Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
November 2023

Mathematics

StemUp Model Solution

Unit M8 Paper 1
(Non-Calculator)
Higher Tier

[GMC81]



GMC81

THURSDAY 23 NOVEMBER, 9.15 am – 10.30 am

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

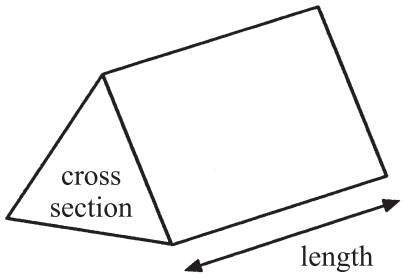
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page, on blank pages or tracing paper.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all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

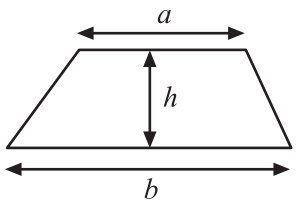
The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You should have a ruler, compasses and a protractor.
The Formula Sheet is on page 2.

Formula Sheet

Volume of prism = area of cross section × length

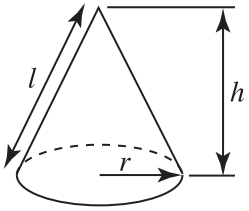


Area of trapezium = $\frac{1}{2}(a+b)h$



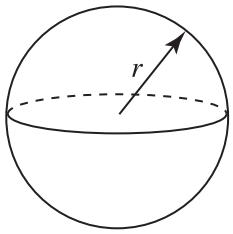
Volume of cone = $\frac{1}{3}\pi r^2 h$

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

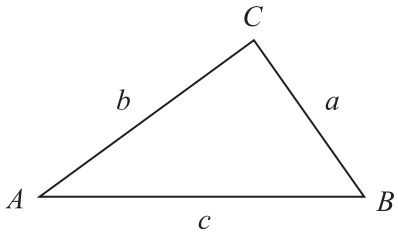


Volume of sphere = $\frac{4}{3}\pi r^3$

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

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1 110110 is a binary number.

20 is a decimal number.

Work out the total of the two numbers.

Give your answer as a binary number.

110110 = 32 + 16 + 4 + 2 = 54

54 + 20 = 74

74 = 64 + 8 + 2

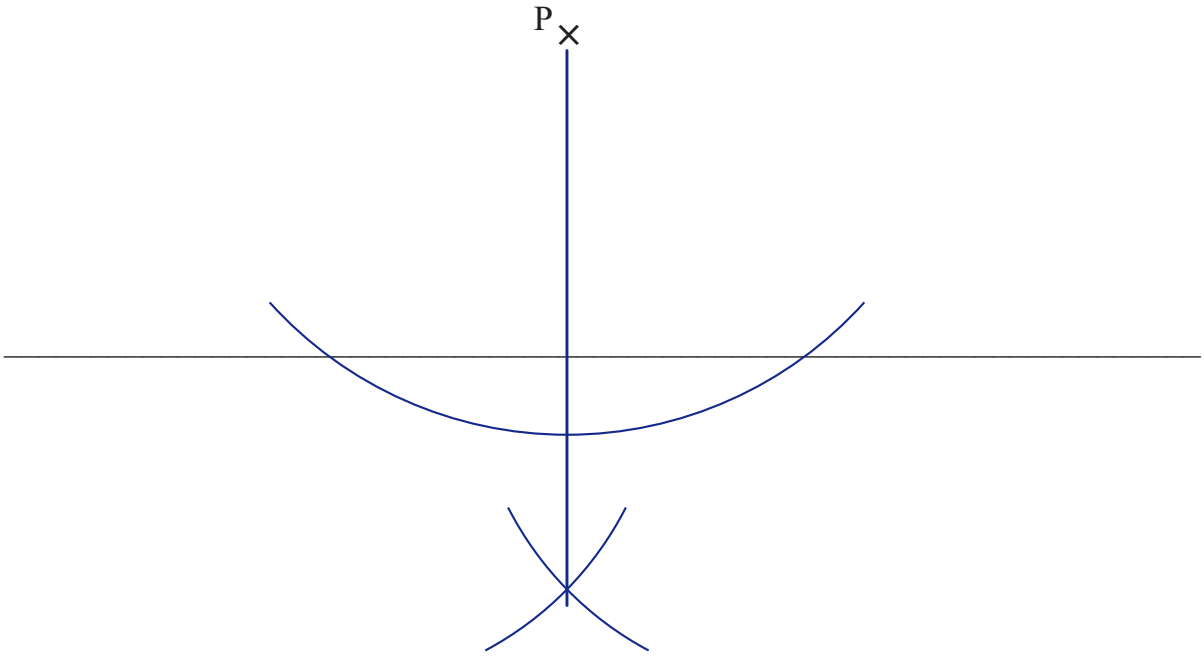
64	32	16	8	4	2	1
1	0	0	1	0	1	0

Answer 1001010 [3]

[Turn over

2 **Use a ruler and compasses** to construct the perpendicular from the point P to the line shown.

Leave all construction arcs and lines.



[2]

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3 7, 10, 13, 16, ...

Using the *n*th term, find the smallest term in the sequence above which is bigger than 1000

Show your working.

7, 10, 13, 16, ... common difference = 3

nth term = 3n + 4

3n + 4 > 1000

3n > 996

n > 332

so n = 333

3 × 333 + 4 = 999 + 4 = 1003

Answer 1003 [5]

[Turn over

4



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September 1st is on a Sunday.

Nina has applied to do her driving test in September.

No test dates are given on a Sunday.

Nina is unable to do her test on Mondays or Fridays due to work.

What is the probability that Nina is given a test date that **she cannot** do?

Sundays: 1, 8, 15, 22, 29 (5 days, no tests)

Possible test dates = 30 − 5 = 25

Mondays: 2, 9, 16, 23, 30 (5 days)

Fridays: 6, 13, 20, 27 (4 days)

Dates she cannot do = 5 + 4 = 9

P(date she cannot do) = $\frac{9}{25}$

Answer $\frac{9}{25}$ [3]

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5 $A = 2.5 \times 10^8$

$B = 8 \times 10^{-2}$

$C = 5 \times 10^4$

Work out the value of $\frac{AB}{C}$

Give your answer in standard form.

$AB = 2.5 \times 10^8 \times 8 \times 10^{-2}$

$= 20 \times 10^6$

$\frac{AB}{C} = \frac{20 \times 10^6}{5 \times 10^4}$

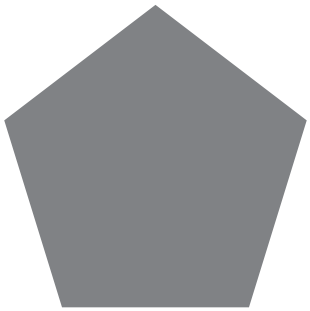
$= 4 \times 10^{6-4}$

$= 4 \times 10^2$

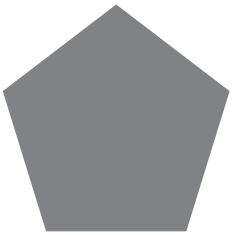
Answer 4×10^2 [3]

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6



A



B

diagram not drawn accurately

A and B are similar pentagons.

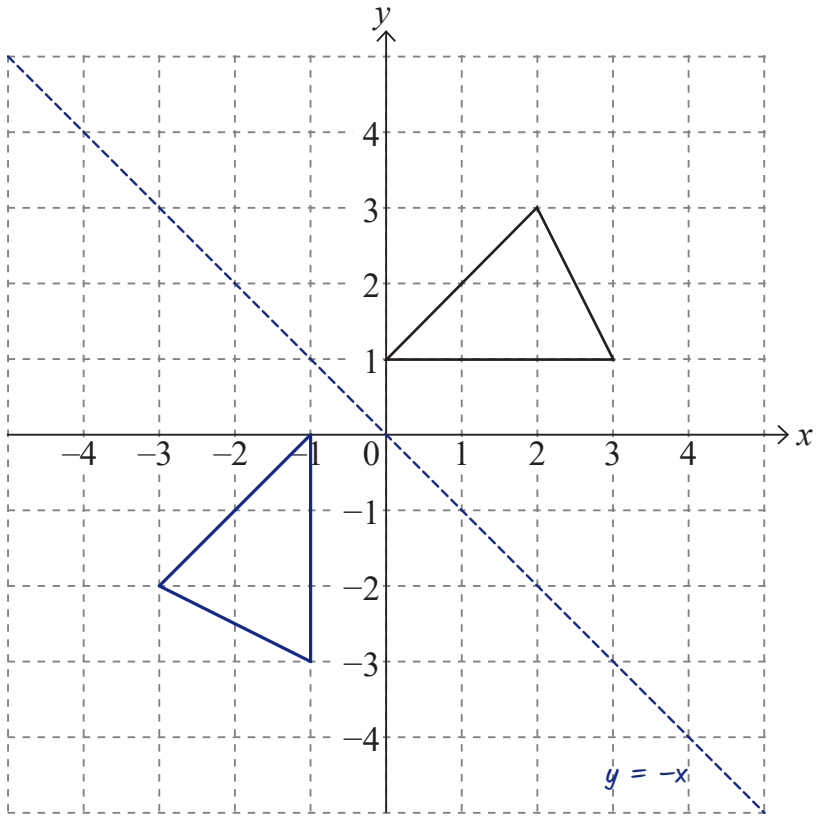
The length of each side of pentagon B is $\frac{3}{4}$ of the length of the corresponding side of pentagon A.

What fraction of the area of A is the area of B?

Area factor = $(\frac{3}{4})^2 = \frac{9}{16}$

Answer $\frac{9}{16}$ [1]

7



Draw the reflection of the triangle in the line $y = -x$. [3]

[Turn over

8 M is directly proportional to d^2

$M = 36$ when $d = 3$

d is directly proportional to x

$d = 4$ when $x = 2$

Work out the value of M when $x = 4$

$M = kd^2$

$36 = k \times 3^2$

$36 = 9k$, so $k = 4$

$M = 4d^2$

$d = cx$

$4 = 2c$, so $c = 2$

$d = 2x$

$x = 4$: $d = 2 \times 4 = 8$

$M = 4 \times 8^2 = 4 \times 64 = 256$

Answer 256 [4]

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9 **(a)** The point $(5, a)$ lies on the circle $x^2 + y^2 = 50$

Find the possible values of a.

$5^2 + a^2 = 50$

$a^2 = 50 - 25 = 25$

$a = \pm\sqrt{25}$

Answer 5 or −5 [2]

(b) Find the equation of the tangent to the circle $x^2 + y^2 = 50$ at $(-1, 7)$.

Gradient of radius $= \frac{7 - 0}{-1 - 0} = -7$

Gradient of tangent $= \frac{1}{7}$ (since $-7 \times \frac{1}{7} = -1$)

$y = \frac{1}{7}x + c$

$7 = \frac{1}{7} \times (-1) + c$

$c = 7 + \frac{1}{7} = \frac{50}{7}$

Answer $y = \frac{1}{7}x + \frac{50}{7}$ [3]

[Turn over



10 **(a)** Change 0.527527527... into a fraction.

$x = 0.527527527...$

$1000x = 527.527527...$

$1000x - x = 527$

$999x = 527$

$x = \frac{527}{999}$

Answer $\frac{527}{999}$ [2]

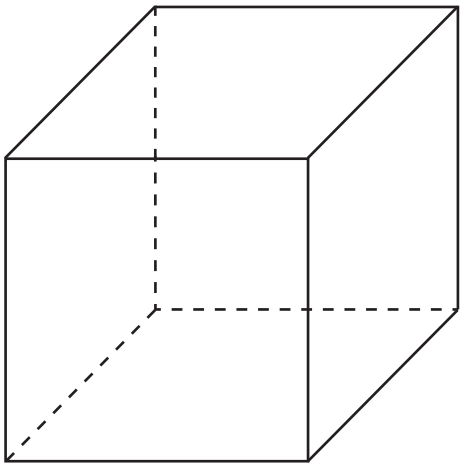
(b) Write down the value of $4^{\frac{3}{2}}$

$4^{3/2} = (\sqrt{4})^3 = 2^3 = 8$

Answer 8 [1]

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11



The length of the space diagonal of a cube is 9 cm.

Find the length of a side of the cube, giving your answer in the form $a\sqrt{b}$

Let the side be x cm

$x^2 + x^2 + x^2 = 9^2$

$3x^2 = 81$

$x^2 = 27$

$x = \sqrt{27} = \sqrt{(9 \times 3)} = 3\sqrt{3}$

Answer $3\sqrt{3}$ cm [3]

[Turn over

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12 A box contains 2 bronze medals, 6 silver medals and 3 gold medals.

Two medals are taken at random from the box.

What is the probability that they are

(a) both silver,

$P(S, S) = \frac{6}{11} \times \frac{5}{10} = \frac{30}{110} = \frac{3}{11}$

Answer $\frac{3}{11}$ [3]

(b) different types of medal?

$P(B, B) = \frac{2}{11} \times \frac{1}{10} = \frac{2}{110}$

$P(S, S) = \frac{30}{110}$

$P(G, G) = \frac{3}{11} \times \frac{2}{10} = \frac{6}{110}$

$P(\text{different}) = 1 - \frac{2}{110} - \frac{30}{110} - \frac{6}{110}$

$= \frac{72}{110} = \frac{36}{55}$

Answer $\frac{36}{55}$ [4]

13

$$A = (7 - \sqrt{5})(7 + \sqrt{5}) \qquad B = \left[(7 - \sqrt{5}) - (7 + \sqrt{5})\right]^2 \qquad C = \frac{14\sqrt{10}}{7\sqrt{2}}$$

Prove that only one of A, B, C is irrational.

$A = (7 - \sqrt{5})(7 + \sqrt{5})$

$= 49 + 7\sqrt{5} - 7\sqrt{5} - 5$

$= 44$, which is rational

$B = [(7 - \sqrt{5}) - (7 + \sqrt{5})]^2$

$= (7 - \sqrt{5} - 7 - \sqrt{5})^2$

$= (-2\sqrt{5})^2 = 4 \times 5 = 20$, which is rational

$C = \frac{14\sqrt{10}}{7\sqrt{2}} = 2 \times \sqrt{(10 \div 2)} = 2\sqrt{5}$

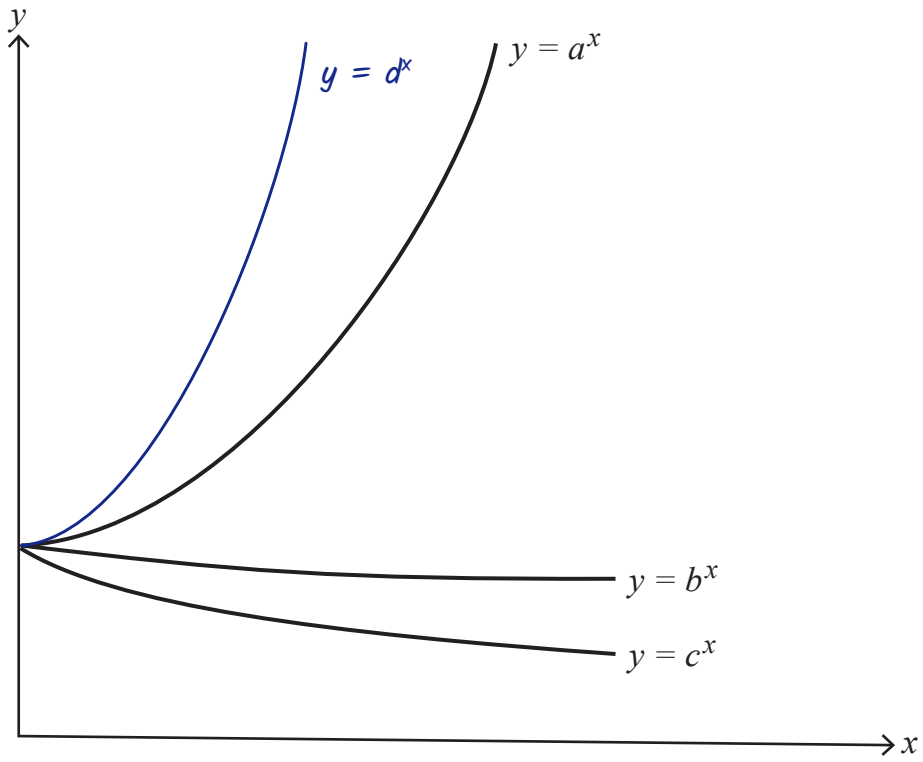
$\sqrt{5}$ is irrational (5 is not a square number), so $2\sqrt{5}$ is irrational

$\therefore$ only C is irrational

[5]

[Turn over

14



a, b and c are three decimal numbers.

The graphs of $y = a^x$, $y = b^x$, $y = c^x$ are sketched above.

One of a, b, c lies between 0.2 and 0.6,
one of a, b, c lies between 0.8 and 1.2,
and one of a, b, c lies between 1.4 and 1.8

(a) Which of a, b, c lies between 0.2 and 0.6?

Answer c [1]

(b) Which of a, b, c lies between 0.8 and 1.2?

Answer b [1]

(c) d is a decimal which lies between 2.0 and 2.4

Draw one possible sketch of the graph $y = d^x$ on the grid above. [1]

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