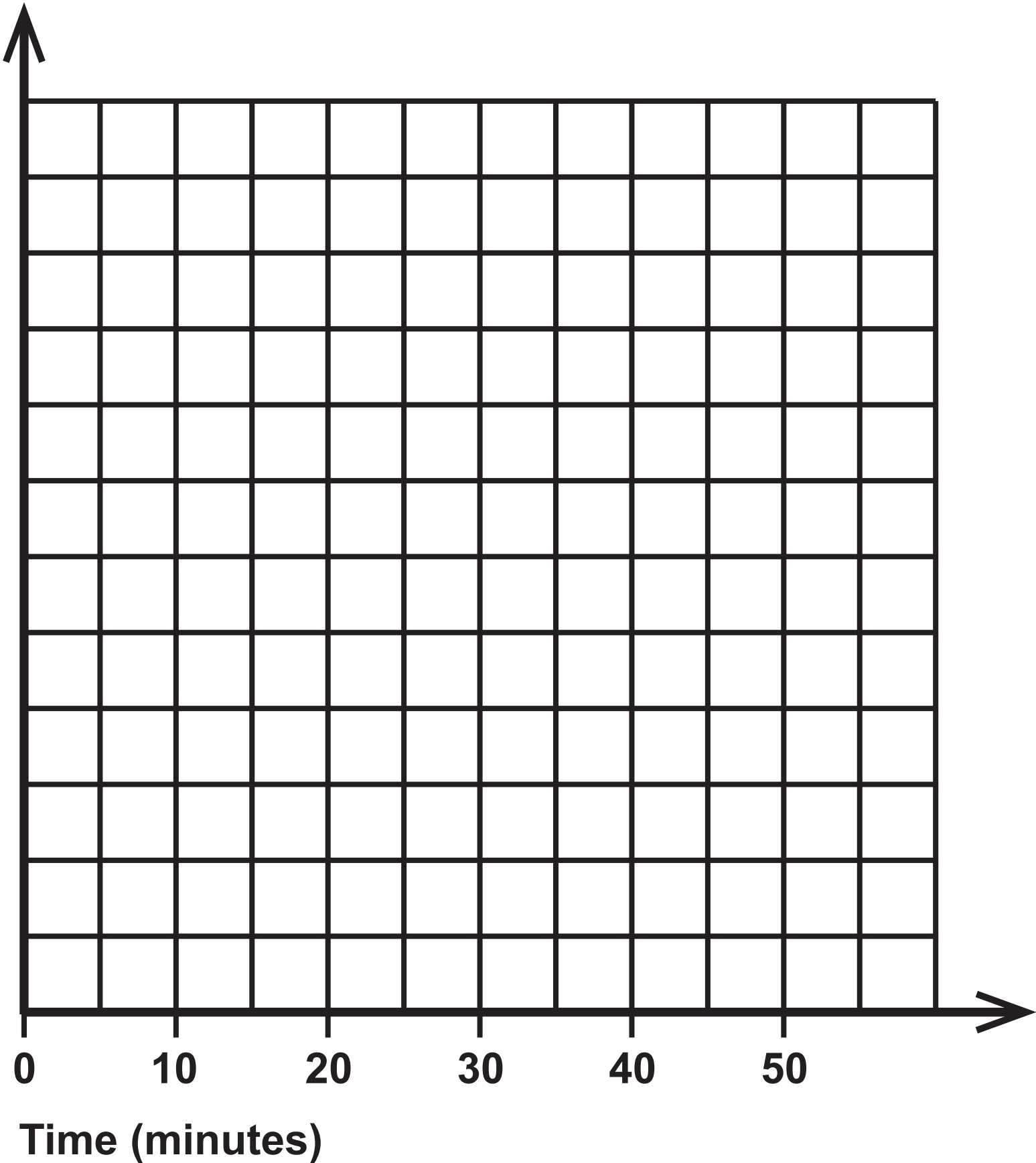


Side elevation

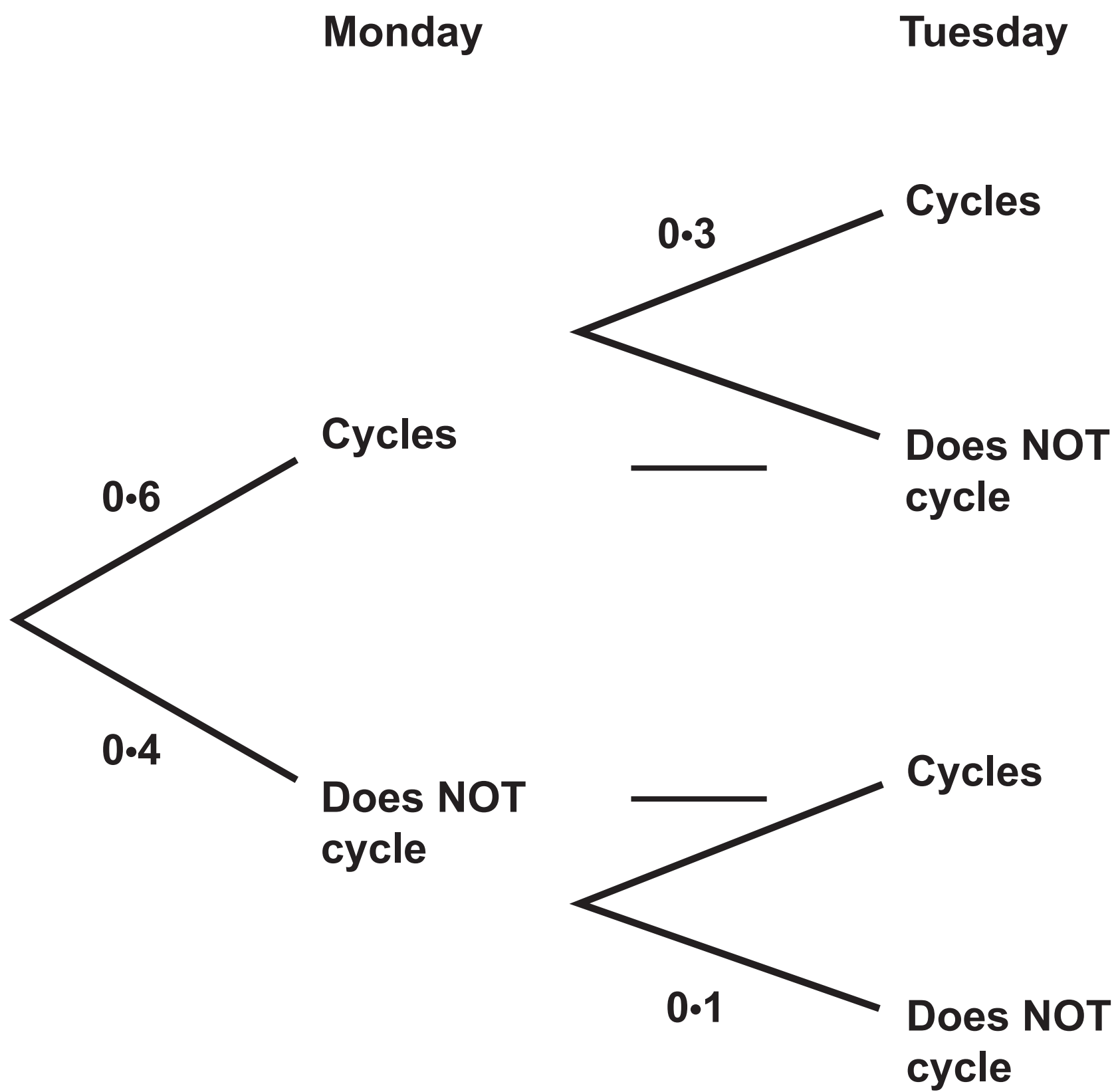


Question 4 (a)

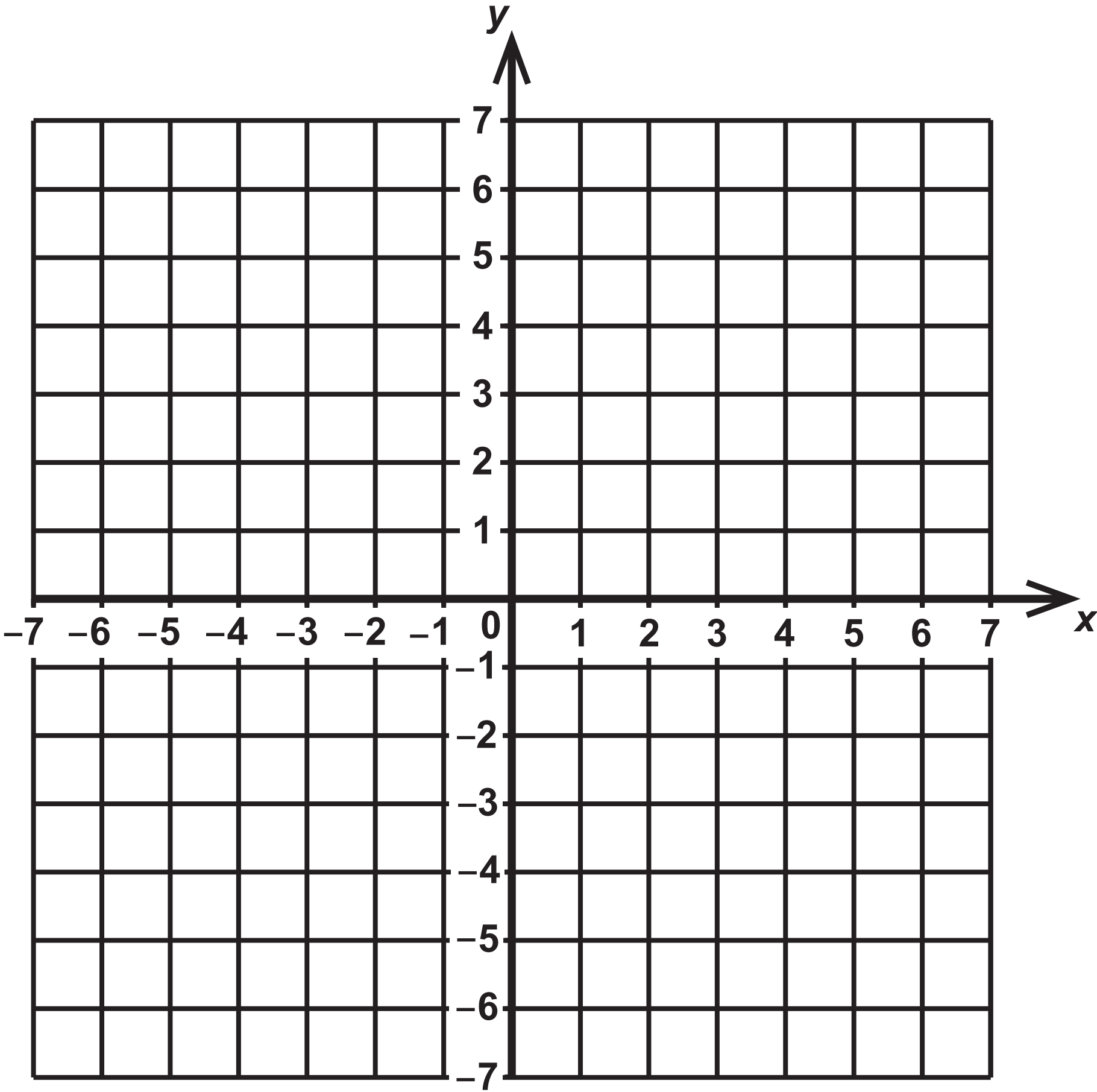
Volume of
water (litres)



Question 5



Question 11 (a)



Question 11 (b)

Diagram 1

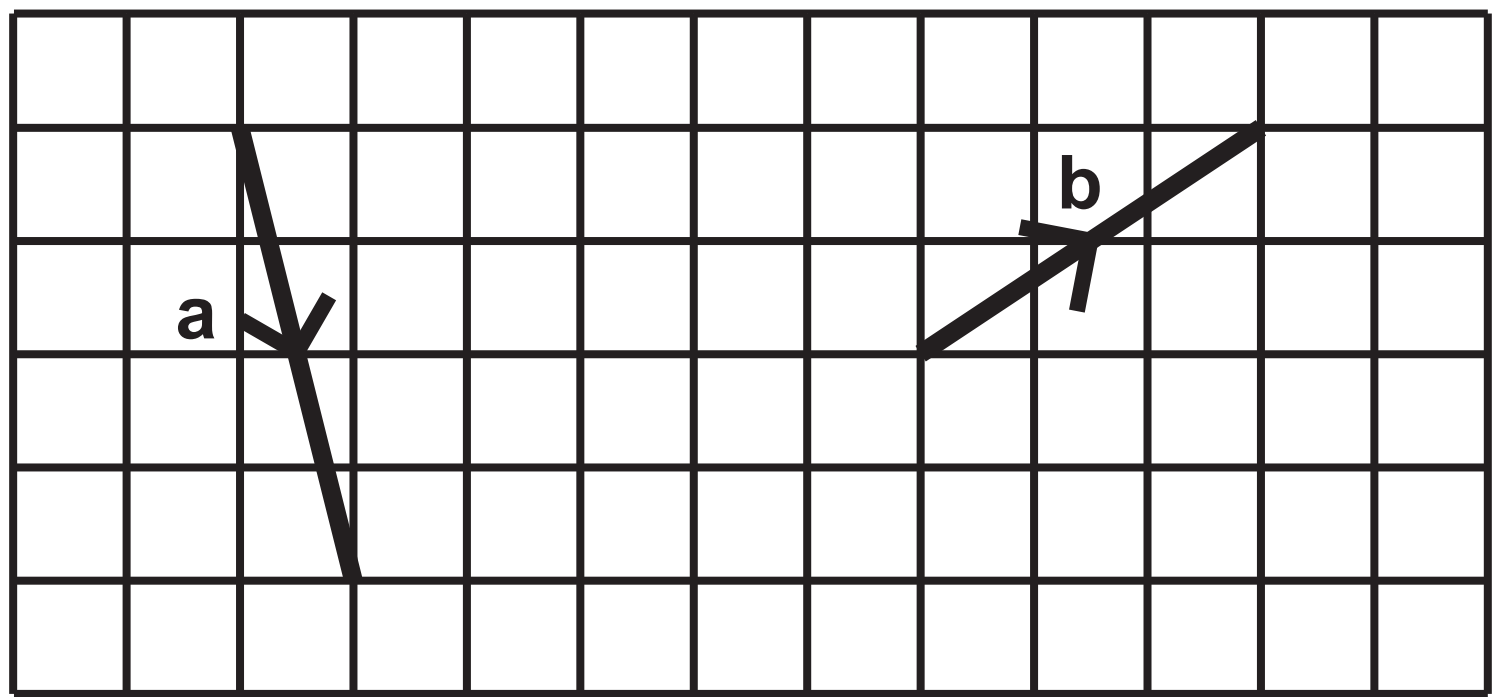
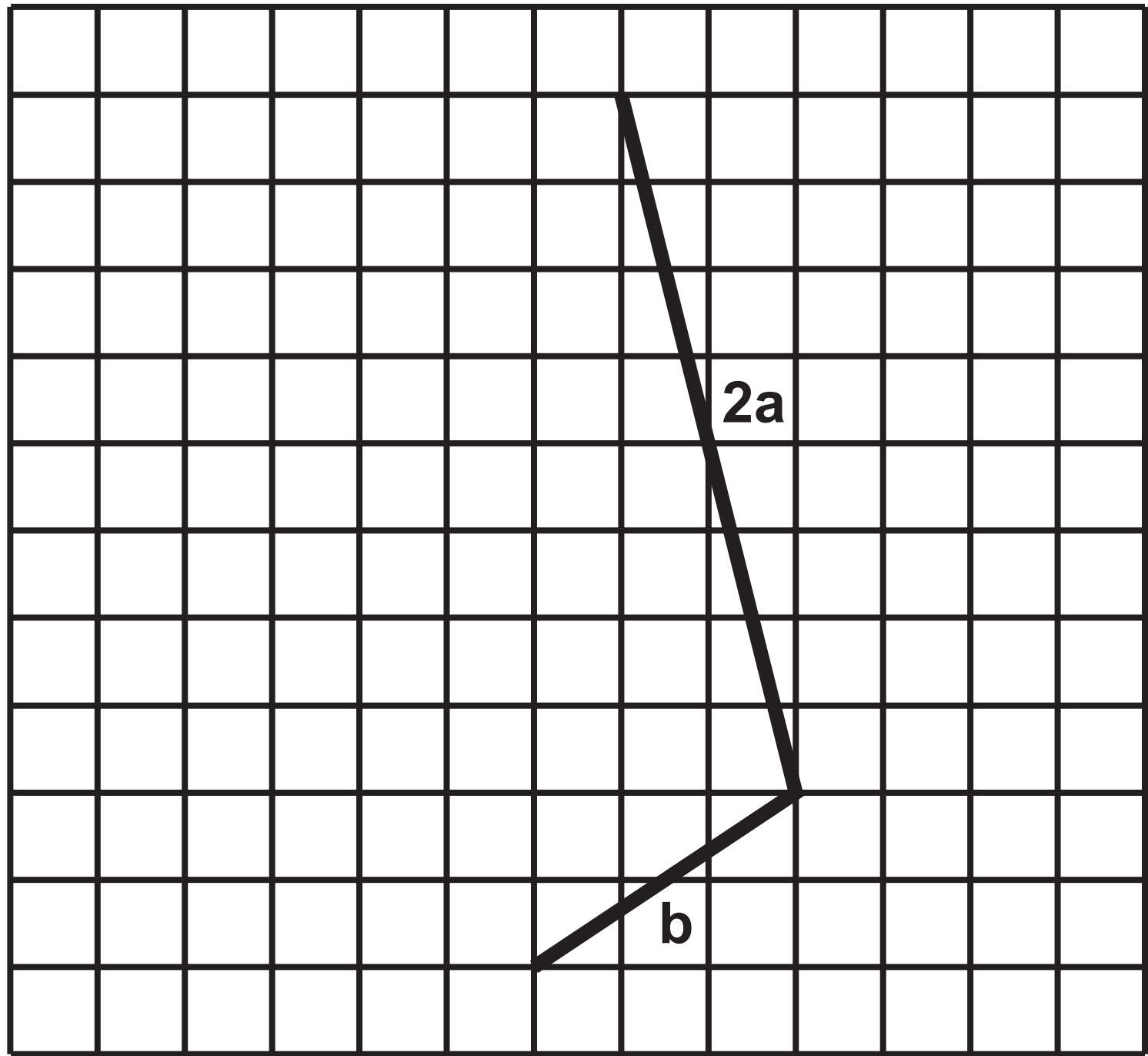
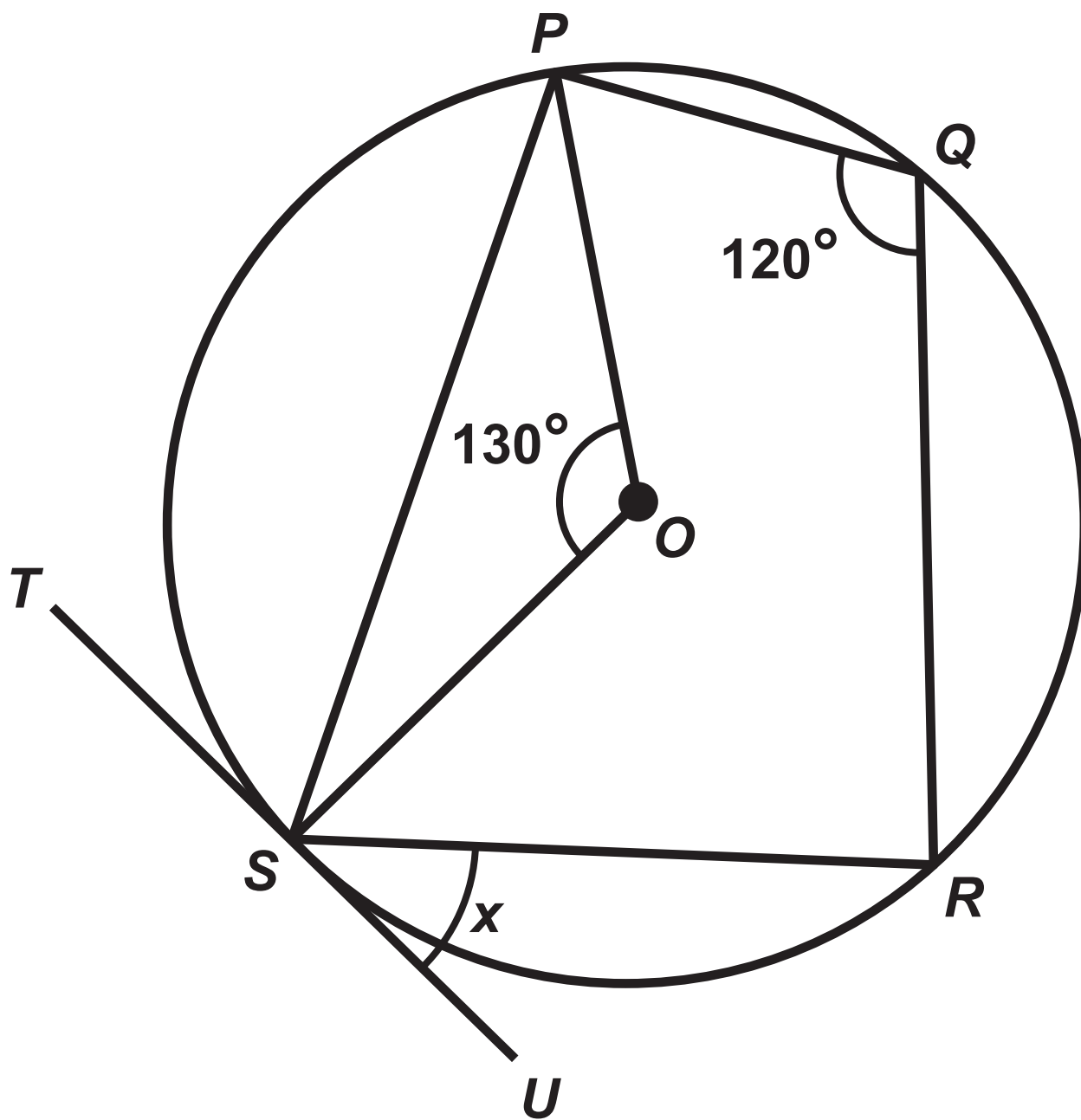


Diagram 2



Question 15

Diagram NOT drawn to scale

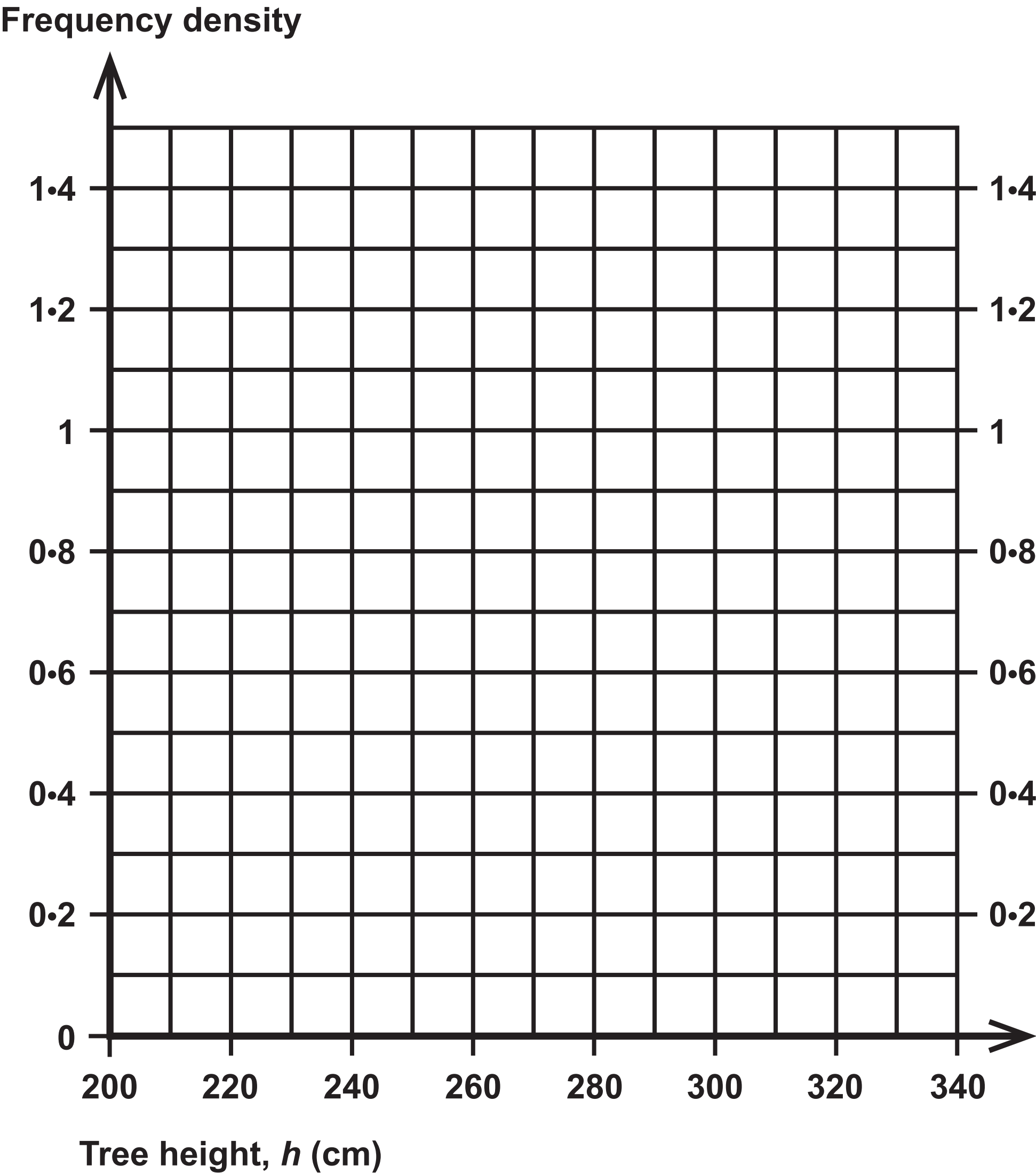


Question 16 (a)

Table

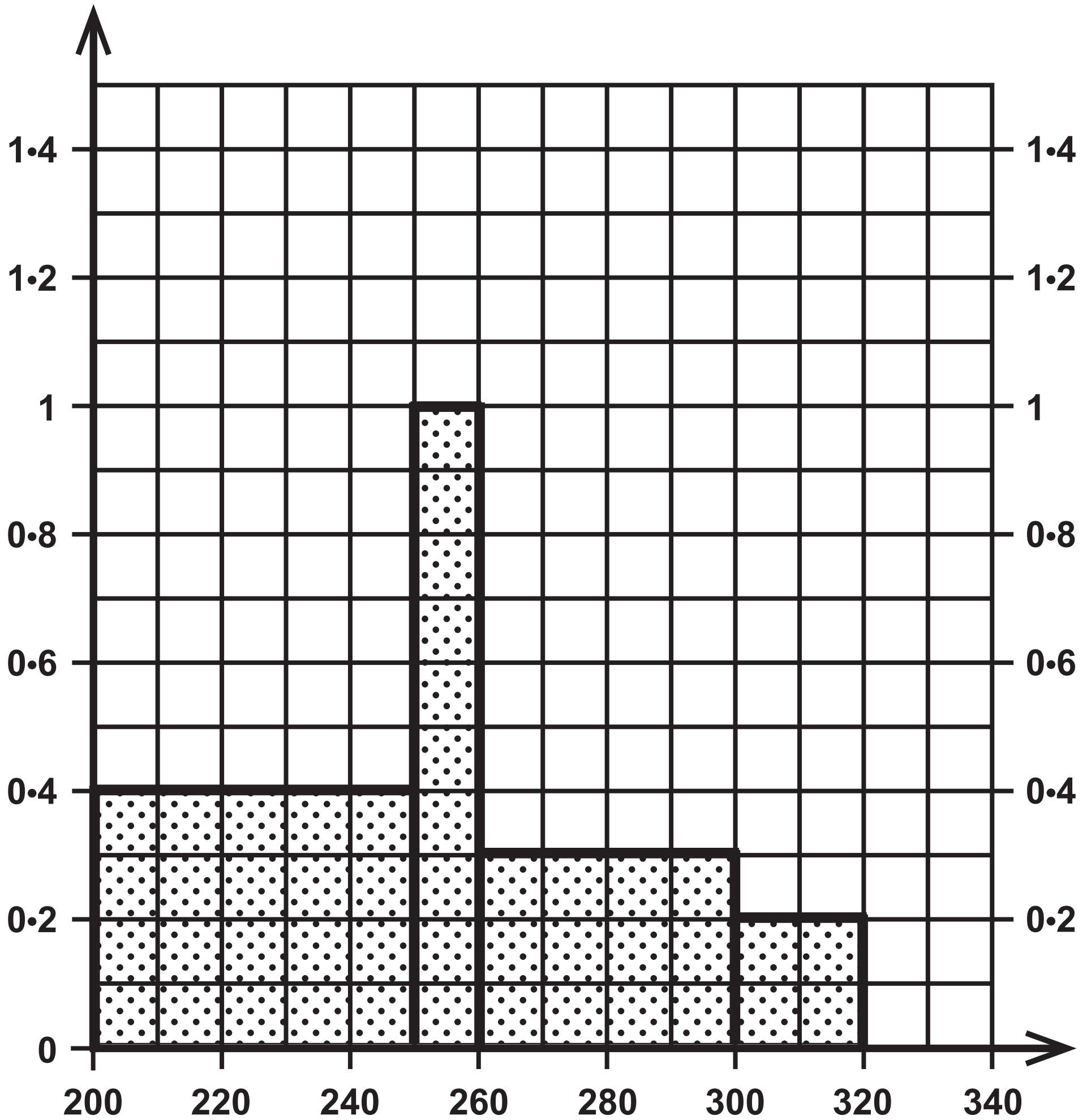
Tree height, h (cm)	Frequency	Frequency density
$200 < h \leq 250$	5	
$250 < h \leq 260$	8	
$260 < h \leq 290$	12	
$290 < h \leq 300$	13	
$300 < h \leq 320$	6	

Question 16 (a) (ii)



Question 16 (b)

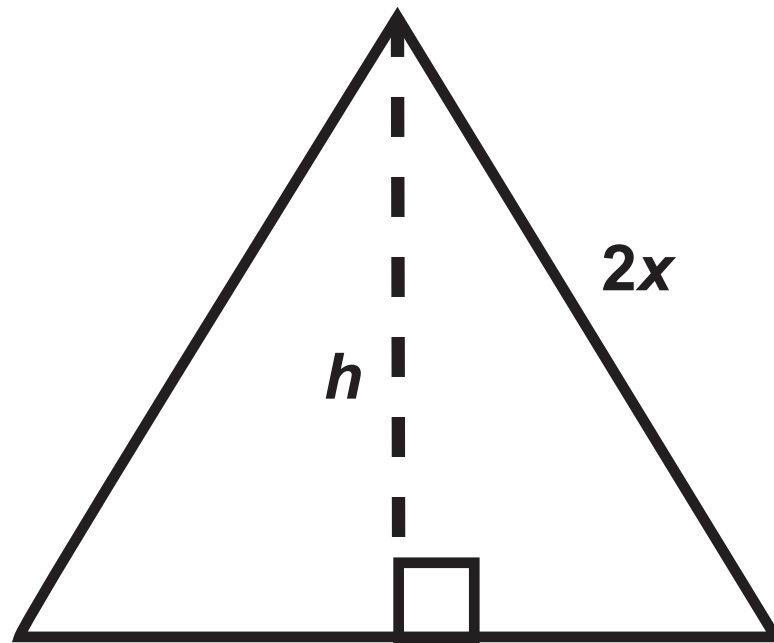
Frequency density



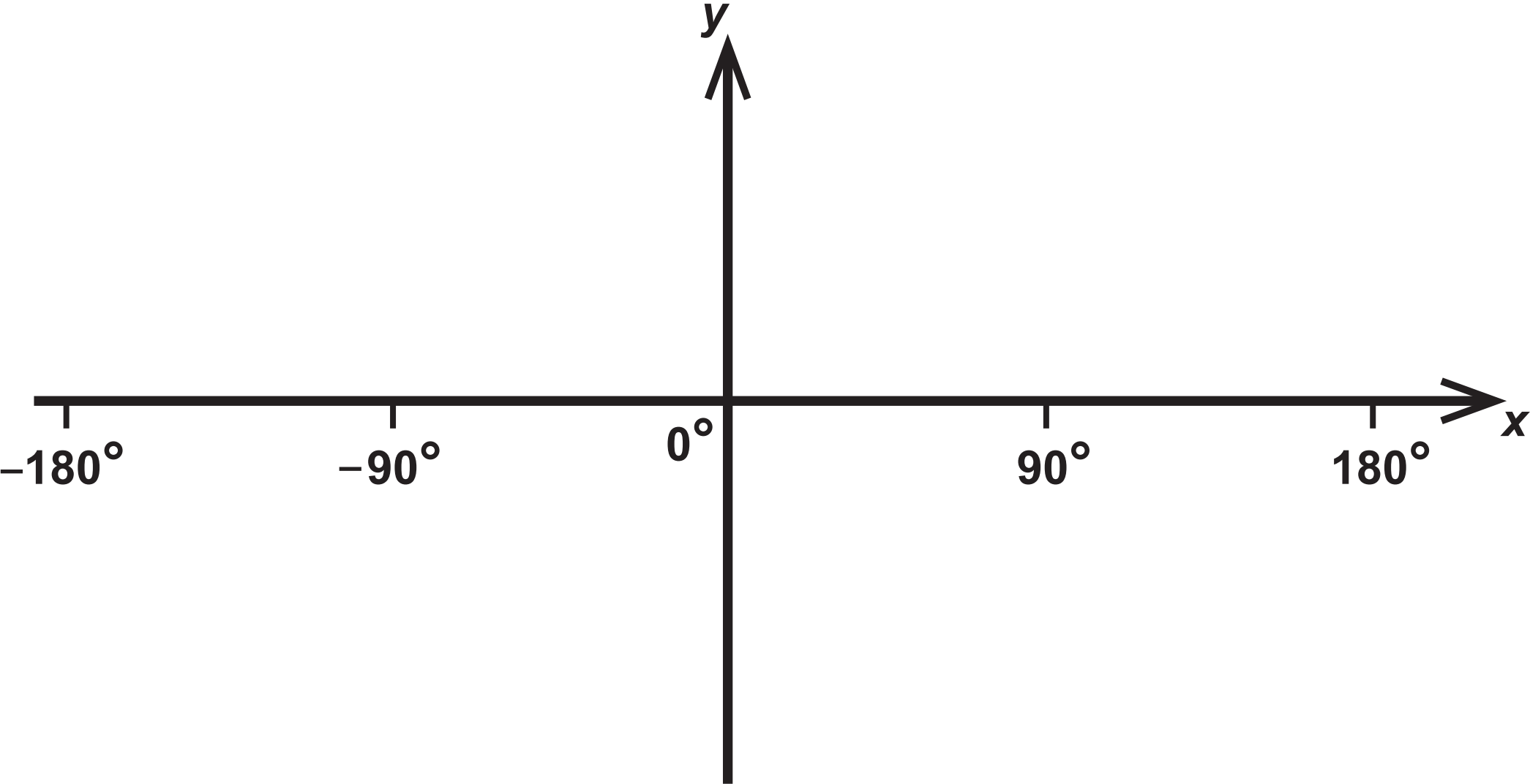
Tree height, h (cm)

Question 17

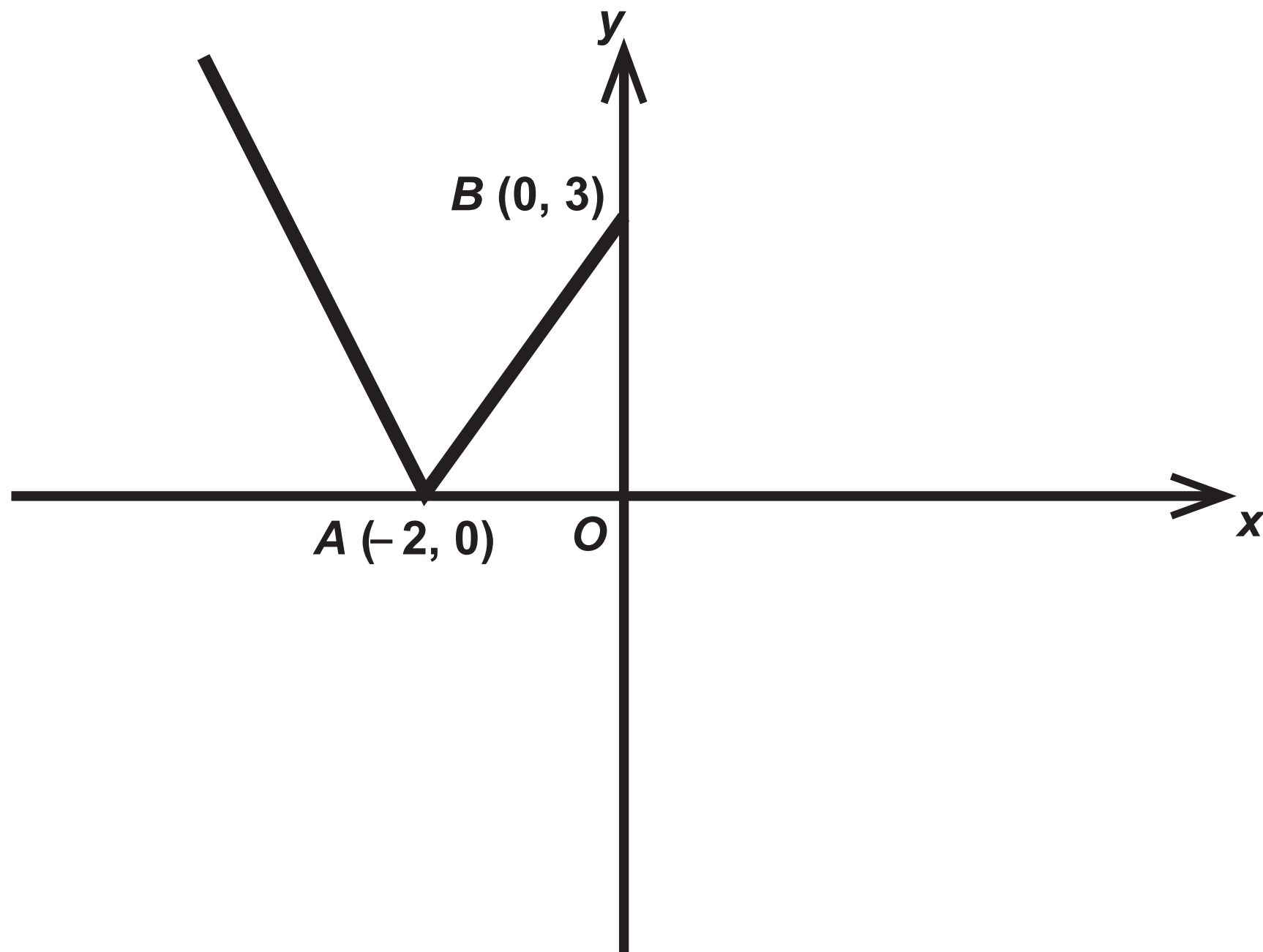
Diagram NOT drawn to scale



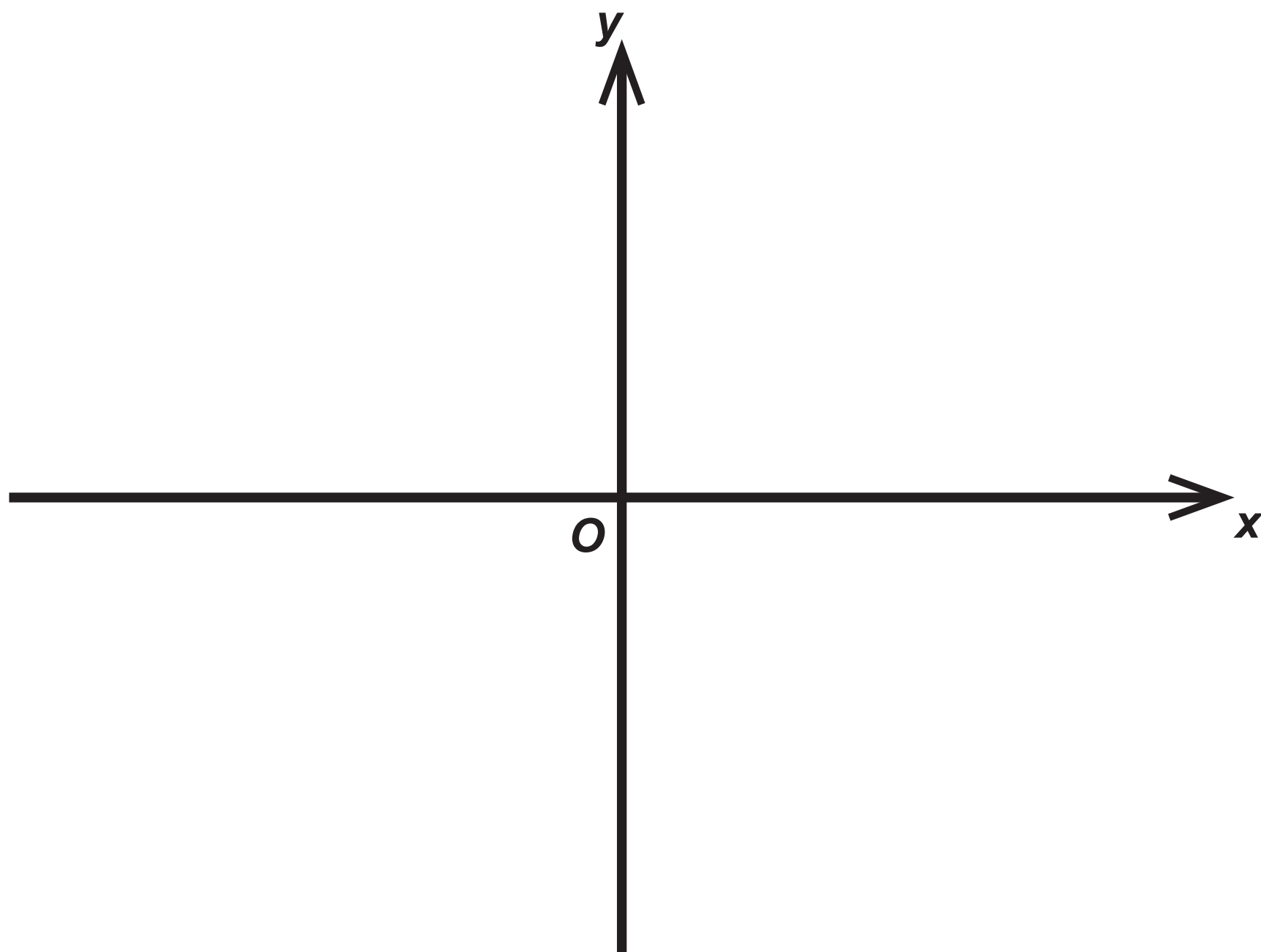
Question 21 (a) (i)



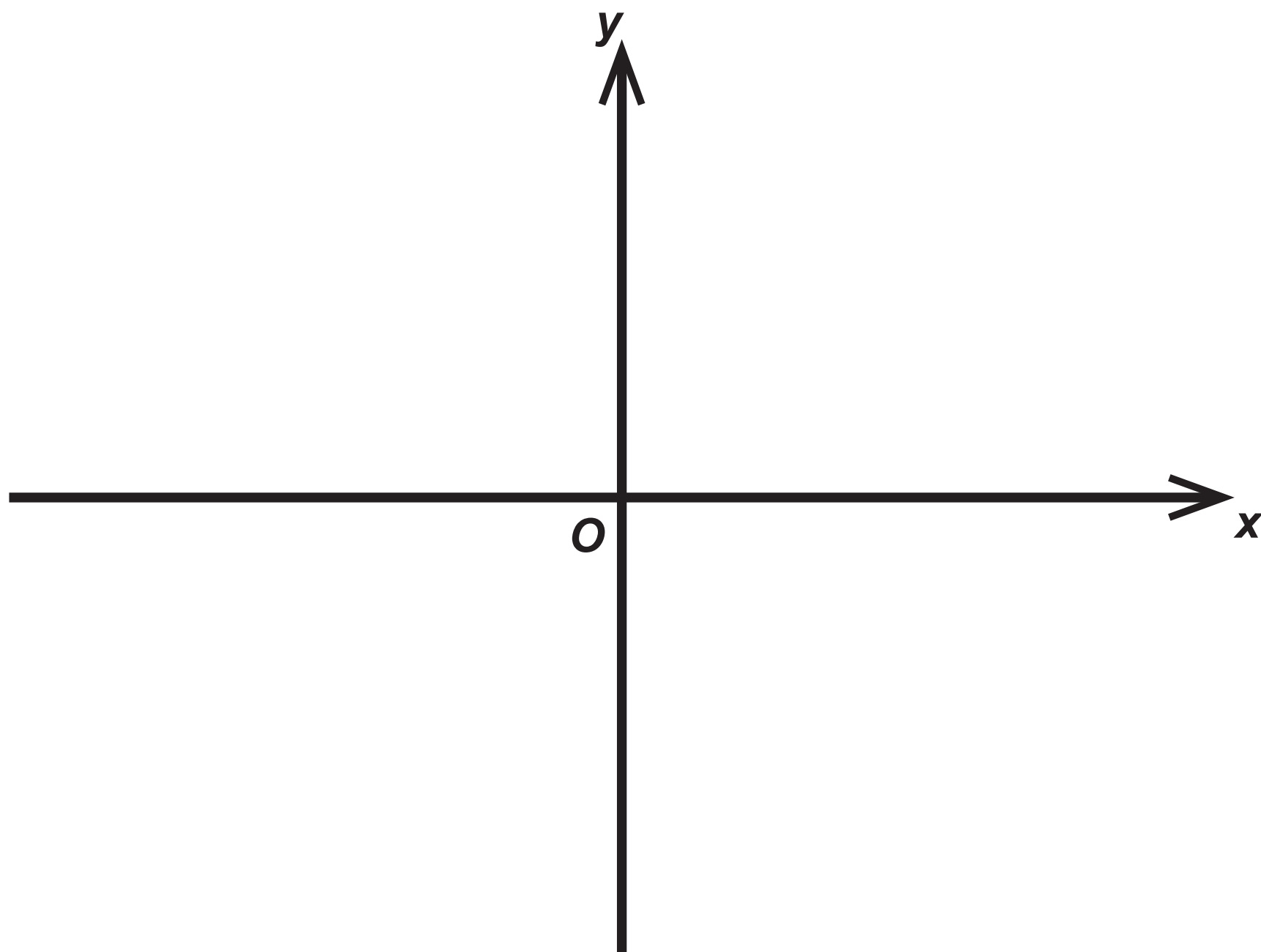
Question 21 (b)



Question 21 (b) (i)

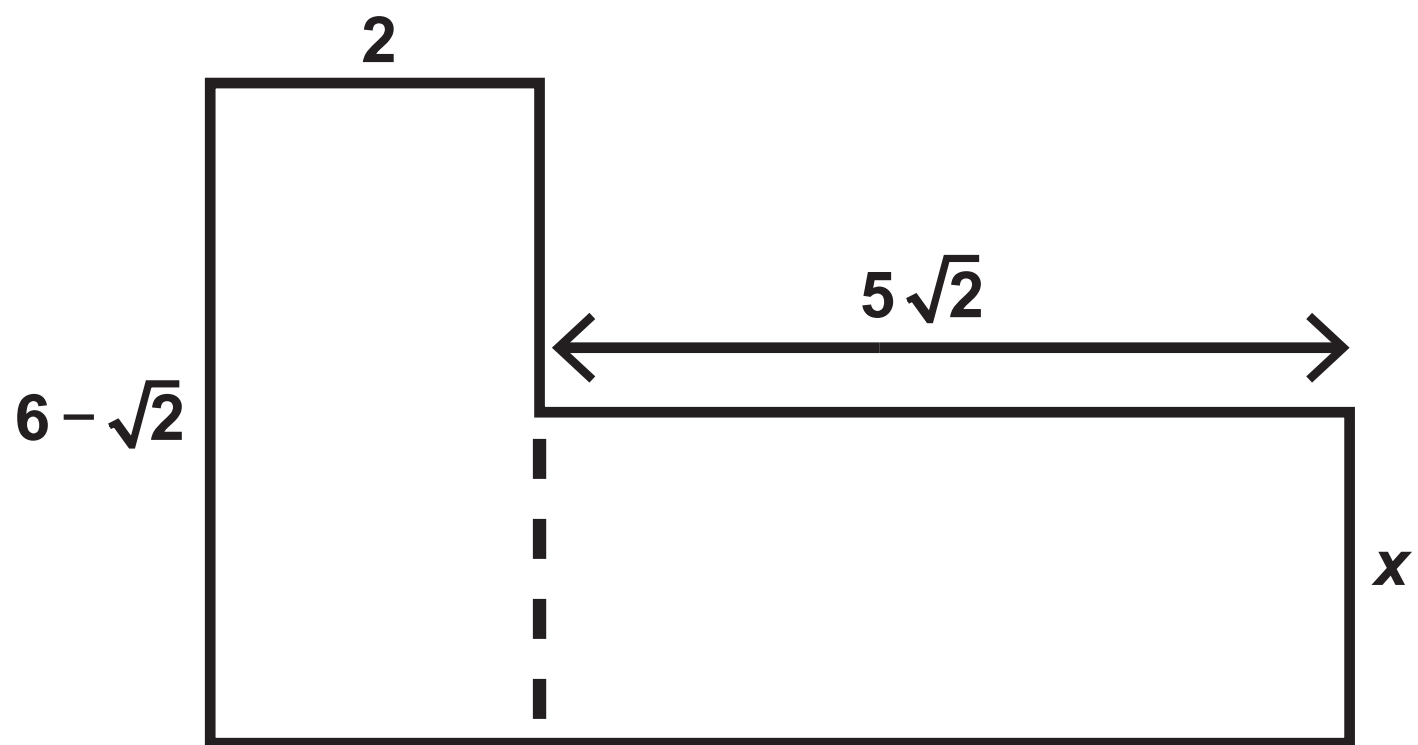


Question 21 (b) (ii)



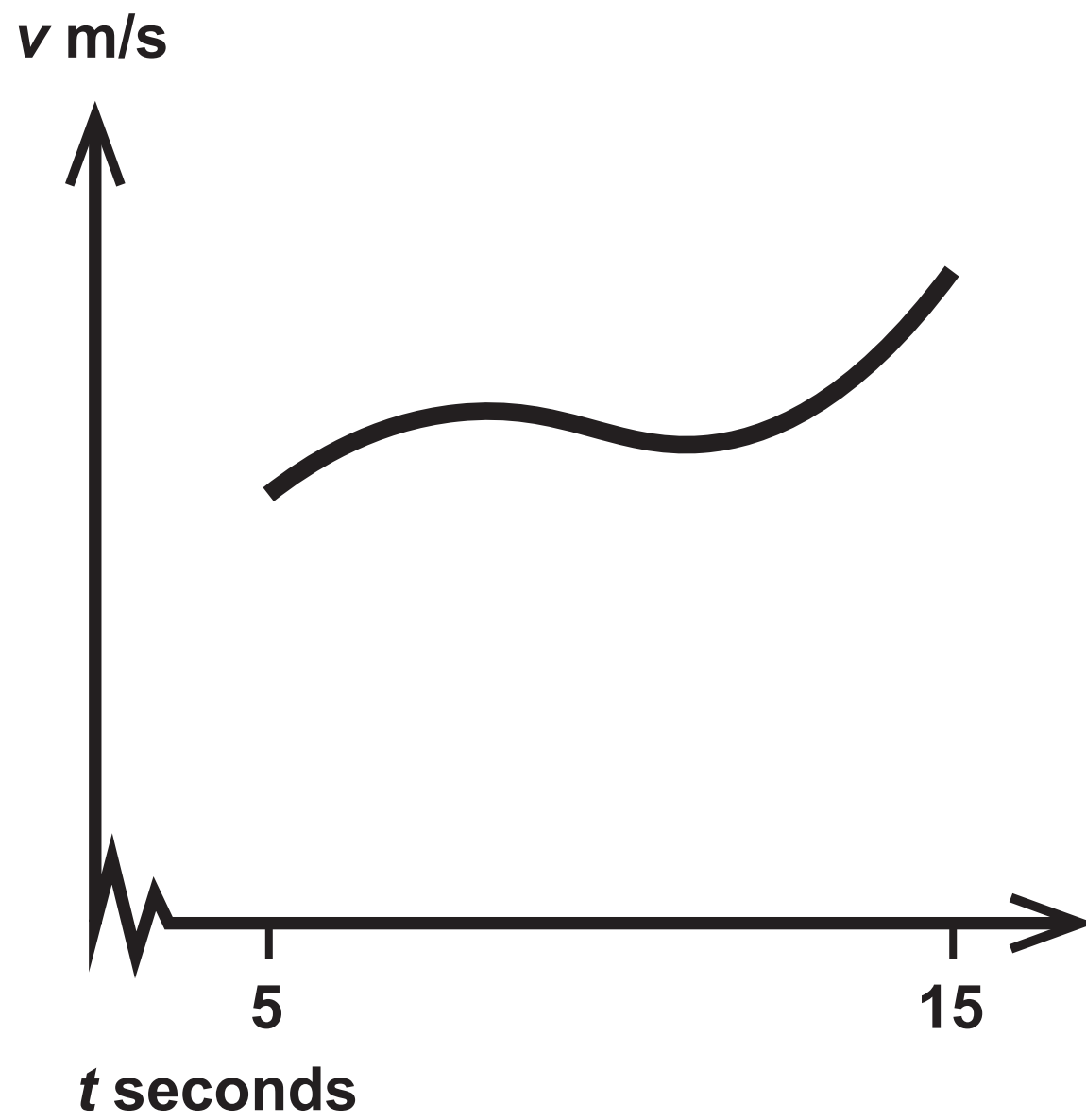
Question 23 (b)

Diagram NOT drawn to scale



Question 25

Diagram NOT drawn to scale



**FORMULA LIST
FOUNDATION TIER
AND HIGHER TIER
GCSE**

You must not write on these formulae pages.

Anything you write on these formulae pages will gain NO credit.

AREA AND VOLUME FORMULAE

Where r is the radius of the sphere or cone,
 l is the slant height of a cone and
 h is the perpendicular height of a cone:

Curved surface area of a cone = $\pi r l$

Surface area of a sphere = $4\pi r^2$

Volume of a sphere = $\frac{4}{3}\pi r^3$

Volume of a cone = $\frac{1}{3}\pi r^2 h$

KINEMATICS FORMULAE

Where a is constant acceleration,
 u is initial velocity, v is final velocity,
 s is displacement from the position
when $t = 0$ and t is time taken:

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

C300UA0-1A

FRIDAY, 20 MAY 2022 – MORNING

MATHEMATICS

HIGHER TIER

Additional Formulae

PERIMETER, AREA AND VOLUME

Where a and b are the lengths of the parallel sides and h is their perpendicular separation:

$$\text{Area of a trapezium} = \frac{1}{2}(a + b)h$$

**Volume of a prism =
area of cross section $\times$ length**

**Where r is the radius and
 d is the diameter:**

$$\text{Circumference of a circle} = 2\pi r = \pi d$$

$$\text{Area of a circle} = \pi r^2$$

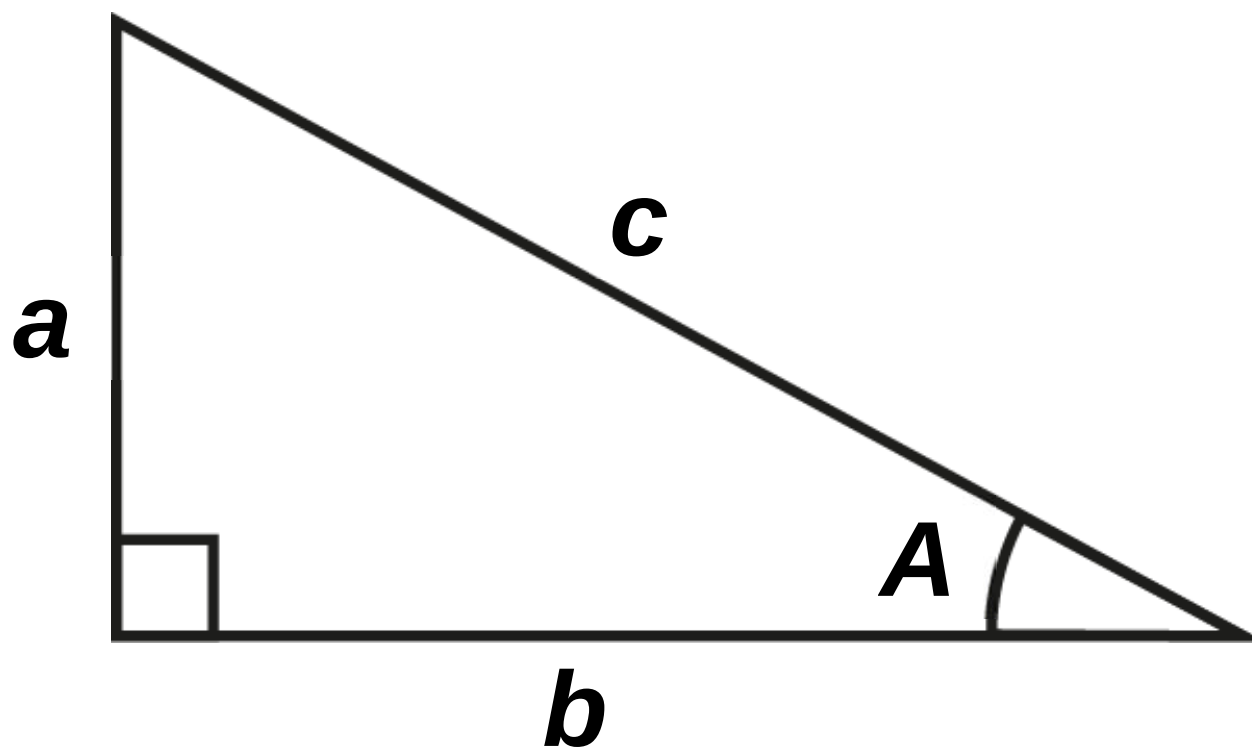
QUADRATIC FORMULA

The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

PYTHAGORAS' THEOREM AND TRIGONOMETRY

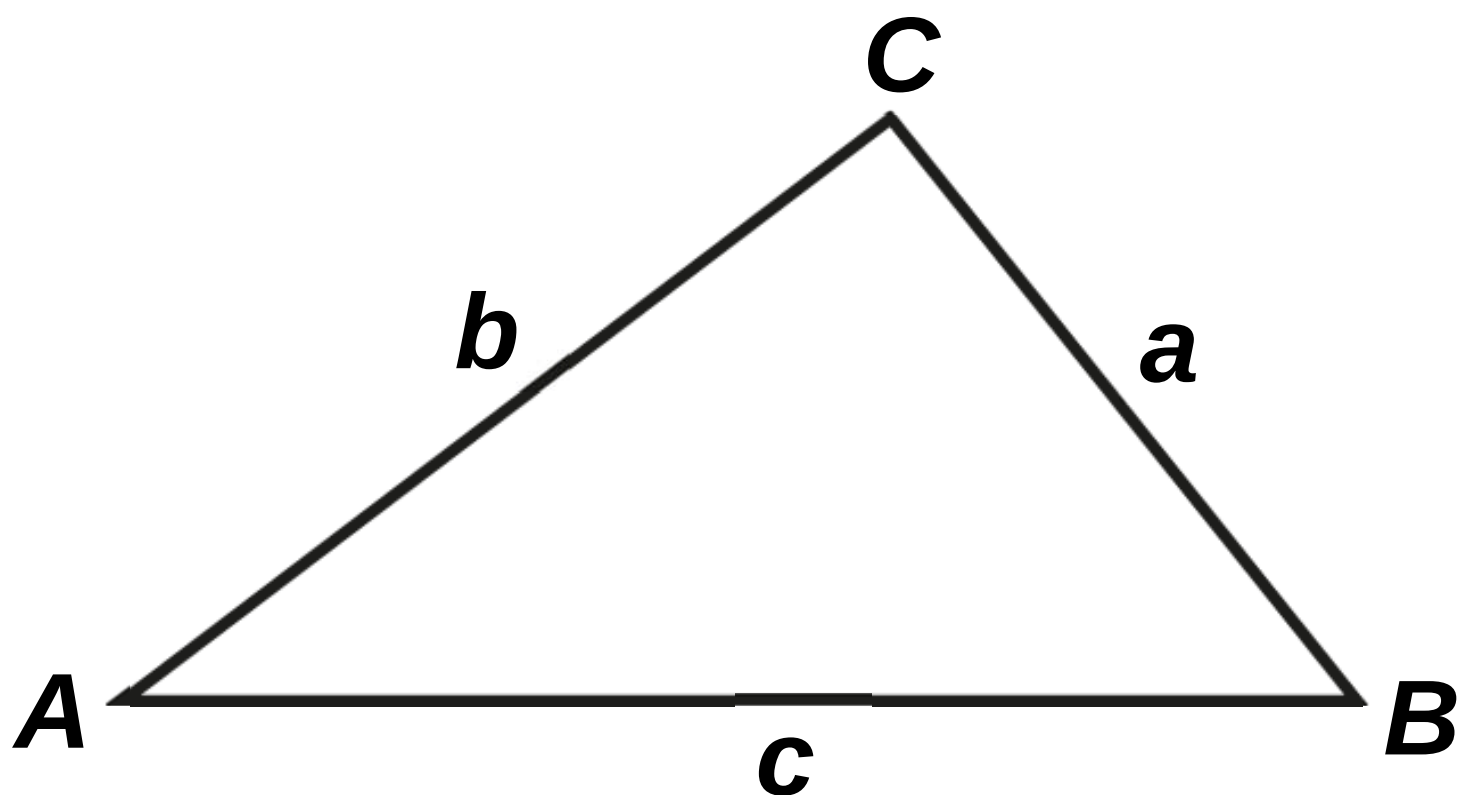


In any right – angled triangle where a , b and c are the length of the sides and c is the hypotenuse:

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

In any right – angled triangle ABC where a , b and c are the length of the sides and c is the hypotenuse:

$$\sin A = \frac{a}{c} \quad \cos A = \frac{b}{c} \quad \tan A = \frac{a}{b}$$



In any triangle **ABC** where **a**, **b** and **c** are the length of the sides:

sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

cosine rule:

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{Area of a triangle} = \frac{1}{2}ab \sin C$$

COMPOUND INTEREST

Where P is the principal amount,
 r is the interest rate over a given period
and n is number of times that the
interest is compounded:

$$\text{Total accrued} = P \left(1 + \frac{r}{100} \right)^n$$

PROBABILITY

Where $P(A)$ is the probability of
outcome A and $P(B)$ is the probability
of outcome B :

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$P(A \text{ and } B) = P(A \text{ given } B) P(B)$$