Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2022

Mathematics

StemUp Model Solution

Unit M7 Paper 2
(With calculator)
Higher Tier



[GMC72]

GMC72

MONDAY 13 JUNE, 10.45am–12 NOON

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

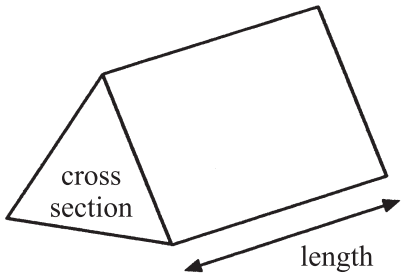
Write your Centre Number and Candidate Number in the spaces provided at the top of this page. **You are provided with Higher Tier Additional Support Materials for use with this paper.**
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page, on blank pages or tracing paper.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all fourteen** 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

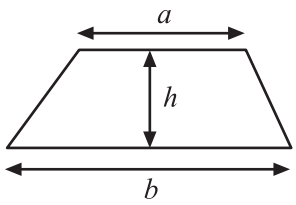
The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on page 2.

Formula Sheet

Volume of prism = area of cross section × length

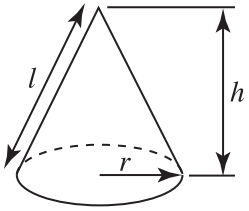


Area of trapezium = $\frac{1}{2}(a+b)h$



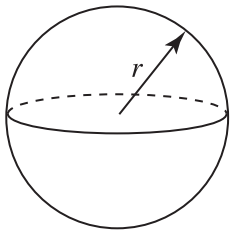
Volume of cone = $\frac{1}{3}\pi r^2 h$

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

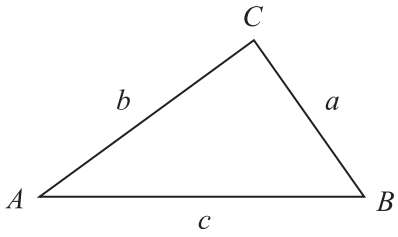


Volume of sphere = $\frac{4}{3}\pi r^3$

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 = $\frac{1}{2}ab\sin C$

1 Winter 2018–19 was the wettest on record in the United States.



The average rainfall was 9.01 inches.

How many centimetres was this to the nearest centimetre?

1 inch = 2.54 cm

9.01 × 2.54 = 22.8854

≈ 23 cm (to the nearest cm)

Answer 23 cm [3]

[Turn over

2 Kendra flips a coin and rolls a dice.

(a) List all the possible outcomes in the table below.

Two have already been filled in for you.

Dice

Coin		**1**	**2**	**3**	**4**	**5**	**6**
	Heads (H)	H1	H2	H3	H4	H5	H6
	Tails (T)	T1	T2	T3	T4	T5	T6

[2]

Given that each outcome is equally likely, find the probability that

(b) Kendra gets a 5,

H5, T5 → 2 out of 12

Answer $\frac{2}{12}$ [1]

(c) Kendra gets a Tail and an odd number.

T1, T3, T5 → 3 out of 12

Answer $\frac{3}{12}$ [1]

3 Write down the next two terms in the sequence below.

1, 8, 27, 64, 125 , 216 [2]

1^3, 2^3, 3^3, 4^3, so next are $5^3 = 125$ and $6^3 = 216$

4 A concrete mixture contains cement, sand and gravel in the ratio 1 : 2 : 3

(a) What weight of concrete contains 36 kg of gravel?

1 + 2 + 3 = 6 parts; gravel = 3 parts = 36 kg
1 part = 36 ÷ 3 = 12 kg
12 + 24 + 36 = 72 kg

Answer 72 kg [2]

(b) Work out the weight of sand contained in 198 kg of concrete.

198 ÷ 6 = 33 kg per part
sand = 2 × 33 = 66 kg

Answer 66 kg [2]

5 Phil changed 230 euro into £ and Gerry changed 168 euro into £.

The exchange rate is £1 = 1.09 euro.

How much more did Phil receive in £?

230 − 168 = 62 euro
62 ÷ 1.09 = 56.88073...
= £56.88

Answer £ 56.88 [3]

[Turn over

6 A supermarket sells coffee in jars of two different sizes, as illustrated below.



£6.48 £8.80

Which jar is better value?

You must show working to justify your answer.

180 g jar: $\frac{6.48}{180} \times 100 = £3.60$ per 100 g

275 g jar: $\frac{8.80}{275} \times 100 = £3.20$ per 100 g

£3.20 < £3.60, so the 275 g jar is cheaper per 100 g

Answer 275 g jar [3]

7 Marie has a recipe for Spaghetti Carbonara which requires the following ingredients.

Spaghetti	500 g
Bacon	200 g
Eggs	8
Cream	76 ml
Parmesan	48 g

Marie only has 150 g of bacon.

Work out how much of the other ingredients she should use.

150 ÷ 200 = 0.75
500 × 0.75 = 375 8 × 0.75 = 6
76 × 0.75 = 57 48 × 0.75 = 36

Answer

Spaghetti	375 g
Eggs	6
Cream	57 ml
Parmesan	36 g

[3]

[Turn over

8 Calculate the size of the angle a.

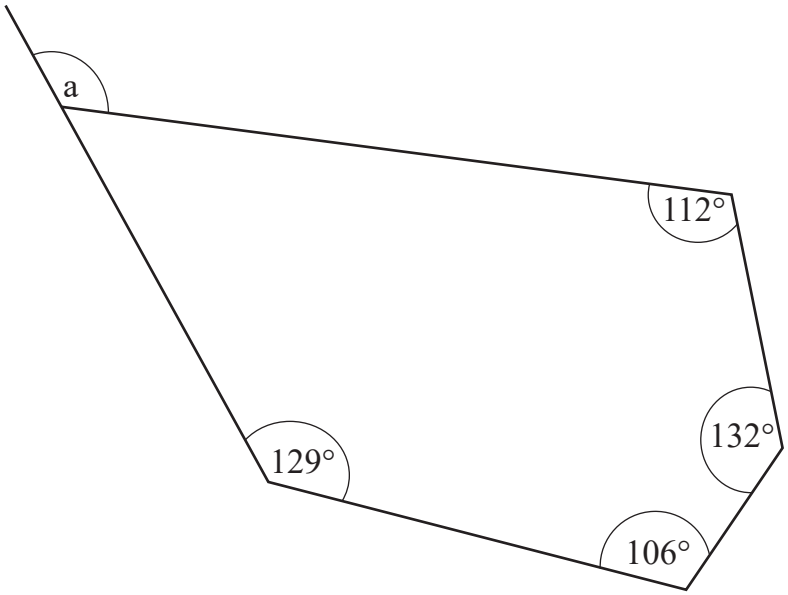


diagram not drawn accurately

Angle sum of pentagon = (5 − 2) × 180 = 540°

112 + 132 + 106 + 129 = 479

Interior angle = 540 − 479 = 61°

a = 180 − 61 = 119° (angles on a straight line)

Answer Angle a = 119 ° [3]

9 The equation $x^3 - 3x = 34$ has a solution between 1 and 5

Use a trial and improvement method to find this solution.

Give your answer correct to one decimal place.

You must show ALL your working.

x	$x^3 - 3x$	
3	18	too small
4	52	too big
3.5	32.375	too small
3.6	35.856	too big
3.55	34.088875	too big

34 lies between 32.375 (x = 3.5) and 34.09 (x = 3.55)
so x = 3.5 to 1 d.p.

Answer x = 3.5 [4]

[Turn over

10 **(a)** When a spinner was spun 50 times, it landed on red 12 times.
When spun another 50 times, it landed on red another 9 times.

Calculate the relative frequency for red

(i) after the first 50 spins,

Answer $\frac{12}{50}$ [1]

(ii) after the 100 spins.

$12 + 9 = 21$

Answer $\frac{21}{100}$ [1]

(b) When spun another 50 times the spinner landed on red another 9 times.

What value of the relative frequency gives the best estimate of the probability of this spinner landing on red?

Explain your answer.

$21 + 9 = 30$ reds in 150 spins

Answer $\frac{30}{150}$ because it uses the most spins (150);

the bigger the number of trials, the more reliable the estimate [2]

(c) The spinner landed on yellow 40 times in the first 100 spins.

(i) Estimate the probability for this spinner landing on yellow.

Answer $\frac{40}{100}$ [1]

(ii) Estimate how many times the spinner will land on yellow in 300 spins.

$0.4 \times 300 = 120$

Answer 120 [1]

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11 A **solid** cone has a vertical height of 12 cm, a slant height of 13 cm and a base radius of 5 cm.

Work out the **total** surface area of the cone, leaving your answer in terms of π

Curved surface area = $\pi rl = \pi \times 5 \times 13 = 65\pi$

Base area = $\pi r^2 = \pi \times 5^2 = 25\pi$

Total = $65\pi + 25\pi = 90\pi$

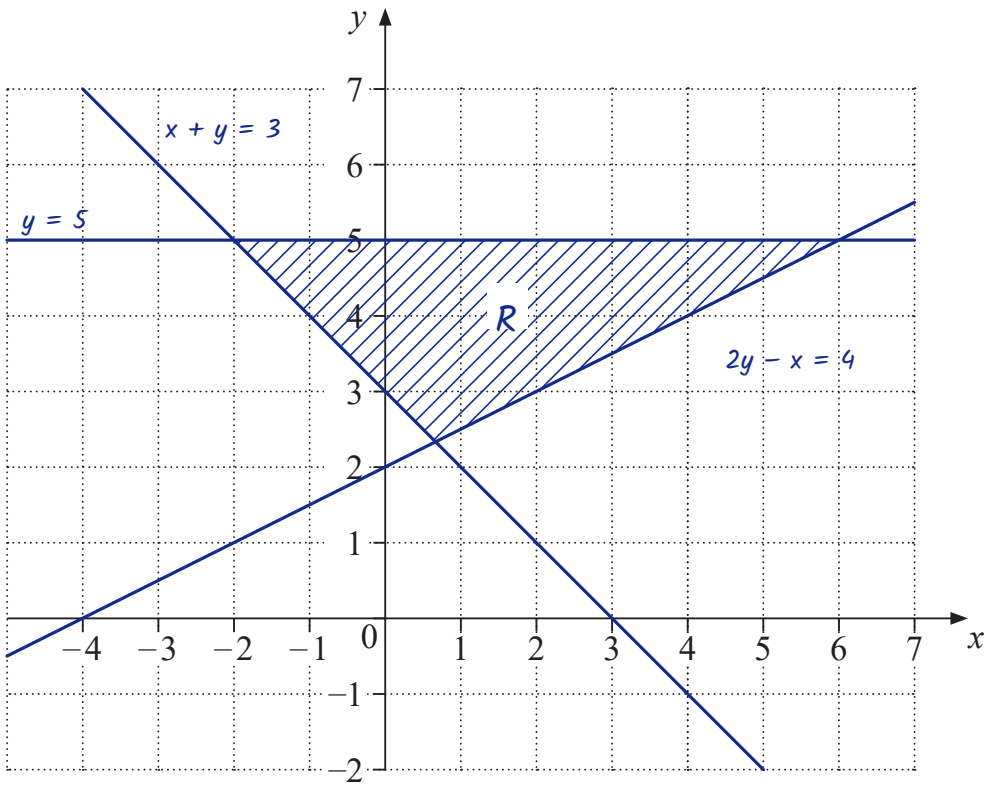
Answer 90π cm^2 [2]

[Turn over

12 The following linear inequalities represent a closed region.

$$x + y \geqslant 3$$
$$2y - x \geqslant 4$$
$$y \leqslant 5$$

(a) By drawing straight lines and shading, show this region on the grid below. Label the region R.



[3]

(b) Hence work out the maximum value of $3x + 2y$ in this region.

Vertices of R: $(-2, 5)$, $(6, 5)$, $(\frac{2}{3}, \frac{7}{3})$

Maximum occurs at $(6, 5)$:

$3 \times 6 + 2 \times 5 = 18 + 10 = 28$

Answer 28 [2]

13 A book club offers 26 **different** books for sale.

Five of the books cost £3 each
Six of the books cost £4 each
Seven of the books cost £6 each
Eight of the books cost £7 each.

Abi wants to buy two books for exactly £10

How many combinations of books can she choose from?

Pairs costing £10:

£3 + £7: 5 × 8 = 40

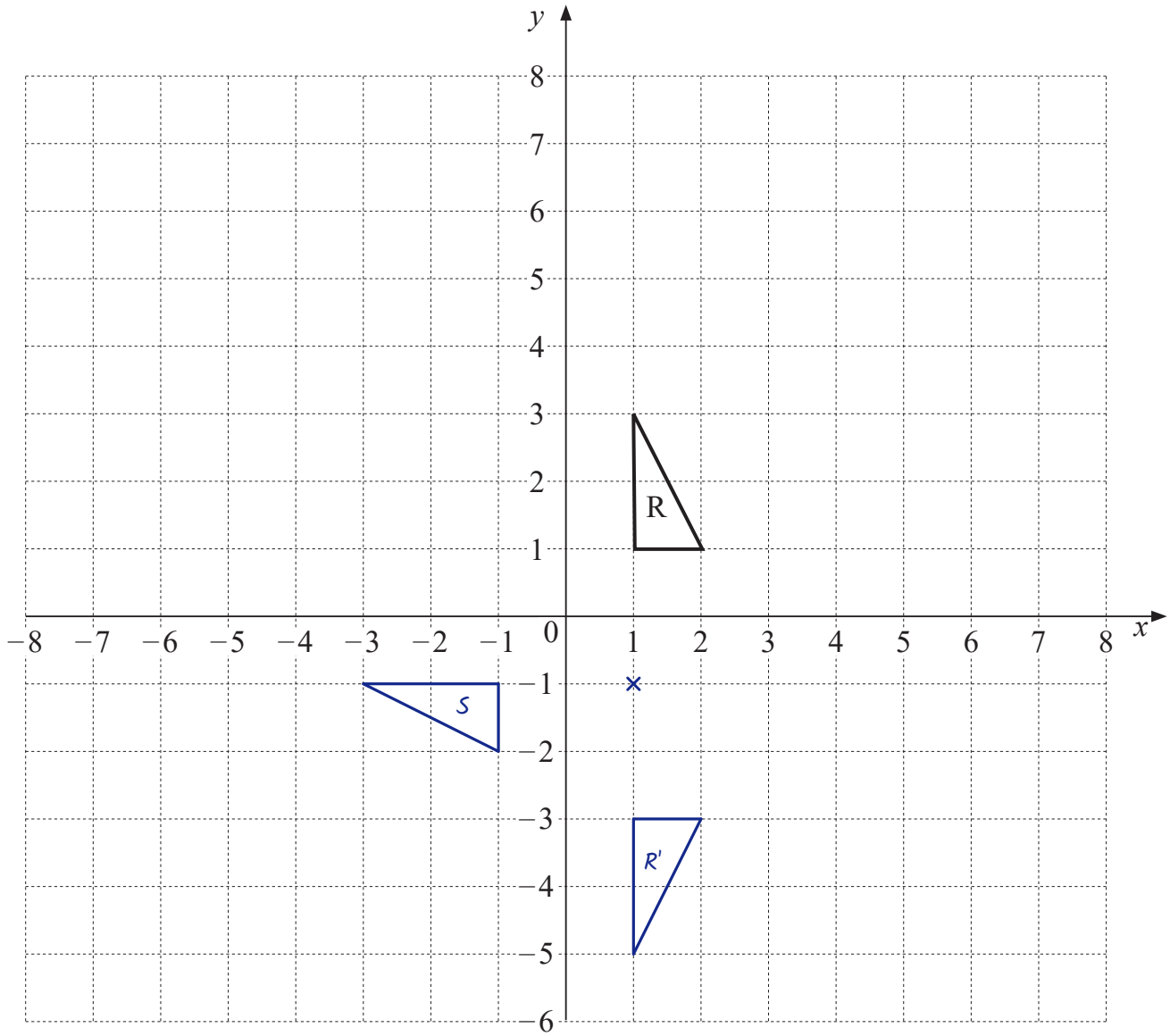
£4 + £6: 6 × 7 = 42

Total = 40 + 42 = 82

Answer 82 [2]

[Turn over

14



(a) Triangle R is reflected in the line $y = -1$ and its image rotated 90° clockwise about the point (1, −1)

Draw the final image after these two transformations and label it S. [4]

(b) Describe fully the single transformation which maps R to S.

Answer *Reflection in the line y = −x* [2]

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Question Number	**Marks**
1	
2	
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Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
Summer 2022

GCSE Mathematics

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

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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

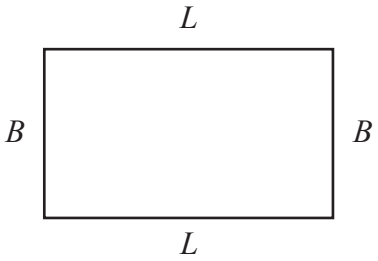
$1 \text{ ml} = 1 \text{ cm}^3$

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

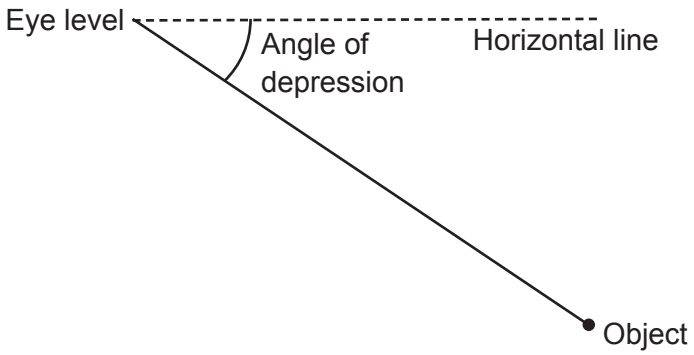
Parallel lines have the same gradient.

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° 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.

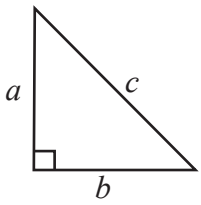
Angle of depression
If a person stands and looks down at an object, the **angle of depression** is the angle between the horizontal line of sight and the object.



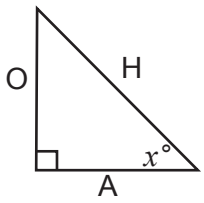
Pythagoras' Theorem

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



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

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°

Probability

The sum of the probabilities of all outcomes equals 1

Frequency density in histograms

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

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