Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
November 2022

Mathematics

StemUp Model Solution

Unit M7 Paper 1
(Non-Calculator)
Higher Tier



[GMC71]

GMC71

THURSDAY 1 DECEMBER, 9.15am–10.30am

TIME

1 hour 15 minutes.

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, on blank pages or tracing paper.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all seventeen** questions.
All working should be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.
You **must not** use a calculator for this paper.

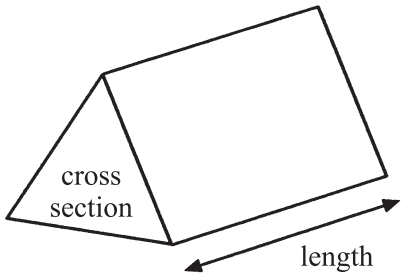
INFORMATION FOR CANDIDATES

The total mark for this paper is 50.
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 ruler, compasses and a protractor.
The Formula Sheet is on page 2.

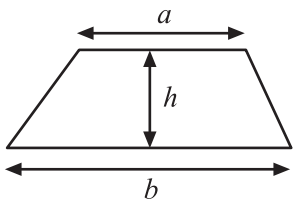
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Formula Sheet

Volume of prism = area of cross section × length

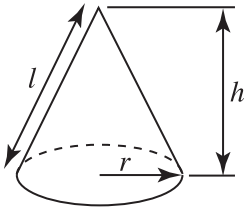


Area of trapezium = $\frac{1}{2}(a+b)h$



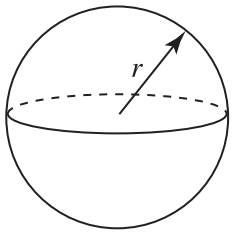
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = πrl

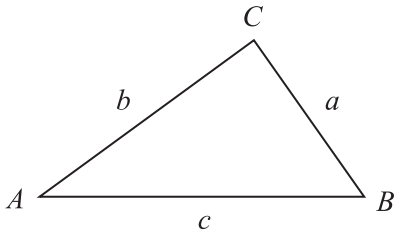


Volume of sphere = $\frac{4}{3}\pi r^3$

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



In any triangle *ABC*



Quadratic Equation

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

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

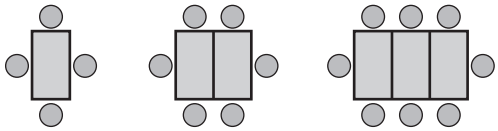
Sine Rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

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

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1 A sequence consists of rectangles and circles as shown.



Pattern 1 Pattern 2 Pattern 3

(a) Complete the table for patterns 2, 3, 4 and 7

	Pattern 1	**Pattern 2**	**Pattern 3**	**Pattern 4**	**Pattern 7**
Number of rectangles	1	2	*3*	*4*	*7*
Number of circles	4	*6*	8	*10*	*16*
Total number of rectangles and circles	5	*8*	*11*	*14*	*23*

[2]

(b) Which pattern number has a total number of 38 rectangles and circles?

Total goes up by 3 each time: 3n + 2

3n + 2 = 38

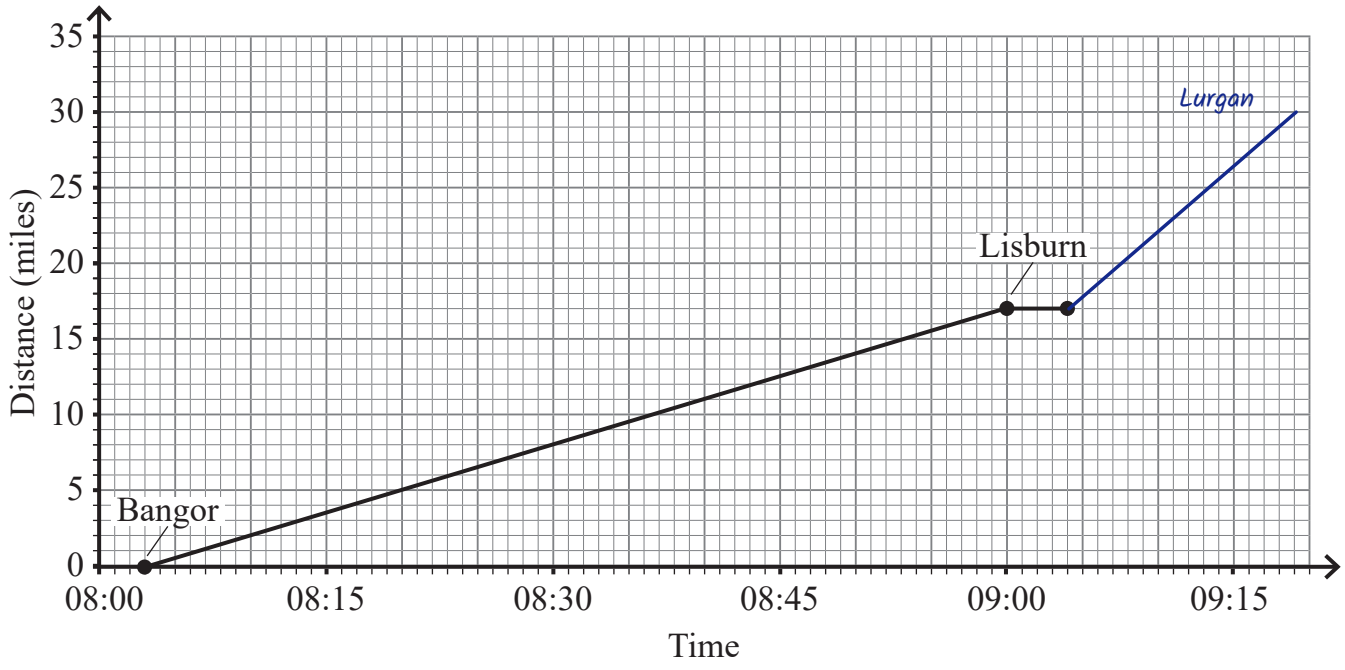
3n = 36

n = 12

Answer Pattern number *12* [1]

[Turn over

2 The distance–time graph shows a train journey.



(a) What is the distance between Bangor and Lisburn?

Answer 17 miles [1]

(b) Give a reason for the horizontal line which starts when the train reaches Lisburn.

Answer The train stops at the station to let passengers get off and on (it is stationary for 4 minutes) [1]

(c) The train leaves Lisburn and travels on to Lurgan.

The distance between Lisburn and Lurgan is 13 miles and the journey takes 15 minutes.

Show this information on the graph. [1]

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(d) What is the average speed of the train from Lisburn to Lurgan?

13 miles in 15 minutes = 13 miles in ¼ hour

speed = 13 × 4 = 52 mph

Answer 52 mph [1]

(e) Give one reason for knowing that the graph shows average speed rather than actual speed.

Answer The line is straight so it shows no speeding up or slowing down [1]

3 Ross works out $200 \times 90 = 18\,000$

Write down a calculation Ross could use to check his answer.

Answer 18 000 ÷ 200 = 90 [1]

[Turn over

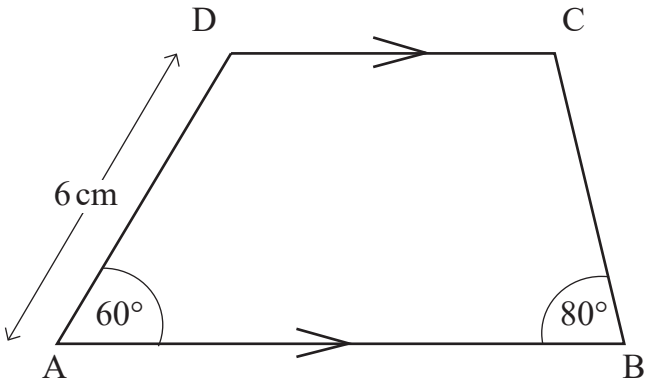
4 Calculate 5% of 45

10% of 45 = 45 ÷ 10 = 4.5

5% of 45 = 4.5 ÷ 2 = 2.25

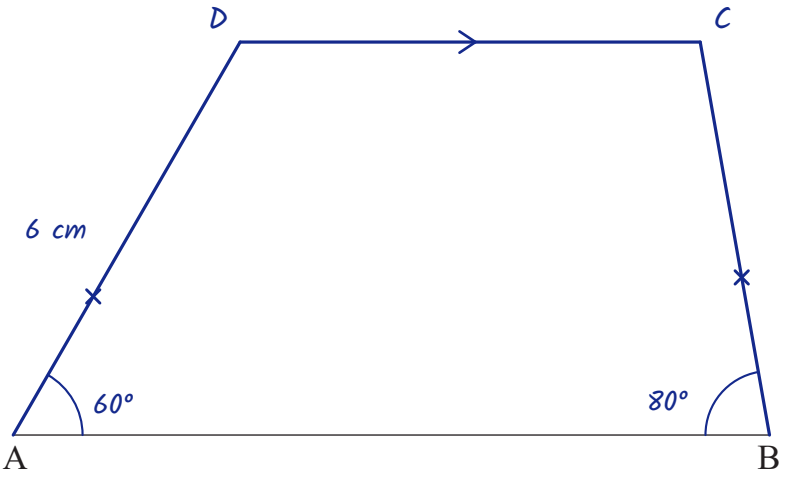
Answer 2.25 [2]

5 Charlie has drawn a **sketch** of a trapezium with lengths and angles as shown.



AB is already drawn.

Using a ruler and protractor, complete Charlie's trapezium **accurately**.



[4]

[Turn over

6 **(a)** 60% of entrants pass a test.

What is the ratio of

number who pass : number who fail?

Give your answer in simplest form.

pass : fail = 60 : 40

= 3 : 2 (÷ 20)

Answer 3 : 2 [2]

(b) The ratio of boys : girls born in a hospital one week was 3 : 5

What fraction were girls?

total parts = 3 + 5 = 8

Answer $\frac{5}{8}$ [1]

7 At the beginning of January an oil tank was $\frac{3}{4}$ full.

At the end of March it was $\frac{1}{6}$ full.

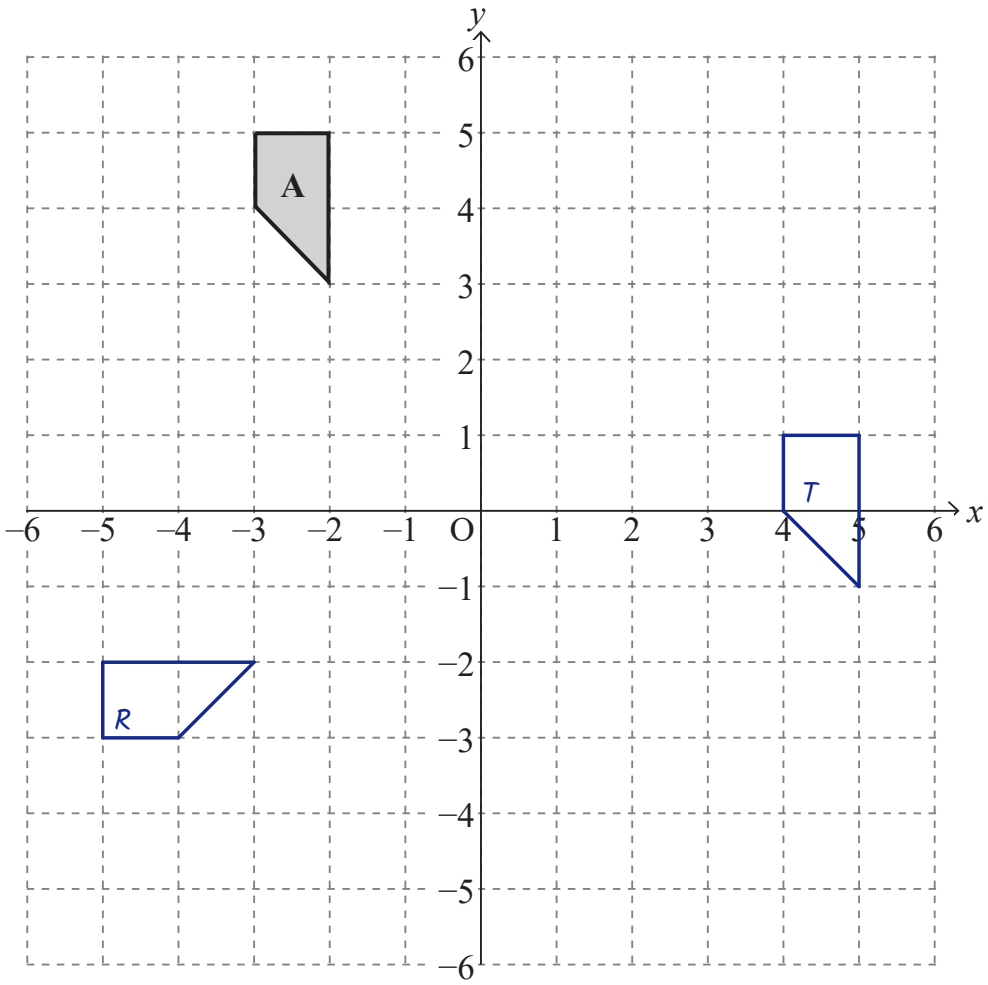
What fraction of the tank was used?

Show your working.

$\frac{3}{4} - \frac{1}{6} = \frac{9}{12} - \frac{2}{12} = \frac{7}{12}$

Answer $\frac{7}{12}$ [2]

8



(a) Draw the image of shape A after a translation, 7 right and 4 down.

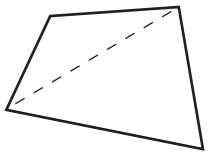
Label it T. [1]

(b) Draw the image of shape A after a rotation, 90° anticlockwise, about the origin.

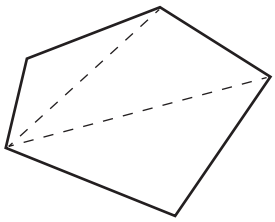
Label it R. [2]

[Turn over

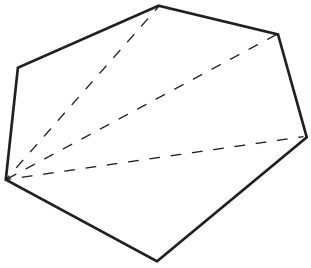
9



Quadrilateral



Pentagon



Hexagon

P is a polygon.

The sum of all the angles in P is three times the sum of the angles in a quadrilateral.

How many sides has P?

Quadrilateral: 2 triangles, 2 × 180 = 360°

Sum of angles in P = 3 × 360 = 1080°

1080 ÷ 180 = 6 triangles

number of sides = 6 + 2 = 8

Answer *8* [2]

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10 A shape has a perimeter of 16 cm and an area of 10 cm^2

It is enlarged using a scale factor of 2

(a) What is the perimeter of the enlarged shape?

16 × 2 = 32

Answer 32 cm [1]

(b) How many times bigger is the area of the enlarged shape than the area of the original shape?

$2^2 = 4$

Answer 4 times [1]

[Turn over

11 Each interior angle of a regular polygon is 140°.

How many sides has the polygon?

exterior angle = 180 − 140 = 40°

number of sides = 360 ÷ 40 = 9

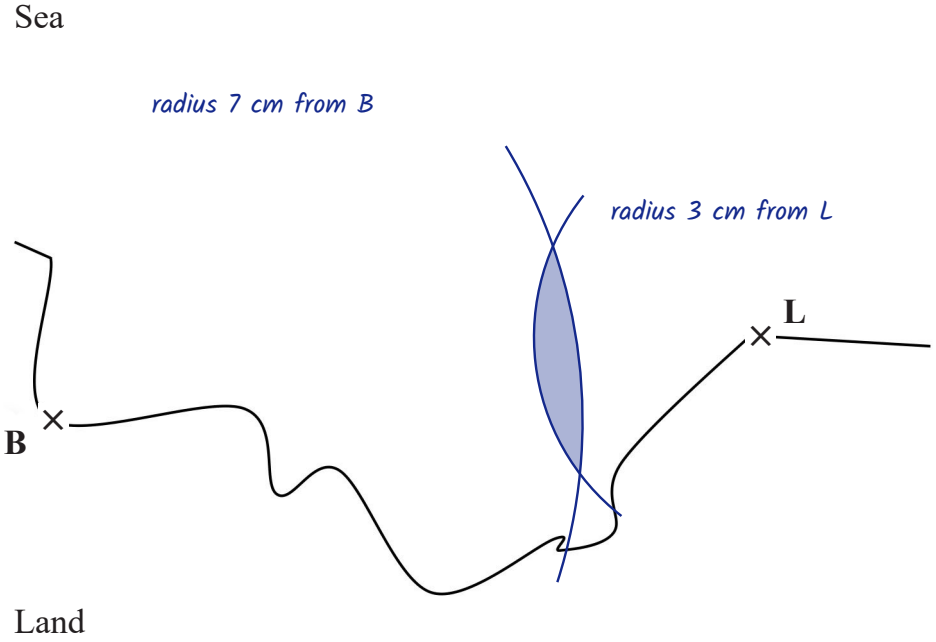
Answer 9 [2]

12 The diagram shows a section of coastline with a lifeboat station marked at B and a lighthouse marked at L.

A sinking ship sends a distress signal.

The ship is less than 70 km from B and less than 30 km from L.

Using a scale of 1 cm = 10 km, **shade the region** in which the ship could be.



[3]

[Turn over

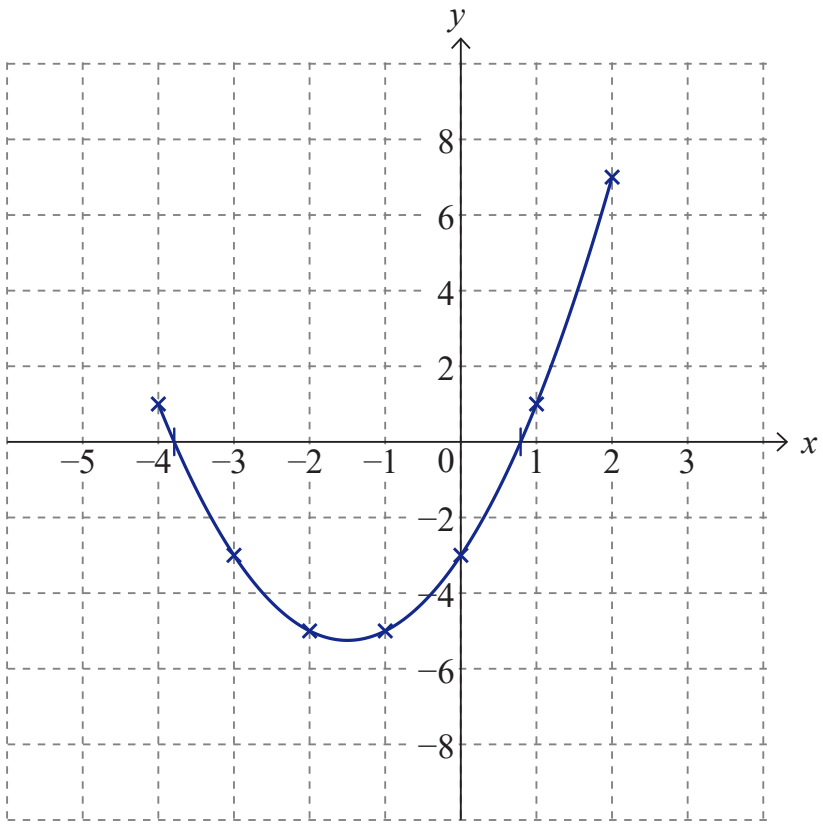
13 **(a)** Complete the table for $y = x^2 + 3x - 3$

x	−4	−3	−2	−1	0	1	2
y	1	−3	−5	−5	−3	1	7

$x = -3$: $9 - 9 - 3 = -3$ $x = 2$: $4 + 6 - 3 = 7$

[2]

(b) Draw the graph of $y = x^2 + 3x - 3$ from $x = -4$ to $x = 2$ [2]



(c) Use your graph to estimate the solutions to $x^2 + 3x - 3 = 0$

curve crosses $y = 0$ (x-axis)

Answer $x = -3.8$ or $x = 0.8$ [2]

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14 **(a)** Write the decimal number 15 as a binary number.

8 4 2 1

1 1 1 1 15 = 8 + 4 + 2 + 1

Answer 1111 [1]

(b) Write the binary number 1000000 as a decimal number.

64 32 16 8 4 2 1

1 0 0 0 0 0 0 = 64

Answer 64 [1]

[Turn over

15 An industrial tank has dimensions 10 times larger than the dimensions of a similar domestic tank.

How many times larger is its volume?

volume scale factor = 10^3 = 1000

Answer 1000 [1]

16 Tom has some 20p coins and some 50p coins.

The total value of Tom's coins is £8.60

Seana has twice as many 20p coins as Tom, but only half as many 50p coins as Tom.

The total value of Seana's coins is £8.20

Find how many of each type of coin Tom has.

A solution by trial and improvement will not be accepted.

Let x = number of 20p coins, y = number of 50p coins

Tom: $20x + 50y = 860$ (1)

Seana: $40x + 25y = 820$ (2)

(1) × 2: $40x + 100y = 1720$ (3)

(3) − (2): $75y = 900$

$y = 12$

$20x + 50 \times 12 = 860$

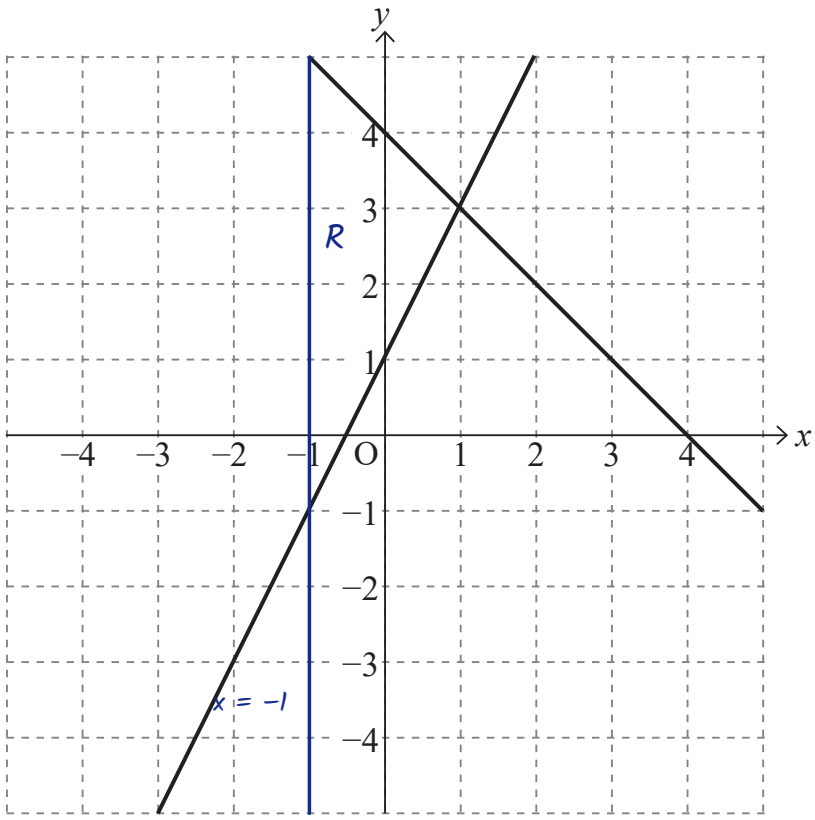
$20x = 860 - 600 = 260$

$x = 13$

Answer 13 20p coins, 12 50p coins [5]

[Turn over

17 (a)

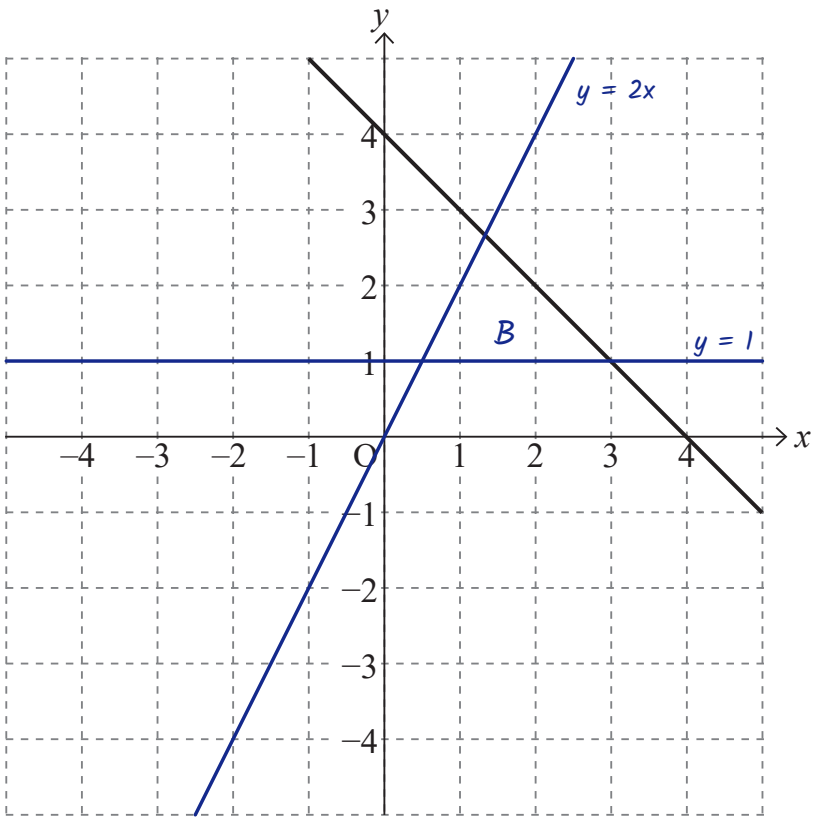


The lines $y = 2x + 1$ and $x + y = 4$ have been drawn on the grid.

By drawing another line on the grid above, indicate clearly by the letter R the region satisfying $y \geq 2x + 1$ and $x + y \leq 4$ and $x \geq -1$ [2]

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(b)



By drawing more lines on the grid above, indicate clearly by the letter B the region satisfying $y \leq 2x$ and $x + y \leq 4$ and $y \geq 1$ [2]

THIS IS THE END OF THE QUESTION PAPER

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

Examiner Number

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GCSE Mathematics

HIGHER TIER
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(For use in November 2022)

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Numbers

Highest Common Factor (HCF): The highest common factor is the largest number that divides evenly into two or more numbers, e.g. 4 is the HCF of 8 and 20

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).

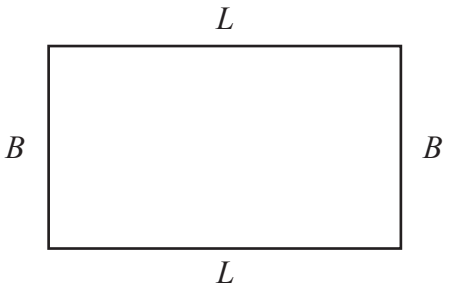
Range

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.

Area and Volume



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

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

The area of a triangle is found by multiplying half the length of the base by the perpendicular height of the triangle.

$A = \frac{1}{2}bh$ where b is the base and h is the perpendicular height of the triangle.

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

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.

Angles

There are 180° on a straight line.
There are 180° 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.

Pie Chart

In a pie chart, the total angle that corresponds to the entire data set is 360°

Probability

The sum of the probabilities of all outcomes equals 1

Compound Measures

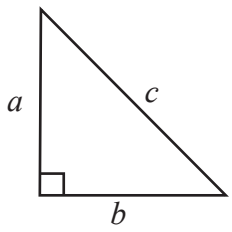
$$\text{Average Speed} = \frac{\text{Distance}}{\text{Time}}$$

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

Pythagoras' Theorem

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

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



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Midpoint 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 $-\frac{1}{m}$

Equation of a circle

The equation of a circle of radius r and centre, the origin (0, 0), is given by $x^2 + y^2 = r^2$ where (x, y) are the coordinates of any point on the circumference of the circle.

Tangent/Radius property

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

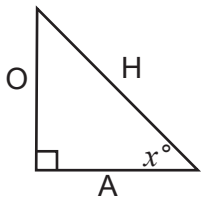
Cyclic Quadrilateral property

The opposite angles of a cyclic quadrilateral add up to 180°

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.

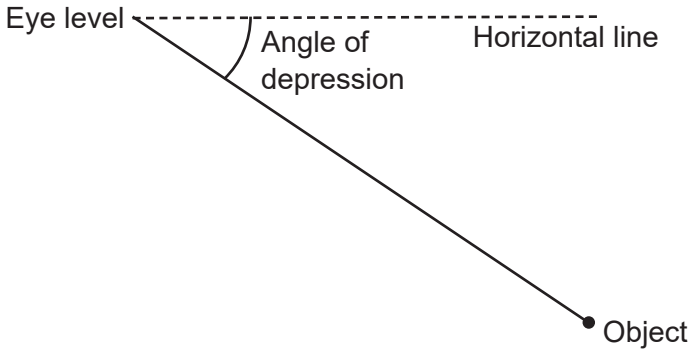
Trigonometric ratios in right angled triangles



$\sin x° = \frac{O}{H}$ $\cos x° = \frac{A}{H}$ $\tan x° = \frac{O}{A}$

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.



Frequency density in histograms

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