Centre Number

Candidate Number

Rewarding Learning

General Certificate of Secondary Education
January 2013

Mathematics

Unit T4

(With calculator)

Higher Tier

[GMT41]

GMT41

FRIDAY 11 JANUARY 9.15 am–11.15 am

TIME

2 hours.

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 box, around each page, on blank pages or tracing paper.
Complete in blue or black ink only. **Do not write in pencil or with a gel pen**.
Answer **all twenty-one** questions.
Any working should be clearly shown in the spaces provided since 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 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Functional Elements will be assessed in this paper.
Quality of written communication will be assessed in **questions 6 and 18**.
You should have a calculator, ruler, compasses and a protractor.
Your Formula Sheet is on page 2.

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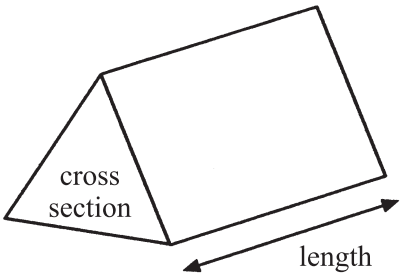
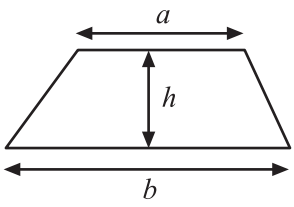
Formula Sheet

Volume of prism = area of cross section × length

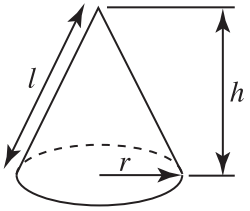


Area of trapezium $= \frac{1}{2}(a+b)h$



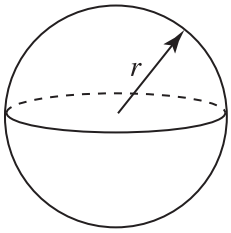
Volume of cone $= \frac{1}{3}\pi r^2 h$

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

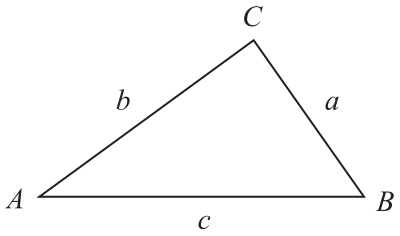


Volume of sphere $= \frac{4}{3}\pi r^3$

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: $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

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

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

Examiner Only	
Marks	Remark

1 A chair has a sale price of £52.48 which is a saving of 18% on the original price.

What was the original price of the chair?

© iStockphoto / Thinkstock

Answer £ _____ [3]

Total Question 1

2 A has coordinates (6, –1), B has coordinates (–4, 6).
Calculate the length of the line AB.

Answer _____ [3]

Total Question 2

3 Factorise fully

(a) $8p^2 + 10pq$

Answer _____ [2]

(b) $25 - a^2$

Answer _____ [1]

(c) $x^2 - x - 20$

Answer _____ [2]

Total Question 3

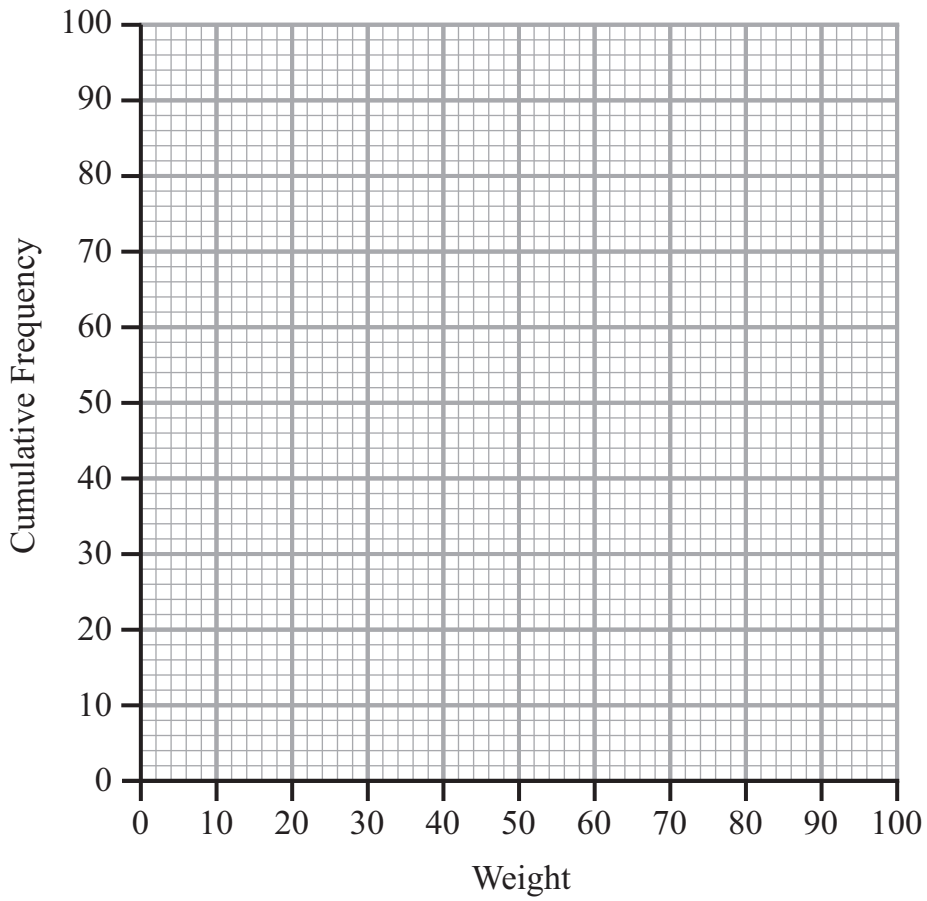
[Turn over

4 The weights of potatoes collected from 100 garden plots are shown in the table.

Weights (w kg)	Frequency	Cumulative Frequency
$0 < w \leqslant 10$	4	4
$10 < w \leqslant 20$	8	
$20 < w \leqslant 30$	11	
$30 < w \leqslant 40$	13	
$40 < w \leqslant 50$	10	
$50 < w \leqslant 60$	32	
$60 < w \leqslant 70$	10	
$70 < w \leqslant 80$	8	
$80 < w \leqslant 90$	4	

(a) Complete the Cumulative Frequency column in the table. [1]

(b) Hence draw the Cumulative Frequency graph on the axes provided.



[3]

Examiner Only	
Marks	Remark

(c) From your completed graph,

Examiner Only	
Marks	Remark

(i) find the median weight,

Answer _____ kg [1]

(ii) find the inter-quartile range,

Answer _____ kg [2]

(iii) estimate the number of garden plots which produced weights of at least 45 kg.

Answer _____ [2]

Total Question 4	

5 **(a)** Solve the simultaneous equations

$$2x - 4y = 10$$
$$3x + 2y = 7$$

Show your working.
A solution by trial and improvement will not be accepted.

Answer $x =$_____, $y =$_____ [3]

(b) Solve the equation $\frac{x-1}{3} + \frac{3x-2}{4} = \frac{4}{3}$

Show your working.
A solution by trial and improvement will not be accepted.

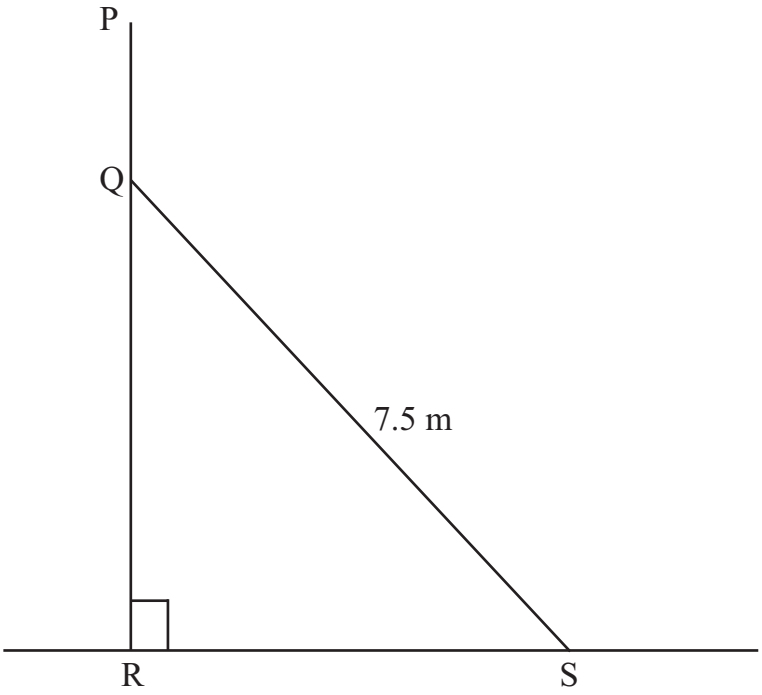
Answer $x =$ _____ [4]

Examiner Only	
Marks	Remark
Total Question 5	

Quality of written communication will be assessed in this question.
Show your working.

Examiner Only	
Marks	Remark

6



The diagram represents a vertical wall PQR.
RS is horizontal ground.
SQ is a metal support of length 7.5 metres.
The height of the wall is 10 metres.
For the support to be effective, the length PQ must be at least 3 metres.
Show that when the angle RSQ = 67° the support will be effective.

[4]

Total Question 6

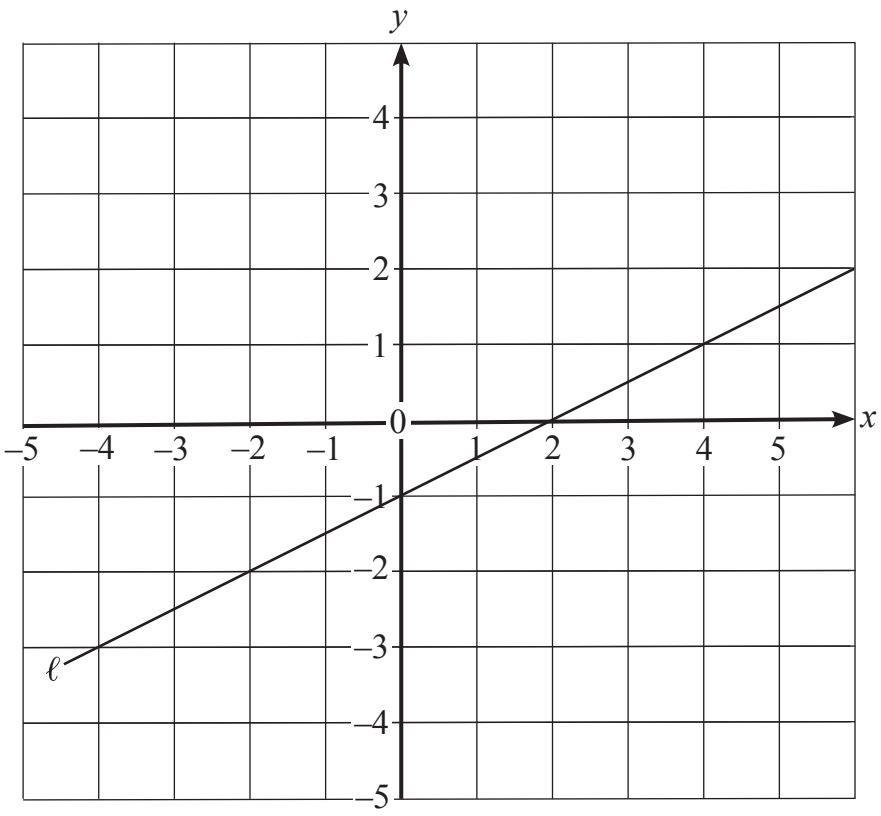
7 Evaluate $\frac{3}{4} + 2\frac{1}{2} \times 1\frac{1}{3}$ giving your answer as a mixed number.

Show all your working.

Answer _____ [2]

Examiner Only	
Marks	Remark
Total Question 7	

8 **(a)** Write down the equation of line ℓ.



Answer _____ [3]

(b) Write down the equation of the line which passes through (0, 2) and is perpendicular to the line $y = 1 - 4x$.

Answer _____ [2]

Examiner Only	
Marks	Remark
Total Question 8	

[Turn over

9

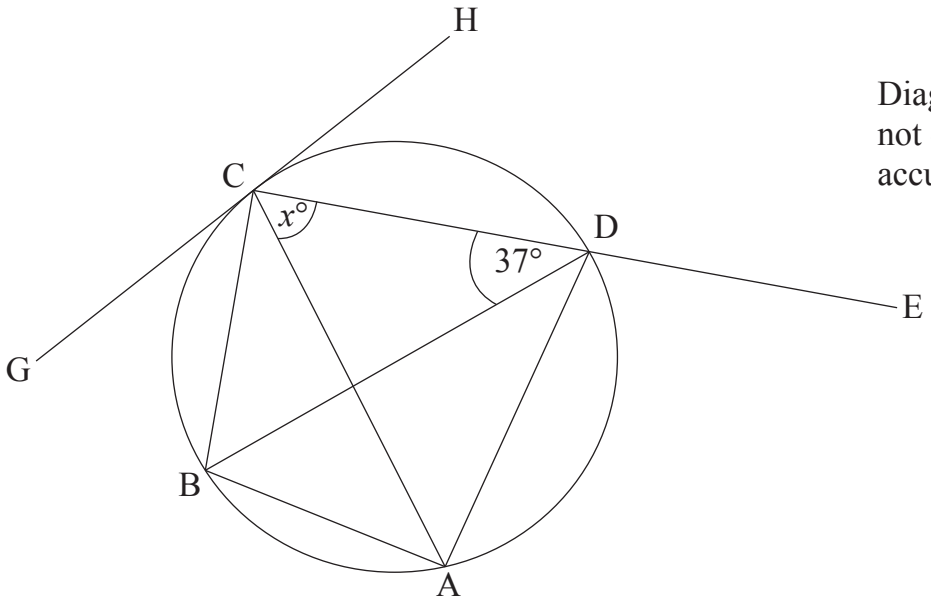


Diagram not drawn accurately

Examiner Only	
Marks	Remark

A, B, C and D are points on the circumference of a circle.
BD is a diameter of the circle.
CDE is a straight line.
GCH is a tangent to the circle.
Angle BDC = 37°.

(a) (i) Explain why the angle BAC is equal to 37°.

_____

_____ [1]

(ii) Calculate the size of angle CBD.

Answer _____ ° [1]

(iii) Angle ACD = x°. Work out the size of angle ADE in terms of x.

Answer _____ [1]

(b) Find the size of angle DCH.

Give a reason for your answer.

Answer _____ °

Reason _____

_____ [2]

Examiner Only

Marks	Remark

Total Question 9

10 A teacher has recorded the marks of all the papers of the 40 students who sat a test for her. Before handing back the papers to the students she realises that she has incorrectly marked the student who scored the highest mark and she has to increase his mark by three. Which statistical average would have been altered by this change and by how much?

_____

_____

_____

_____ [2]

Total Question 10

11 **(a)** Solve

(i) $3^x = 1$

Answer x = _____ [1]

(ii) $3^y = \frac{1}{81}$

Answer y = _____ [1]

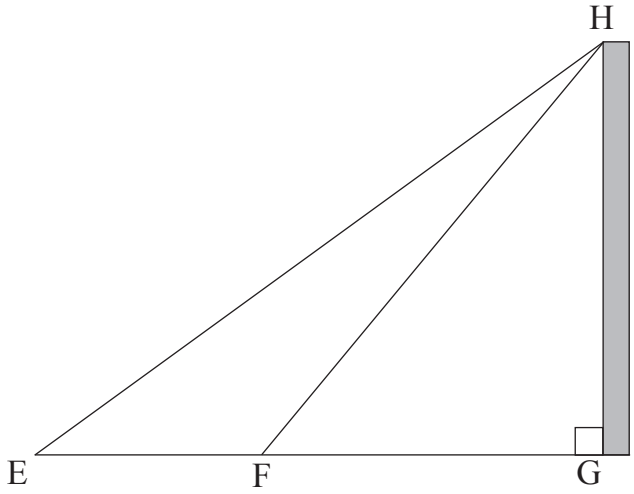
(b) Evaluate $625^{-\frac{3}{4}}$

Answer _____ [1]

Total Question 11

[Turn over

12



Not drawn to scale

Arthur wants to work out the height of a tall chimney GH which is standing on horizontal ground.

To do this, Arthur measures the angle of elevation of the top of the chimney from two different points E and F on the ground.
The angle of elevation from E is 56°.
The angle of elevation from F is 71°.
EF = 28 metres.
Calculate the height of the chimney.

Answer _____ metres [5]

Examiner Only	
Marks	Remark
Total Question 12	

13 Simplify $\dfrac{4x^2 + 6xy}{2x^2 + 3xy - 8x - 12y}$

Answer _____ [4]

Examiner Only	
Marks	Remark
Total Question 13	

14 The pressure P, in a weather balloon is **inversely** proportional to the square root of the height h, at which it is flying.
At a height of 25 m, the pressure is 1.44 atmospheres.

Examiner Only	
Marks	Remark

(a) Find a formula connecting P and $\sqrt{h}$.

Answer _____ [3]

(b) What will the pressure be at a height of 36 m?

Answer _____ atmospheres [1]

(c) At what height will the balloon be flying when the pressure is 1.6 atmospheres?

Answer _____ m [2]

(d) If the height quadruples (becomes four times greater), what effect will this have on the pressure?

Answer _____ [1]

Total Question 14

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(Questions continue overleaf)

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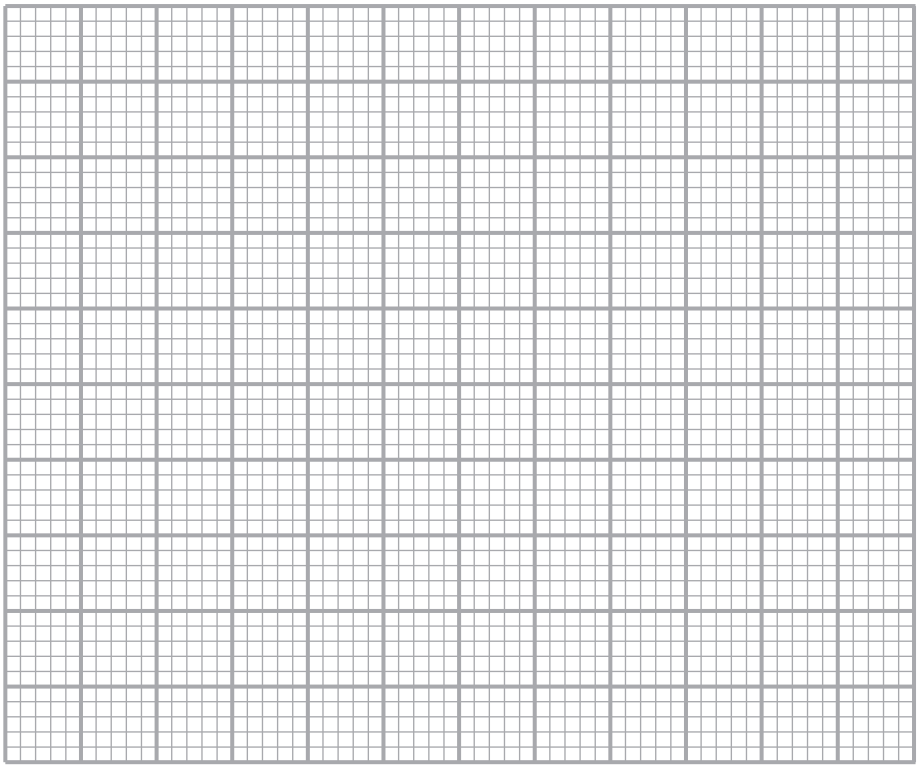
15 The lengths of pieces of wood cut by a machine are shown in the table.

Lengths (cm)	Frequency
$10 < l \leqslant 20$	12
$20 < l \leqslant 40$	36
$40 < l \leqslant 55$	48
$55 < l \leqslant 65$	25
$65 < l \leqslant 95$	24
$95 < l \leqslant 120$	15

(a) Draw a clearly labelled histogram for this information on the grid provided.



[3]

Examiner Only	
Marks	Remark

(b) Estimate the number of pieces that have a length longer than the middle length in the modal class.

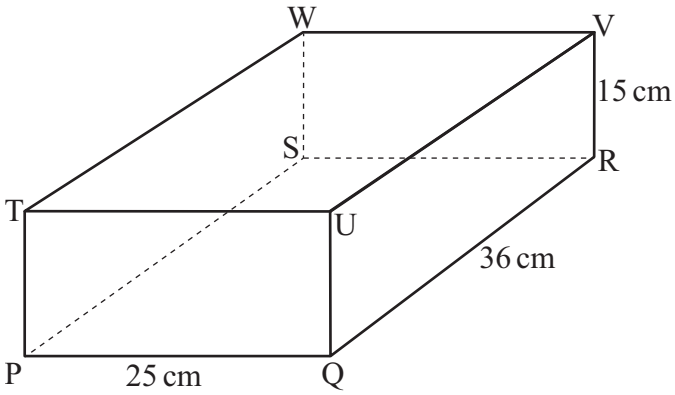
Answer _____ [2]

(c) A sample of size 50 is to be taken from the lengths which are shorter than 75 cm. Estimate how many of this sample will have a length shorter than 45 cm.

Answer _____ [4]

Examiner Only	
Marks	Remark
Total Question 15	

16



The cuboid above has dimensions 36 cm × 25 cm × 15 cm.

(a) Find the length of the space diagonal TR.

Answer _____ cm [2]

(b) Find the angle which TR makes with the face PQUT of the cuboid.

Answer _____ ° [3]

Examiner Only	
Marks	Remark
Total Question 16	

17 Given that $x^2 - 6x + 15 = (x - a)^2 + b$, find a and b.

Answer a = _____ b = _____ [3]

Total Question 17	

Quality of written communication will be assessed in this question.
Show your working.

Examiner Only	
Marks	Remark

18 To estimate the number of ants in an anthill a sample of 200 was collected and marked with a blue dye. The next day a sample of 400 was taken and it was found to contain 64 ants with the blue dye.

(a) Estimate the number of ants in the anthill.

Answer _____ [2]

(b) Suggest an improvement to this sampling process which would give a more accurate estimate of the population of ants in the anthill.

_____

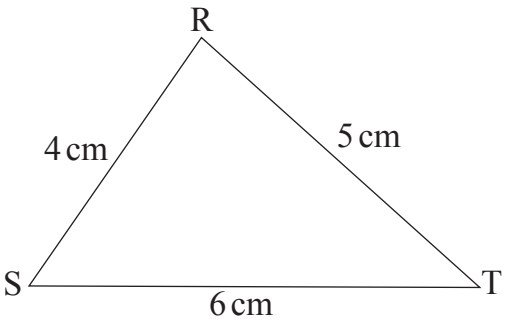
_____

_____

_____ [2]

Total Question 18

19



Not drawn to scale

RST is a triangle with sides of length 4 cm, 5 cm and 6 cm.
Find the area of the triangle RST.

Answer _____ cm^2 [4]

Examiner Only	
Marks	Remark
Total Question 19	

20 Solve $\frac{3}{x+2} - \frac{2}{x+1} = -2$

Show all your working.

A solution by trial and improvement will not be accepted.

Answer _____ [7]

Examiner Only	
Marks	Remark
Total Question 20	

21

In an election 45% of the votes went to Candidate A, $\frac{2}{3}$ of the remaining votes went to Candidate B and the rest of the votes were split evenly between Candidates C, D and E. Candidate D received 957 votes.
If no votes were spoiled, how many people voted altogether?

Answer _____ [4]

Examiner Only	
Marks	Remark
Total Question 21	

THIS IS THE END OF THE QUESTION PAPER

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For Examiner's use only	
Question Number	**Marks**
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Examiner Number