Rewarding Learning

General Certificate of Secondary Education

Centre Number

Candidate Number

Mathematics

StemUp Model Solution

Unit M8 Paper 1
(Non-Calculator)
Higher Tier



[GMC81]
Assessment

GMC81

Assessment Level of Control:
Tick the relevant box (✓)

Controlled Conditions	
Other	

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

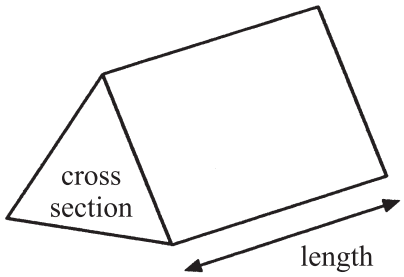
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page, on blank pages or tracing paper.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all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

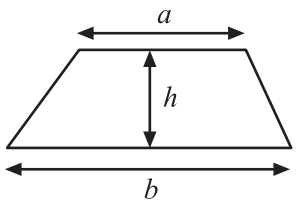
The total mark for this paper is 50.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You should have a ruler, compasses and a protractor.
The Formula Sheet is on page 2.

Formula Sheet

Volume of prism = area of cross section × length

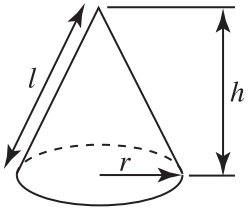


Area of trapezium = $\frac{1}{2}(a+b)h$



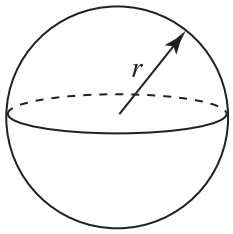
Volume of cone = $\frac{1}{3}\pi r^2 h$

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

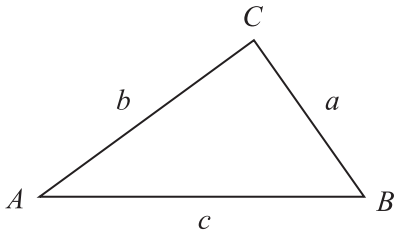


Volume of sphere = $\frac{4}{3}\pi r^3$

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

12378

1 Simplify each of the following.

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

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

Answer $12p^7$ [1]

(b) $(q^2)^3 \div q^8$

$(q^2)^3 = q^6, \quad q^6 \div q^8 = q^{6-8}$

Answer $\frac{1}{q^2}$ or q^{-2} [1]

2 Find the nth term of the sequence

7, 4, 1, −2, ...

7 4 1 −2 difference −3, so −3n

−3 −3 −3 n = 1: −3 × 1 = −3, 7 − (−3) = 10

nth term = −3n + 10

Answer nth term = $-3n + 10$ [2]

[Turn over

3 Tony tests a six-sided dice which he thinks is biased towards the even numbers.

He carries out an experiment by rolling the dice.

He records the results as E (even) or O (odd).

E O E O E E O E E O E O

(a) What is the relative frequency of an even number?

Evens: 7 out of 12 rolls

Answer $\frac{7}{12}$ [1]

(b) How could Tony improve the experiment?

Answer Roll the dice more times (increase the number of trials) [1]

4 Make y the subject of

$$3y - 12 = 4x$$

$3y - 12 = 4x$

$3y = 4x + 12$

$y = \frac{4x + 12}{3}$

Answer $y =$ $\frac{4x + 12}{3}$ or $\frac{4}{3}x + 4$ [2]

5 A rectangle has a length of $3x$ cm and a width of $(x + 5)$ cm.

The length is greater than the width.

(a) Write this information as an inequality in x.

Answer $3x > x + 5$ [1]

(b) (i) Solve the inequality.

$3x > x + 5$

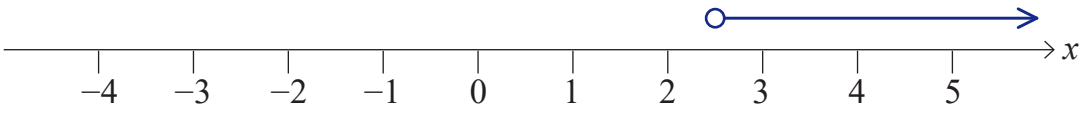
$3x - x > 5$

$2x > 5$

$x > 2.5$

Answer $x > 2.5$ [1]

(ii) Show your answer on the number line below.

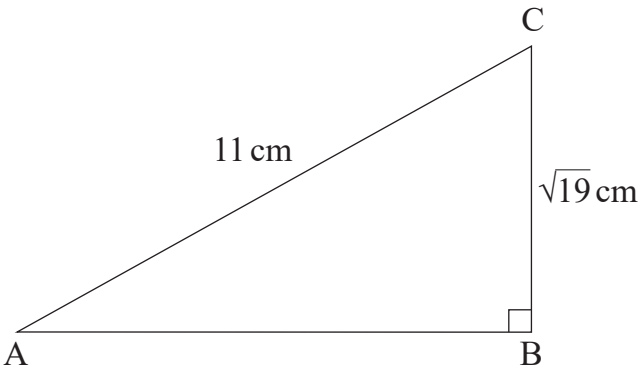


[1]

[Turn over

6

diagram
not drawn
accurately



ABC is a right-angled triangle.

Work out the length of AB, giving your answer as a surd.

$AB^2 + (\sqrt{19})^2 = 11^2$

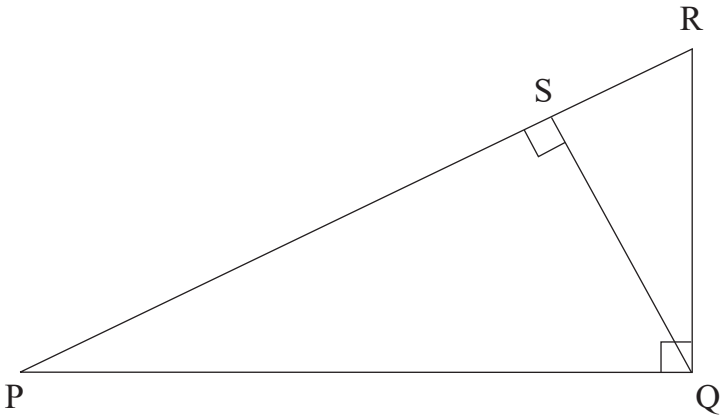
$AB^2 = 11^2 - (\sqrt{19})^2$

$AB^2 = 121 - 19 = 102$

$AB = \sqrt{102}$

Answer $\sqrt{102}$ cm [3]

7



PQR is a right-angled triangle and QS is the perpendicular line from Q to PR.

Prove that the triangles PQR and QSR are similar.

In triangles PQR and QSR:

Angle PQR = angle QSR = 90° (both are right angles)

Angle QRS = angle PRQ (angle R is common to both triangles)

So angle QPR = angle SQR (angles in a triangle add to 180°)

The triangles are equiangular, hence PQR and QSR are similar.

[3]

[Turn over

8

Special Menu

Two Courses (starter and main **or** main and dessert) £15.95

Starters
Soup of the Day
Caesar Salad
Baked Brie
Bruschetta

Mains
Fish of the Day
Chicken Kiev
Pork Medallions
Ribeye Steak (£3 supplement)
Spaghetti Bolognese

Desserts
Cheesecake
Apple Pie
Ice Cream

A restaurant has the above Special Menu available.

How many different ways are there of choosing two courses (starter and main **or** main and dessert)?

Starter + Main: 4 × 5 = 20

Main + Dessert: 5 × 3 = 15

Total = 20 + 15 = 35

Answer 35 [3]

9 Re-arrange the formula to make r the subject.

$$V = \frac{4}{3}\pi r^3$$

$3V = 4\pi r^3$

$r^3 = \frac{3V}{4\pi}$

Answer $r = \sqrt[3]{\frac{3V}{4\pi}}$ [2]

10 The height of a balloon, h, varies directly as the square root of its surface area, A.

When the balloon's surface area is 81 its height is 12

What is its height when its surface area is 144?

$h = k\sqrt{A}$

$12 = k\sqrt{81} = 9k$

$k = \frac{12}{9} = \frac{4}{3}$

$h = \frac{4}{3}\sqrt{144} = \frac{4}{3} \times 12 = 16$

Answer 16 [3]

[Turn over

11 Change 0.0171717… into a fraction.

$x = 0.0171717...$

$100x = 1.7171717...$

$100x - x = 1.7171717... - 0.0171717...$

$99x = 1.7$

$x = \frac{1.7}{99} = \frac{17}{990}$

Answer $\frac{17}{990}$ [2]

12 P is a point on the circle $x^2 + y^2 = 169$

P also lies on the line $y = 12$

(a) Show that the radius to P has gradient $\pm\frac{12}{5}$

Sub $y = 12$: $x^2 + 12^2 = 169$

$x^2 = 169 - 144 = 25$

$x = 5$ or $x = -5$

P is $(5, 12)$ or $(-5, 12)$; radius from $O(0, 0)$

Gradient $OP = \frac{12 - 0}{5 - 0} = \frac{12}{5}$ or $\frac{12 - 0}{-5 - 0} = -\frac{12}{5}$

So the radius to P has gradient $\pm\frac{12}{5}$

[3]

(b) Hence find the two possible equations for the tangent at P.

Tangent $\perp$ radius, so gradient = $-1 \div$ gradient of radius

P(5, 12): $m = -\frac{5}{12}$, $y - 12 = -\frac{5}{12}(x - 5)$

$y = -\frac{5}{12}x + \frac{25}{12} + 12$, $y = -\frac{5}{12}x + \frac{169}{12}$

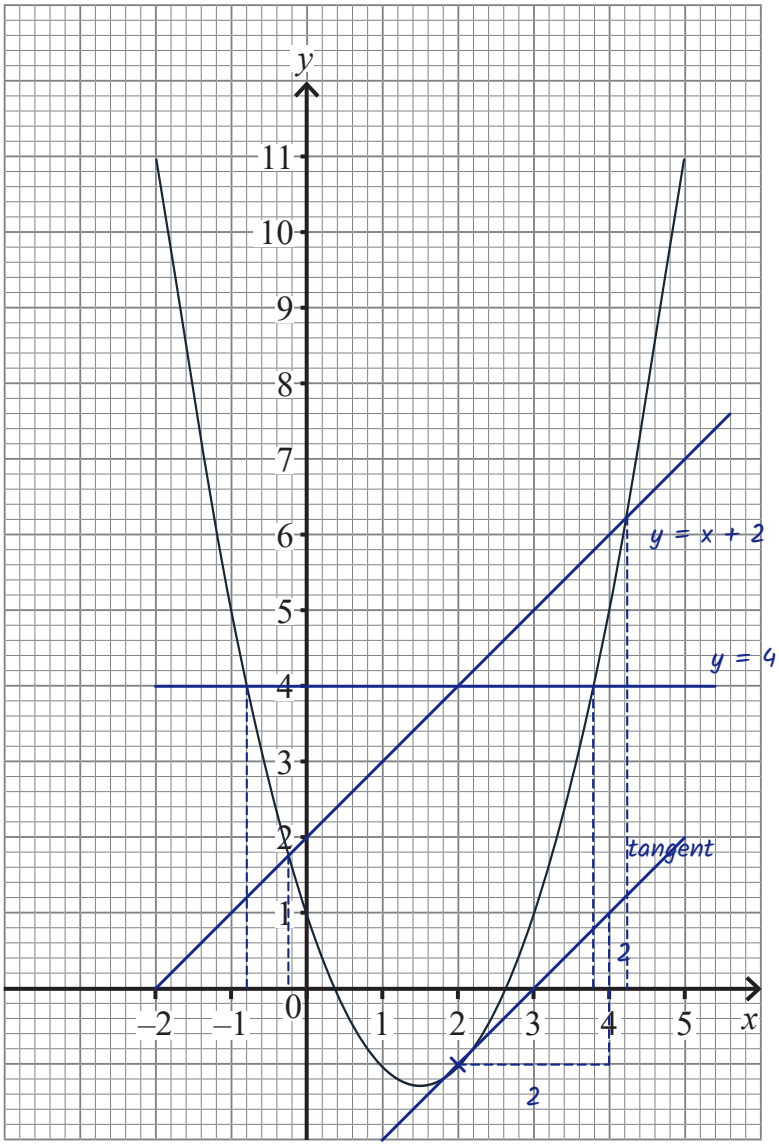
P(−5, 12): $m = \frac{5}{12}$, $y - 12 = \frac{5}{12}(x + 5)$

$y = \frac{5}{12}x + \frac{25}{12} + 12$, $y = \frac{5}{12}x + \frac{169}{12}$

Answer $y = -\frac{5}{12}x + \frac{169}{12}$, $y = \frac{5}{12}x + \frac{169}{12}$ [3]

[Turn over

13 On the grid is drawn the graph of $y = x^2 - 3x + 1$



12378

By drawing appropriate lines, use this graph to

(a) find the gradient of the curve at the point (2, −1)

From the tangent: gradient = 2 ÷ 2 = 1

Answer *1* [2]

(b) solve $x^2 - 3x - 3 = 0$

$x^2 - 3x + 1 = 4 \Leftrightarrow x^2 - 3x - 3 = 0$

Draw y = 4, read x where it meets the curve

Answer $x =$ *−0.8 or 3.8* [2]

(c) solve $x^2 - 4x - 1 = 0$

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

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

$x^2 - 3x + 1 = x + 2$

Draw y = x + 2: x = 0, y = 2; x = 2, y = 4; x = 4, y = 6

Read x where the line meets the curve

Answer $x =$ *−0.2 or 4.2* [3]

[Turn over

14 Work out $\dfrac{4}{\sqrt{3}} + \dfrac{\sqrt{3}(\sqrt{27} - 8)}{6}$

$\frac{4}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{4\sqrt{3}}{3} = \frac{8\sqrt{3}}{6}$

$\frac{\sqrt{3}(\sqrt{27} - 8)}{6} = \frac{\sqrt{81} - 8\sqrt{3}}{6} = \frac{9 - 8\sqrt{3}}{6}$

$\frac{8\sqrt{3}}{6} + \frac{9 - 8\sqrt{3}}{6} = \frac{9}{6} = \frac{3}{2}$

Answer $\frac{3}{2}$ [4]

15 Simplify $\dfrac{(25)^{-\frac{1}{2}}}{32^{0.2} + 6^0}$

$(25)^{-1/2} = \frac{1}{\sqrt{25}} = \frac{1}{5}$

$32^{0.2} = 32^{1/5} = 2, \quad 6^0 = 1, \quad 2 + 1 = 3$

$\frac{1}{5} \div 3 = \frac{1}{15}$

Answer $\frac{1}{15}$ [3]

16 In each case decide if x, y or z is rational or irrational, giving a reason for your answer.

(a) x is the radius of a circle of circumference 12π

$2\pi x = 12\pi$

$x = 6$

Answer x is *rational* because *$x = 6$, which is rational* [1]

(b) y is the radius of a circle of area $9\pi^2$

$\pi y^2 = 9\pi^2$

$y^2 = 9\pi$

$y = 3\sqrt{\pi}$

Answer y is *irrational* because *$y = 3\sqrt{\pi}$ and $\sqrt{\pi}$ is irrational* [1]

(c) z is the radius of a circle of area 8π

$\pi z^2 = 8\pi$

$z^2 = 8$

$z = \sqrt{8} = 2\sqrt{2}$

Answer z is *irrational* because *$z = \sqrt{8}$ and $\sqrt{8}$ is irrational* [1]

THIS IS THE END OF THE QUESTION PAPER

DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
Total Marks	

Examiner Number

Permission to reproduce all copyright material has been applied for.
In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA will be happy to rectify any omissions of acknowledgement in future if notified.

stemup.co.uk