



Rewarding Learning

General Certificate of Secondary Education  
2022

Centre Number

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Candidate Number

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# Mathematics

Unit M4  
(With calculator)  
Higher Tier



[GMC41]  
TUESDAY 24 MAY, 9.15am–11.15am

\*GMC41\*

## TIME

2 hours.

## INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page. **You are provided with Higher Tier Additional Support Materials for use with this paper.**

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

**Do not write outside the boxed area on each page or on blank pages.**

Complete in black ink only. **Do not write with a gel pen.**

Answer **all twenty-one** questions.

All working should be clearly shown in the spaces provided. 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 down the right-hand side of pages indicate the marks awarded to each question or part question.

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

The Formula Sheet is on page 2.

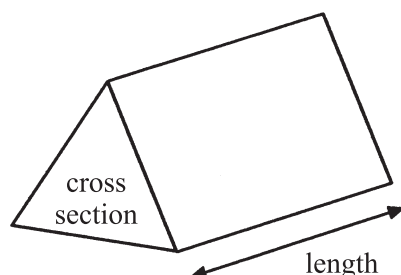
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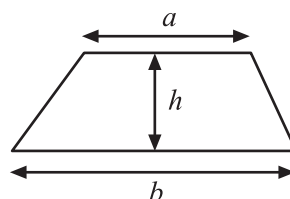
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# Formula Sheet

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

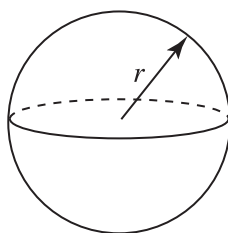


**Area of trapezium** =  $\frac{1}{2}(a + b)h$



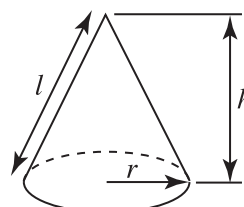
**Volume of sphere** =  $\frac{4}{3}\pi r^3$

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

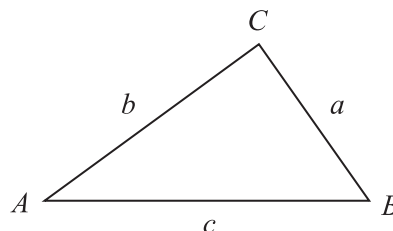


**Volume of cone** =  $\frac{1}{3}\pi r^2 h$

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



**In any triangle ABC**



## Quadratic Equation

The solutions of  $ax^2 + bx + c = 0$  where  $a \neq 0$ , are given by

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

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

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

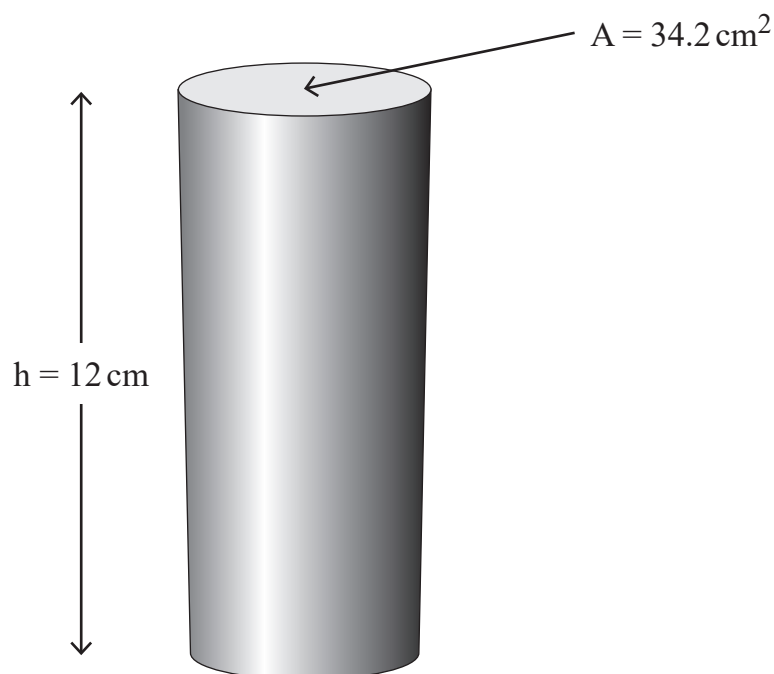
**Area of triangle** =  $\frac{1}{2} ab \sin C$



1 A solid cylinder has a height of 12 cm and a circular cross-sectional area of  $34.2 \text{ cm}^2$

The density is  $0.83 \text{ g/cm}^3$

Find the mass of the cylinder.



Answer \_\_\_\_\_ g [3]

[Turn over]



2 Shares were bought with an original value of £1600

The value increased by 5% each year.

Calculate the value after three years.

Answer £ \_\_\_\_\_ [3]



- 3 The number of flights delayed at an airport were recorded over a 24-hour period.

The number of minutes they were delayed is shown in the table below.

Minutes delayed ( $t$ )	Number of flights		
$0 < t \leq 20$	31		
$20 < t \leq 40$	19		
$40 < t \leq 60$	10		
$60 < t \leq 80$	14		
$80 < t \leq 100$	12		
$100 < t \leq 120$	6		

- (a) Calculate an estimate for the mean number of minutes the flights were delayed.

Answer \_\_\_\_\_ minutes [4]

- (b) Write down the modal class interval.

Answer \_\_\_\_\_ [1]

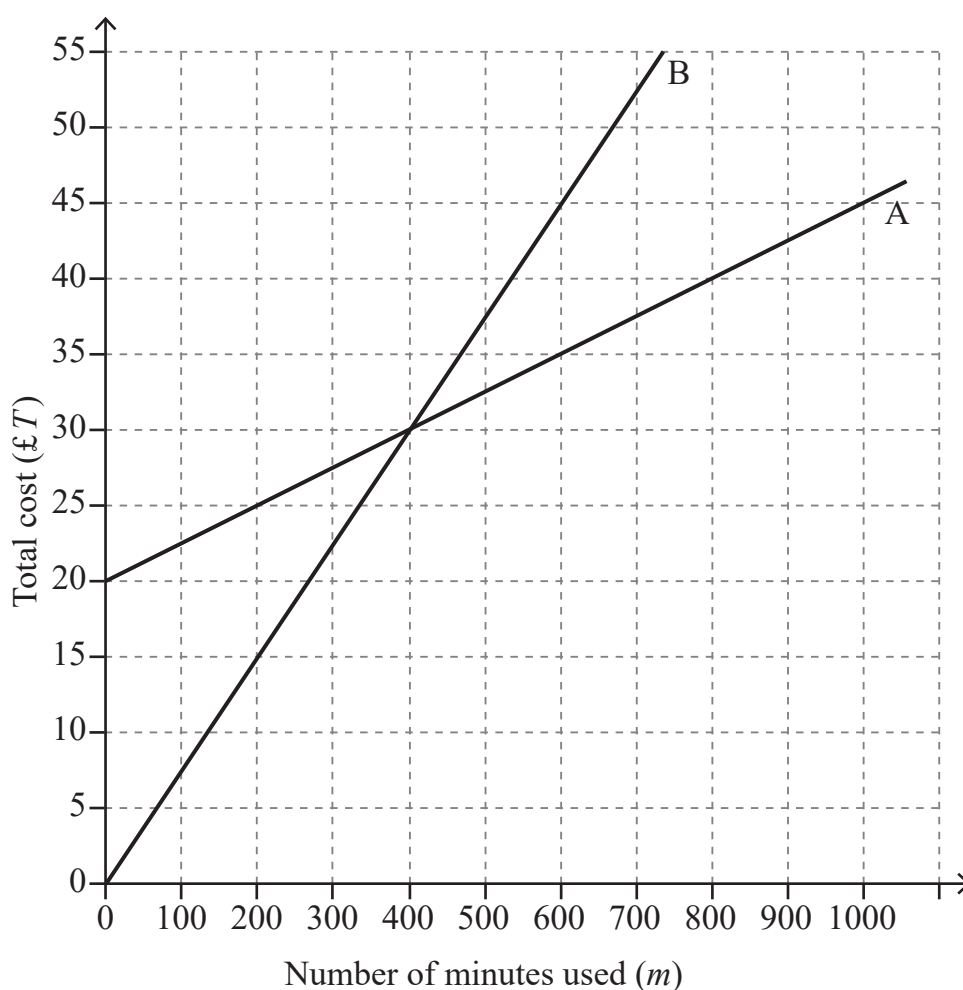
- (c) Write down the class interval in which the median lies.

Answer \_\_\_\_\_ [1]

[Turn over



- 4 The graph below illustrates two different monthly tariffs, A and B, for a mobile phone.



Tariff A has a fixed charge per month plus a charge per minute for phone calls.

- (a) What is the fixed charge per month?

Answer £ \_\_\_\_\_ [1]

- (b) What is the charge per minute for tariff A?

Answer \_\_\_\_\_ p [2]



(c) Hence write a formula for the total cost  $T$  of tariff A for  $m$  minutes.

Answer \_\_\_\_\_ [2]

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[Turn over]



\*28GMC4107\*

5 Expand and simplify  $(x - 3)(x + 5)$

Answer \_\_\_\_\_ [2]

6 Two cyclists start from the same location.

One cyclist travels due North at an average speed of 22 km/h and the other travels due East at an average speed of 26 km/h.

How far apart are the cyclists after 2 hours?

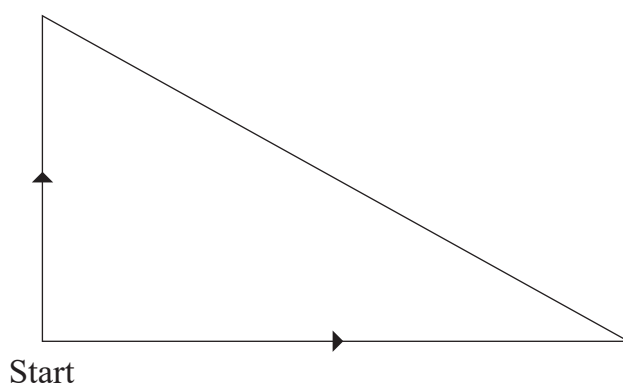


diagram  
not drawn  
accurately

Answer \_\_\_\_\_ km [4]





7 Simplify  $5 - \frac{x+10}{2}$

Answer \_\_\_\_\_ [2]

8 A factory produces three types of lightbulbs: clear, pearl and colour.

In a week 45 360 clear bulbs are produced.

Pearl and colour make up 36% of the total produced each week.

There are four times as many pearl produced as colour.

How many pearl are produced?

Answer \_\_\_\_\_ [4]

[Turn over

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\*28GMC4109\*

- 9 180 Year 11 pupils in Glasgow High School were asked to record how much time they spent on their phones one Saturday.

The results are shown in the table below.

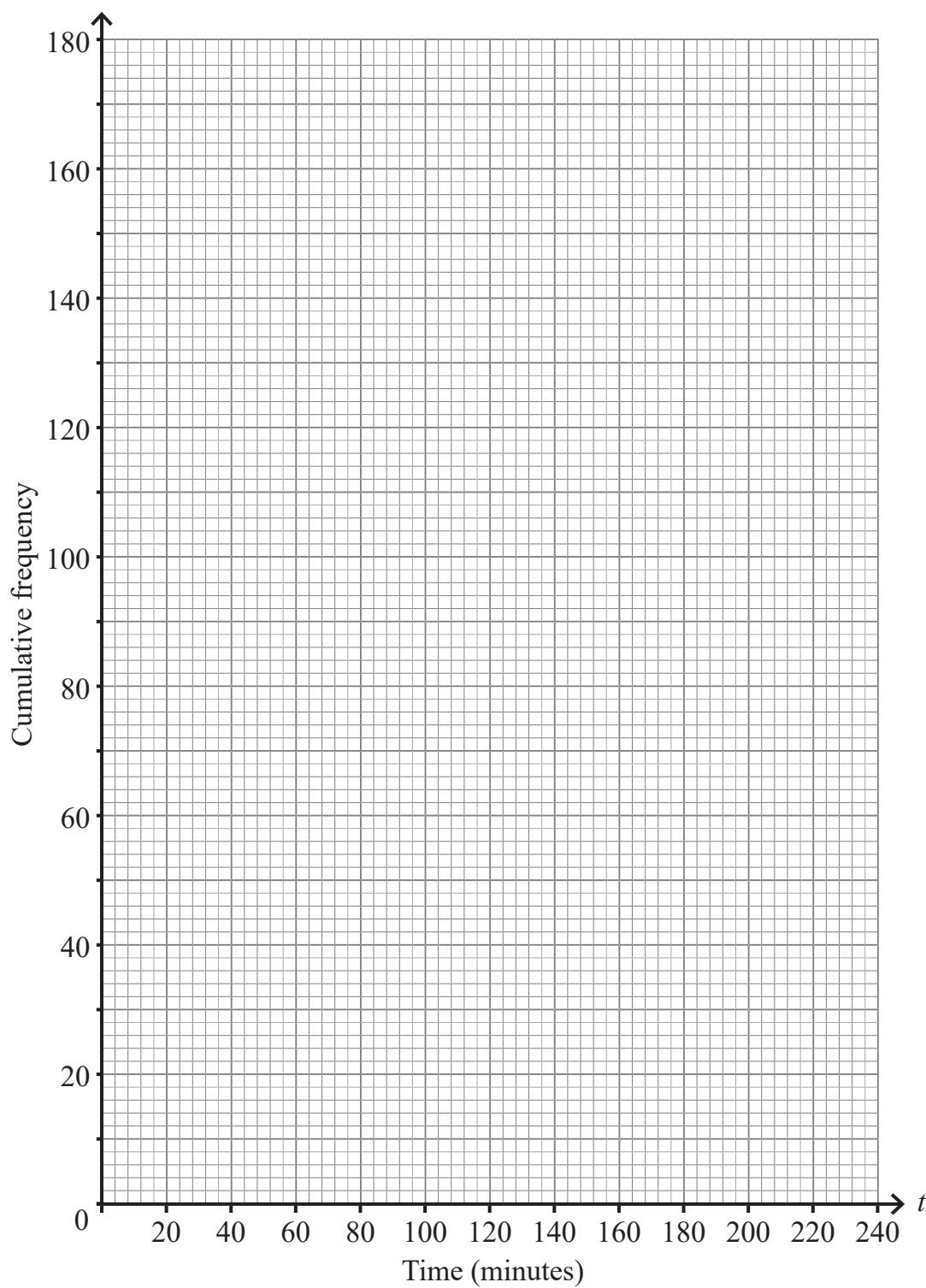
Time, $t$ (minutes)	Number of pupils	Time, $t$ mins ( $\leq$ )	Cumulative frequency
$0 < t \leq 30$	6		
$30 < t \leq 60$	10		
$60 < t \leq 90$	25		
$90 < t \leq 120$	37		
$120 < t \leq 150$	32		
$150 < t \leq 180$	29		
$180 < t \leq 210$	27		
$210 < t \leq 240$	14		

- (a) Complete the cumulative frequency column in the table.

[1]



(b) Plot a cumulative frequency graph on the given axes.



[3]

[Turn over]

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\*28GMC4111\*

(c) Use your graph to estimate

(i) the median,

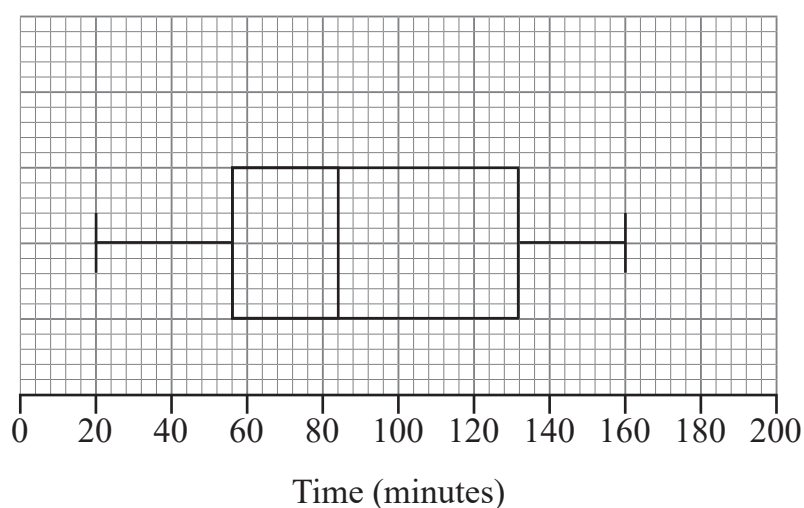
Answer \_\_\_\_\_ minutes [1]

(ii) the inter-quartile range.

Answer \_\_\_\_\_ minutes [2]

The staff at the same school were also asked to record the time they spent on their phones on the same Saturday.

Their results are recorded on the box-plot diagram.



(d) Compare the results for the pupils and staff.

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_ [3]

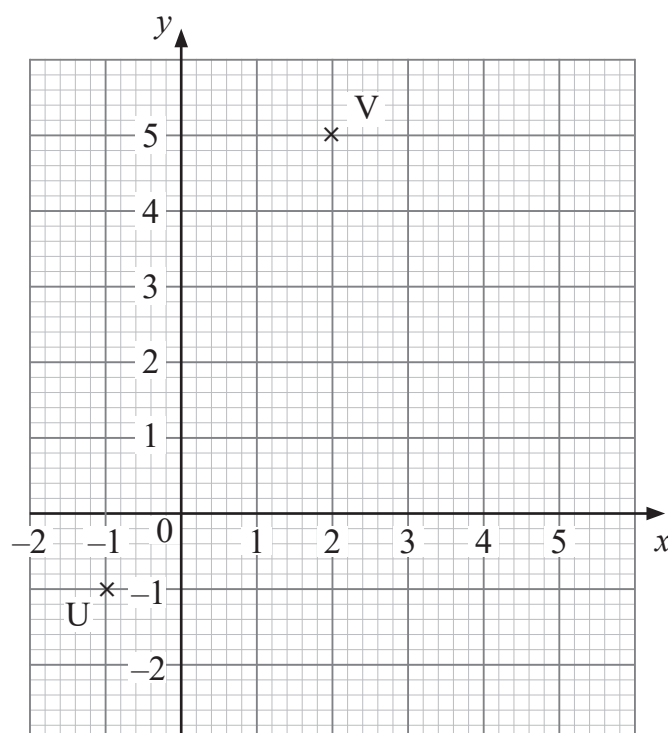


10 Solve  $\frac{1}{4}(y + 3) - 2 = \frac{1}{2}(3 - 2y)$

Answer  $y =$  \_\_\_\_\_ [4]



- 11 U has coordinates  $(-1, -1)$  and V has coordinates  $(2, 5)$  as shown.



- (a) Find the equation of the straight line joining U and V.

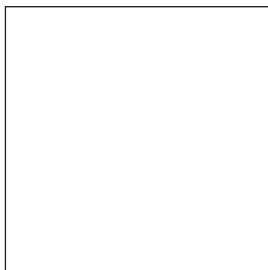
Answer \_\_\_\_\_ [3]

- (b) Find the equation of the line perpendicular to UV that passes through the point  $(0, -1)$ .

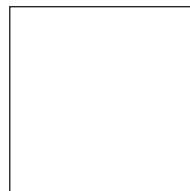
Answer \_\_\_\_\_ [2]



12



$$4n + 3$$



$$3n + 4$$

Find an expression in  $n$  for the difference between the areas of the two squares.

**Give your answer in fully factorised form.**

**Show your working.**

Answer \_\_\_\_\_ [4]

**[Turn over]**



- 13 The diagram shows two vertical masts A and B.  
A is 210 m high and B is 1.5 times the height of A.  
The angle of depression from the top of B to the top of A is  $25^\circ$

Calculate the horizontal distance between the two masts.

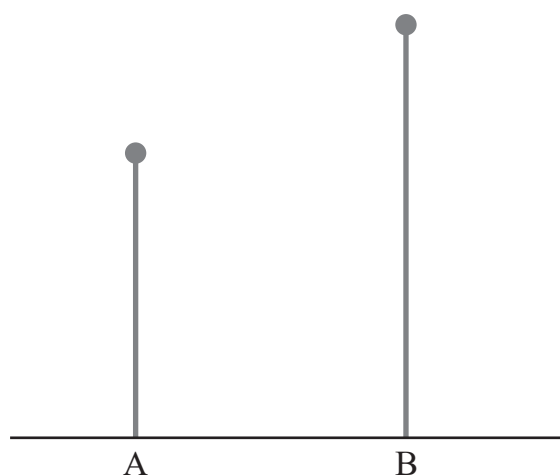


diagram  
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accurately

Answer \_\_\_\_\_ m [4]





14 Solve  $(x - 2)^2 = 10$  giving your answers correct to 2 decimal places.

Answer \_\_\_\_\_ [4]

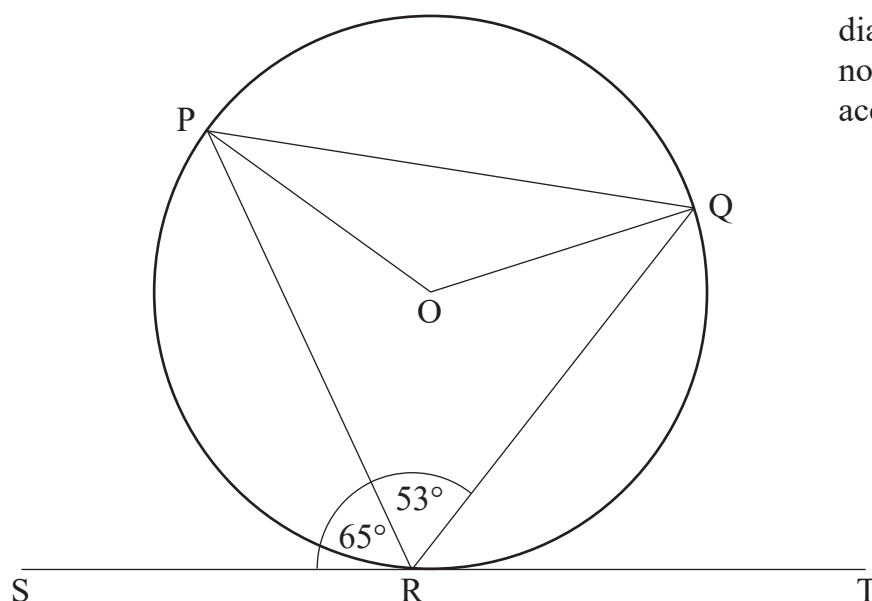
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[Turn over]



\*28GMC4117\*

diagram  
not drawn  
accurately



P, Q and R are points on the circumference of a circle, centre O.  
The line ST is a tangent to the circle.  
Angle PRS =  $65^\circ$   
Angle PRQ =  $53^\circ$

(a) Calculate the size of angle POQ, giving a reason for your answer.

Answer \_\_\_\_\_  $^\circ$  because \_\_\_\_\_  
\_\_\_\_\_ [2]



(b) Calculate the size of angle OQR, giving reasons for each step of your answer.

Answer \_\_\_\_\_ ° [3]

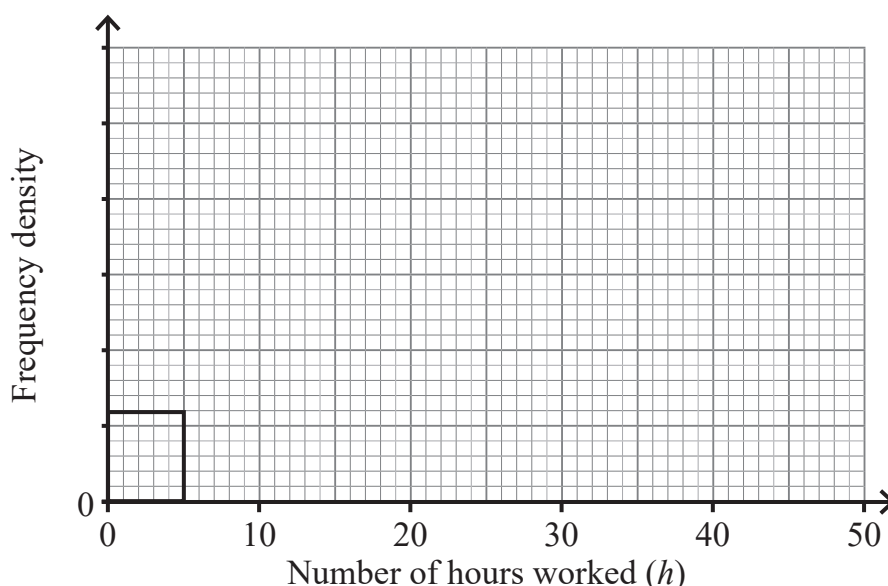


- 16 The table gives information about the number of hours worked by employees of a factory in one week.

No employees worked more than 50 hours.

Number of hours ( $h$ )	Frequency
$0 < h \leq 5$	6
$5 < h \leq 15$	32
$15 < h \leq 30$	54
$30 < h \leq 45$	75
$45 < h \leq 50$	16

- (a) Complete the histogram for this information.



[4]

- (b) To investigate the link between job satisfaction and number of hours worked, explain why a stratified sample is the best method to use here.

Answer \_\_\_\_\_

\_\_\_\_\_ [1]



- (c) A stratified sample of 30 employees is taken from this data.

Calculate an estimate for how many employees in the stratified sample worked more than 36 hours.

Answer \_\_\_\_\_ [3]

## 17 Factorise

(a)  $25 - 0.01t^2$

Answer \_\_\_\_\_ [2]

(b)  $ab - cd - ca + db$

Answer \_\_\_\_\_ [2]

[Turn over]

12990.06 R



\*28GMC4121\*

- 18 An employee of a company earns £260 per week for a basic 40 hour week.  
She is offered a 10% rise in her hourly rate.  
She is also offered a percentage reduction in her working hours.  
The combined impact of these changes is a 4.5% increase in her total weekly pay.

Calculate the percentage reduction in her working hours.

Answer \_\_\_\_\_ % [4]



- 19 A lampshade is made by removing a small cone from a larger cone as shown in the diagram.

The volume of the lampshade is  $16\,625\text{ cm}^3$

Find the value of  $r$ .

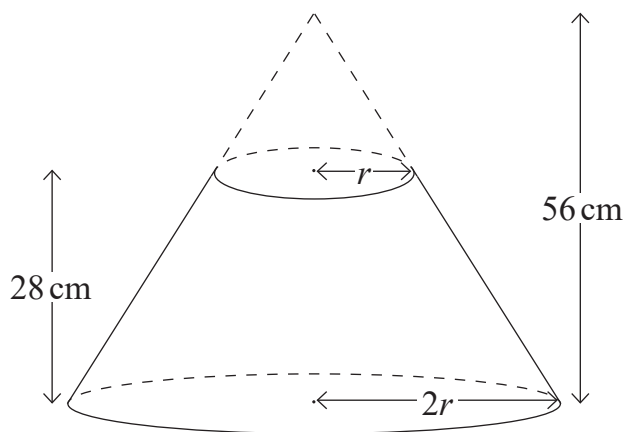


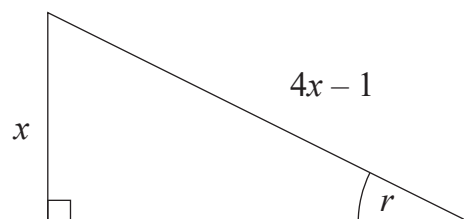
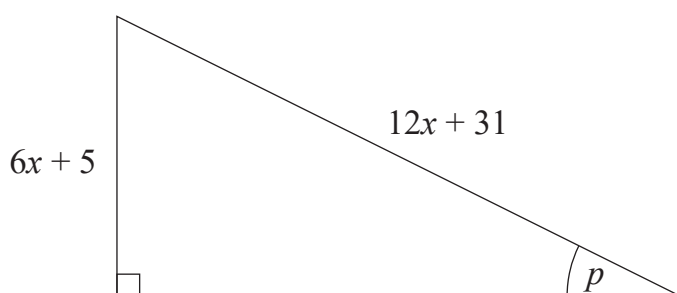
diagram  
not drawn  
accurately

Answer  $r =$  \_\_\_\_\_ cm [5]

[Turn over]



diagram not  
drawn accurately



(a) If  $\sin p = \sin r$ , show that  $12x^2 - 17x - 5 = 0$

[4]

(b) Hence calculate the size of angle  $p$

Answer  $p = \underline{\hspace{2cm}}^\circ$  [4]





21 Given that  $\frac{2}{x+a} - \frac{5}{x-a} = 1$  has a solution  $x = 3$ , find the possible values of  $a$ .

Answer \_\_\_\_\_ [6]

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**THIS IS THE END OF THE QUESTION PAPER**

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Examiner Number

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*Rewarding Learning*

**General Certificate of Secondary Education  
Summer 2022**

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# **GCSE Mathematics**

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## **HIGHER TIER ADDITIONAL SUPPORT MATERIALS (For use in Summer 2022)**

## HIGHER TIER ADDITIONAL SUPPORT MATERIALS (Summer 2022)

### Numbers

Lowest common multiple (LCM): The lowest common multiple is the lowest multiple shared by 2 or more numbers.

### Trial and Improvement

This is a method of trying different values in an equation until you get a suitable solution (e.g to 1 decimal place).

### Metric units

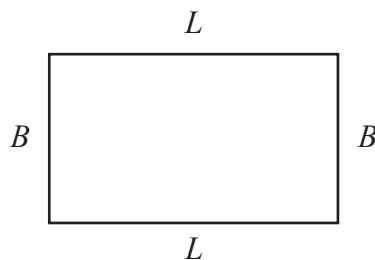
$$1 \text{ ml} = 1 \text{ cm}^3$$

### Compound Measures

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{Average Speed} = \frac{\text{Distance}}{\text{Time}}$$

## Perimeter, Area and Volume



The perimeter of a rectangle is the distance around the outside of the rectangle. It is found by adding the lengths of the 4 sides of the rectangle.

$P = 2L + 2B$  where  $P$  is perimeter,  $L$  is length and  $B$  is breadth.

The area of a rectangle is found by multiplying the length of the rectangle by the breadth.

$A = L \times B$  where  $L$  is length and  $B$  is breadth.

The volume of a cuboid is found by multiplying the length by the breadth by the height of the cuboid.

$V = L \times B \times H$  where  $V$  is volume,  $L$  is length,  $B$  is breadth and  $H$  is height.

The area of a circle is  $A = \pi r^2$  where  $r$  is the radius of the circle.

The circumference (perimeter) of a circle is  $C = 2\pi r$  where  $r$  is the radius of the circle. An alternative formula is  $C = \pi d$  where  $d$  is the diameter of the circle.

## Mid point of a line

If  $(x_1, y_1)$  and  $(x_2, y_2)$  are the end points of a line, then the coordinates of the midpoint  $M$  of the line are

$$M = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

## Gradient of a line

If  $(x_1, y_1)$  and  $(x_2, y_2)$  are two points on a line, then the gradient  $m$  of the line is

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

## Lines

Parallel lines have the same gradient.

If a straight line has gradient  $m$ , then a line which is perpendicular to this line has a gradient  $-\frac{1}{m}$

## Geometry and Angles

There are  $180^\circ$  on a straight line.

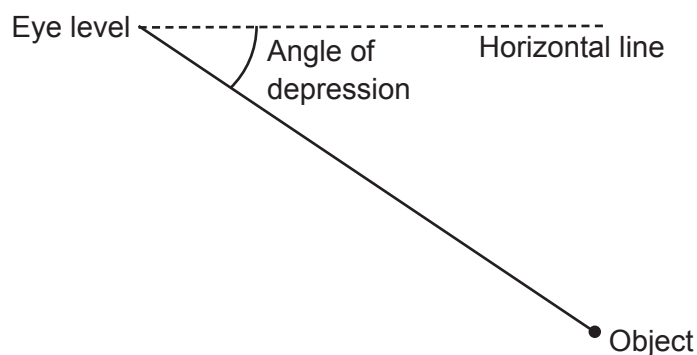
There are  $180^\circ$  inside a triangle.

An isosceles triangle is a triangle with 2 equal sides and 2 equal angles.

The sum of all the angles inside a polygon is given by  $180(n - 2)$  where  $n$  is the number of sides in the polygon.

### Angle of depression

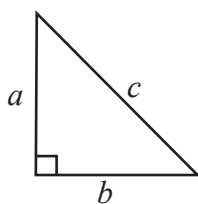
If a person stands and looks down at an object, the **angle of depression** is the angle between the horizontal line of sight and the object.



### Pythagoras' Theorem

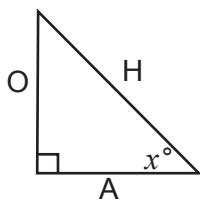
If  $a$ ,  $b$  and  $c$  are the sides of a right angled triangle shown below, then

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





## Trigonometric ratios in right angled triangles



$$\sin x^\circ = \frac{O}{H} \quad \cos x^\circ = \frac{A}{H} \quad \tan x^\circ = \frac{O}{A}$$

## Tangent/Radius property

The tangent to a circle is perpendicular to the radius at the point of contact with the circle.

## Alternate Segment Theorem

In a circle, the angle between a chord and a tangent through one of the end points of the chord is equal to the angle in the alternate segment.

## Range

The range of a set of data is the difference between the largest value and the smallest value in the data set.

## Mean

The mean of a set of data is the sum of all the data values divided by the number of data values.

## Estimate for the mean of a grouped frequency distribution

Estimated mean = sum of (mid interval values multiplied by their frequency) divided by the sum of all the frequencies.

## Pie Chart

In a pie chart, the total angle that corresponds to the entire data set is  $360^\circ$

## Probability

The sum of the probabilities of all outcomes equals 1

## Frequency density in histograms

$$\text{Frequency density} = \frac{\text{Frequency}}{\text{Class width}}$$