Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2019

Mathematics

StemUp Model Solution

Unit M8 Paper 1
(Non-Calculator)
Higher Tier



[GMC81]

GMC81

THURSDAY 6 JUNE, 9.15am–10.30am

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

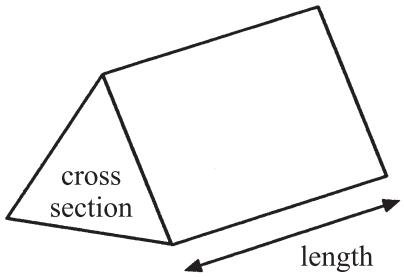
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page, on blank pages or tracing paper.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all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

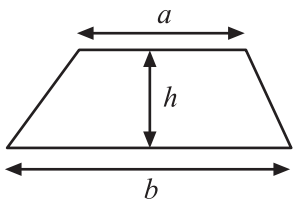
The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You should have a ruler, compasses and a protractor.
The Formula Sheet is on page 2.

Formula Sheet

Volume of prism = area of cross section × length

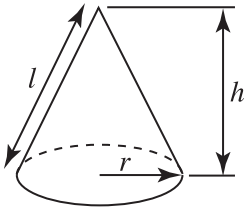


Area of trapezium = $\frac{1}{2}(a+b)h$



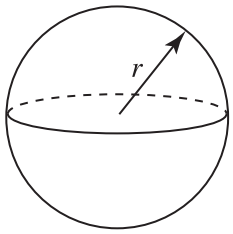
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = πrl

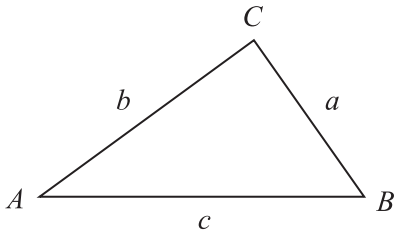


Volume of sphere = $\frac{4}{3}\pi r^3$

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

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

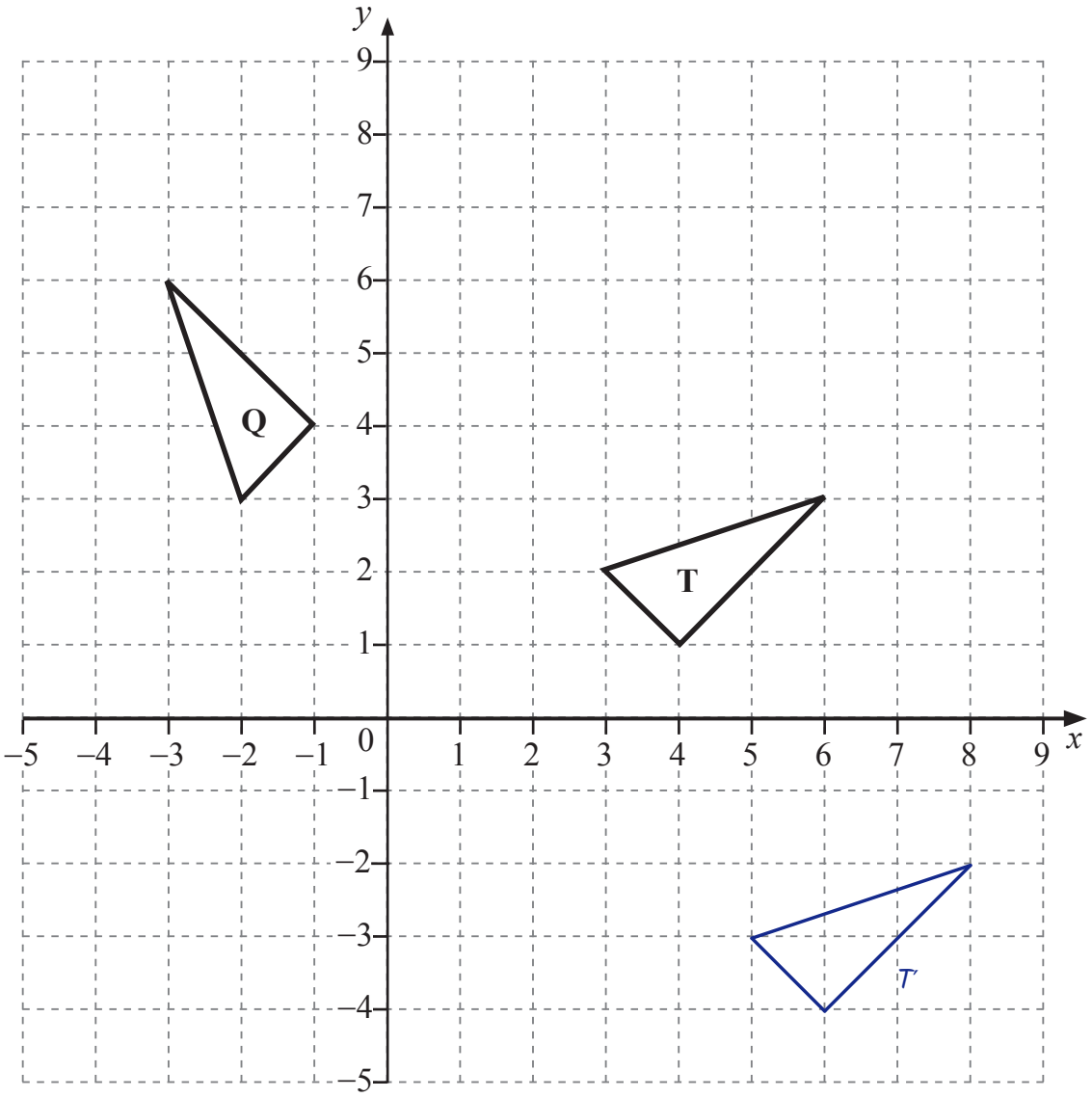
Sine Rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

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

11947

1



(a) Describe fully the **single** transformation which maps triangle **T** onto triangle **Q**.

Answer Rotation of 90° anticlockwise about (0, 0) [3]

(b) On the grid, draw the image of triangle **T** after a translation $\begin{pmatrix} 2 \\ -5 \end{pmatrix}$. [2]

(3, 2) → (5, −3), (4, 1) → (6, −4), (6, 3) → (8, −2)

[Turn over

2 A six-sided dice is rolled 800 times.

The table below shows the relative frequency of scoring a six after different numbers of rolls.

Number of rolls	Relative frequency of a six
100	0.3
200	0.26
300	0.27
500	0.23
800	0.25

(a) How many times was a six scored after 300 rolls?

Show how you obtained your answer.

$300 \times 0.27 = 81$

Answer 81 [2]

(b) Which relative frequency from the table gives the best estimate of the probability of scoring a six when this dice is rolled?

Explain your answer.

Answer 0.25

Reason 800 rolls is the most trials, so it is the most reliable [2]

(c) How many sixes would you expect to get if a **fair** six-sided dice was rolled 300 times?

$P(six) = \frac{1}{6}$, $300 \times \frac{1}{6} = 50$

Answer 50 [2]

3 John has six shirts, eight ties and five cravats.

John is going out to dinner and he must choose a shirt **and** either a tie or a cravat to wear.

How many different combinations has John got to choose from?

Shirt and tie: $6 \times 8 = 48$

Shirt and cravat: $6 \times 5 = 30$

Total $= 48 + 30 = 78$

Answer 78 [3]

4 **(a)** **(i)** Write the binary number 10101 as a decimal number.

16	8	4	2	1
1	0	1	0	1

$16 + 4 + 1 = 21$

Answer 21 [1]

(ii) Write the decimal number 26 as a binary number.

16	8	4	2	1
1	1	0	1	0

$26 = 16 + 8 + 2$

Answer 11010 [1]

(b) Find the value of $3^0 + 4^0$

$3^0 = 1$, $4^0 = 1$, $1 + 1 = 2$

Answer 2 [1]

[Turn over

5 A one gram bag of seed contains half a million seeds.

If each seed weighs the same, calculate the weight, in grams, of one seed.

Give your answer in standard form.

$1 \div 500\,000 = \frac{1}{500\,000} = \frac{1}{5 \times 10^5}$

$= 0.2 \times 10^{-5}$

$= 2 \times 10^{-6}$

Answer 2×10^{-6} g [3]

6 Tom bought shares costing £4 000

The value, V, of the shares depreciated by 0.05% each year.

Circle the formula which gives the value, V, of the shares after two years.

$V = (4000 - 0.05)^2$ $V = 4000\,(1.05)^2$

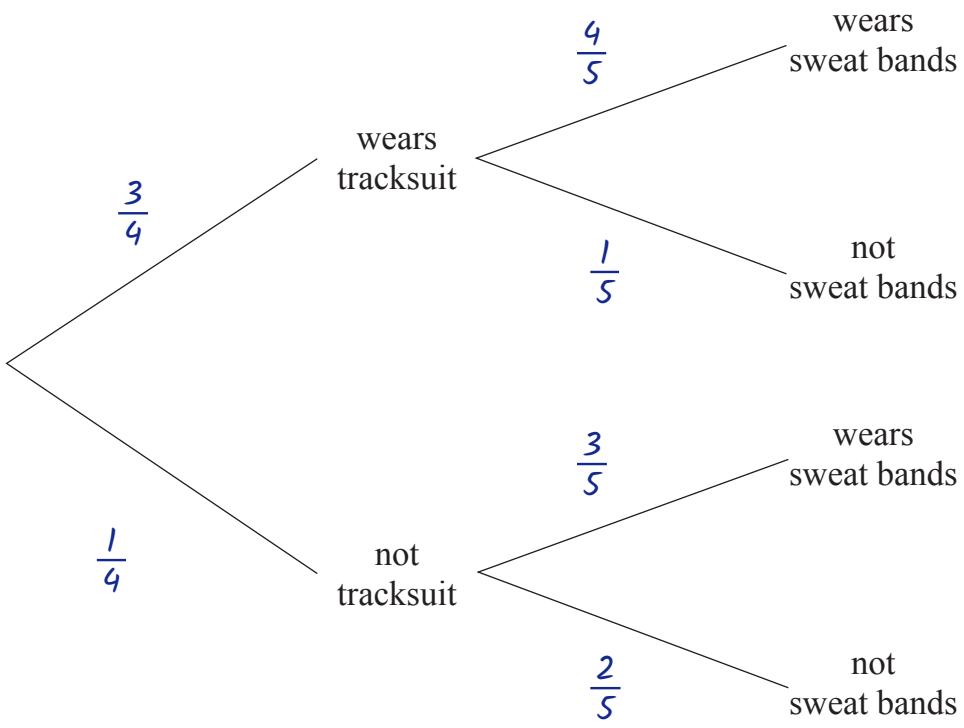
$V = 4000\,(0.9995)^2$ $V = 4000\,(0.95)^2$ [1]

7 When Jan goes to the gym, the probability that she wears a tracksuit is $\frac{3}{4}$

When she wears a tracksuit, the probability that she wears sweat bands is $\frac{4}{5}$

When she does not wear a tracksuit, the probability that she wears sweat bands is $\frac{3}{5}$

(a) Complete the tree diagram.



[3]

(b) Calculate the probability that Jan does not wear sweat bands.

$P(\text{not SB}) = \frac{3}{4} \times \frac{1}{5} + \frac{1}{4} \times \frac{2}{5}$

$= \frac{3}{20} + \frac{2}{20} = \frac{5}{20} = \frac{1}{4}$

Answer $\frac{1}{4}$ [2]

[Turn over

8 Change the recurring decimal 0.561561 … into a fraction in its simplest form.

$x = 0.561561...$

$1000x = 561.561561...$

$999x = 561$

$x = \frac{561}{999} = \frac{187}{333}$

Answer $\frac{187}{333}$ [2]

9 Evaluate

(a) $16^{\frac{3}{4}}$

$16^{3/4} = (\sqrt[4]{16})^3 = 2^3 = 8$

Answer 8 [1]

(b) $\dfrac{81^{\frac{1}{2}} - 125^{\frac{1}{3}}}{100^{-0.5}}$

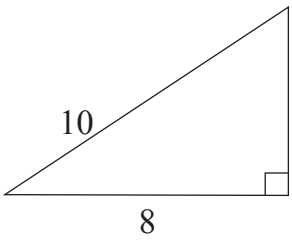
$81^{1/2} = 9, \quad 125^{1/3} = 5$

$100^{-0.5} = \frac{1}{\sqrt{100}} = \frac{1}{10}$

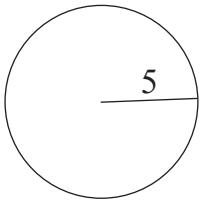
$\frac{9-5}{1/10} = 4 \div \frac{1}{10} = 4 \times 10 = 40$

Answer 40 [3]

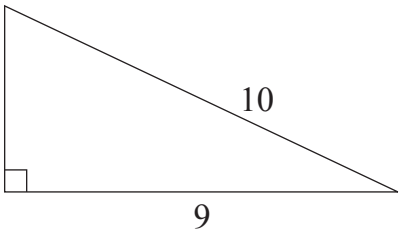
10 For each shape, decide whether the area is a rational or an irrational number.
Give a reason for each answer.



Shape A



Shape B



Shape C

A: missing side = $\sqrt{(10^2 - 8^2)} = \sqrt{36} = 6$

area = $\frac{1}{2} \times 8 \times 6 = 24$

B: area = $\pi \times 5^2 = 25\pi$

C: missing side = $\sqrt{(10^2 - 9^2)} = \sqrt{19}$

area = $\frac{1}{2} \times 9 \times \sqrt{19} = 4.5\sqrt{19}$

Area of Shape A is rational because area = 24, a whole number

[1]

Area of Shape B is irrational because area = 25π and π is irrational

[1]

Area of Shape C is irrational because area = $4.5\sqrt{19}$ and $\sqrt{19}$ is irrational

[1]

[Turn over

11 $(-3, 4)$ is a point on the circle $x^2 + y^2 = 25$

(a) Show that the equation of the tangent to the circle at this point is $4y = 3x + 25$

Gradient of radius $= \frac{4 - 0}{-3 - 0} = -\frac{4}{3}$

Gradient of tangent $= \frac{3}{4}$ (perpendicular: $-1 \div -\frac{4}{3}$)

$y = \frac{3}{4}x + c$: $4 = \frac{3}{4} \times (-3) + c$, $c = 4 + \frac{9}{4} = \frac{25}{4}$

$y = \frac{3}{4}x + \frac{25}{4}$ $\times 4$: $4y = 3x + 25$

[4]

(b) Find the coordinates of the points of intersection of this tangent and the curve $y = x^2 + 6$

$4(x^2 + 6) = 3x + 25$

$4x^2 + 24 = 3x + 25$

$4x^2 - 3x - 1 = 0$

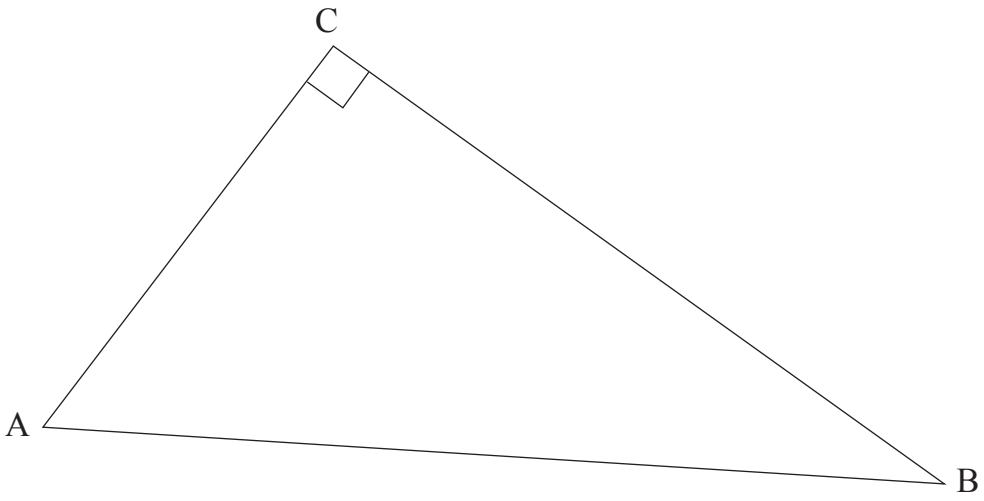
$(4x + 1)(x - 1) = 0$

$x = -\frac{1}{4}$ or $x = 1$

$x = -\frac{1}{4}$: $y = \frac{1}{16} + 6 = 6\frac{1}{16}$; $x = 1$: $y = 1 + 6 = 7$

Answer $\left(-\frac{1}{4}, 6\frac{1}{16}\right)$ and $(1, 7)$ [6]

12



BC $= 3\sqrt{5} - 1$ and AC $= 3 + \sqrt{5}$

Find AB.

Give your answer in the form $p\sqrt{q}$

$AB^2 = BC^2 + AC^2$

$(3\sqrt{5} - 1)^2 = 9 \times 5 - 6\sqrt{5} + 1 = 46 - 6\sqrt{5}$

$(3 + \sqrt{5})^2 = 9 + 6\sqrt{5} + 5 = 14 + 6\sqrt{5}$

$AB^2 = 46 - 6\sqrt{5} + 14 + 6\sqrt{5} = 60$

$AB = \sqrt{60} = \sqrt{4} \times \sqrt{15}$

$AB = 2\sqrt{15}$

[5]

THIS IS THE END OF THE QUESTION PAPER

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For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

Examiner Number

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