Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2025

Mathematics

StemUp Model Solution

Unit M8 Paper 1
(Non-Calculator)
Higher Tier



[GMC81]

GMC81

WEDNESDAY 4 JUNE, 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 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.**
Questions which require drawing or sketching should be completed using an HB pencil.
All working **must** be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.
You **must not** use a calculator for this paper.
Answer **all fourteen** questions.

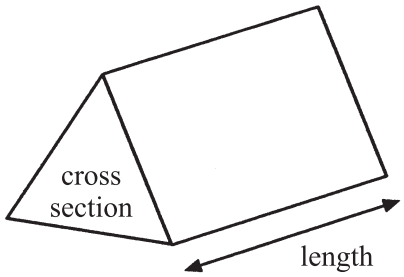
INFORMATION FOR CANDIDATES

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.

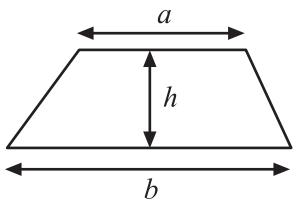
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Formula Sheet

Volume of prism = area of cross section × length

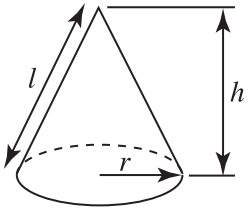


Area of trapezium = $\frac{1}{2}(a+b)h$



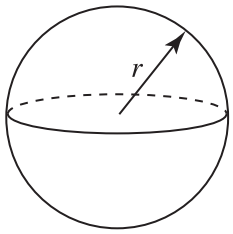
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = πrl

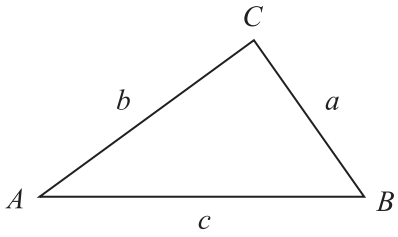


Volume of sphere = $\frac{4}{3}\pi r^3$

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 The exterior angle of a regular polygon is 9°

How many sides has the polygon?

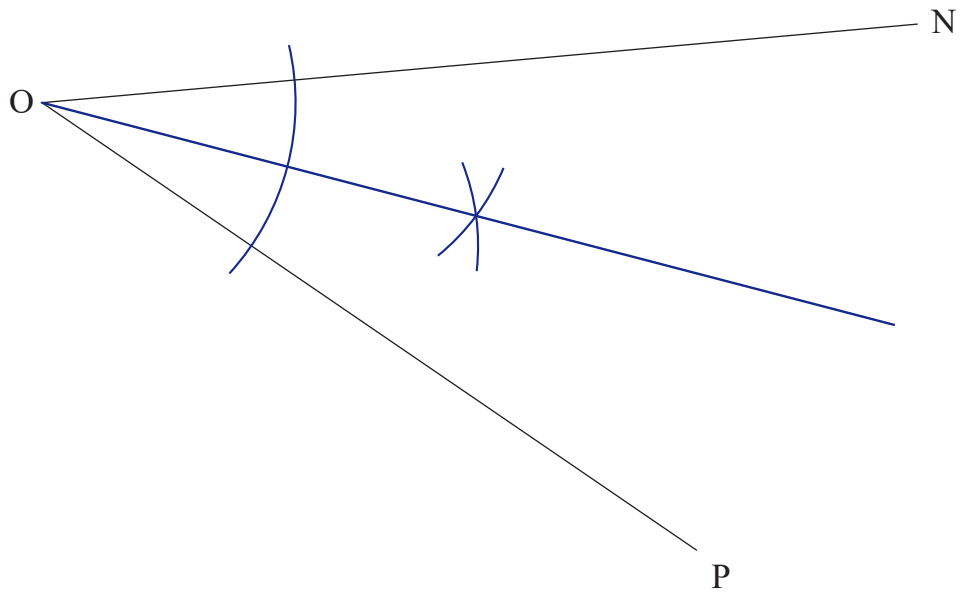
Sum of exterior angles = 360°

360 ÷ 9 = 40

Answer 40 [2]

2 Using a ruler and compasses only, construct the bisector of the angle NOP below.

Do not rub out your construction arcs.



[2]

[Turn over

3 Jacqui and Gil each flip a coin a number of times.

Jacqui says, "The coin was 'Heads' 6 times out of 13, so I think it is a fair coin."

Gil says, "The coin was 'Heads' 15 times out of 32, so I think it is a fair coin."

Whose conclusion is more reliable?

Explain your answer clearly.

Jacqui: 13 flips, Gil: 32 flips

More trials give a more reliable estimate of the probability.

Answer *Gil* because *he flipped the coin more times (32 is more than 13), so his results are based on more trials* [2]

4 **(a)** Write the binary number 10111 as a decimal number.

16 8 4 2 1

1 0 1 1 1

16 + 4 + 2 + 1 = 23

Answer 23 [1]

(b) Write the decimal number 34 as a binary number.

32 16 8 4 2 1

1 0 0 0 1 0

34 = 32 + 2

Answer 100010 [1]

[Turn over

5 A parallelogram is enlarged by scale factor 5

(a) How many times bigger is the perimeter of the enlargement than the perimeter of the original?

Answer 5 [1]

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

$5^2 = 25$

Answer 25 [1]

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6 Given that

$$2x + 3y = 10$$
$$5x - 2y = 44$$

work out the value of $9x + 5y$

A solution by trial and improvement will not be accepted.

$2x + 3y = 10 \quad (\times 2) \quad \rightarrow \quad 4x + 6y = 20$

$5x - 2y = 44 \quad (\times 3) \quad \rightarrow \quad 15x - 6y = 132$

Add: $19x = 152$

$x = 8$

$2(8) + 3y = 10 \quad \rightarrow \quad 3y = -6 \quad \rightarrow \quad y = -2$

$9x + 5y = 9 \times 8 + 5 \times (-2)$

$= 72 - 10 = 62$

Answer 62 [5]

[Turn over



7 The volume of water in a reservoir was 9×10^8 cubic metres.

The volume increased by 30%

Work out the new volume.

Give your answer in **standard form**.

30% of $9 \times 10^8 = 0.3 \times 9 \times 10^8 = 2.7 \times 10^8$

$9 \times 10^8 + 2.7 \times 10^8 = 11.7 \times 10^8$

$= 1.17 \times 10^9$

Answer 1.17×10^9 cubic metres [3]

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8 Write down the value of

(a) 3^0

Answer 1 [1]

(b) 5^{-1}

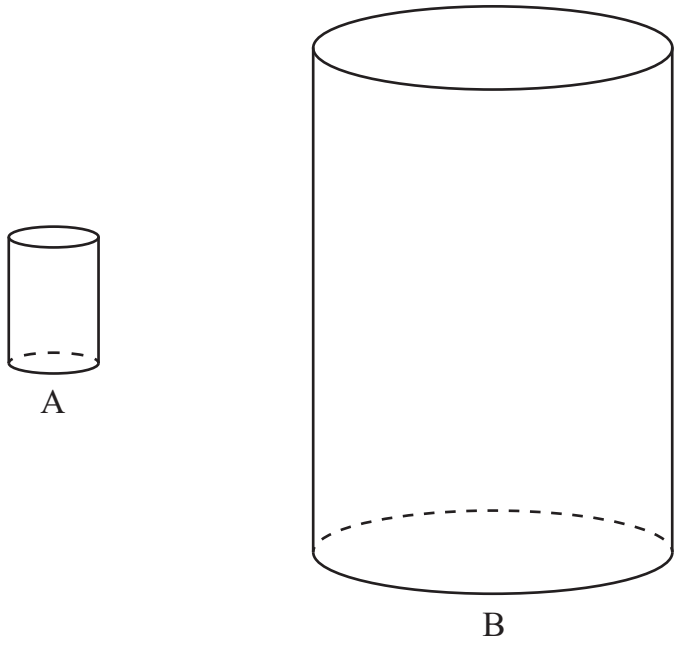
Answer $\frac{1}{5}$ [1]

(c) 10^{-3}

Answer $\frac{1}{1000}$ [1]

[Turn over

9



A and B are similar shapes.

The ratio of the surface area of A to the surface area of B is 1 : 9

(a) What is the ratio of the height of A to the height of B?

Length ratio = $\sqrt{1} : \sqrt{9}$

Answer 1 : 3 [1]

(b) What is the ratio of the volume of A to the volume of B?

$1^3 : 3^3$

Answer 1 : 27 [1]

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10 y is inversely proportional to the square of $(x - 1)$

$y = 5$ when $x = 3$

Work out the values of x when $y = 80$

$$y = \frac{k}{(x-1)^2}$$

$$5 = \frac{k}{(3-1)^2} = \frac{k}{4} \qquad \text{so} \quad k = 20$$

$$80 = \frac{20}{(x-1)^2}$$

$$80(x-1)^2 = 20$$

$$(x-1)^2 = \frac{20}{80} = \frac{1}{4}$$

$$x - 1 = \frac{1}{2} \quad \text{or} \quad x - 1 = -\frac{1}{2}$$

$$x = 1.5 \quad \text{or} \quad x = 0.5$$

Answer $x =$ 1.5 or 0.5 [6]

[Turn over



11 Solve the equation $x\sqrt{50} - x\sqrt{2} = 5$

Give your answer as a surd with a rationalised denominator.

$x\sqrt{50} - x\sqrt{2} = 5$

$\sqrt{50} = \sqrt{25} \times \sqrt{2} = 5\sqrt{2}$

$5x\sqrt{2} - x\sqrt{2} = 5$

$4x\sqrt{2} = 5$

$x = \frac{5}{4\sqrt{2}}$

$x = \frac{5}{4\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{5\sqrt{2}}{4 \times 2}$

$x = \frac{5\sqrt{2}}{8}$

Answer $\frac{5\sqrt{2}}{8}$ [5]

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12 Work out the value of $0.8\dot{1} - 0.\dot{5}$ as a fraction in its lowest terms.

Let $x = 0.8111...$ $\quad 10x = 8.111...$

$10x - x$: $\quad 9x = 7.3$ $\quad x = \frac{7.3}{9} = \frac{73}{90}$

Let $y = 0.555...$ $\quad 10y = 5.555...$

$10y - y$: $\quad 9y = 5$ $\quad y = \frac{5}{9} = \frac{50}{90}$

$\frac{73}{90} - \frac{50}{90} = \frac{23}{90}$

Answer $\frac{23}{90}$ [4]

[Turn over

13 A circle has centre (0, 0).

The equation of the tangent to the circle at the point P is $y = 3x + 20$

(a) Find the equation of the radius OP.

Gradient of tangent = 3

Radius is perpendicular to tangent, so gradient of OP = $-\frac{1}{3}$

OP passes through (0, 0): $y = -\frac{1}{3}x$

Answer $y = -\frac{1}{3}x$ [2]



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(b) Find the coordinates of the point P.

P is where $y = -\frac{1}{3}x$ meets $y = 3x + 20$

$-\frac{1}{3}x = 3x + 20$

$-x = 9x + 60$

$-10x = 60$ so $x = -6$

$y = 3(-6) + 20 = 2$

Answer P = (-6 , 2) [3]

(c) Hence find the equation of the circle.

$r^2 = (-6)^2 + 2^2 = 36 + 4 = 40$

Answer $x^2 + y^2 = 40$ [1]

[Turn over

14 $A = (3 - \sqrt{2})(5 + \sqrt{3}) - (3\sqrt{3} - 5\sqrt{2})$

$B = (2 - \sqrt{27})^2 + 12\sqrt{3}$

$C = (\sqrt{83} + \sqrt{77})(\sqrt{83} - \sqrt{77})$

Prove that one of A, B and C is irrational, one is prime and one is neither prime nor irrational.

$(3 - \sqrt{2})(5 + \sqrt{3}) = 15 + 3\sqrt{3} - 5\sqrt{2} - \sqrt{6}$

$A = 15 + 3\sqrt{3} - 5\sqrt{2} - \sqrt{6} - 3\sqrt{3} + 5\sqrt{2} = 15 - \sqrt{6}$

$\sqrt{6}$ is irrational, so $A = 15 - \sqrt{6}$ is irrational

$B = (2 - \sqrt{27})^2 + 12\sqrt{3}$

$(2 - \sqrt{27})^2 = 4 - 2\sqrt{27} - 2\sqrt{27} + 27 = 31 - 4\sqrt{27}$

$\sqrt{27} = \sqrt{9} \times \sqrt{3} = 3\sqrt{3}$, so $4\sqrt{27} = 12\sqrt{3}$

$B = 31 - 12\sqrt{3} + 12\sqrt{3} = 31$, 31 is prime

$C = (\sqrt{83})^2 - \sqrt{83}\sqrt{77} + \sqrt{77}\sqrt{83} - (\sqrt{77})^2$

$= 83 - 77 = 6$

$6 = 2 \times 3$ is not prime, and 6 is rational,

so C is neither prime nor irrational.

$\therefore$ A is irrational, B is prime, C is neither.

[6]

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Question Number	**Marks**
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Total Marks	

Examiner Number

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