New Specification

Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
January 2019

Mathematics

StemUp Model Solution

Unit M3
(With calculator)
Higher Tier



[GMC31] *GMC31*

TUESDAY 8 JANUARY, 9.15am–11.15am

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

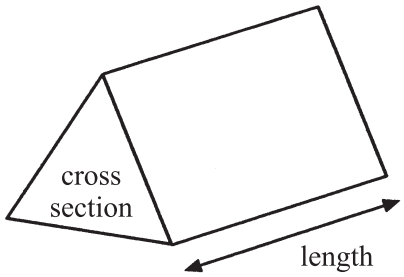
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all twenty-four**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

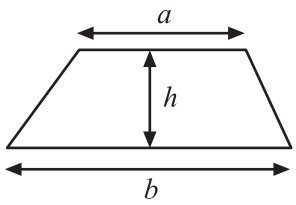
The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on page 2.

Formula Sheet

Volume of prism = area of cross section × length

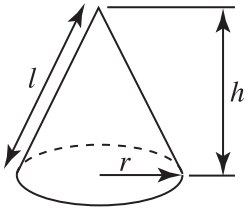


Area of trapezium = $\frac{1}{2}(a+b)h$



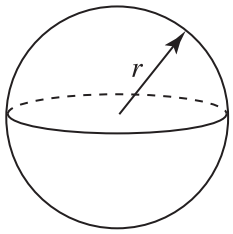
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = πrl

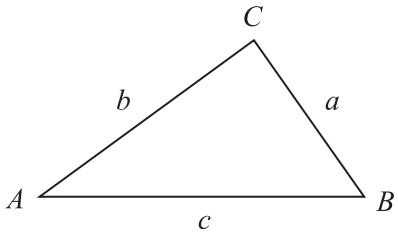


Volume of sphere = $\frac{4}{3}\pi r^3$

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

1 Brian hired some equipment.

There was a fixed charge of £45 plus a hire fee of £13.50 per day.

He paid £274.50 in total.

How many days did he hire the equipment for?

£274.50 − £45 = £229.50
£229.50 ÷ £13.50 = 17

Answer 17 [3]

2 Place a digit from 1, 2, 3, 4, 5 in each box to make a true statement.

1	+	4	×	5	= 21

[2]

1 + 4 × 5 = 1 + 20 = 21

[Turn over

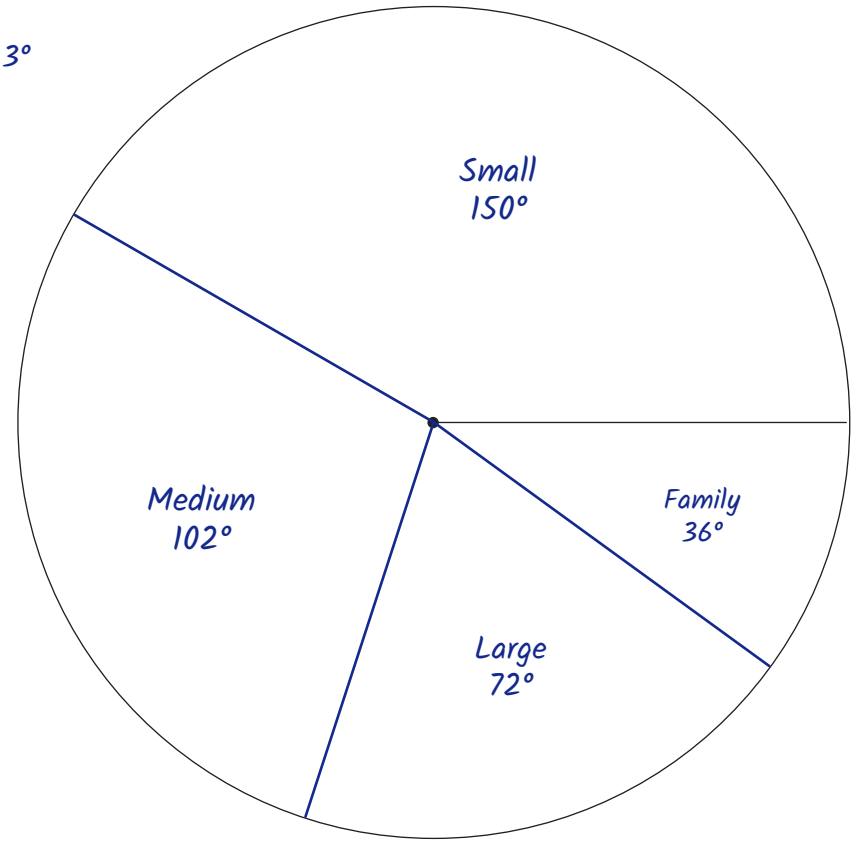
3 **(a)** Dodd's Ice Cream shop sold four sizes of ice cream tubs.

The owner wants to see a pie chart showing the numbers of tubs sold.

Size of tub	Number of tubs sold	Angle
Small	50	50 × 3 = 150°
Medium	34	34 × 3 = 102°
Large	24	24 × 3 = 72°
Family	12	12 × 3 = 36°

Draw a pie chart to show this information.

360 ÷ 120 = 3°
per tub



[4]

(b) Complete the table to find the total number of scoops used.

Size of tub	Number of tubs sold	Number of scoops per tub	Number of scoops used
Small	50	1	50
Medium	34	2	68
Large	24	3	72
Family	12	10	120
		Total	310

[2]

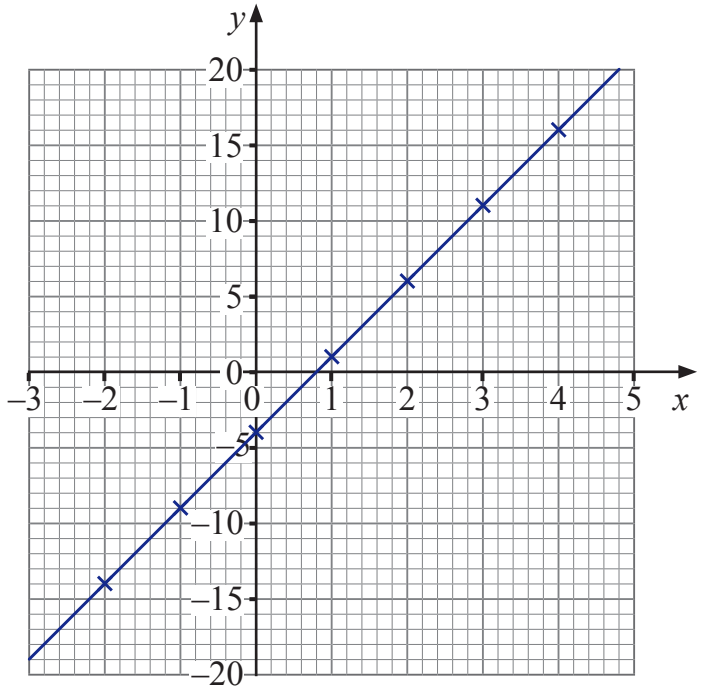
24 × 3 = 72
12 × 10 = 120
50 + 68 + 72 + 120 = 310

4 **(a)** Complete the table below for $y = 5x - 4$

x	−2	−1	0	1	2	3	4
y	−14	−9	−4	1	6	11	16

[1]

(b) On the grid below, draw the graph of $y = 5x - 4$



[2]

5 Mary raised some money.

She gave $\frac{2}{5}$ of the money to a charity.

She gave $\frac{1}{4}$ of the money to a housing project.

She gave the rest of the money to a first aid group.

What **percentage** of the money did the first aid group receive?

$\frac{2}{5} = 40\%$ (charity)

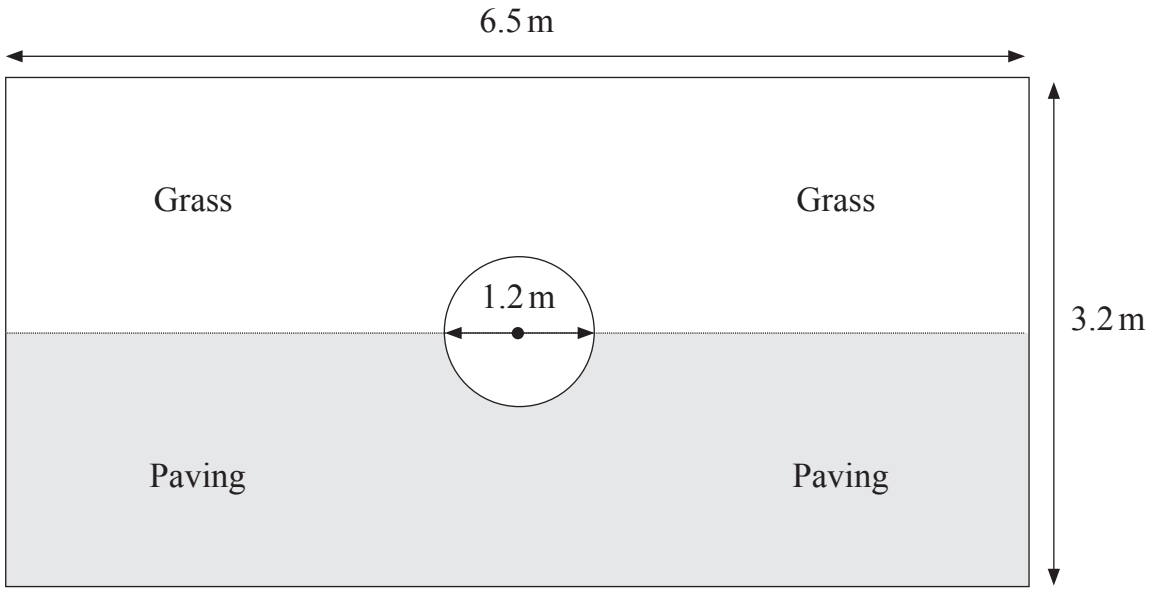
$\frac{1}{4} = 25\%$ (housing project)

$40\% + 25\% = 65\%$
$100\% - 65\% = 35\%$

Answer 35 % [4]

[Turn over

6 The diagram below shows a rectangular garden with a circular pond in the centre.



(a) Work out the area of the pond.

State the units of your answer.

radius = 1.2 ÷ 2 = 0.6 m
Area = π × 0.6^2
= 1.130973...
= 1.13 m^2

Answer 1.13 m^2 [3]

(b) Paving costs £30 per square metre.

It can only be bought in whole square metres.

How much will it cost to pave the section shown on the diagram?

Rectangle: $6.5 \times 3.2 = 20.8\ m^2$
$20.8 - 1.130973... = 19.669...\ m^2$
Paving $= 19.669... \div 2 = 9.834...\ m^2$
Must buy whole m^2, so buy $10\ m^2$
$10 \times £30 = £300$

Answer £ 300 [4]

[Turn over

7 Leah wants to check how economical her car is.

She travels 275 miles, using 22 litres of petrol.

(a) How many miles does her car travel per litre of petrol?

275 ÷ 22 = 12.5

Answer 12.5 miles [1]

(b) The 275 mile journey took Leah 5 hours 30 minutes.

What was her average speed for the journey?

5 hours 30 minutes = 5.5 hours
Speed = 275 ÷ 5.5
= 50

Answer 50 miles per hour [3]

8 Jayne owns a hotel.

On Monday morning 54 of her 75 guests had breakfast.

What percentage had breakfast?

$\frac{54}{75} \times 100 = 72\%$

Answer 72 % [2]

9 **(a)** Multiply out $5(2t + 7)$

Answer $10t + 35$ [1]

(b) Factorise $16r - 8$

Answer $8(2r - 1)$ [1]

[Turn over

10 Dean bought a new car.

He had to pay £220 plus 20% VAT per month for 3 years.

The mileage allowed before any charge was 30 000 miles for the 3 years.

Each additional mile was charged at 8p per mile.

After 3 years Dean had driven 37 200 miles.

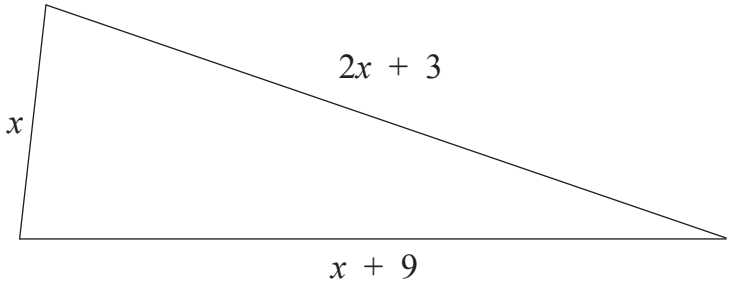
How much did Dean pay in total for the 3-year period?

3 years = 36 months
36 × £220 = £7920
VAT: 20% of £7920 = 0.2 × 7920 = £1584
7920 + 1584 = £9504
Extra miles: 37 200 − 30 000 = 7200
7200 × 8p = 7200 × £0.08 = £576
Total = 9504 + 576 = £10 080

Answer £ 10 080 [5]

11 **(a)** Write an expression, in terms of x, for the perimeter of the triangle shown.

Give your answer in its simplest form.



$x + (2x + 3) + (x + 9)$
$= 4x + 12$

Answer $4x + 12$ [2]

(b) The perimeter of this triangle is 32

(i) Write down an equation in terms of x.

Answer $4x + 12 = 32$ [1]

(ii) Solve your equation to find x.

$4x + 12 = 32$
$4x = 20$
$x = 20 \div 4 = 5$

Answer 5 [1]

[Turn over

12 (a) (i) Fiona wanted to do a survey about attendance at her school.

She designed a questionnaire for students to complete.

One of the questions was:

"How many days have you had off school?"

State **one** criticism of her question.

Answer No time period is given (e.g. this term or this year), so the answers can't be compared. [1]

(ii) She decides to give her questionnaires out to the first 20 students coming out of the Year 12 assembly one Monday.

State **two** reasons why her sample may not be representative of the whole school population.

Answer 1. She only asks Year 12 students, so other year groups are not represented.

2. She only asks students who were in school that day, so pupils who were absent are missed. [2]

(b) Fiona asked the school office for information about pupils who had arrived late to school on a certain day.

They told her that 14 pupils were late that day.

The list below shows how many minutes late each pupil was.

8	12	15	27	19	26	24
38	29	14	11	16	23	16

Show this information in an ordered stem and leaf diagram.

Stem	Leaf
0	8
1	1 2 4 5 6 6 9
2	3 4 6 7 9
3	8

Key: 3 | 8 = 38 minutes late

[3]

[Turn over

13 A badge is the shape of a quarter circle as shown below.

Calculate the perimeter of the badge.

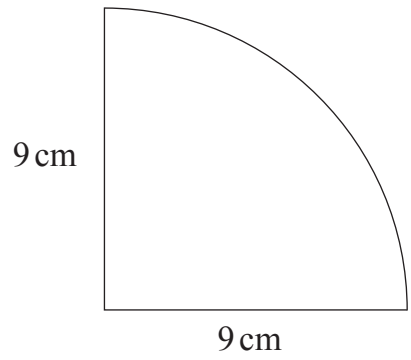


diagram not
drawn accurately

Arc $= \frac{2 \times \pi \times 9}{4} = 14.137...$

Perimeter = 14.137... + 9 + 9
= 32.137...
= 32.14 cm

Answer 32.14 cm [3]

14 The test scores for the 10 boys in a class are

7 8 5 8 7 9 4 5 3 9

The mean test score for the 5 girls in the class is 8

Calculate the mean for this class.

Show your working clearly.

Boys total = 7+8+5+8+7+9+4+5+3+9 = 65
Girls total = 8 × 5 = 40
Class total = 65 + 40 = 105

Mean = $\frac{105}{15}$ = 7

Answer 7 [3]

[Turn over

15 **(a)** Given that $4\,500 = 2^a \times 3^2 \times 5^b$

work out the values of a and b.

$4500 = 2 \times 2250$

$2250 = 2 \times 1125$

$1125 = 3 \times 375$

$375 = 3 \times 125$

$125 = 5 \times 25 = 5 \times 5 \times 5$

$4500 = 2 \times 2 \times 3 \times 3 \times 5 \times 5 \times 5 = 2^2 \times 3^2 \times 5^3$

Answer $a =$ 2 $b =$ 3 [3]

(b) Hence, write down the lowest value by which 4 500 needs to be multiplied to make a **cube** number.

For a cube every power must be a multiple of 3:

$2^2 \times 3^2 \times 5^3 \times 2 \times 3 = 2^3 \times 3^3 \times 5^3$

so multiply by $2 \times 3 = 6$

Answer 6 [2]

16 The speeds of cars on a road were recorded over a period of time.

The results are recorded in the grouped frequency table.

Speed (s miles per hour)	**Frequency**	Mid-point (x)	$f \times x$
$20 < s \leqslant 30$	12	25	$12 \times 25 = 300$
$30 < s \leqslant 40$	16	35	$16 \times 35 = 560$
$40 < s \leqslant 50$	18	45	$18 \times 45 = 810$
$50 < s \leqslant 60$	2	55	$2 \times 55 = 110$
$60 < s \leqslant 70$	2	65	$2 \times 65 = 130$

(a) How many cars were travelling at more than 40 mph?

$18 + 2 + 2 = 22$

Answer 22 [1]

(b) Which class interval contains the median speed?

Answer $30 < s \leq 40$ [1]

50 cars: median is 25.5th, $12 + 16 = 28$

(c) Calculate an estimate for the mean speed of the cars on the road.

$\Sigma fx = 300 + 560 + 810 + 110 + 130 = 1910$

$\Sigma f = 12 + 16 + 18 + 2 + 2 = 50$

$\text{Mean} = \frac{1910}{50} = 38.2$

Answer 38.2 mph [4]

[Turn over

17 A child's height increased from 84 cm to 91 cm.

Calculate the percentage increase.

Increase = 91 − 84 = 7 cm

$\frac{7}{84} \times 100 = 8.3333...$

= 8.33%

Answer 8.33 % [3]

18 ABCD is a square of side 6 cm.

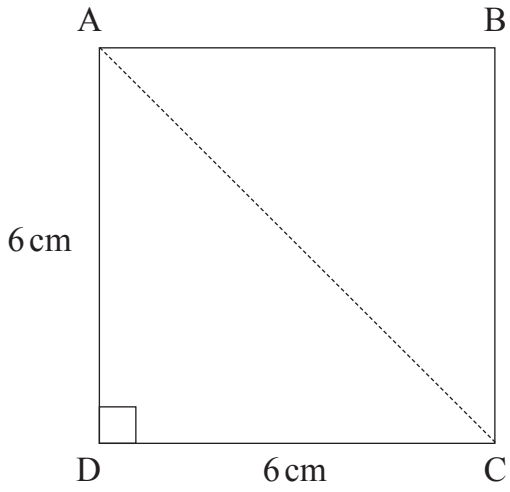


diagram not drawn accurately

How much longer is AC than AD?

You must show all your working.

$AC^2 = 6^2 + 6^2$

$AC^2 = 36 + 36 = 72$

$AC = \sqrt{72} = 8.485281...$

$AC - AD = 8.485281... - 6$

$= 2.485281...$

$= 2.49$ cm

Answer 2.49 cm [4]

[Turn over

19 Yasmin draws a rectangle measuring 2 cm by 4 cm (both to the nearest cm).

She says the area must be 8 cm^2 to the nearest cm^2

Explain why she is wrong.

2 cm could be from 1.5 to 2.5 cm and 4 cm from 3.5 to 4.5 cm.
Smallest area = 1.5 × 3.5 = 5.25 cm^2
Largest area = 2.5 × 4.5 = 11.25 cm^2
So the area could be anything from 5.25 to 11.25 cm^2,
e.g. 5.25 cm^2 rounds to 5 cm^2, not 8 cm^2.

[2]

20 Peter, Jack and Colin share a flat. They pay the rent monthly.

Peter pays 30% of the monthly rent.

Jack pays $\frac{3}{8}$ of the monthly rent.

Colin pays £520 of the monthly rent.

Calculate the total monthly rent for the flat.

Jack: $\frac{3}{8}$ = 37.5%

Peter + Jack = 30% + 37.5% = 67.5%
Colin = 100% − 67.5% = 32.5%
32.5% = £520
1% = 520 ÷ 32.5 = £16
100% = 16 × 100 = £1600

Answer £ 1600 [5]

21 Factorise each of the following.

(a) $10cp^2 - 4cp$

common factor 2cp

Answer 2cp(5p − 2) [2]

(b) $y^2 - 1$

difference of two squares: $y^2 - 1^2$

Answer (y − 1)(y + 1) [1]

(c) $k^2 - 2k - 3$

$-3 \times 1 = -3$, $-3 + 1 = -2$

Answer (k − 3)(k + 1) [2]

(d) $(x - 2)^2 + 5(x - 2)$

(x − 2)[(x − 2) + 5]

Answer (x − 2)(x + 3) [2]

[Turn over

22 PQR is a right-angled triangle.

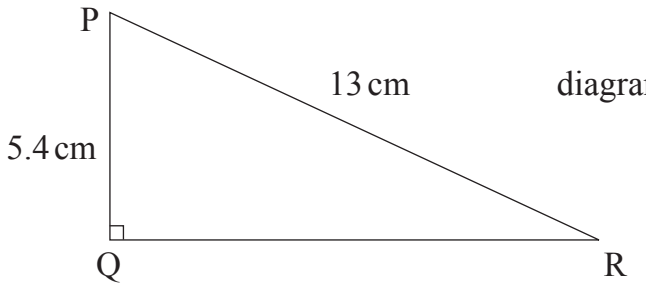


diagram not drawn accurately

By how many degrees is angle P bigger than angle R?

Give your answer to the nearest degree.

Show all your working clearly.

$\cos P = \frac{5.4}{13}$

$P = \cos^{-1}\frac{5.4}{13} = 65.45646...°$

$R = 180° - 90° - 65.45646...° = 24.54353...°$

$P - R = 65.45646... - 24.54353... = 40.91292...$

$= 41°$

Answer 41 ° [5]

23 Solve $\frac{x+3}{2} = \frac{5x}{6}$

$6(x + 3) = 2(5x)$

$6x + 18 = 10x$

$18 = 4x$

$x = 18 \div 4 = 4.5$

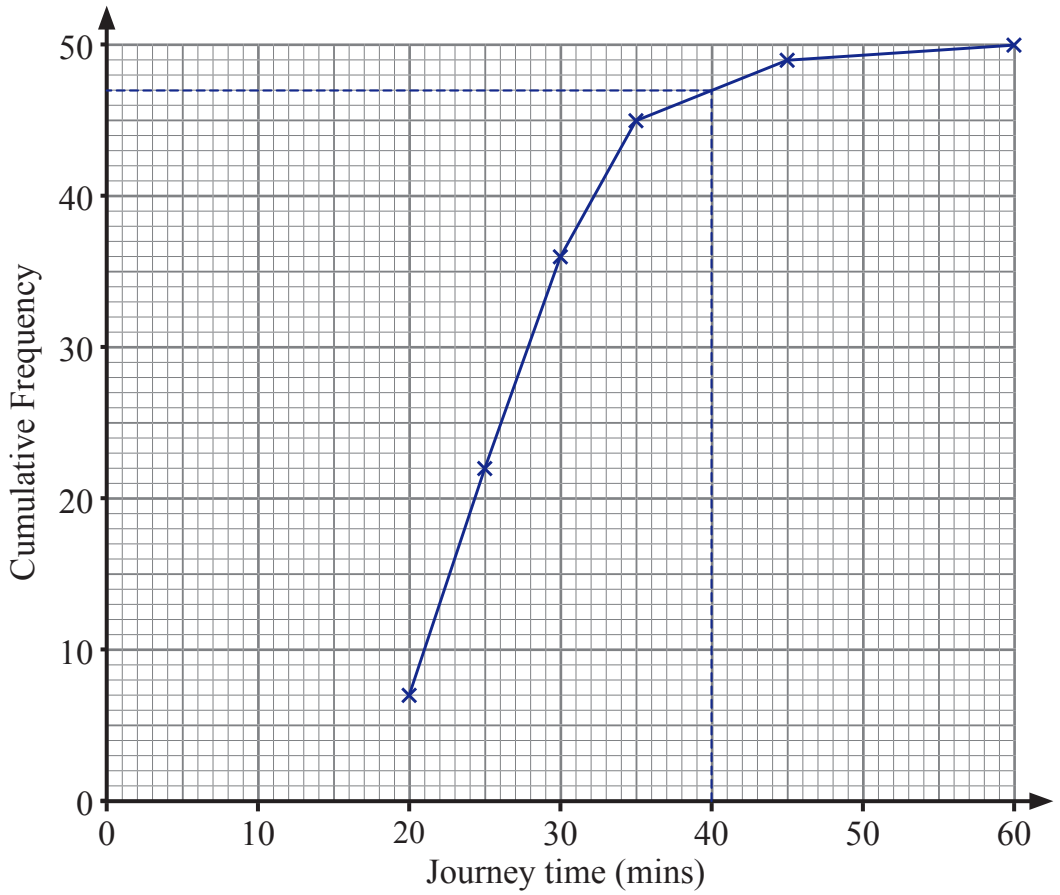
Answer $x =$ 4.5 [4]

[Turn over

24 The cumulative frequency table gives data about the length of time it takes for 50 workers to travel to work one morning.

Journey time (t minutes)	**Cumulative Frequency**
$t \leqslant 20$	7
$t \leqslant 25$	22
$t \leqslant 30$	36
$t \leqslant 35$	45
$t \leqslant 45$	49
$t \leqslant 60$	50

(a) On the graph paper below, draw a cumulative frequency graph to illustrate the data.



[3]

(b) Use the graph to estimate the percentage of workers whose journey time was longer than 40 minutes.

At 40 minutes, cumulative frequency = 47
50 − 47 = 3 workers took longer than 40 minutes

$\frac{3}{50} \times 100 = 6\%$

Answer *6* % [2]

THIS IS THE END OF THE QUESTION PAPER

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Question Number	**Marks**
1	
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Examiner Number

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