Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
November 2025

# Mathematics

StemUp Model Solution

Unit M8 Paper 1
**(Non-Calculator)**
Higher Tier



**[GMC81]**

*GMC81*

## THURSDAY 20 NOVEMBER, 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 fifteen** questions.

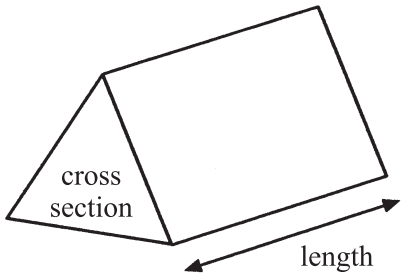
**INFORMATION FOR CANDIDATES**

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.

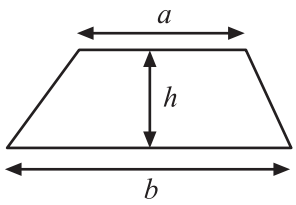
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# Formula Sheet

**Volume of prism** = area of cross section × length

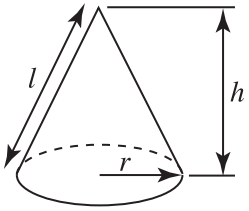



**Area of trapezium** = $\frac{1}{2}(a+b)h$



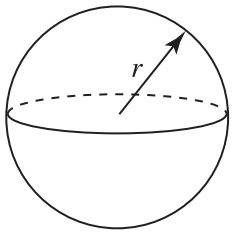

**Volume of cone** = $\frac{1}{3}\pi r^2 h$

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

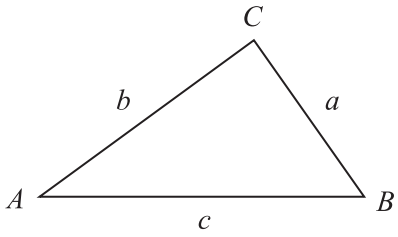



**Volume of sphere** = $\frac{4}{3}\pi r^3$

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

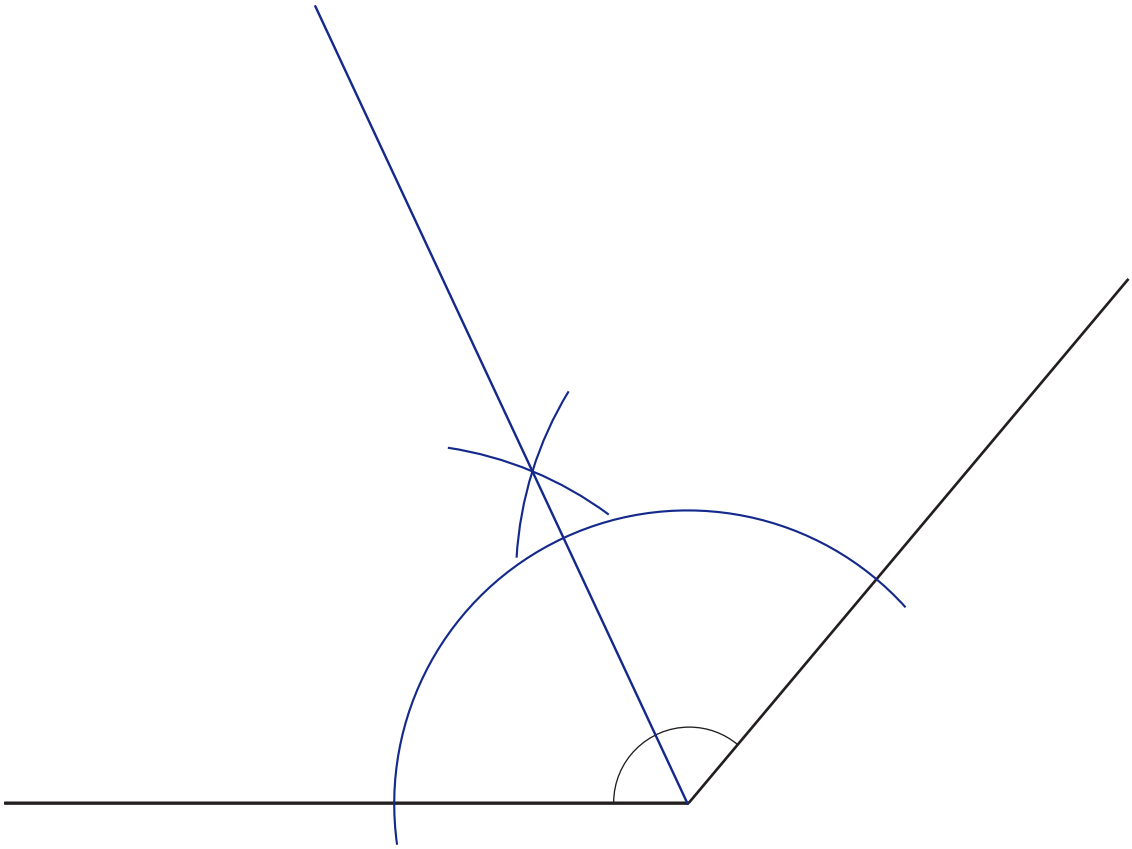
**Area of triangle** = $\frac{1}{2}ab\sin C$

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**1** Use a ruler and compasses to construct the bisector of the angle.

**You must show all your construction arcs.**



[2]

**[Turn over**

**2** Jan asks some delivery drivers how much money they spend on fuel each week.

The results are shown below.

| Amount, £A | Frequency |
|---|---|
| $0 < A \leqslant 40$ | 12 |
| $40 < A \leqslant 80$ | 18 |
| $80 < A \leqslant 120$ | 26 |
| $120 < A \leqslant 160$ | 27 |
| $160 < A \leqslant 200$ | 17 |

There are 2000 delivery drivers in the area.

Estimate how many delivery drivers in the area spend over £160 on fuel each week.

**Show your working out clearly.**

Total = 12 + 18 + 26 + 27 + 17 = 100

Over £160: $\frac{17}{100} \times 2000 = 17 \times 20 = 340$

Answer 340 [2]





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**3** A college has 270 students.

120 of the students are male.

The probability that a male student plays sport is $\frac{7}{20}$

The probability that a female student plays sport is 0.4

What **fraction** of the students who play sport are male?

*Male who play sport* $= \frac{7}{20} \times 120 = 42$

*Female* $= 270 - 120 = 150$

*Female who play sport* $= 0.4 \times 150 = 60$

*Total who play sport* $= 42 + 60 = 102$

*Fraction male* $= \frac{42}{102} = \frac{7}{17}$

Answer $\frac{7}{17}$ [4]

**[Turn over**

**4** **(a)** Explain why 105001 is not a binary number.

Answer *Binary numbers only use the digits 0 and 1 (it has a 5)* [1]

**(b)** Write the number 23 as a binary number.

16 8 4 2 1

1 0 1 1 1

16 + 4 + 2 + 1 = 23

Answer *10111* [1]

**(c)** Jim says that the binary number 110001 is a square number when it is changed into a decimal number.

Is Jim correct?

**Show your working out clearly.**

32 16 8 4 2 1

1 1 0 0 0 1

32 + 16 + 1 = 49

$49 = 7 \times 7 = 7^2$

Answer *Yes* because *110001 = 49 = $7^2$, a square number* [2]

**5** The first 6 terms in sequence P are

3, 5, 7, 9, 11, 13, …

The first 6 terms in sequence Q are

1, 5, 9, 13, 17, 21, …

Joanne adds the first term of sequence P to the first term of sequence Q.

She adds the second term of sequence P to the second term of sequence Q.

She continues in this way to produce a new sequence.

**(a)** Write down the $n$th term for this new sequence.

New sequence: 4, 10, 16, 22, 28, 34, …

Common difference = 6

$6n - 2$

Answer $6n - 2$ [2]

**(b)** Find the 20th term for this new sequence.

$6 \times 20 - 2 = 120 - 2 = 118$

Answer 118 [1]

**[Turn over**

**6** E and F are independent events.

The probability of E happening = $x$

The probability of F happening = $y$

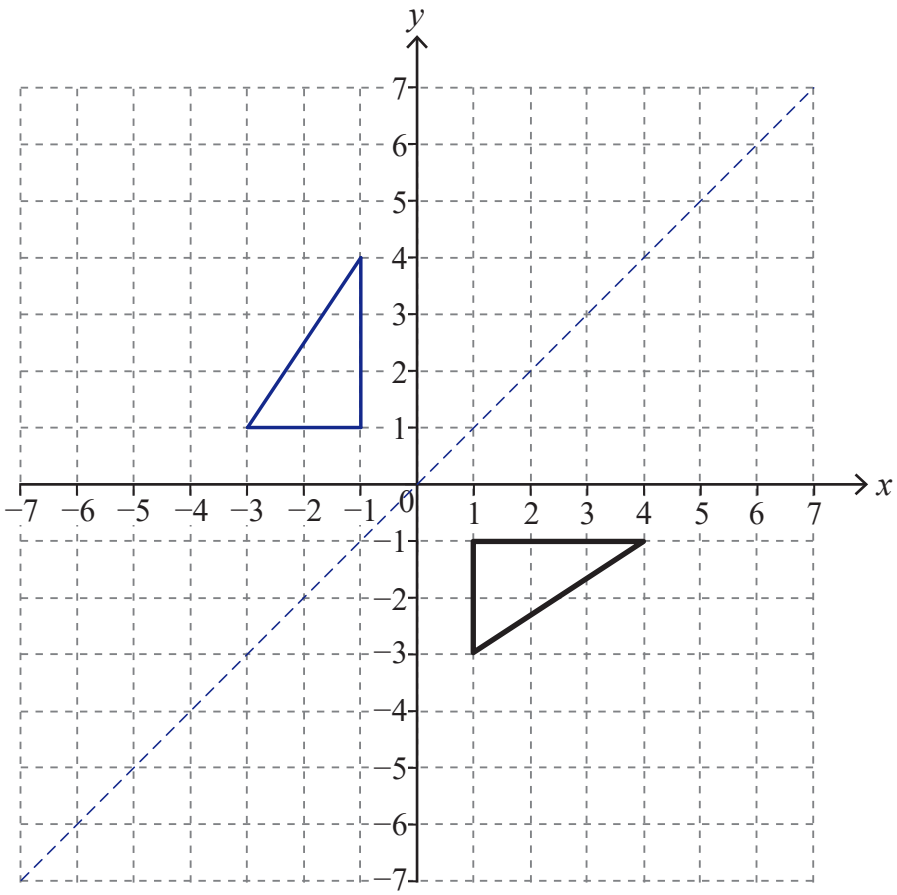
What is the probability of E and F happening?

**Circle the correct answer.**

$xy$ $\quad x - y \quad x + y \quad 1 - xy$

[1]

**7** Reflect the triangle in the line $y = x$.




[2]

**[Turn over**

**8** $A = (8 \times 10^{-5}) + (2 \times 10^{2})$

$B = (8 \times 10^{-5}) \times (2 \times 10^{2})$

$C = (8 \times 10^{-5}) \div (2 \times 10^{2})$

Write A, B, C in order of size, beginning with the smallest.

**Show your working out clearly.**

$A = 0.00008 + 200 = 200.00008$

$B = 16 \times 10^{-5+2} = 16 \times 10^{-3} = 0.016$

$C = 4 \times 10^{-5-2} = 4 \times 10^{-7} = 0.0000004$

Answer C , B , A [3]





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**9** Mary works in a garage and in a café.

Last week she worked 5 hours in the garage and 8 hours in the café.

She earned £155

This week she worked 4 hours in the garage and 6 hours in the café.

She earned £119

How much does she earn per hour in the garage and per hour in the café?

**A solution by trial and improvement will not be accepted.**

Let garage = £x per hour, café = £y per hour

$5x + 8y = 155 \quad (\times 4) \quad \rightarrow \quad 20x + 32y = 620$

$4x + 6y = 119 \quad (\times 5) \quad \rightarrow \quad 20x + 30y = 595$

Subtract: $2y = 25$

$y = 12.50$

$5x + 8(12.50) = 155$

$5x + 100 = 155 \quad \rightarrow \quad 5x = 55 \quad \rightarrow \quad x = 11$

Answer Garage £ 11 per hour, Café £ 12.50 per hour [5]

**[Turn over**

**10** Change $0.\dot{7}\dot{0}$ to a fraction.

$x = 0.707070...$

$100x = 70.707070...$

$99x = 70$

$x = \frac{70}{99}$

Answer $\frac{70}{99}$ [2]

**11** **(a)** Simplify the expression $(2mn^4)^3$

$2^3 \times m^3 \times n^{4\times3}$

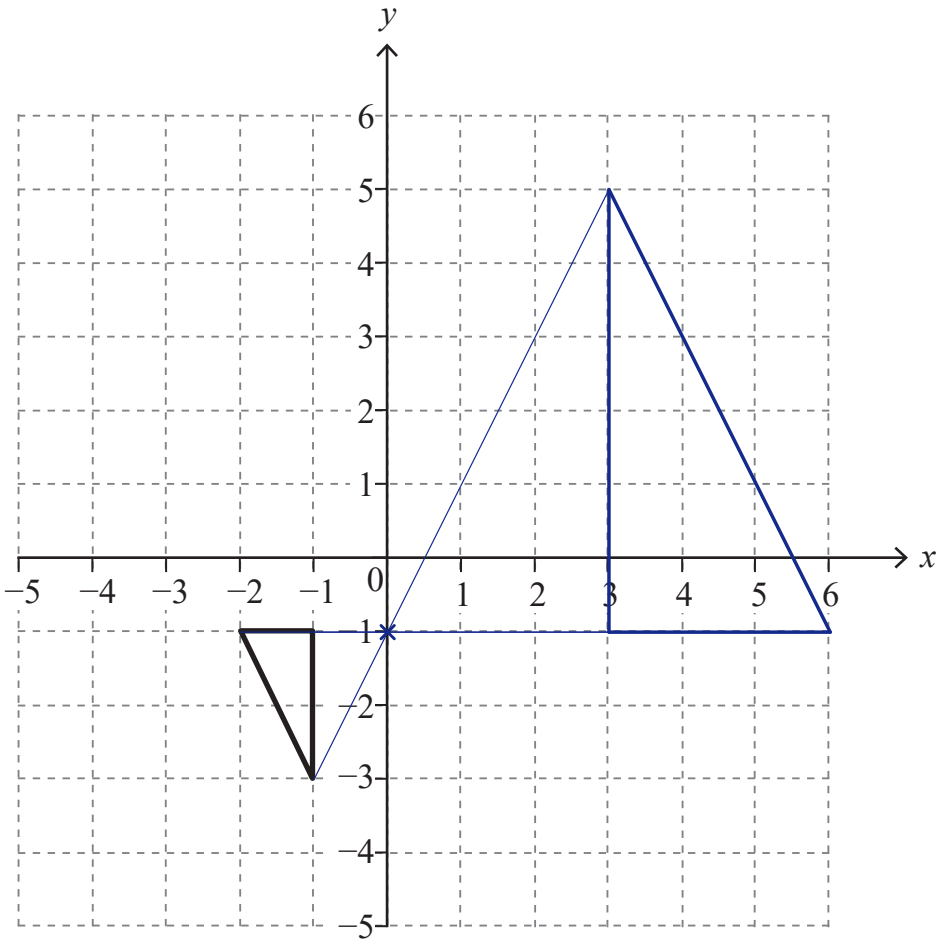
Answer $8m^3n^{12}$ [2]

**(b)** Show that $32^{-\frac{2}{5}} = \frac{1}{4}$

$32^{-2/5} = \frac{1}{32^{2/5}} = \frac{1}{(\sqrt[5]{32})^2} = \frac{1}{2^2} = \frac{1}{4}$

[2]

**12** Enlarge the triangle by scale factor –3 using centre (0, –1).




[3]

**[Turn over**

**13** $T$ is inversely proportional to the **cube** of $x$.

$T = 1000$ when $x = 2$

**(a)** Express $T$ in terms of $x$.

$T = \frac{k}{x^3}$

$1000 = \frac{k}{2^3} = \frac{k}{8}$

$k = 1000 \times 8 = 8000$

$T = \frac{8000}{x^3}$

Answer $T = \frac{8000}{x^3}$ [3]

**(b)** Calculate $x$ when $T = 8$

$8 = \frac{8000}{x^3}$

$x^3 = 8000 \div 8 = 1000$

$x = \sqrt[3]{1000} = 10$

Answer 10 [2]

**14** A bag contains 8 red counters and 3 yellow counters.

Two counters are taken from the bag at random.

What is the probability that they are the same colour?

$P(RR) = \frac{8}{11} \times \frac{7}{10} = \frac{56}{110}$

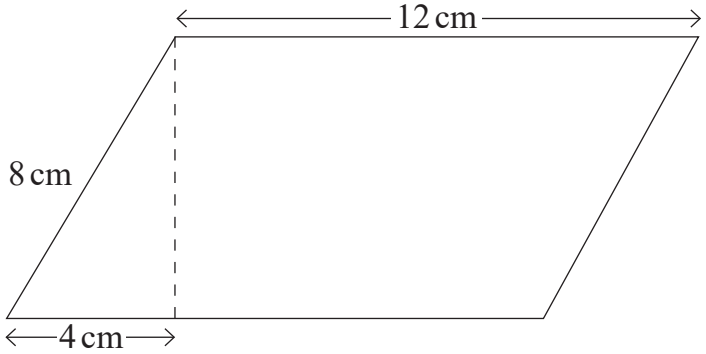
$P(YY) = \frac{3}{11} \times \frac{2}{10} = \frac{6}{110}$

$P(\text{same colour}) = \frac{56}{110} + \frac{6}{110} = \frac{62}{110} = \frac{31}{55}$

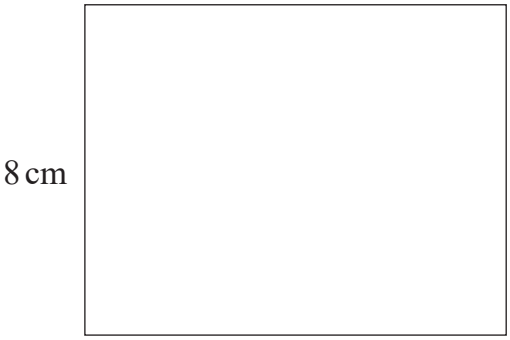
Answer $\frac{31}{55}$ [4]

**[Turn over**

**15**




diagrams not drawn accurately




The parallelogram and the rectangle have equal areas.

Calculate the length of the diagonal of the rectangle, giving your answer in the form $a\sqrt{b}$

Height of parallelogram:

$h^2 = 8^2 - 4^2 = 64 - 16 = 48$

$h = \sqrt{48} = \sqrt{16} \times \sqrt{3} = 4\sqrt{3}$

Area of parallelogram $= 12 \times 4\sqrt{3} = 48\sqrt{3}$ cm$^2$

Rectangle: $8 \times$ length $= 48\sqrt{3} \rightarrow$ length $= \frac{48\sqrt{3}}{8} = 6\sqrt{3}$

$\text{Diagonal}^2 = 8^2 + (6\sqrt{3})^2$

$= 64 + 36 \times 3$

$= 64 + 108 = 172$

$\text{Diagonal} = \sqrt{172} = \sqrt{4} \times \sqrt{43} = 2\sqrt{43}$

Answer $2\sqrt{43}$ cm [6]

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| **Question Number** | **Marks** |
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| **Total Marks** | |

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