Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
January 2020

Mathematics

StemUp Model Solution

Unit M8 Paper 2
(With calculator)
Higher Tier



[GMC82]

GMC82

WEDNESDAY 15 JANUARY, 10.45am–12 noon

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 **may** use a calculator for this paper.

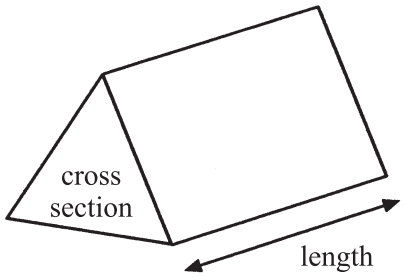
INFORMATION FOR CANDIDATES

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 calculator, ruler, compasses and a protractor.
The Formula Sheet is on page 2.

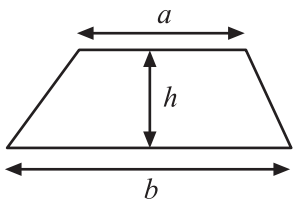
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Formula Sheet

Volume of prism = area of cross section × length

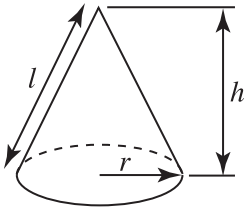


Area of trapezium = $\frac{1}{2}(a+b)h$



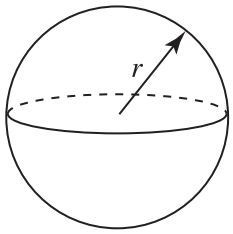
Volume of cone = $\frac{1}{3}\pi r^2 h$

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

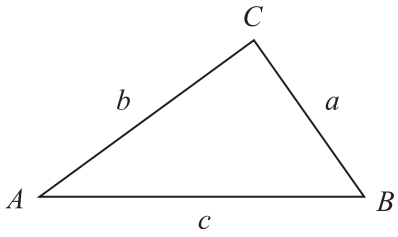


Volume of sphere = $\frac{4}{3}\pi r^3$

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

12516

1 The equation $x^3 + 3x = 25$ has a solution between 2 and 3

Use a trial and improvement method to find this solution.

Give your answer correct to one decimal place.

You must show **all** your working.

x	$x^3 + 3x$	
2	14	too low
3	36	too high
2.5	23.125	too low
2.6	25.376	too high
2.55	24.231375	too low

Solution lies between 2.55 and 2.6
so x = 2.6 to one decimal place

Answer 2.6 [3]

[Turn over

2 The first four terms of a sequence are

2 7 12 17

Write down an expression for the n^{th} term of the sequence.

common difference = 5
Sn: 5 10 15 20
subtract 3: 2 7 12 17

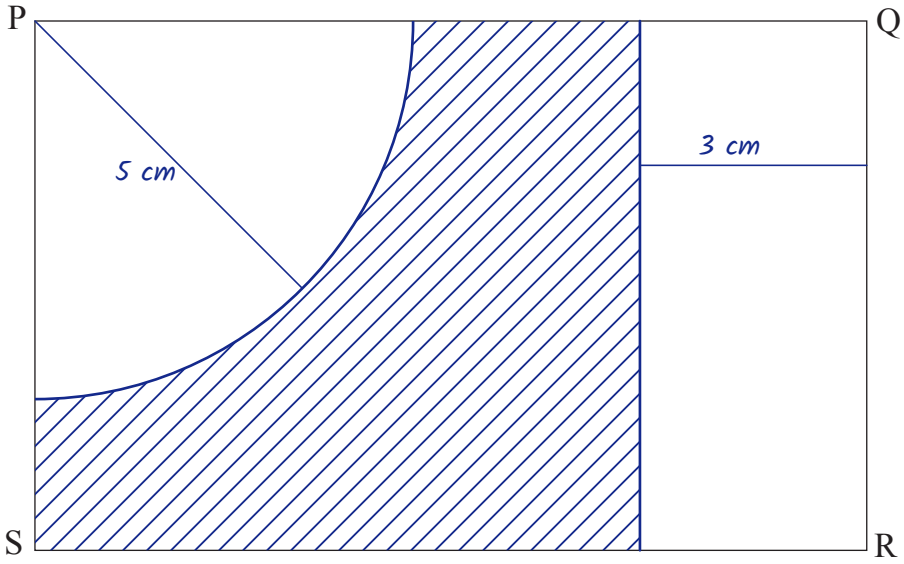
Answer Sn − 3 [2]

3 PQRS is a rectangle.

Shade the region inside the rectangle which is

more than 5 cm from P

and more than 3 cm from the line QR.



[3]

[Turn over

4 A survey is carried out to find out the number of electric cars on the road.

One hundred cars are surveyed each day for four days.

The results are recorded in the following table along with the relative frequencies so far.

Day	Number of cars surveyed	Number of electric cars	Relative frequency
1	100	11	0.11
2	100	12	0.115
3	100	16	0.13
4	100	9	0.12

(a) Work out the missing relative frequency and record it in the table. [1]

(b) What would be the best estimate for the probability that a car chosen at random is electric?

(11 + 12 + 16 + 9) ÷ 400 = 48 ÷ 400 = 0.12

Answer 0.12 [1]

(c) There are 15 000 cars on the road.

How many would you expect to be electric?

0.12 × 15 000 = 1800

Answer 1800 [1]

5 Write the following in standard form.

(a) 0.00000385

Answer 3.85×10^{-6} [1]

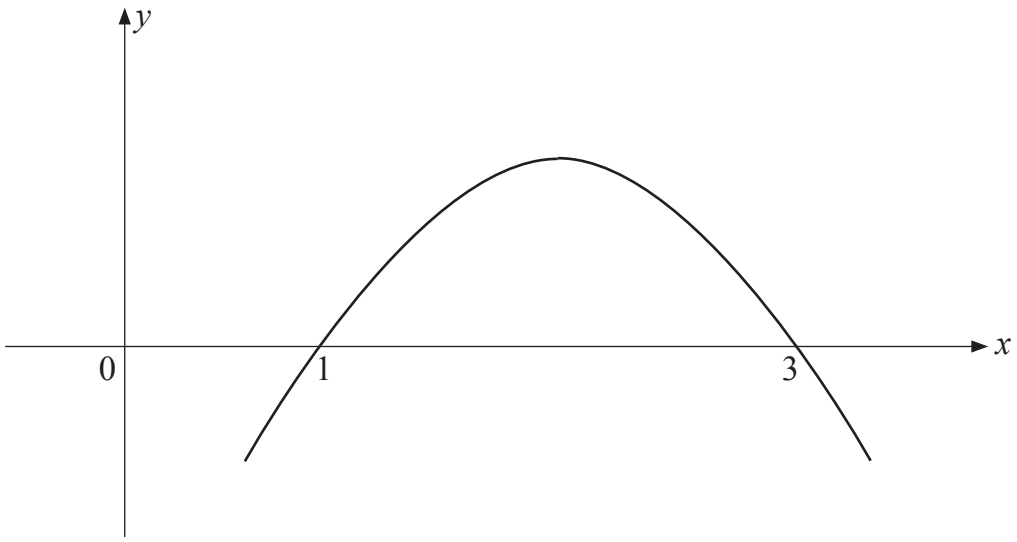
(b) 167×10^{-9}

$167 \times 10^{-9} = 1.67 \times 10^{2} \times 10^{-9}$

Answer 1.67×10^{-7} [1]

[Turn over

6



The sketch above shows part of the graph of the quadratic function $y = -x^2 + 4x - 3$

(a) Write down the coordinates of the point where the graph will cross the y-axis.

$x = 0$: $y = -0 + 0 - 3 = -3$

Answer (0, −3) [1]

(b) Work out the coordinates of the highest point on the graph.

line of symmetry $x = (1 + 3) \div 2 = 2$
$y = -2^2 + 4 \times 2 - 3 = -4 + 8 - 3 = 1$

Answer (2, 1) [1]

7 A model of a building site is to be made.

The length of the building site is 100 times the length of the model.

How many times larger is the area of the building site than the area of the model?

area scale factor = 100^2 = 10 000

Answer 10 000 [1]

8 Simplify the expressions

(a) $(4x^5 y^3)(3x^2y^2)$

$4 \times 3 = 12$, $x^5 \times x^2 = x^7$, $y^3 \times y^2 = y^5$

Answer $12x^7y^5$ [2]

(b) $(2pq^2)^3$

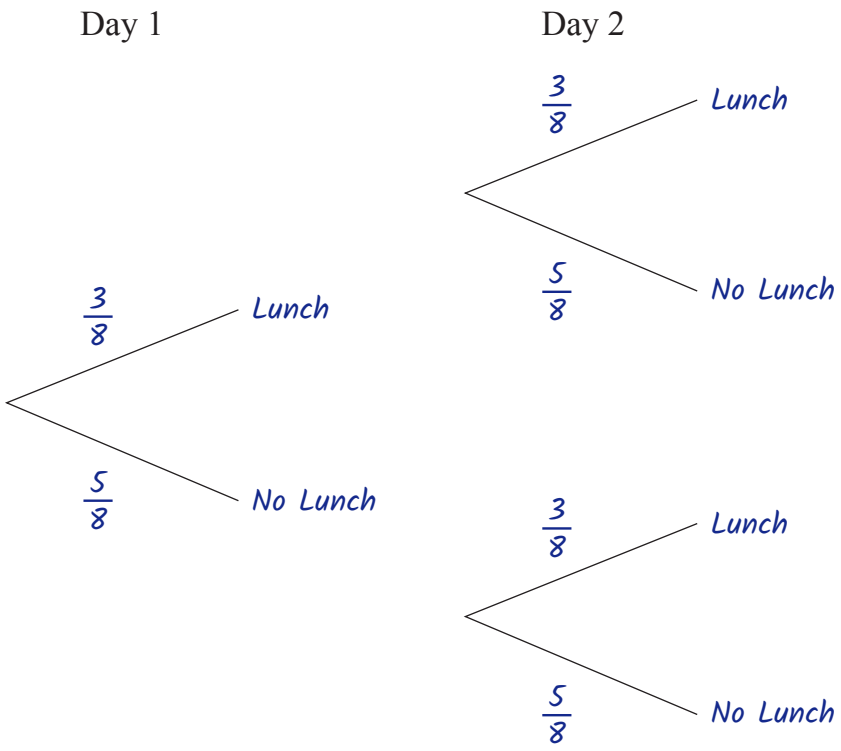
$2^3 = 8$, $(p)^3 = p^3$, $(q^2)^3 = q^6$

Answer $8p^3q^6$ [2]

[Turn over

9 The probability that Jack takes a packed lunch to school on any given day is $\frac{3}{8}$

(a) Complete the tree diagram to show this information for two days.



[2]

(b) What is the probability that Jack takes a packed lunch to school on only one of the two days?

$P = \frac{3}{8} \times \frac{5}{8} + \frac{5}{8} \times \frac{3}{8} = \frac{15}{64} + \frac{15}{64} = \frac{30}{64} = \frac{15}{32}$

Answer $\frac{15}{32}$ [2]

10 There are two types of ticket available for a concert, seated and standing.

Julie buys three seated tickets and one standing ticket for £82

Gemma buys five seated tickets and four standing tickets for £174

Work out the cost of each type of ticket.

A solution by trial and improvement will not be accepted.

Let s = seated, t = standing

3s + t = 82 (1)

5s + 4t = 174 (2)

(1) × 4: 12s + 4t = 328

subtract (2): 7s = 154

s = 22

3 × 22 + t = 82, 66 + t = 82

t = 16

Check: 5 × 22 + 4 × 16 = 110 + 64 = 174

Answer Seated tickets cost £ 22 each

Standing tickets cost £ 16 each [4]

[Turn over

11

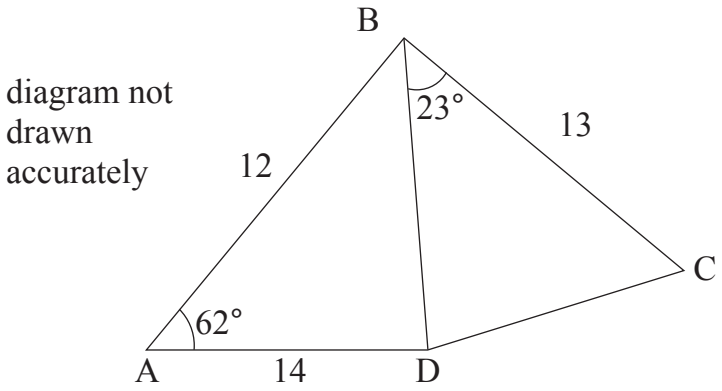


diagram not drawn accurately

AB = 12 cm, AD = 14 cm and BC = 13 cm.

Calculate the area of the triangle BCD.

$BD^2 = 12^2 + 14^2 - 2 \times 12 \times 14 \times \cos 62°$

$BD^2 = 340 - 157.742... = 182.2575549$

$BD = \sqrt{182.2575549} = 13.500...$

$BD = 13.5$ cm

Area BCD $= \frac{1}{2} \times BD \times BC \times \sin 23°$

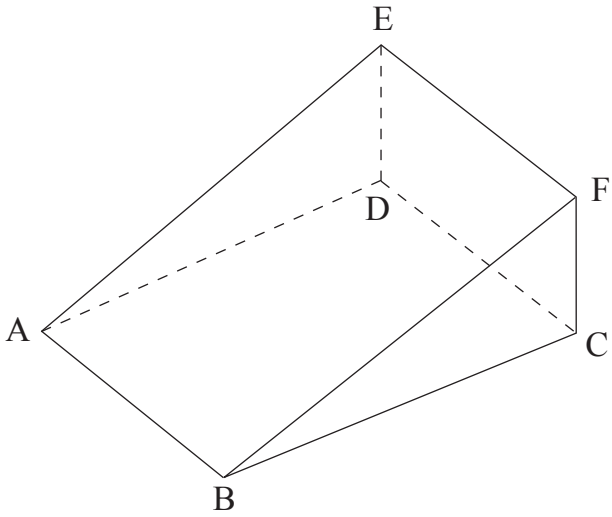
$= \frac{1}{2} \times 13.5 \times 13 \times \sin 23°$

$= 34.2866...$

$= 34.29$ cm^2

Answer 34.29 cm^2 [5]

12



ABCDEF is a triangular prism with ABCD a horizontal rectangle and CDEF a vertical rectangle.

AB = 20 cm, BC = 28 cm and CF = 14 cm.

Calculate the difference in size of the angles of elevation EAD and EBD.

$\tan EAD = \frac{ED}{AD} = \frac{14}{28}$

$EAD = \tan^{-1}(0.5) = 26.56505...°$

$DB^2 = AB^2 + AD^2 = 20^2 + 28^2 = 1184$

$DB = \sqrt{1184} = 34.4093...$

$\tan EBD = \frac{ED}{DB} = \frac{14}{34.4093}$

$EBD = 22.13977...°$

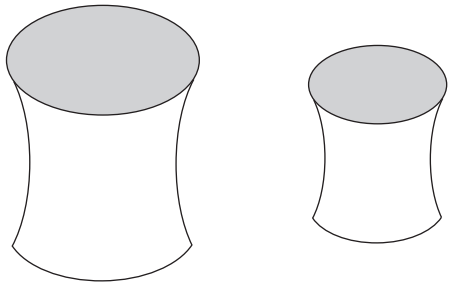
$Difference = 26.56505 - 22.13977 = 4.42528...$

$= 4.43°$

Answer 4.43 ° [6]

[Turn over

13



Two vases are of similar shape.

The surface area of the small one is $\frac{16}{25}$ of the surface area of the large one.

The small vase has volume 320 ml.

Calculate the volume of the large vase.

ratio of areas = $\frac{16}{25}$ so ratio of lengths = $\frac{4}{5}$

ratio of volumes = $(\frac{4}{5})^3 = \frac{64}{125}$

Volume of large = $320 \times \frac{125}{64}$

= 625 ml

Answer 625 ml [4]

14 y varies inversely as x.

When $x = 12$, $y = 10$

Find the values of x when $y = x + 7$

$y = \frac{k}{x}$ $\quad 10 = \frac{k}{12}$ $\quad k = 120$

$y = \frac{120}{x}$

$x + 7 = \frac{120}{x}$

$x^2 + 7x = 120$

$x^2 + 7x - 120 = 0$

$(x + 15)(x - 8) = 0$

$x + 15 = 0$ or $x - 8 = 0$

$x = -15$ or $x = 8$

Answer $x = -15$ or $x = 8$ [7]

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	
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7	
8	
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11	
12	
13	
14	
Total Marks	

Examiner Number

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