Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
January 2016

Mathematics

Unit T3 **(With calculator)**
Higher Tier

ML

[GMT31]
MONDAY 11 JANUARY, 9.15 am–11.15 am

TIME

2 hours, plus your additional time allowance.

INSTRUCTIONS TO CANDIDATES

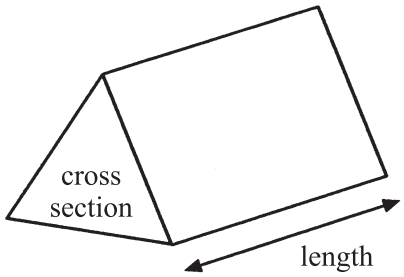
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page, on blank pages or tracing paper.
Complete in blue or black ink only.
Answer **all twenty-eight** questions.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

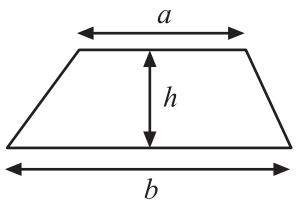
The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Functional Elements will be assessed in this paper.
Quality of written communication will be assessed in Questions **2** and **8(b)**.
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on page 2.

Formula Sheet

Volume of prism = area of cross section × length

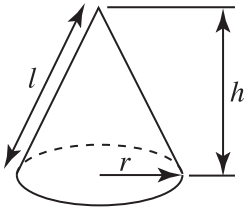


Area of trapezium $= \frac{1}{2}(a+b)h$



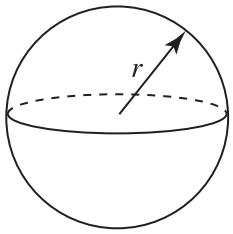
Volume of cone $= \frac{1}{3}\pi r^2 h$

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

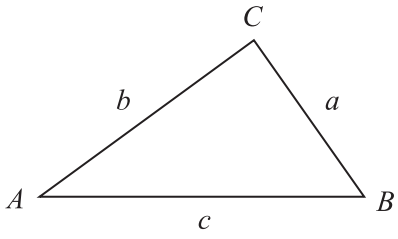


Volume of sphere $= \frac{4}{3}\pi r^3$

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

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

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

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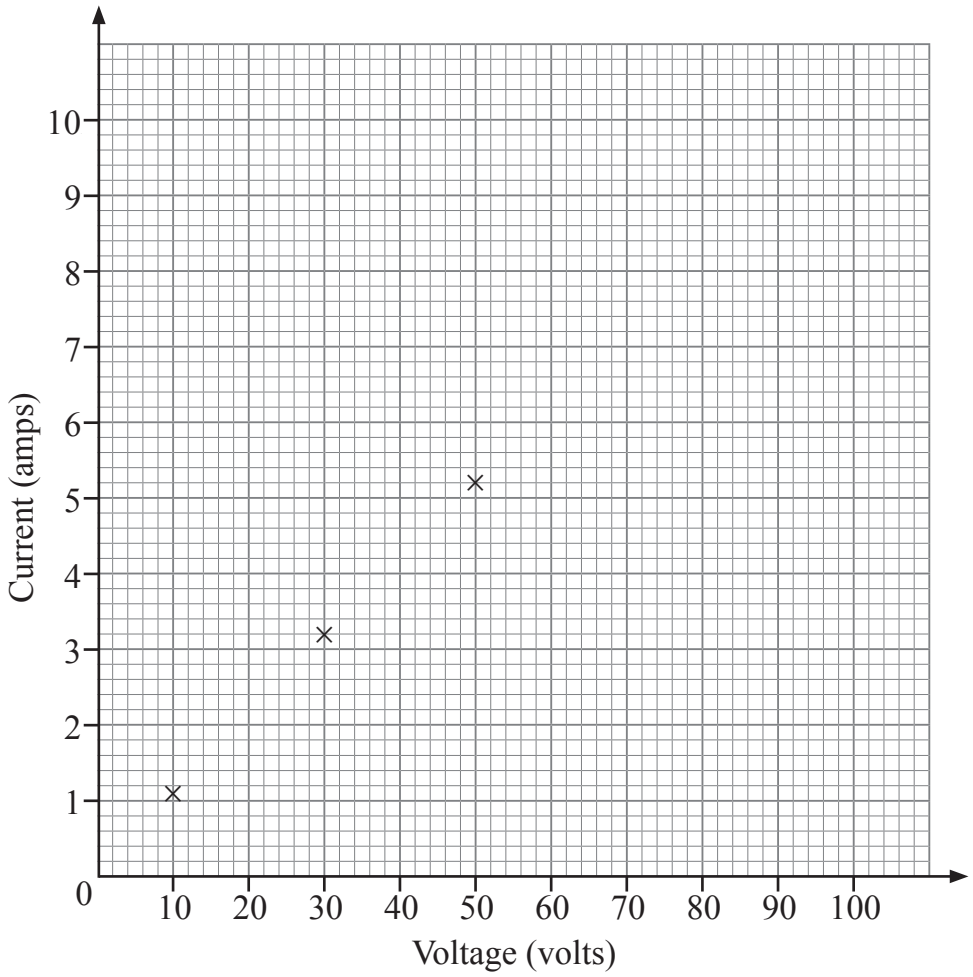
(Questions start overleaf)

1 Nine science pupils each measured the current (in amps) that flowed through a circuit at various voltages.

Their results are recorded below.

Pupil	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Voltage	10	50	30	20	80	40	60	70	90
Current	1.1	5.2	3.2	1.9	8.2	3.7	3.8	6.5	9.3

(a) Draw a scatter graph of the points. The first three points have already been plotted.



[2]

(b) Which pupil appears to have taken an incorrect reading?

Answer pupil _____ [1]

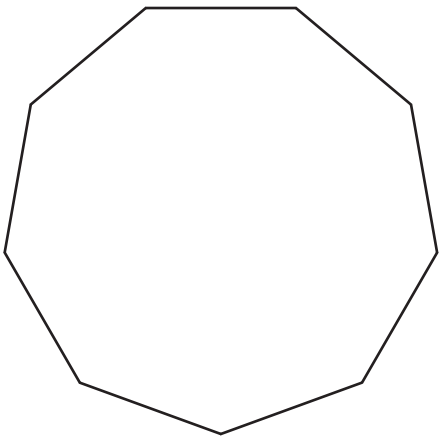
(c) Draw a line of best fit on your scatter graph. [1]

(d) Use the line of best fit to estimate the current for the incorrect reading taken by the pupil.

Answer current = _____ amps [1]

Quality of written communication will be assessed in this question.

2



This is a drawing of a regular nonagon (a shape with nine sides of equal length).

Explain why the size of an interior angle is 140°

[2]

[Turn over

3 In the diagram lines AB and CD are parallel.

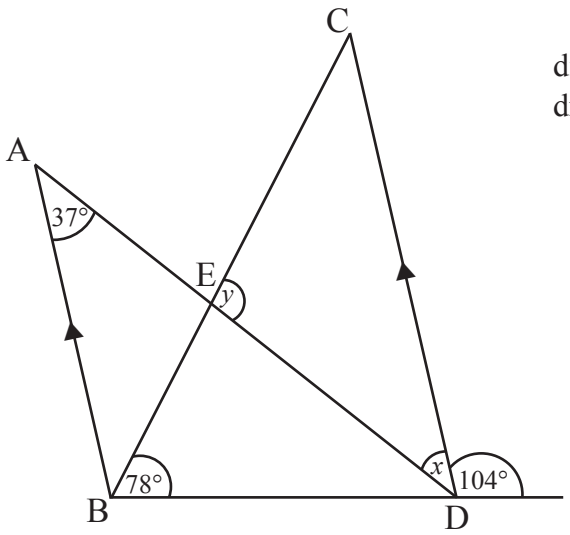


diagram not drawn accurately

(a) Find the size of the angle x.

Answer _____ ° [1]

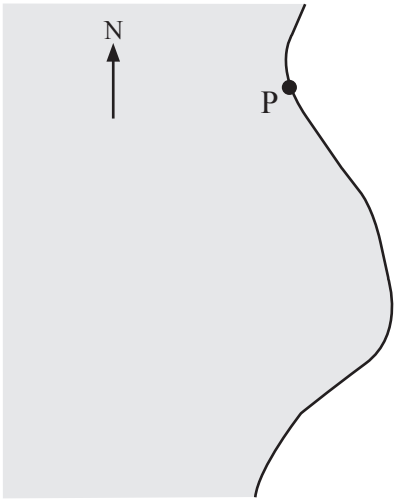
(b) Calculate the size of the angle y.

Answer _____ ° [2]

4 A lifeboat leaves port P to answer an emergency call from a ship S.

The ship is 30 km from P on a bearing of 120°

Using a scale of 1 cm = 4 km, mark the position of the ship S.



[2]

[Turn over

5 **(a)** What percentage is £35.25 of £47?

Answer _____ % [2]

(b) John bought a new phone for £44 plus 17.5% VAT.

Mark bought a similar phone in a different shop.

Mark paid £50.31 including VAT at 17.5%

Whose phone was more expensive and by how much?

Show all your working out.

Answer _____ by £ _____ [3]

6 Factorise fully each of the following:

(a) $12a + 6$

Answer _____ [1]

(b) $y^2 - 6y$

Answer _____ [1]

(c) $b + b^2$

Answer _____ [1]

[Turn over

7 ABC is a triangle.

The length of the side AB is $(x + 2)$ cm.

(a) The length of the side AC is twice the length of the side AB.

Find an expression for the length of AC.

Answer _____ cm [1]

(b) The length of the remaining side CB is calculated by adding the lengths of the sides AB and AC together and subtracting 7 cm.

Find an expression for the length of CB.

Answer _____ cm [1]

(c) The perimeter of the triangle ABC is 20 cm.

Form an equation and solve it to find the length of the side AB.

Answer AB = _____ cm [3]

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(Questions continue overleaf)

Quality of written communication will be assessed in part (b) of this question.

8 Pupils are asked to investigate the number of electronic devices such as mobile phones, tablets, laptops etc. that people own.

(a) Joanne surveys her classmates and her results are recorded in the frequency table below.

Number of devices	Frequency
0	3
1	5
2	6
3	4
4	5
5	2
6	3

Calculate the mean number of devices for Joanne's classmates.

Answer _____ [3]

(b) Paula surveys 100 people at random coming out of the Leisure Centre one Saturday morning. She calculates the mean for her results to be 3.4

Whose value should give a better estimate for the mean for the whole population?

Write down 2 reasons for your answer.

[2]

9 **Without using a calculator** and showing every step in your working out, calculate $\frac{2}{9} \div 4$ giving your answer in its simplest form.

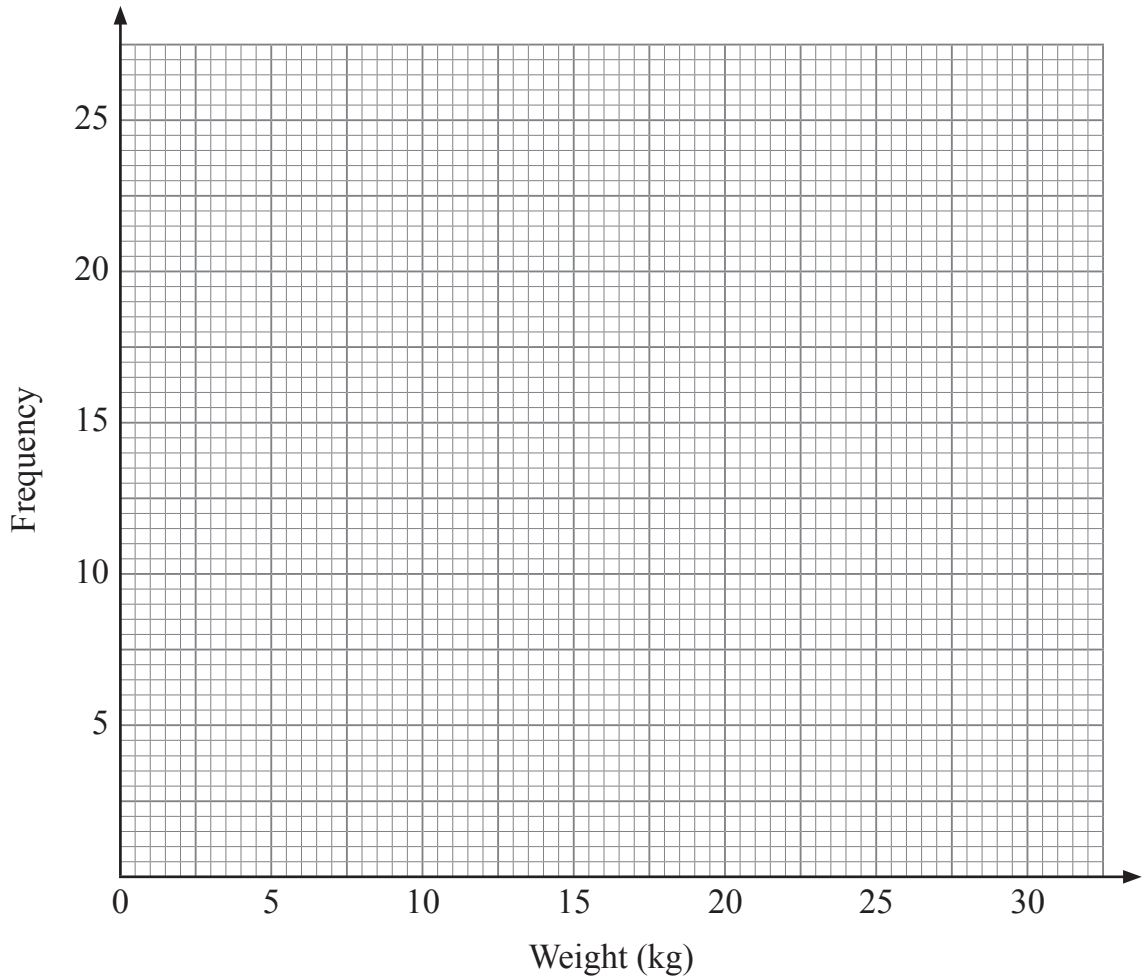
Answer _____ [2]

[Turn over

10 The table below shows the weight of suitcases checked in for a flight to Spain.

Weight (kg)	Frequency
$0 < w \leqslant 5$	2
$5 < w \leqslant 10$	11
$10 < w \leqslant 15$	25
$15 < w \leqslant 20$	18
$20 < w \leqslant 25$	13
$25 < w \leqslant 30$	11

(a) Draw a frequency polygon for the data.



[2]

(b) Which class interval contains the median weight?

Answer _____ [1]

(c) It costs £20 to take a suitcase on the flight to Spain. A suitcase weighing over 20 kg will cost an **extra** £7.50

How much money does it cost for all the suitcases on this flight to Spain?

Answer £ _____ [2]

11 **(a)** Write down the two numbers that are the square roots of 25

Answer _____ and _____ [1]

(b) Simplify the expression

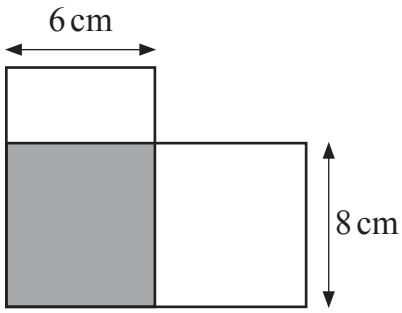
$$\frac{e}{5} - \frac{e}{7}$$

Answer _____ [3]

[Turn over

12 A 10 cm × 6 cm rectangular card overlaps a 12 cm × 8 cm card. This is shown in the diagram below.

Calculate the area **not** shaded.



Answer _____ cm^2 [2]

13 A circular glass shaving mirror has a diameter of 21 cm.

© clark_fang /iStock / Thinkstock

It has glass on both sides.

Calculate the **total** area of glass correct to the nearest whole number.

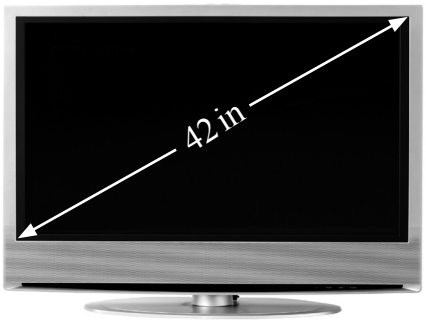
Answer _____ cm^2 [3]

14 The size of a television is given as the length of the diagonal of the screen.

This television has a size of 42 inches.

The height of the screen is 20.4 inches.

What is the width of the screen?



Answer _____ inches [3]

15 A Christmas Log cake has a uniform cross-sectional area of 120 cm^2 and a length of 22 cm.

Calculate the volume of the cake.

Answer _____ cm^3 [2]

[Turn over

16 **(a)** Write 200 as a product of its prime factors.

Write your answer in index notation.

Answer _____ [3]

(b) Hence find the smallest number you can multiply 200 by to make a cube number.

Answer _____ [1]

17 Calculate the compound interest that £1 600 would earn after three years at 5% interest per annum.

Write your answer correct to the nearest £.

Answer £_____ [4]

[Turn over

18 Use the method of trial and improvement to solve the equation

$x^3 - 6x = 12$

Write your answer correct to 1 decimal place.

Show all your working out.

x	$x^3 - 6x$	

Answer $x =$ _____ [4]

19 **(a)** Simplify

$5(t - 2) - 3(4 - 2t)$

Answer _____ [2]

(b) Expand and simplify $(e + 4)(e - 7)$.

Answer _____ [2]

20 **(a)** Write the missing words in the sentence below.

As the age (in years) of a family car increases, its value in pounds (£)

_____ , hence there is _____ correlation. [1]

(b) Write down two variables (quantities) which would display no correlation.

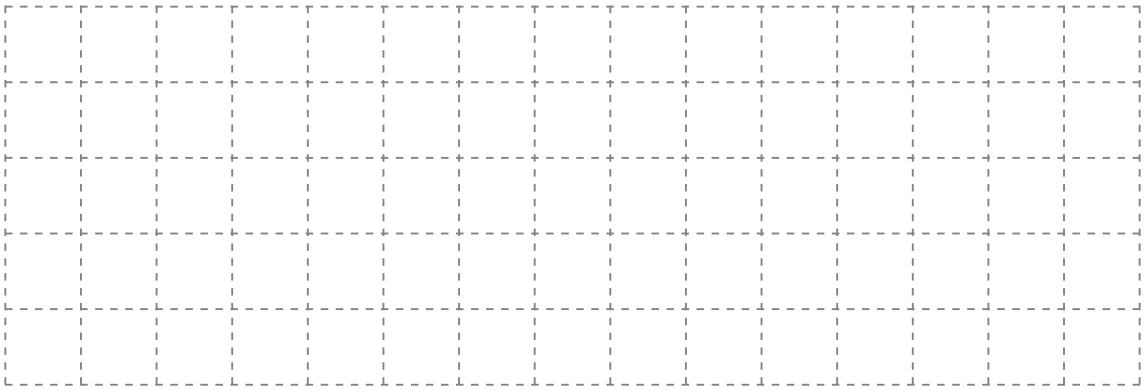
_____ and _____ [1]

[Turn over

21 In a group of 11 pupils, the number of days absent from school was recorded as listed below.

12 6 5 2 8 2 3 11 4 10 7

Draw a box plot for this data on the grid.



[4]

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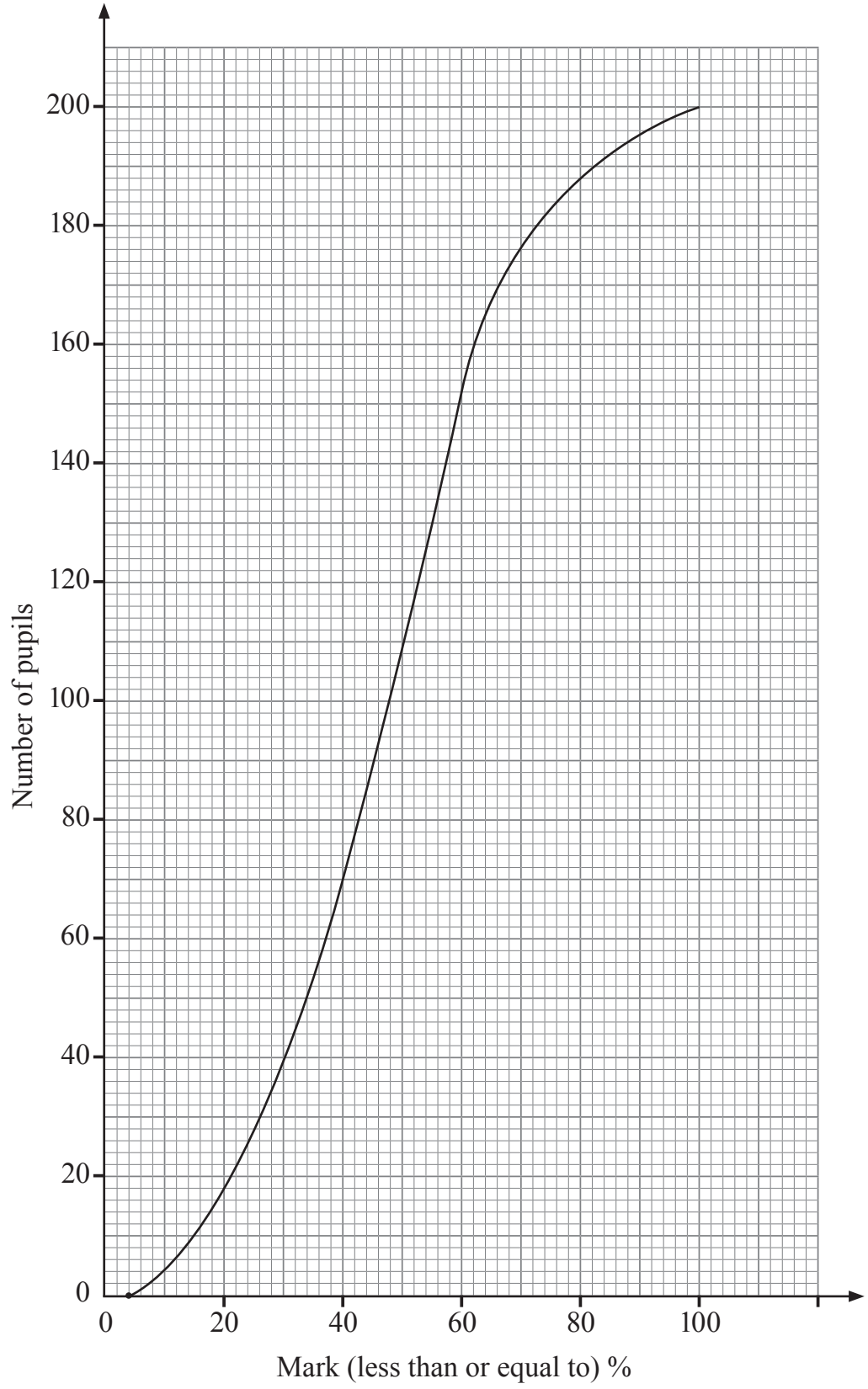
(Questions continue overleaf)

22 Two hundred pupils sat an English test. The cumulative frequency curve for the percentage marks gained is shown.



(a) Use the graph to complete table **(i)** and hence table **(ii)** below:

(i)

Percentage Mark	Cumulative Frequency
$\leqslant 20$	18
$\leqslant 40$	70
$\leqslant 60$	
$\leqslant 80$	
$\leqslant 100$	

[1]

(ii)

Percentage Mark	Frequency
$0 < p \leqslant 20$	18
$20 < p \leqslant 40$	52
$40 < p \leqslant 60$	
$60 < p \leqslant 80$	
$80 < p \leqslant 100$	

[2]

(b) Use the graph to estimate the median mark.

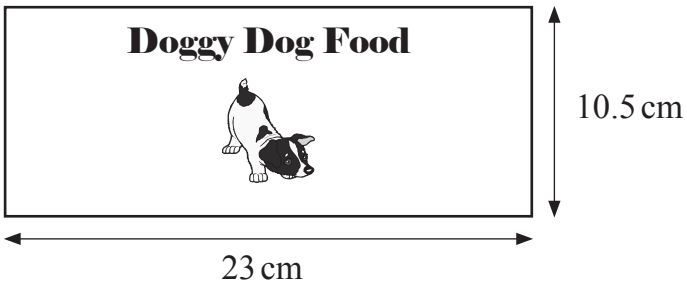
Answer _____ [1]

[Turn over

23 Look at the picture below. It shows the dimensions of a label taken from a cylindrical tin of dog food.

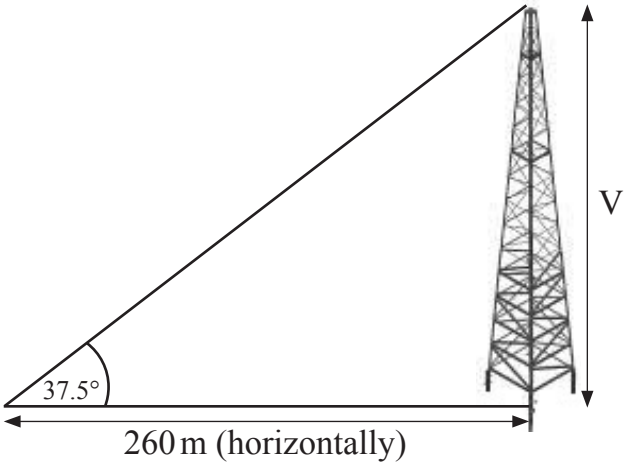
The label covers all the curved surface of the tin with no overlap.

Calculate the volume of the tin.



Answer _____ cm^3 [4]

24 Calculate the height V of this vertical radio mast.



Answer _____ m [3]

25 The population of a town in 2014 was 80 058

This was a 65% increase on its population in 1994

What was the population in 1994?

Answer _____ [3]

[Turn over

26 Solve

$(x - 5)(x + 5) = 24x$

Answer _____ [4]

27 The total weight of 5 brown and 2 white eggs was 21.6 g.

The total weight of 3 brown and 5 white eggs was 23.6 g.

Write down two simultaneous equations and solve them to find the weight of a brown egg and the weight of a white egg.

You may assume that all brown eggs have the same weight and all white eggs have the same weight.

Show all your working out.

Answer Brown egg weighs _____ g

White egg weighs _____ g [5]

[Turn over

28 Solve

$$\frac{3x-2}{6} - \frac{x-2}{3} = \frac{7}{4}$$

Show all your working out.

A solution by trial and improvement will not be accepted.

Answer $x =$ _____ [4]

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