Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2025

Mathematics

StemUp Model Solution

Unit M4
(With calculator)
Higher Tier



[GMC41]

GMC41

THURSDAY 15 MAY, 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.**
Questions which require drawing or sketching should be completed using an HB pencil.
All working **must** be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.
You **may** use a calculator for this paper.
Answer **all twenty-two** questions.

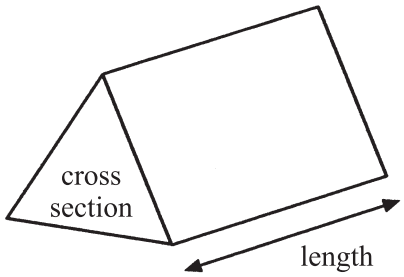
INFORMATION FOR CANDIDATES

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.

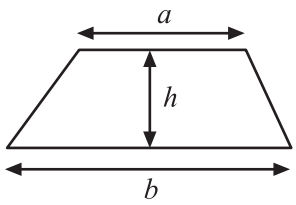
15855

Formula Sheet

Volume of prism = area of cross section × length

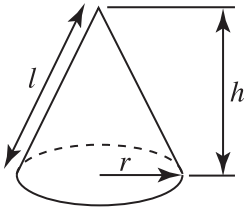


Area of trapezium = $\frac{1}{2}(a+b)h$



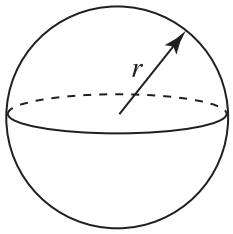
Volume of cone = $\frac{1}{3}\pi r^2 h$

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

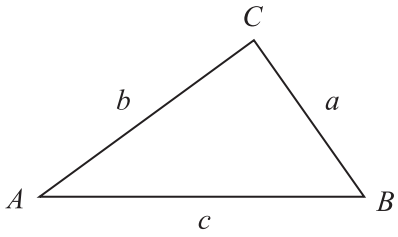


Volume of sphere = $\frac{4}{3}\pi r^3$

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

15855

1 ABCD is a square of side 60 cm.

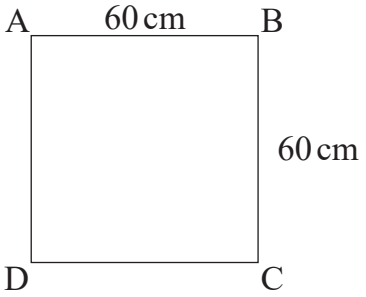


diagram not drawn accurately

The lengths of AB and DC are **increased** by 15%
and the lengths of BC and AD are **decreased** by 20%
to form a rectangle.

State whether the **perimeter** has increased or decreased, and by what percentage.

$AB = DC = 60 \times 1.15 = 69$ cm

$BC = AD = 60 \times 0.8 = 48$ cm

Original perimeter $= 4 \times 60 = 240$ cm

New perimeter $= 2 \times 69 + 2 \times 48 = 138 + 96 = 234$ cm

Change $= 240 - 234 = 6$ cm (decrease)

% change $= \frac{6}{240} \times 100 = 2.5\%$

Answer Perimeter has decreased by 2.5 % [6]

[Turn over

2 **(a)** Calculate the midpoint of the line joining the points (0, 6) and (2, 14).

Midpoint = $\left(\frac{0+2}{2}, \frac{6+14}{2}\right)$

$= (1, 10)$

Answer (1 , 10) [2]

(b) Find the equation of the straight line joining the points (0, 6) and (2, 14).

gradient = $\frac{14-6}{2-0} = \frac{8}{2} = 4$

y-intercept: line passes through (0, 6) so $c = 6$

$y = mx + c$

$y = 4x + 6$

Answer $y = 4x + 6$ [3]

3 Solve $\frac{4a-2}{3} = 8$

$4a - 2 = 8 \times 3$

$4a - 2 = 24$

$4a = 26$

$a = 26 \div 4$

$a = 6.5$

Answer $a =$ 6.5 [3]

4 Expand and simplify $m^2 + (m + 7)(m - 2)$

$(m + 7)(m - 2) = m^2 - 2m + 7m - 14$

$= m^2 + 5m - 14$

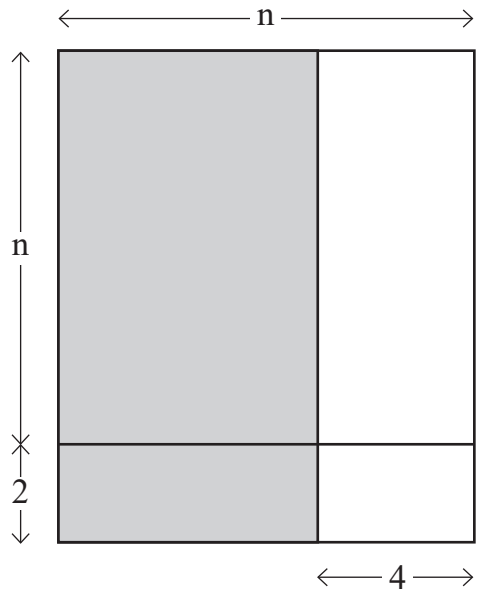
$m^2 + m^2 + 5m - 14$

$= 2m^2 + 5m - 14$

Answer $2m^2 + 5m - 14$ [3]

[Turn over

5 A shape is split into four rectangles.



Find an expression for the shaded area.

Write your answer as a quadratic expression, simplifying where necessary.

Shaded width = $n - 4$, shaded height = $n + 2$

Area = $(n - 4)(n + 2)$

$= n^2 + 2n - 4n - 8$

$= n^2 - 2n - 8$

Answer $n^2 - 2n - 8$ [3]

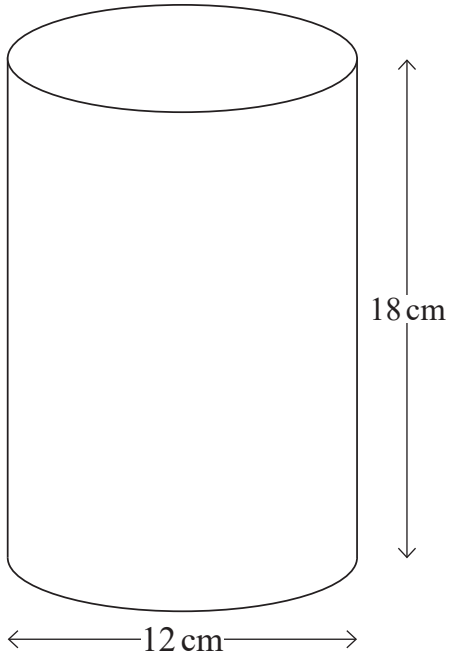
BLANK PAGE

DO NOT WRITE ON THIS PAGE

(Questions continue overleaf)

[Turn over

6 **(a)** Calculate the volume of the cylinder.



radius = 12 ÷ 2 = 6 cm

$V = \pi r^2 h$

$= \pi \times 6^2 \times 18$

= 2035.752040...

$= 2035.75\ cm^3$

Answer 2035.75 cm^3 [3]

(b) The pressure exerted by the cylinder on the floor is 0.3 N/cm^2

Find the force exerted by the cylinder on the floor.

Give your answer to the nearest whole number.

Force = pressure × area

Area of base = π × 6^2 = 113.0973355 cm^2

Force = 0.3 × 113.0973355

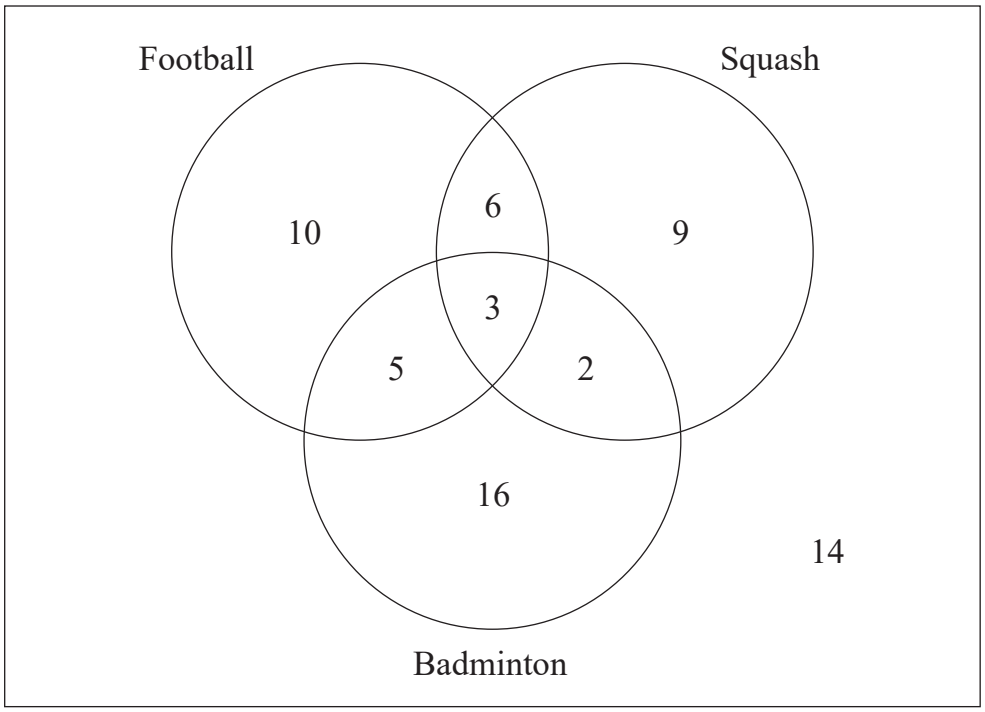
= 33.92920066...

= 34 N (nearest whole number)

Answer *34* N [3]

[Turn over

7 The Venn diagram shows which sports members play at a leisure centre.



(a) How many members play Squash?

Squash = 6 + 9 + 3 + 2 = 20

Answer *20* [1]

(b) How many members play both Football and Badminton?

Football and Badminton = 5 + 3 = 8

Answer *8* [1]

8 Find the area of the triangle ABC.

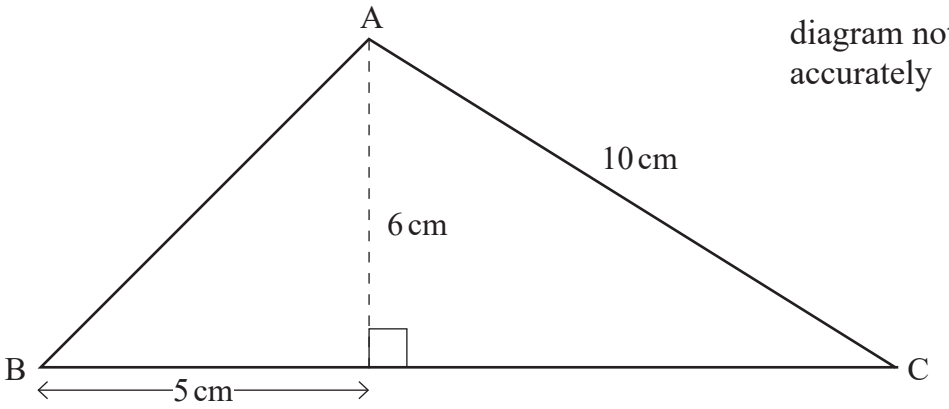


diagram not drawn accurately

Let x = the base length under AC (from the foot of the height to C)

$x^2 = 10^2 - 6^2$

$x^2 = 100 - 36 = 64$

$x = \sqrt{64} = 8$ cm

BC = 5 + 8 = 13 cm

Area = $\frac{1}{2} \times 13 \times 6 = 39$ cm^2

Answer 39 cm^2 [4]

[Turn over

9 Ben is making lemonade.

He can buy bottles in packs of 12

He can buy labels in packs of 33

Ben does not want to have any bottles or labels left over.

What is the **minimum** number of **packs of labels** he needs to buy?

$12 = 2 \times 2 \times 3$

$33 = 3 \times 11$

$LCM = 2 \times 2 \times 3 \times 11 = 132$

Ben needs 132 bottles and 132 labels

packs of labels $= 132 \div 33 = 4$

(packs of bottles $= 132 \div 12 = 11$)

Answer 4 [3]

10 **(a)** Factorise

(i) $8a^2b + 12a$

HCF of $8a^2b$ and $12a$ is $4a$

$8a^2b + 12a = 4a(2ab + 3)$

Answer $4a(2ab + 3)$ [2]

(ii) $p^2 - 49$

difference of two squares: $p^2 - 7^2$

$= (p + 7)(p - 7)$

Answer $(p + 7)(p - 7)$ [1]

(b) Solve the equation $w^2 - 2w - 35 = 0$

$w^2 - 2w - 35 = 0$

$(w - 7)(w + 5) = 0$

$w - 7 = 0$ or $w + 5 = 0$

$w = 7$ or $w = -5$

Answer $w =$ 7 or -5 [3]

[Turn over

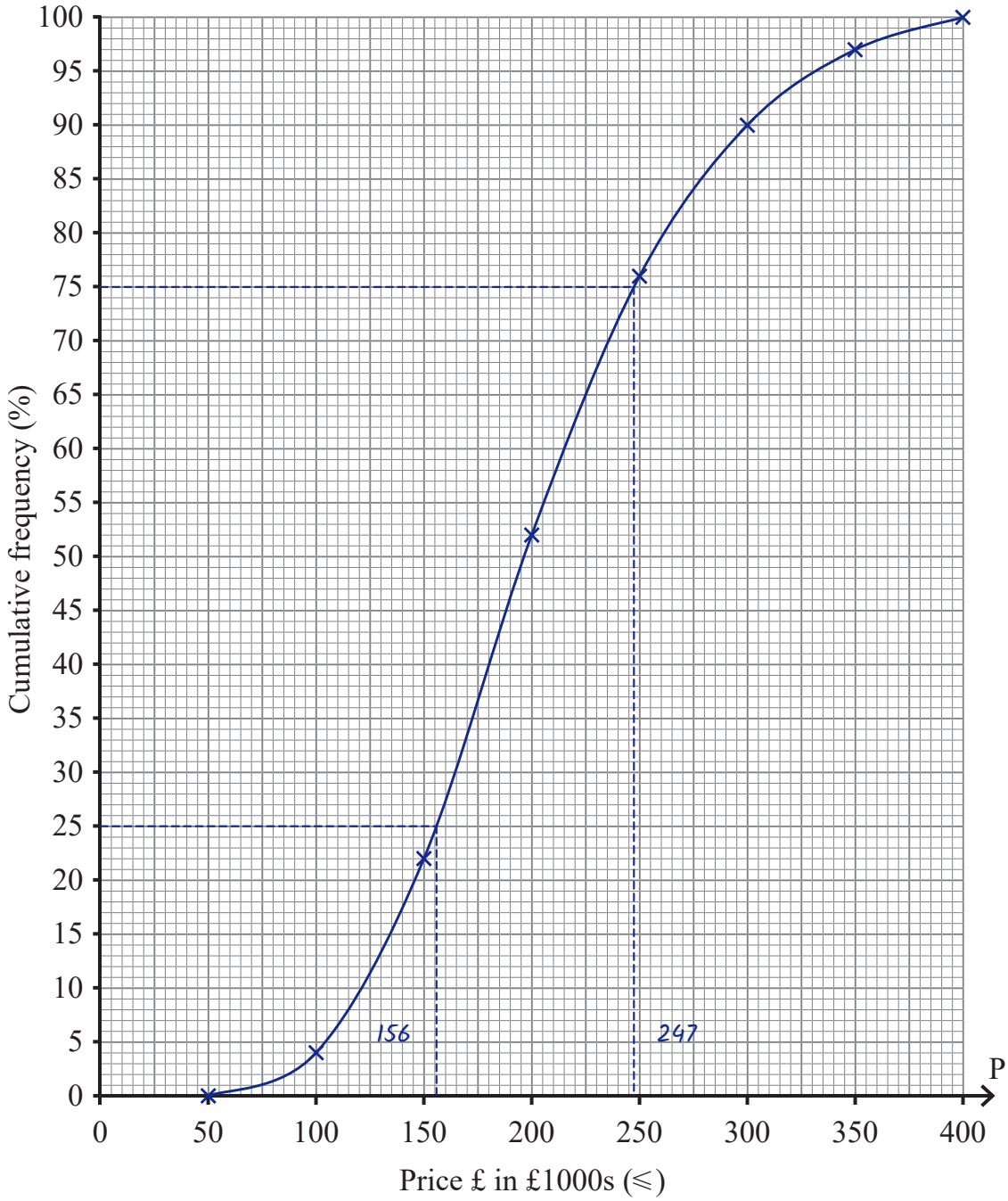
11 (a) The table shows the percentage distribution of house prices, P, in a town in Northern Ireland in 2020

House prices, P, in £	Percentage of houses	Cumulative frequency
$50\,000 < P \leqslant 100\,000$	4	4
$100\,000 < P \leqslant 150\,000$	18	22
$150\,000 < P \leqslant 200\,000$	30	52
$200\,000 < P \leqslant 250\,000$	24	76
$250\,000 < P \leqslant 300\,000$	14	90
$300\,000 < P \leqslant 350\,000$	7	97
$350\,000 < P \leqslant 400\,000$	3	100

Complete the cumulative frequency column in the table. [1]

stemup.co.uk

(b) Plot the cumulative frequency graph on the given axes. [3]



(c) Use your graph to estimate the interquartile range.

LQ ≈ £156 000, UQ ≈ £247 000

IQR = 247 000 − 156 000 = 91 000

Answer £ 91 000 [2]

[Turn over

15855

12

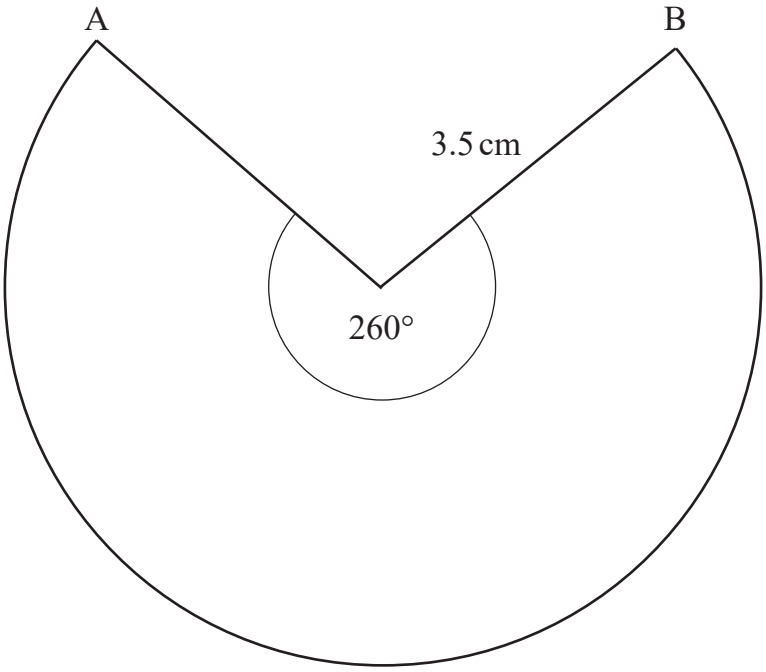


diagram not drawn accurately

Calculate the length of the arc AB, giving your answer to 1 decimal place.

$\text{Arc} = \frac{260}{360} \times 2 \times \pi \times 3.5$

$= \frac{260}{360} \times \pi \times 7$

$= 15.88249619...$

$= 15.9 \text{ cm (1 d.p.)}$

Answer 15.9 cm [3]

13 Pam has to deliver containers of food.

Each container weighs 50 kg, to the nearest 5 kg.

The maximum load her van can carry is 1500 kg, measured to the nearest 100kg.

What is the greatest possible number of containers that Pam can carry in her van?

Show your working out clearly.

Container: 50 kg to nearest 5 kg

lower bound = 47.5 kg (upper bound 52.5 kg)

Van: 1500 kg to nearest 100 kg

upper bound = 1550 kg (lower bound 1450 kg)

Greatest number: largest load ÷ lightest container

$\frac{1550}{47.5} = 32.63157895...$

She cannot carry part of a container, so round down:

32 containers

Answer 32 [4]

[Turn over

14 Find the equation of the line which passes through the point (8, 3) and is perpendicular to the line $y = 4x$

gradient of $y = 4x$ is 4, perpendicular gradient $= -\frac{1}{4}$

(since $4 \times m = -1$)

$y = mx + c$ through (8, 3):

$3 = -\frac{1}{4} \times 8 + c$

$3 = -2 + c$

$c = 5$

$y = -\frac{1}{4}x + 5$

Answer $y = -\frac{1}{4}x + 5$ [4]

15

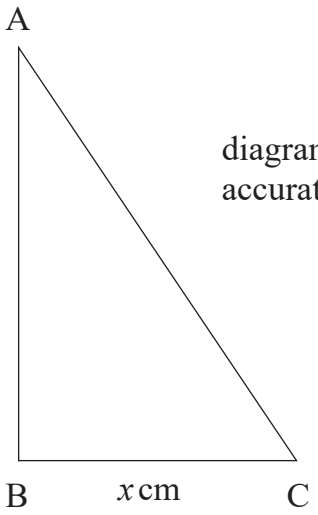


diagram not drawn accurately

In the right-angled triangle, AB is 4 cm longer than BC.

The area of the triangle is 38.5 cm^2

(a) Show that $x^2 + 4x - 77 = 0$

$BC = x$, $AB = x + 4$

$\text{Area} = \frac{1}{2} \times x \times (x + 4) = 38.5$

$x(x + 4) = 77$

$x^2 + 4x - 77 = 0$

[3]

(b) Hence calculate the size of angle C.

$(x + 11)(x - 7) = 0$

$x = 7$ ($x = -11$ is impossible, a length is positive)

$BC = 7$ cm, $AB = 7 + 4 = 11$ cm

$\tan C = \frac{\text{opp}}{\text{adj}} = \frac{11}{7}$

$C = \tan^{-1}(11 \div 7) = 57.52880771...$

Answer 57.5 ° [3]

[Turn over

16 Find the value of the angle marked x.

Give your answer correct to 1 decimal place.

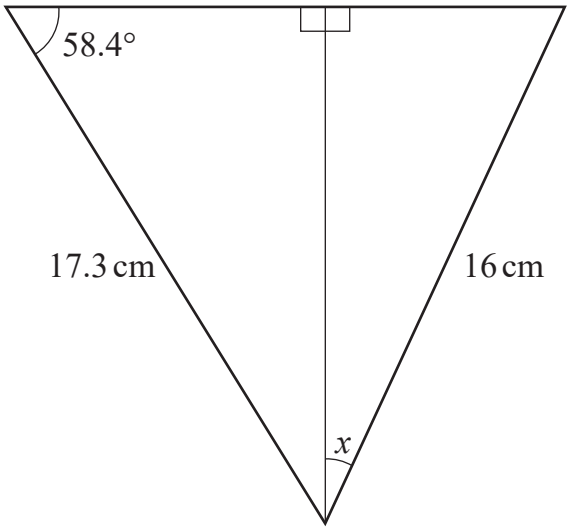


diagram not drawn accurately

Let h = the vertical height (the common side)

$\sin 58.4° = \frac{h}{17.3}$

$h = 17.3 \times \sin 58.4° = 14.73487596$ cm

$\cos x = \frac{14.73487596}{16} = 0.9209297...$

$x = \cos^{-1}(0.9209297...)$

$x = 22.93761463...$

$x = 22.9°$ (1 d.p.)

Answer x = 22.9 ° [4]

17

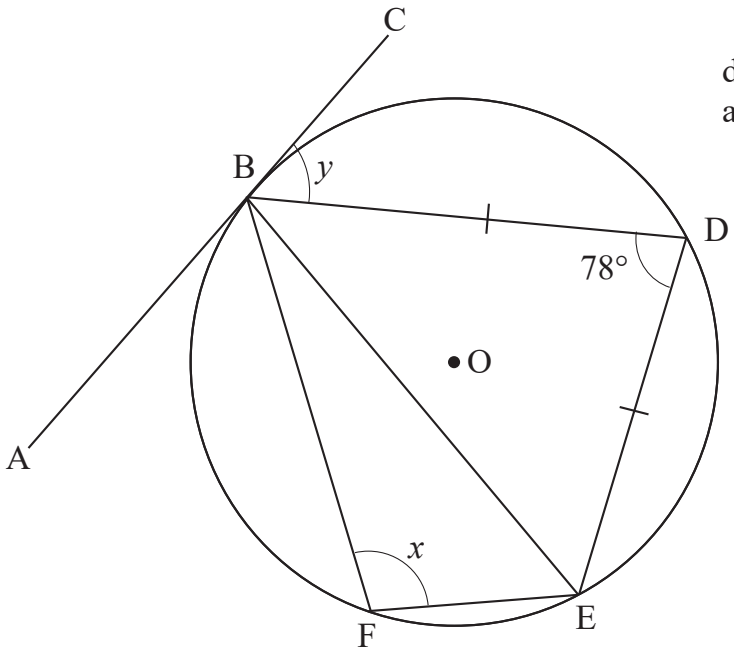


diagram not drawn accurately

ABC is a tangent to the circle.

O is the centre of the circle.

(a) Work out the value of angle x, giving a reason for your answer.

Answer $x =$ 102 ° because opposite angles in a cyclic quadrilateral add up to 180° (180° – 78° = 102°) [2]

(b) Work out the value of angle y, giving full reasons for your answer.

BD = DE so triangle BDE is isosceles: angle DBE = angle DEB = (180 – 78) ÷ 2 = 51°

Answer $y =$ 51 ° because triangle BDE is isosceles (BD = DE), so angle BED = (180° – 78°) ÷ 2 = 51°. Angle between tangent and chord equals angle in the alternate segment, so y = BED = 51° [3]

[Turn over

18 Mr Clarke wants to take a 30% random sample of the Year 12 boys in his school.

There are 40 boys in his sample.

There are 142 boys in Year 12

Jim says this is a fair representation of the number of boys in the year group.

Jenny says this is not a fair representation of the number of boys in the year group.

Give possible reasons for their answers.

Jim says this is fair because *30% of 142 = 0.3 × 142 = 42.6,*

which is close to 40, so 40 is roughly a 30% sample [1]

Jenny says this is not fair because *42.6 rounds to 43, so a 30% sample*

should be 43 boys; 40 is only 40 ÷ 142 = 28.2% of the year [1]

19 Darren bought an antique clock at a showroom price.

He sold it to Edith for £1008 and made 12% profit.

Edith sold it to Fran at 17.6% above the **showroom** price.

Calculate how much profit Edith made.

Darren: £1008 = 112% of the showroom price

Showroom price = $\frac{1008}{1.12}$ = £900

Edith sells at 117.6% of showroom price:

900 × 1.176 = £1058.40

Edith bought it for £1008

Profit = 1058.40 − 1008 = £50.40

Answer £ 50.40 [4]

[Turn over

20 Simplify

$$\frac{10 + 2w + 5c + cw}{75 - 3w^2}$$

Numerator: $10 + 2w + 5c + cw = 2(5 + w) + c(5 + w) = (2 + c)(5 + w)$

Denominator: $75 - 3w^2 = 3(25 - w^2) = 3(5 - w)(5 + w)$

$$\frac{10 + 2w + 5c + cw}{75 - 3w^2} = \frac{(2 + c)(5 + w)}{3(5 - w)(5 + w)} = \frac{2 + c}{3(5 - w)}$$

Answer $\frac{2 + c}{3(5 - w)}$ [4]

21 An expression is written as

$$\frac{2x}{x+4} - \frac{x+3}{x+1}$$

Simplify the expression to a single fraction whose numerator is a quadratic expression.

$$\frac{2x}{x+4} - \frac{x+3}{x+1} = \frac{2x(x+1) - (x+3)(x+4)}{(x+4)(x+1)}$$

$$= \frac{2x^2 + 2x - (x^2 + 4x + 3x + 12)}{(x+4)(x+1)}$$

$$= \frac{2x^2 + 2x - x^2 - 7x - 12}{(x+4)(x+1)}$$

$$= \frac{x^2 - 5x - 12}{(x+4)(x+1)}$$

Answer $\frac{x^2 - 5x - 12}{(x+4)(x+1)}$ [5]

[Turn over

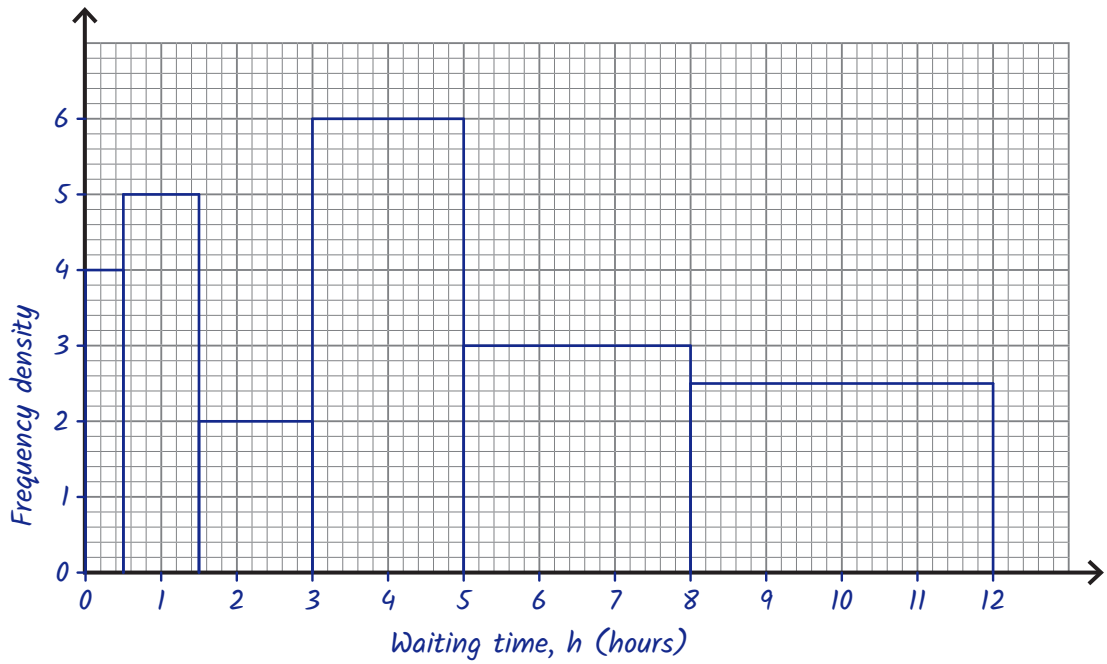
22 (a) The table shows the waiting times, h, in hours, for patients at an Emergency Department one evening.

Waiting time, h (hours)	Frequency
$0 < h \leqslant 0.5$	2
$0.5 < h \leqslant 1.5$	5
$1.5 < h \leqslant 3$	3
$3 < h \leqslant 5$	12
$5 < h \leqslant 8$	9
$8 < h \leqslant 12$	10

Frequency density
= frequency ÷ class width

2 ÷ 0.5 = 4 *12 ÷ 2 = 6*
5 ÷ 1 = 5 *9 ÷ 3 = 3*
3 ÷ 1.5 = 2 *10 ÷ 4 = 2.5*

Draw a histogram on the axes provided to illustrate this data.



[4]

15855

(b) Calculate an estimate for the median waiting time.

Total frequency = 2 + 5 + 3 + 12 + 9 + 10 = 41

Median position = $\frac{41}{2}$ = 20.5th value

Cumulative: 2, 7, 10, 22 so median is in $3 < h \leq 5$

20.5 − 10 = 10.5 values into this class of 12

Median = $3 + \frac{10.5}{12} \times 2 = 3 + 1.75$

= 4.75 hours

Answer 4.75 hours [4]

(c) A stratified sample of five patients is to be selected from those waiting longer than 6 hours.

Estimate how many patients in this sample would have waiting times between 7 and 10 hours.

Show your working out clearly.

Longer than 6 hours: $5 < h \leq 8$ has 9 over 3 hours, so 6 to 8 h: 2 × 3 = 6

$8 < h \leq 12$: 10, total longer than 6 hours = 6 + 10 = 16

Between 7 and 10 hours: 7 to 8 h: 1 × 3 = 3, 8 to 10 h: 2 × 2.5 = 5

total between 7 and 10 hours = 3 + 5 = 8

$\frac{8}{16} \times 5 = 2.5$, so about 2 or 3 patients (round up to 3)

Answer 3 [4]

SOURCES:

All images © CCEA unless stated.

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	
17	
18	
19	
20	
21	
22	
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.