



General Certificate of Secondary Education  
2016

Centre Number

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Candidate Number

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## Mathematics

Unit T4  
(With calculator)  
Higher Tier



**MV18**

[GMT41]

**THURSDAY 26 MAY, 9.15am–11.15am**

### Time

2 hours, plus your additional time allowance.

### Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

**You must answer the questions in the spaces provided.**

Complete in blue or black ink only.

Answer **all twenty-one** questions.

Any working should be clearly shown in the spaces provided since marks may be awarded for partially correct solutions.

You **may** use a calculator for this paper.

## Information for Candidates

The total mark for this paper is 100.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

Functional Elements will be assessed in this paper.

Quality of written communication will be assessed in

**Questions 10 and 18.**

You should have a calculator, ruler, compasses and a protractor.

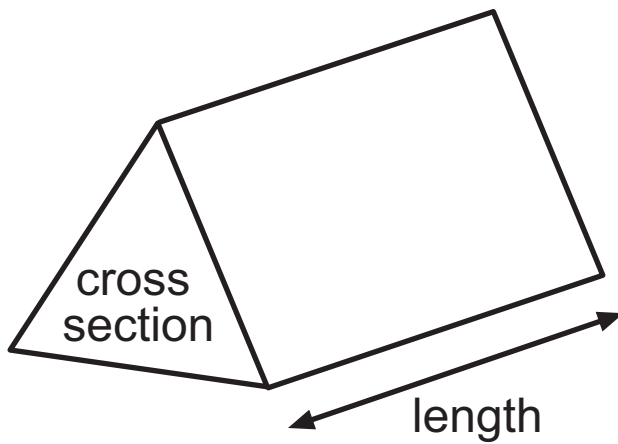
The Formula Sheet is on pages 4 and 5.

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**(Questions start overleaf)**

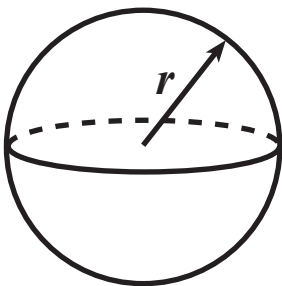
# Formula Sheet

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



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

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



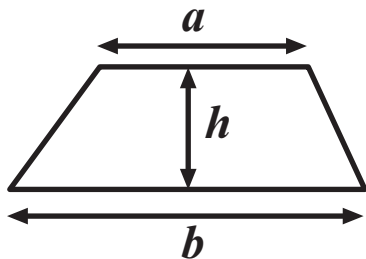
## Quadratic Equation

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

where  $a \neq 0$ , are given by

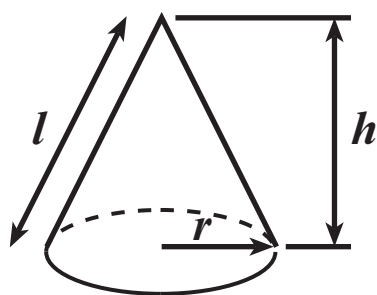
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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

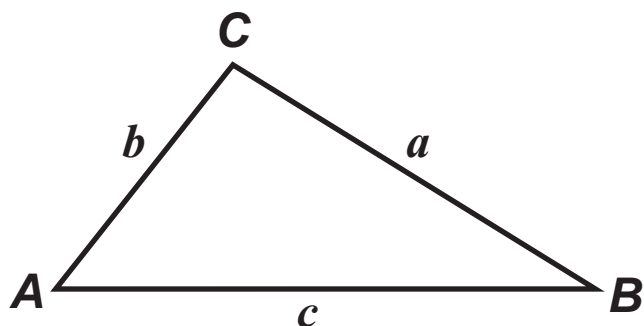


**Volume of cone**  $= \frac{1}{3} \pi r^2 h$

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



**In any triangle  $ABC$**



**Sine Rule:**  $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

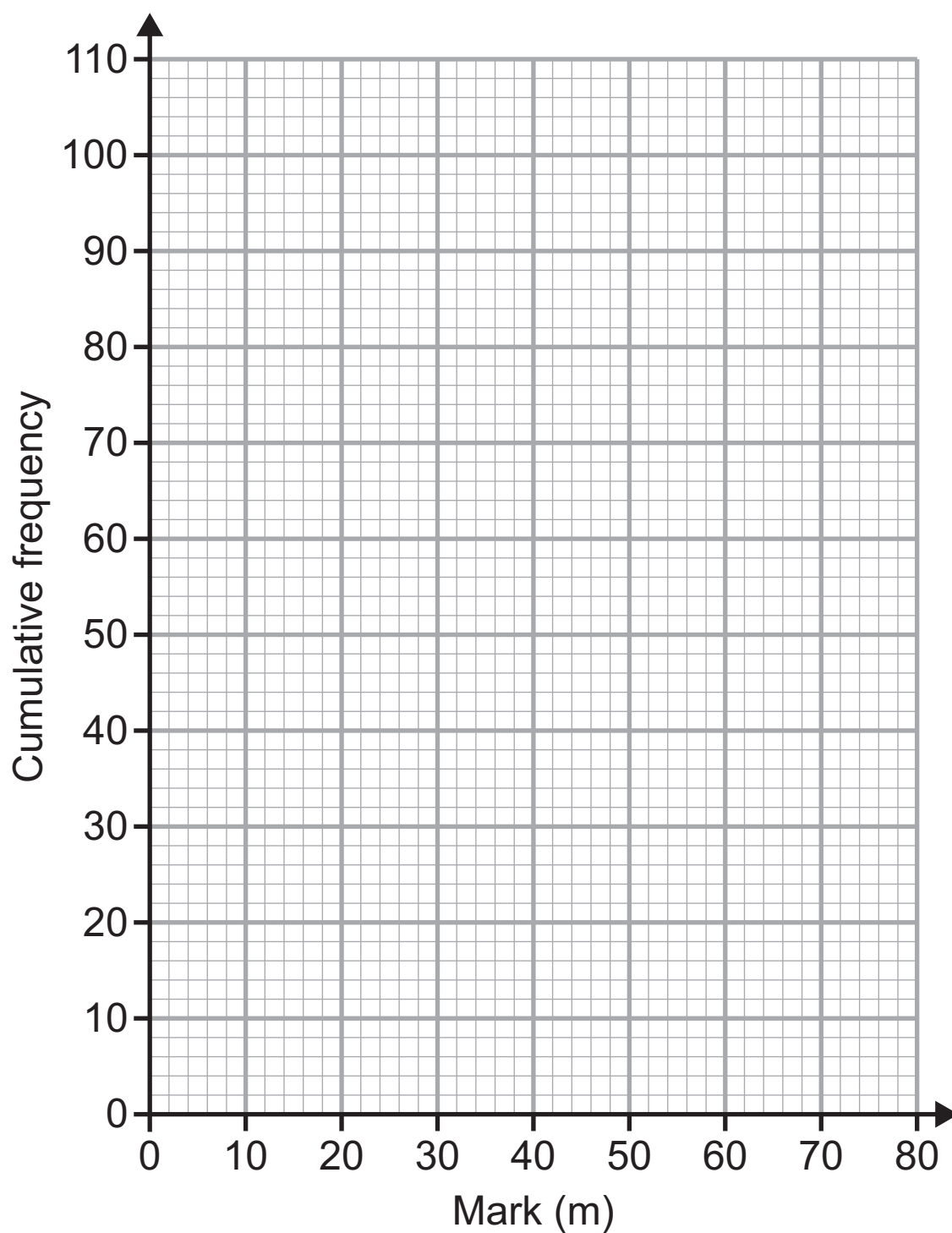
**Cosine Rule:**  $a^2 = b^2 + c^2 - 2bc \cos A$

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

- 1 (a) The marks in an examination are recorded. Complete the cumulative frequency column in the table below.  
[1 mark]

Mark (m)	Frequency	Cumulative Frequency
$0 < m \leq 10$	4	
$10 < m \leq 20$	6	
$20 < m \leq 30$	16	
$30 < m \leq 40$	24	
$40 < m \leq 50$	30	
$50 < m \leq 60$	16	
$60 < m \leq 70$	12	
$70 < m \leq 80$	4	

- (b) On the axes provided draw a cumulative frequency graph.  
[2 marks]



(c) Use the cumulative frequency graph to estimate

(i) the median, [1 mark]

Answer \_\_\_\_\_

(ii) the interquartile range. [2 marks]

Answer \_\_\_\_\_

(d) The pass mark is 36

Use the cumulative frequency graph to estimate the percentage of the candidates who pass. [2 marks]

Answer \_\_\_\_\_ %

2

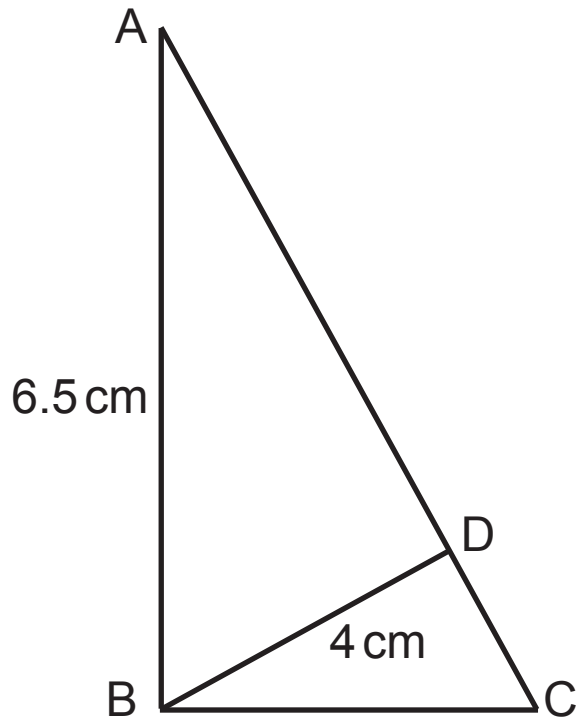


diagram not drawn  
accurately

ABC and BDA are right-angled triangles.

$AB = 6.5\text{ cm}$  and  $BD = 4\text{ cm}$ .

Calculate the length of CD. [6 marks]

Answer \_\_\_\_\_ cm

3

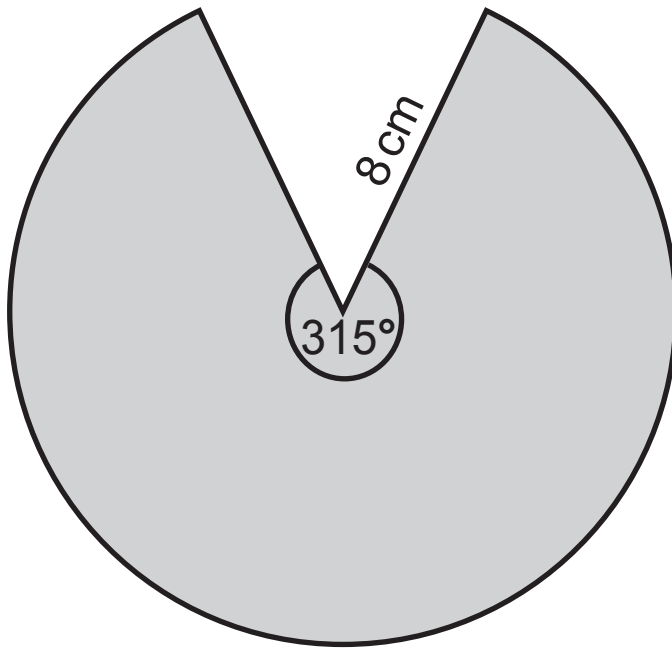


diagram not drawn  
accurately

Calculate the area of the shaded sector. [3 marks]

Answer \_\_\_\_\_  $\text{cm}^2$

- 4 A special offer shampoo bottle contains 20% extra.

It contains 900 ml of shampoo.

How much shampoo was in the original bottle? [3 marks]

Answer \_\_\_\_\_ ml

- 5 A full jar of coffee weighs 670 g. An empty coffee jar weighs 450 g.

Both are measured to the nearest 5 g.

Calculate the maximum weight of coffee in the jar.  
[3 marks]

Answer \_\_\_\_\_ g

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**(Questions continue overleaf)**

**6** Solve the simultaneous equations

$$3x - y = 7 \quad \text{and} \quad 5x - 2y = 10 \quad [3 \text{ marks}]$$

**A solution by trial and improvement will not be accepted.**

Answer  $x =$  \_\_\_\_\_  $y =$  \_\_\_\_\_

7 (a) Expand and simplify  $(2x - 3)(3x + 4)$  [2 marks]

Answer \_\_\_\_\_

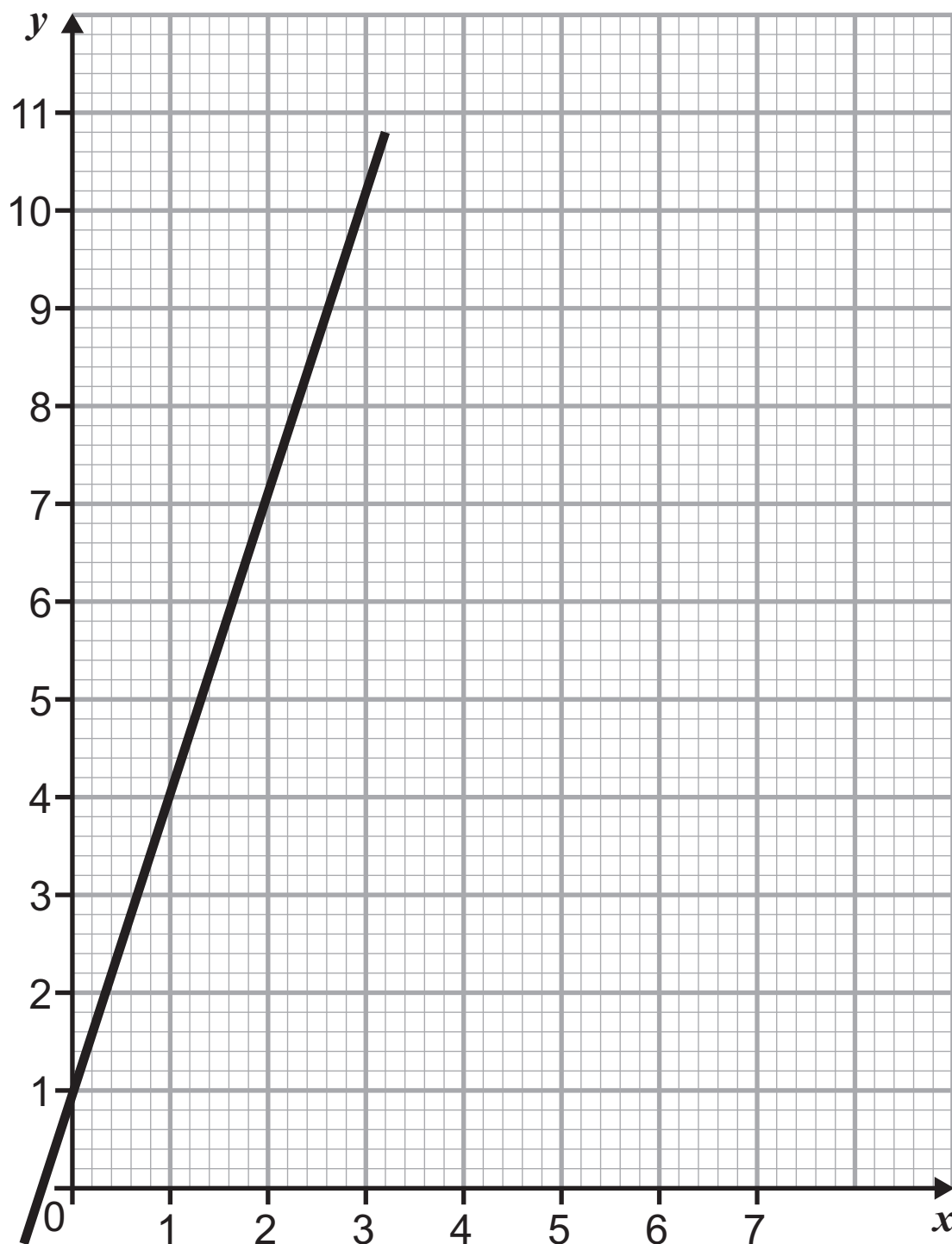
(b) Factorise  $p^2 - 64$  [1 mark]

Answer \_\_\_\_\_

(c) Simplify  $\frac{4x^3h}{12x^2h^3}$  [2 marks]

Answer \_\_\_\_\_

8



(a) Find the gradient of the line shown. [1 mark]

Answer \_\_\_\_\_

- (b) Hence write down the equation of the line in the form  $y = mx + c$  [1 mark]

Answer \_\_\_\_\_

- (c) Write down the equation of the line which is parallel to the line shown and which passes through the point  $(0, -1)$ . [2 marks]

Answer \_\_\_\_\_

- (d) Explain why the straight lines  $y = 3x - 2$  and  $3y + x = 5$  are perpendicular. [2 marks]

- 9 Jenna completes one lap of a cross-country circuit in 9 minutes.

Her younger brother Luke completes the same circuit in 15 minutes.

They start together. They run in the same direction and maintain the same lap times.

How many **more** laps will Jenna have completed than Luke when they next meet on the starting line together?  
[3 marks]

Answer \_\_\_\_\_

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**(Questions continue overleaf)**

**Quality of written communication will be assessed in this question.**

- 10** The grouped frequency table shows the performance of 22 students in a test.

Test Result (marks)	Frequency
$0 \leq x < 20$	7
$20 \leq x < 40$	4
$40 \leq x < 60$	4
$60 \leq x < 80$	3
$80 \leq x < 100$	4

The teacher has identified the mean, the range, the modal class and the class containing the median.

Later, he discovers he has forgotten to record the results for two students. These students scored 21 and 39. He amends the data in the table.

- (a)** How will the range be affected when he includes these two students? [2 marks]

**Explain your answer clearly.**

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- (b) How will the mean be affected when he includes these two students? [2 marks]

**Explain your answer clearly.**

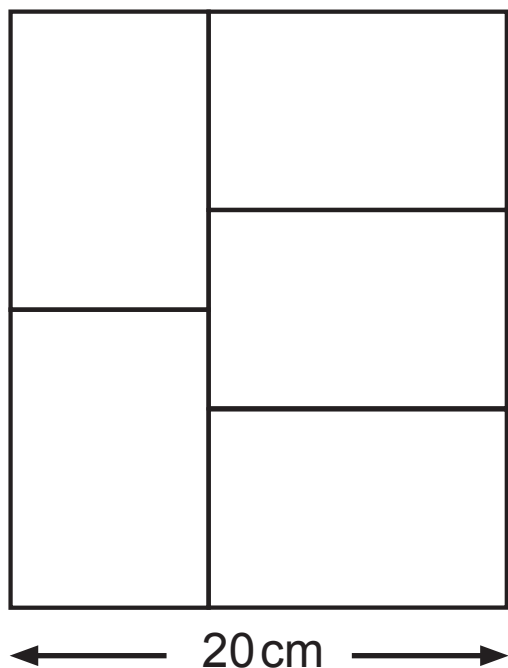
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- (c) Which class interval will contain the median when he includes these two students? [1 mark]

Answer \_\_\_\_\_

11 Five identical rectangles fit together as shown.



What is the total area covered by the rectangles?  
[5 marks]

A solution by trial and improvement will not be accepted.

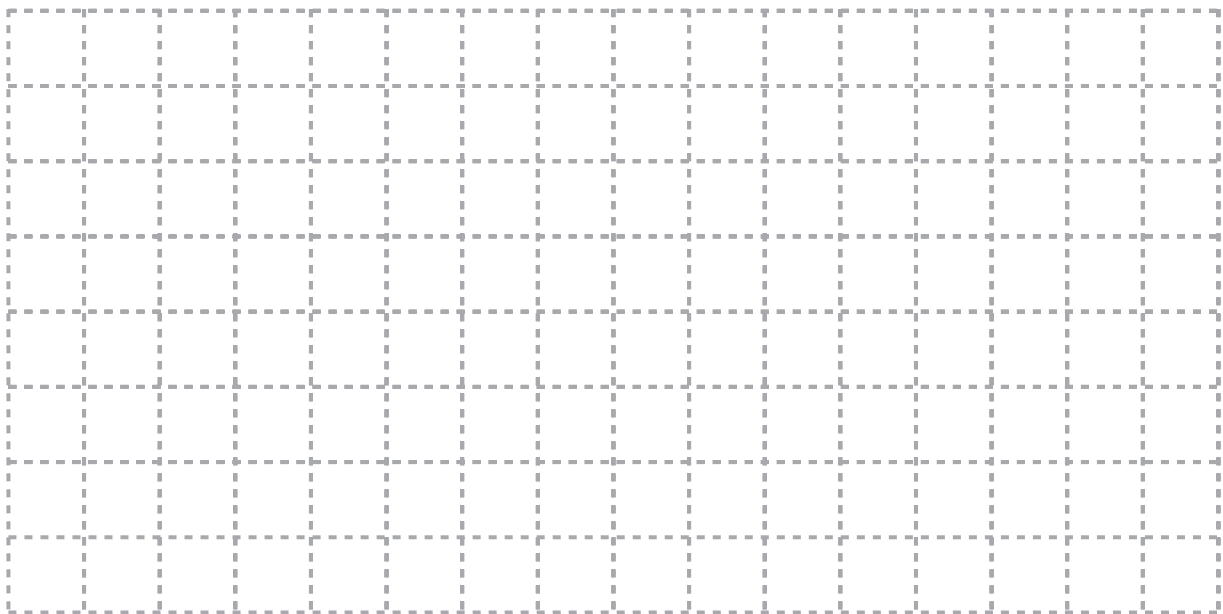
Show your working.

Answer \_\_\_\_\_  $\text{cm}^2$

- 12** The lengths of times, in minutes, for a group of people to complete a questionnaire online are recorded below.

Length of time	Number of people	
$0 < t \leq 5$	10	
$5 < t \leq 8$	36	
$8 < t \leq 11$	24	
$11 < t \leq 16$	10	
$16 < t \leq 32$	4	

- (a)** Draw a histogram on the grid provided to illustrate this data. [3 marks]



A stratified sample of 20 people is to be selected from those who took less than or equal to 16 minutes to complete the task.

- (b)** Estimate how many of this sample would have taken more than 8 minutes. [2 marks]

Answer \_\_\_\_\_

**13** A rectangular garden has a length which is 3 metres longer than its width.

Its length is extended by adding 3 metres. The width is reduced by 2 metres.

The area of the newly made garden is exactly the same as the area of the original garden.

Find the new length and width. [4 marks]

New length = \_\_\_\_\_ m

New width = \_\_\_\_\_ m

**14 (a)** Y is directly proportional to the cube of X.

$$Y = 960 \text{ when } X = 4$$

Express Y in terms of X. [2 marks]

Answer \_\_\_\_\_

**(b)** Calculate the value of X when  $Y = 405$  [2 marks]

Answer \_\_\_\_\_

**15 (a)** Given  $(2^n)^{\frac{2}{3}} = 16$ , find the value of  $n$ . [2 marks]

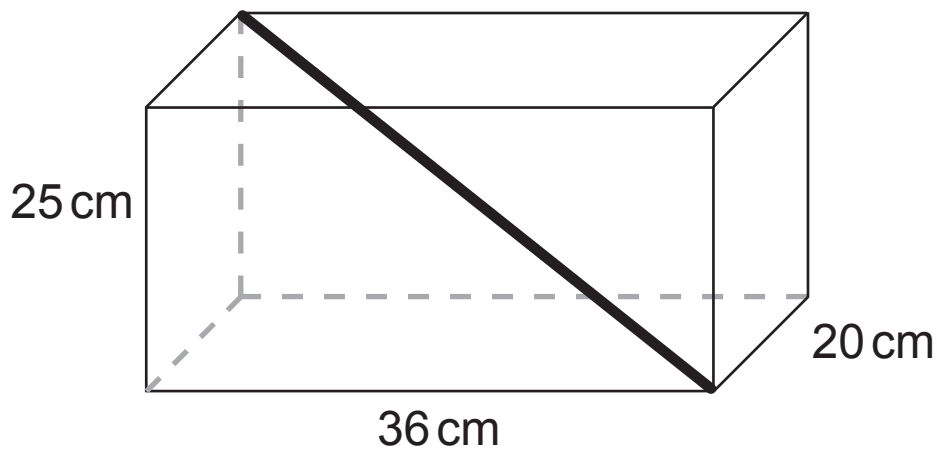
Answer  $n =$  \_\_\_\_\_

**(b)** The value of  $P = 81$  and the value of  $Q = 32$

Find the value of  $m$  given that  $(P^{\frac{1}{2}} + Q^{\frac{4}{5}})^{-m} = \frac{1}{5}$   
[3 marks]

Answer  $m =$  \_\_\_\_\_

- 16** The diagram below shows the position of the longest rod that can fit inside a box.



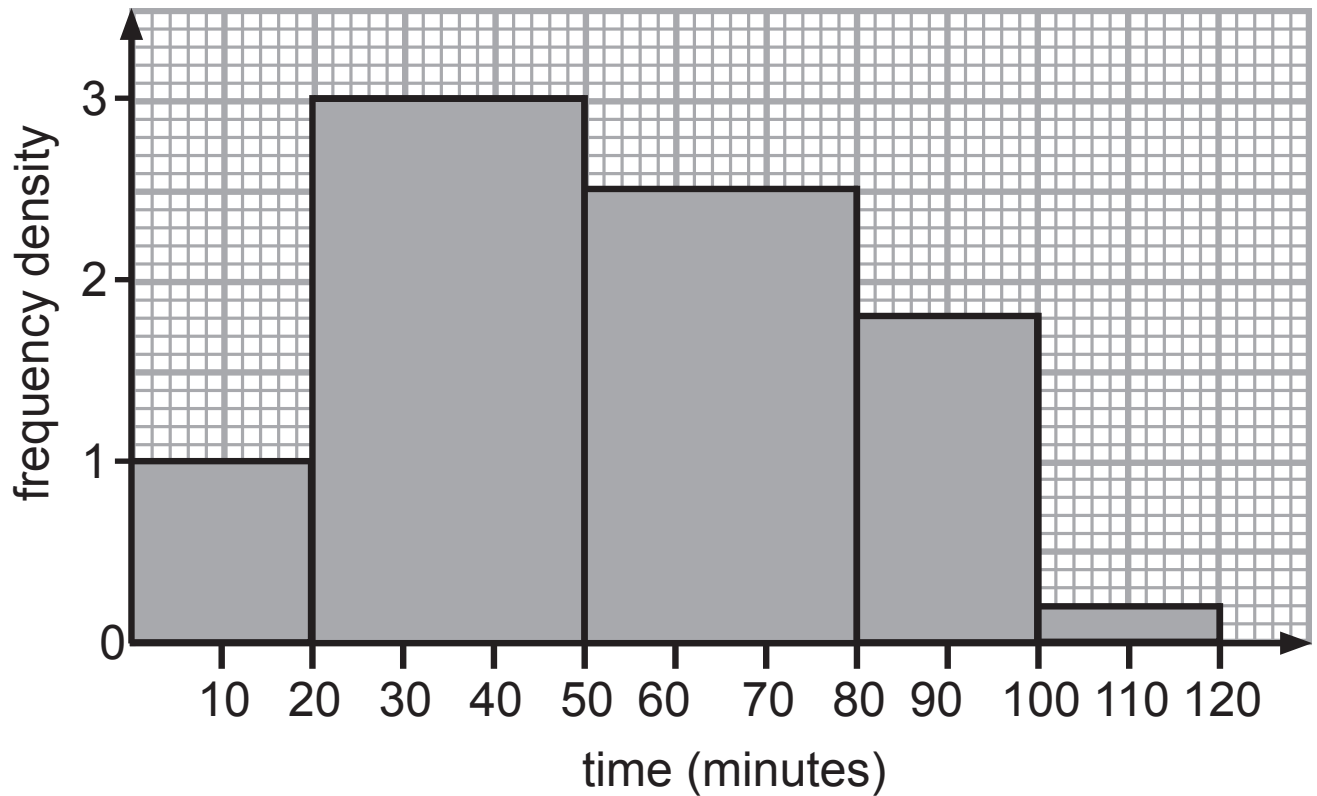
- (a)** Calculate the length of the rod. [2 marks]

Answer \_\_\_\_\_ cm

- (b)** Calculate the angle that the rod makes with the base of the box. [3 marks]

Answer \_\_\_\_\_ °

- 17** The histogram illustrates how much time drivers took on a particular journey.



- (a)** Calculate an estimate for the mean time. [4 marks]

Answer \_\_\_\_\_ minutes

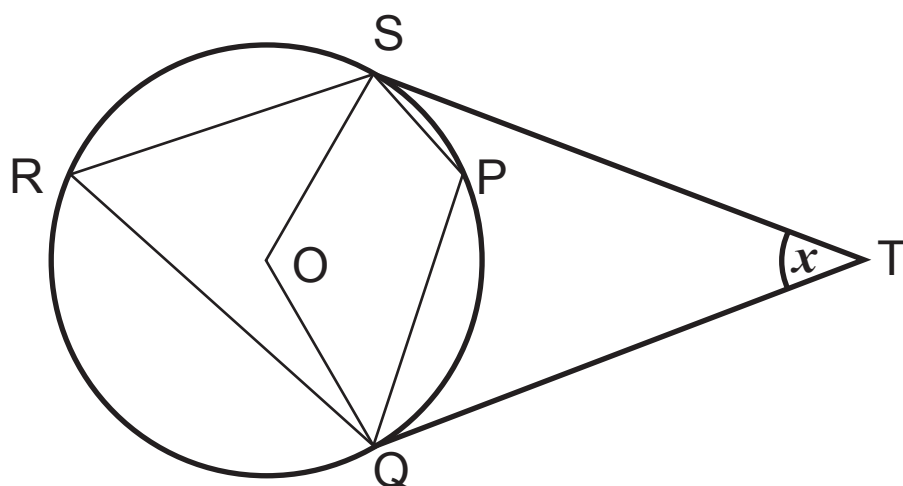
**(b)** Two-thirds of the drivers took more than M minutes.

Calculate an estimate for the value of M. [3 marks]

Answer \_\_\_\_\_ minutes

**Quality of written communication will be assessed in this question.**

- 18** In the diagram,  $O$  is the centre of the circle.  
 $P$ ,  $Q$ ,  $R$  and  $S$  are points on the circumference of the circle.  
 $ST$  and  $QT$  are tangents to the circle.  
 Angle  $STQ = x$ .



Work out the size of angle  $SPQ$  in terms of  $x$ . [5 marks]

**Explain each stage of your working clearly.**

Answer  $SPQ =$  \_\_\_\_\_

**19** Simplify  $\frac{6a^2 + 4a - 16}{8 - 2a^2}$  [3 marks]

Answer \_\_\_\_\_

**20** Solve the simultaneous equations

$$2x^2 + 3y^2 = 2 \quad \text{and} \quad x - y + 1 = 0 \quad [7 \text{ marks}]$$

Answer \_\_\_\_\_

**21** Given  $\frac{y+z}{y-z} = 3$  find the value of  $\frac{y+3z}{y-3z}$  [5 marks]

Answer \_\_\_\_\_





For Examiner's use only	
Question Number	Marks
1	
2	
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Total Marks	
Examiner Number	

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