Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
January 2020

Mathematics

StemUp Model Solution

Unit M8 Paper 1
(Non-Calculator)
Higher Tier



[GMC81]

GMC81

WEDNESDAY 15 JANUARY, 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 sixteen** 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.

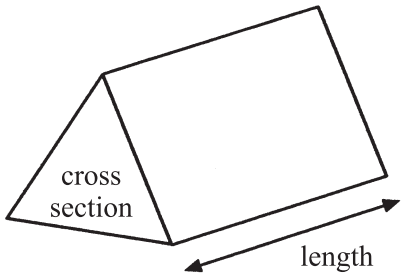
INFORMATION FOR CANDIDATES

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.

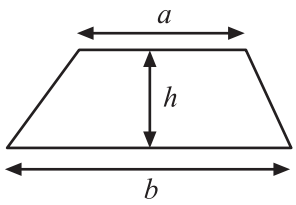
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Formula Sheet

Volume of prism = area of cross section × length

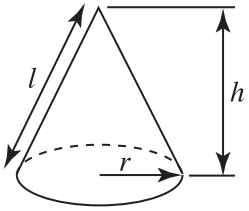


Area of trapezium = $\frac{1}{2}(a+b)h$



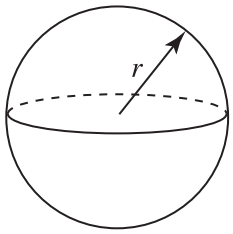
Volume of cone = $\frac{1}{3}\pi r^2 h$

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

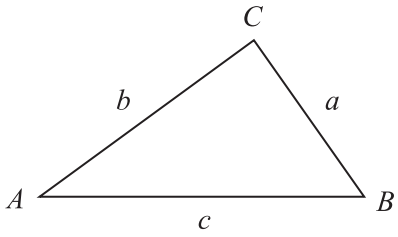


Volume of sphere = $\frac{4}{3}\pi r^3$

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

12515

1 Simplify the following.

(a) $4y^3 \times 3y^4$

$4 \times 3 = 12, \quad y^{3+4} = y^7$

Answer $12y^7$ [1]

(b) $(m^4)^5$

$4 \times 5 = 20$

Answer m^{20} [1]

2 **(a)** Solve the inequality $6y + 5 \geq 2$

$6y + 5 \geqslant 2$

$6y \geqslant 2 - 5$

$6y \geqslant -3$

$y \geqslant -\frac{3}{6} = -\frac{1}{2}$

Answer $y \geqslant -\frac{1}{2}$ [2]

(b) Write down the smallest **integer** value of y which satisfies the inequality

$6y + 5 \geq 2$

$y \geqslant -0.5$, so integers are 0, 1, 2, ...

Answer $y =$ 0 [1]

[Turn over

3 **(a)** Write 25 as a binary number.

16 8 4 2 1
1 1 0 0 1

25 = 16 + 8 + 1

Answer 11001 [1]

(b) Write the binary number 1101001 in decimal form.

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

64 + 32 + 8 + 1 = 105

Answer 105 [1]

4 Make m the subject of the formula $H = mr + s$

$H = mr + s$

$H - s = mr$

$m = \frac{H - s}{r}$

Answer $m = \frac{H - s}{r}$ [2]

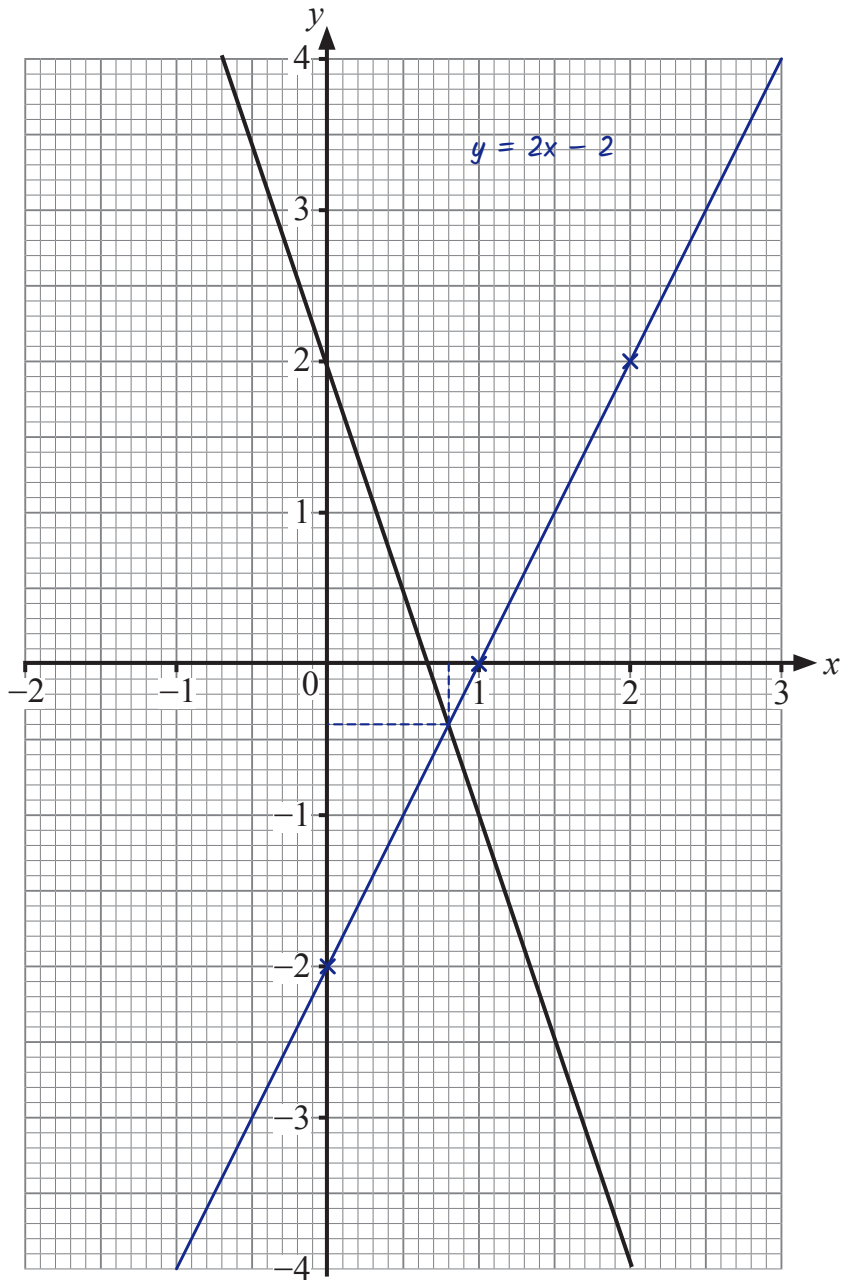
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(Questions continue overleaf)

[Turn over

5



12515

By drawing a suitable line on the grid opposite solve the simultaneous equations

$y = 2x - 2$

$y = -3x + 2$

$y = 2x - 2$: $x = 0$, $y = -2$
$x = 1$, $y = 0$; $x = 2$, $y = 2$

Lines cross at (0.8, −0.4)

Answer $x =$ 0.8 $y =$ −0.4 [4]

[Turn over

6 Two fair dice are rolled.

Make a list of all the ways it is possible to get a total score of 7 on the two dice.

Answer (1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1) [2]

7 Find the value of $(-2)^{-2}$

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

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

8 Make x the subject of the formula $y = \frac{b}{\sqrt{x}}$

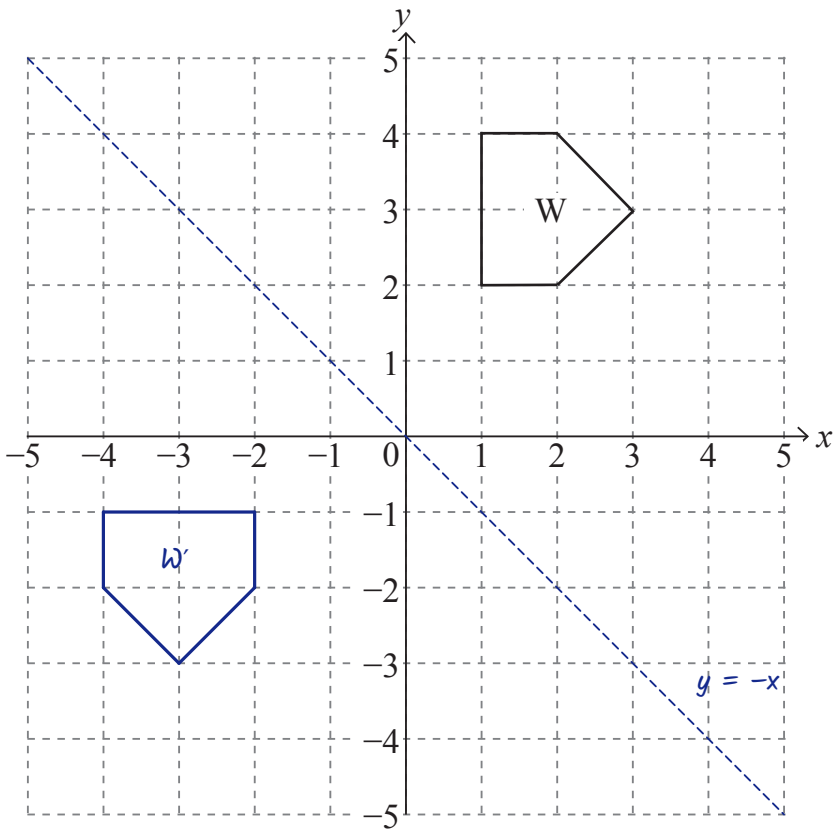
$y = \frac{b}{\sqrt{x}} \rightarrow \sqrt{x} = \frac{b}{y}$

$x = \left(\frac{b}{y}\right)^2$

$x = \frac{b^2}{y^2}$

Answer $x =$ $\frac{b^2}{y^2}$ [2]

9



On the grid, draw the reflection of the shape W in the line $y = -x$ [2]

[Turn over

10 There are three main routes from Belleek to Enniskillen by car.

There are five main routes from Enniskillen to Fintona by car.

(a) How many different ways can James travel from Belleek to Enniskillen to Fintona by car using only main routes?

$3 \times 5 = 15$

Answer 15 [1]

(b) On a particular day, two of the main routes from Enniskillen to Fintona were closed.

By what percentage has the number of different ways for James to travel from Belleek to Enniskillen to Fintona by car using only main routes been reduced?

$3 \times 3 = 9$ ways, $15 - 9 = 6$ fewer

$\frac{6}{15} = \frac{2}{5} = 40\%$

Answer 40 % [2]

11 **(a)** Rationalise the denominator of $\frac{28}{\sqrt{7}}$

$\frac{28}{\sqrt{7}} \times \frac{\sqrt{7}}{\sqrt{7}} = \frac{28\sqrt{7}}{7} = 4\sqrt{7}$

Answer $4\sqrt{7}$ [2]

(b) Show that $(\sqrt{45} - \sqrt{5})^2 = 20$

$(\sqrt{45} - \sqrt{5})^2 = 45 - 2\sqrt{45}\sqrt{5} + 5$

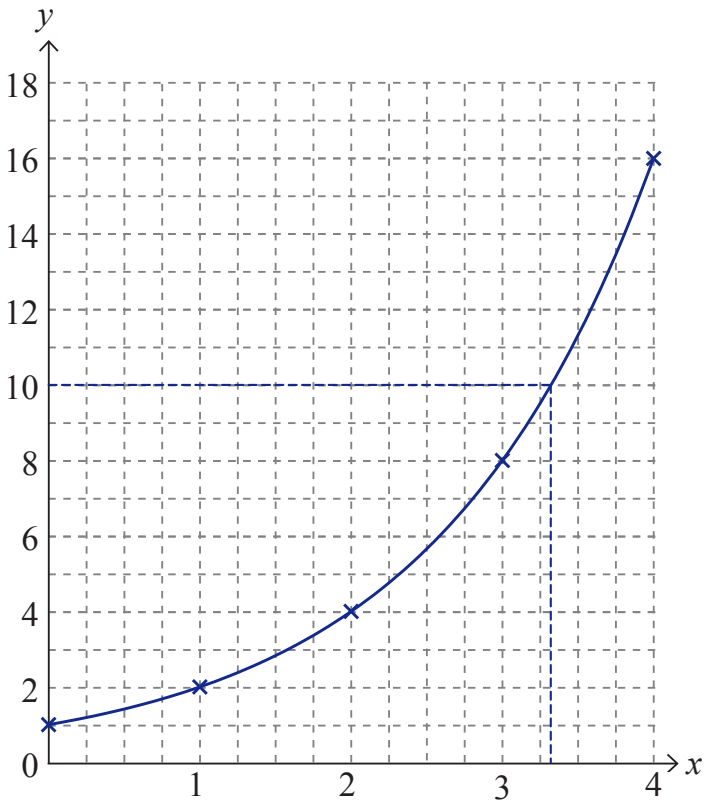
$= 50 - 2\sqrt{225}$

$= 50 - 2 \times 15$

$= 50 - 30 = 20$

[2]

12 **(a)** Sketch the curve $y = 2^x$ on the grid below for $0 \leq x \leq 4$



[3]

(b) In **(a)**, if £y represents the value of one share in an investment company x years after purchase, explain in words what is happening to the value.

Answer The value doubles every year (exponential growth) [1]

(c) Use your graph to predict after how many **months** the value of the share will be 10 times greater than the original purchase value.

Original value = £1 ($x = 0$), 10 times = £10

From graph, $y = 10$ when $x \approx 3.3$ years

$3.3 \times 12 = 39.6 \approx 40$ months

Answer 40 months [2]

[Turn over

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13 Simplify $\sqrt[3]{(x^6y^9)^2}\,(xy)^{-2}$

$\sqrt[3]{((x^6y^9)^2)} = \sqrt[3]{(x^{12}y^{18})} = x^4y^6$

$(xy)^{-2} = x^{-2}y^{-2}$

$x^4y^6 \times x^{-2}y^{-2} = x^{4-2}y^{6-2} = x^2y^4$

Answer x^2y^4 [3]

14 A bag contains five red badges and three yellow badges.

Two badges are taken at random from the bag.

What is the probability that they are the same colour?

$P(RR) = \frac{5}{8} \times \frac{4}{7} = \frac{20}{56}$

$P(YY) = \frac{3}{8} \times \frac{2}{7} = \frac{6}{56}$

$P(\text{same}) = \frac{20}{56} + \frac{6}{56} = \frac{26}{56} = \frac{13}{28}$

Answer $\frac{13}{28}$ [4]

15 Circle the irrational numbers in the list

$\frac{\pi^2}{4}$ $\frac{\sqrt{27}}{\sqrt{2}}$ $\frac{\sqrt{27}}{\sqrt{3}}$ $\frac{\sqrt{27}}{\sqrt{4}}$ $\sqrt[3]{27}$ [3]

16 $y = \frac{3}{4}x + c$ is a tangent at the point P to the circle $x^2 + y^2 = 100$, centre O at $(0, 0)$.

(a) Write down the gradient of the radius OP.

Gradient of tangent $= \frac{3}{4}$

OP is perpendicular to the tangent: $m = -1 \div \frac{3}{4} = -\frac{4}{3}$

Answer $-\frac{4}{3}$ [1]

(b) Write down the equation of the line OP.

Answer $y = -\frac{4}{3}x$ [1]

(c) Hence find the possible coordinates of P.

$x^2 + (-\frac{4}{3}x)^2 = 100$

$x^2 + \frac{16}{9}x^2 = 100$

$\frac{25}{9}x^2 = 100$

$x^2 = 100 \times \frac{9}{25} = 36$

$x = 6$ or $x = -6$

$x = 6$: $y = -\frac{4}{3} \times 6 = -8$; $x = -6$: $y = -\frac{4}{3} \times (-6) = 8$

Answer $(6, -8)$ or $(-6, 8)$ [4]

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For Examiner's use only	
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Examiner Number

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