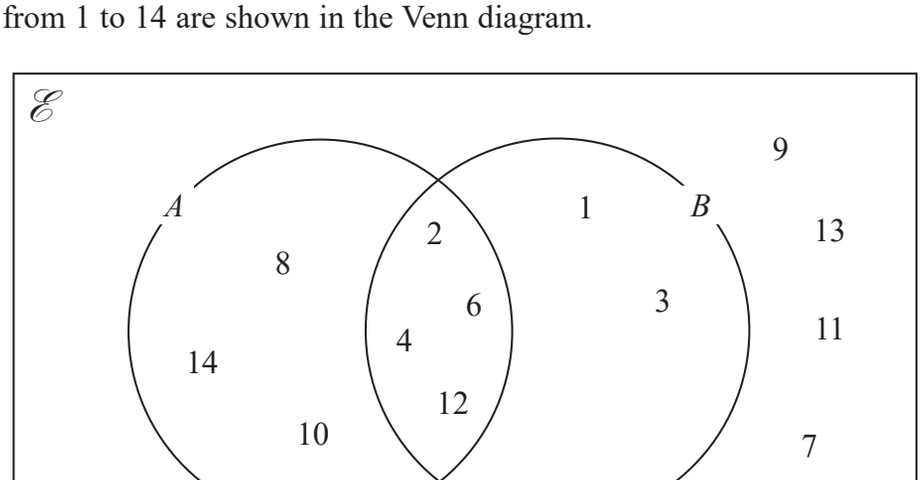
Answer ALL TWENTY FIVE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 The numbers from 1 to 14 are shown in the Venn diagram.



(a) List the members of the set $A \cap B$

2 4 6 12

(1)

(b) List the members of the set B'

5 7 8 9 10 11 13 14

(1)

A number is picked at random from the numbers in the Venn diagram.

(c) Find the probability that this number is in set A but is **not** in set B.

$\frac{3}{14}$

(2)

(Total for Question 1 is 4 marks)

2 Toy cars are made in a factory.
The toy cars are made for 15 hours each day.
5 toy cars are made every 12 seconds.

For the toy cars made each day, the probability of a toy car being faulty is 0.002

Work out an estimate of the number of faulty toy cars that are made each day.

5 cars = 12 seconds ↓ x5
25 = 60 seconds (1 min) ↓ x60
1500 = 3600 s (1 hour) ↓ x15
22500 = 15 hours

0.002×22500
$= 45$

45

(Total for Question 2 is 4 marks)

3 On the grid, draw the graph of $y = 7 - 4x$ for values of x from -2 to 3

$x = -2$

$y = 7 - 4 \times -2$

$= 7 + 8$

$= 15$

$x = 0$

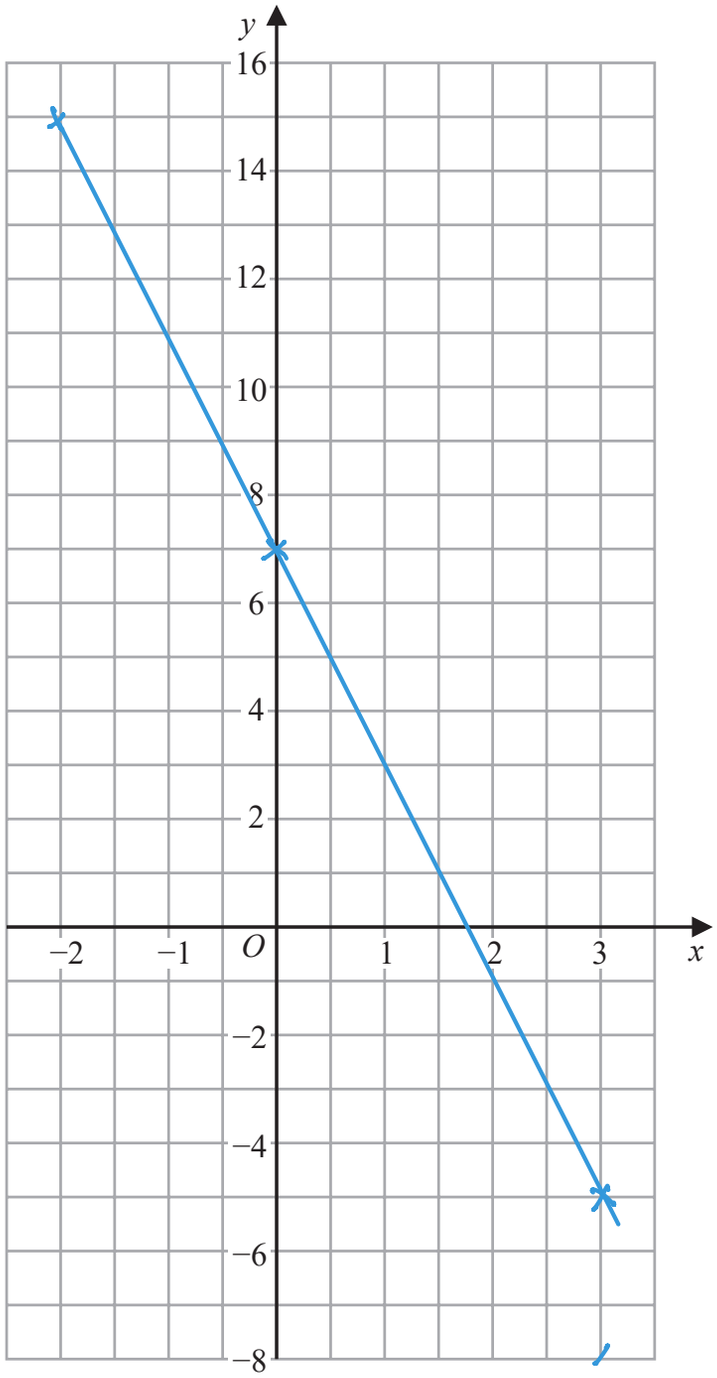
$y = 7$

$x = 3$

$y = 7 - 4 \times 3$

$= 7 - 12$

$= -5$



(Total for Question 3 is 3 marks)

4 Here is a list of six numbers written in order of size.

4 7 8 ~~x~~ 10 y y

↑ 9

The numbers have

a median of 9
a mean of 11

Find the value of x and the value of y.

median = 9 so $x = 8$

mean = 11 so total = $6 \times 11 = 66$

$66 - (4 + 7 + 8 + 10)$

$= 66 - 29$

$= 37$

$2y = 37$

$y = \frac{37}{2}$

$= 18.5$

$x =$ 8

$y =$ 18.5

(Total for Question 4 is 4 marks)

5 (a) Write 5.7×10^{-3} as an ordinary number.

0·0057

(1)

(b) Write 800 000 in standard form.

8×10^5

(1)

(c) Work out $\dfrac{3 \times 10^5 - 2.7 \times 10^4}{6 \times 10^{-2}}$

$= \dfrac{273000}{6 \times 10^{-2}}$

$= 4550000$

4.55×10^6

(2)

(Total for Question 5 is 4 marks)

6 A rocket travelled 100 km at an average speed of 28 440 km/h.

Work out how long it took the rocket to travel the 100 km.
Give your answer in seconds, correct to the nearest second.

28 440 km = 1 hour = 3600s

÷28440 ↓ 1km = 0.126...

×100 ↓ 100km = 12.658...

nearest second

13 seconds

(Total for Question 6 is 3 marks)

7 (a) Solve $5(4 - x) = 7 - 3x$

Show clear algebraic working.

$20 - 5x = 7 - 3x$

$+5x \qquad +5x$

$20 = 7 + 2x$

$-7 \qquad -7$

$13 = 2x$

$\frac{13}{2} = x$

$x = 6.5$

$x =$ 6.5

(3)

(b) Factorise fully $16m^3g^3 + 24m^2g^5$

$8m^2g^3(2m + 3g^2)$

(2)

(c) (i) Factorise $y^2 - 2y - 48$

6, 8

+6 −8

$(y + 6)(y - 8)$

(2)

(ii) Hence, solve $y^2 - 2y - 48 = 0$

$(y + 6)(y - 8) = 0$

$y = -6 \quad y = 8$

$y = -6 \quad y = 8$

(1)

(Total for Question 7 is 8 marks)

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8 Here is a 10-sided polygon.

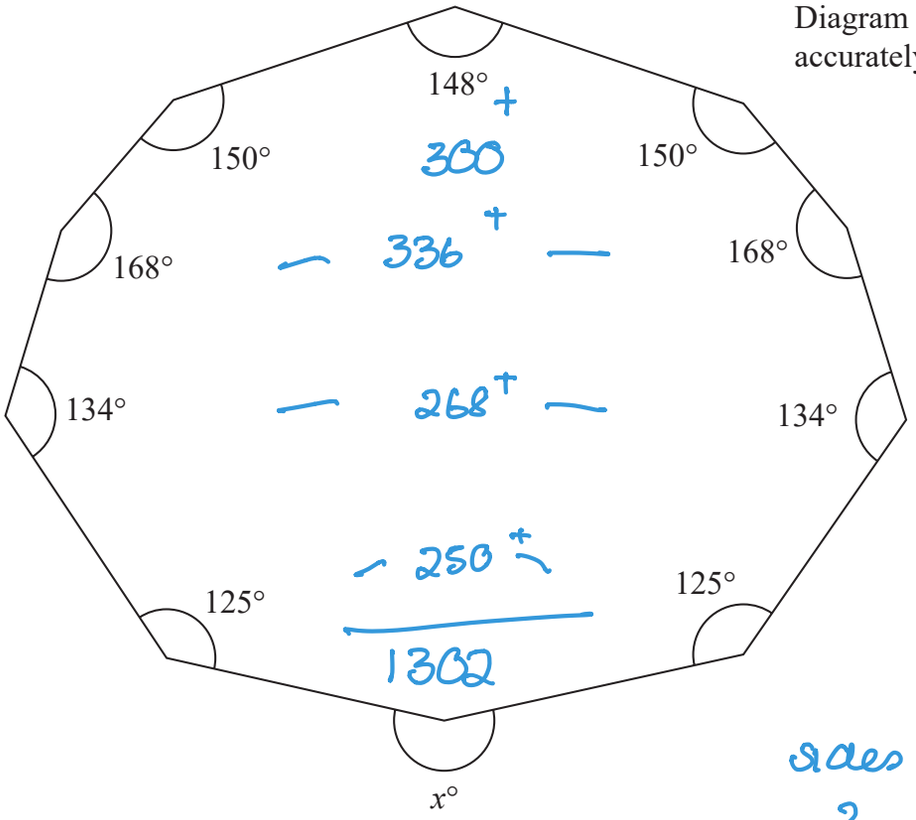

Diagram **NOT** accurately drawn

148° + 150° + 150° + 168° + 168° = 336 + 134° + 134° = 268 + 125° + 125° = 250 + x° = 1302

sides	angles
3	180
4	360
5	540
6	720
7	900
8	1080
9	1260
10	1440

Work out the value of x.

interior angle

1440 - 1302

= 138

so x = 360 - 138

= 222

$x =$ 222

(Total for Question 8 is 4 marks)

9 In a sale, normal prices are reduced by 20%

A bag costs 1080 rupees in the sale.

Work out the normal price of the bag.

80% = 1080 ÷80
1% = 13·5 ×100
100% = 1350
÷80 ×100

1350 rupees

(Total for Question 9 is 3 marks)

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

10 $A = 2 \times 3^{43}$
$B = 16 \times 3^{37}$

(a) Find the highest common factor (HCF) of A and B.

$A = 2 \times 3^{43}$
$B = 2^4 \times 3^{37}$

2×3^{37}

(1)

(b) Express the number $A \times B$ as a product of powers of its prime factors.
Give your answer in its simplest form.

$A \times B = 2^{1+4} \times 3^{43+37}$

$2^5 \times 3^{80}$

(2)

(Total for Question 10 is 3 marks)

11 The diagram shows trapezium $ABCD$ in which BC and AD are parallel.

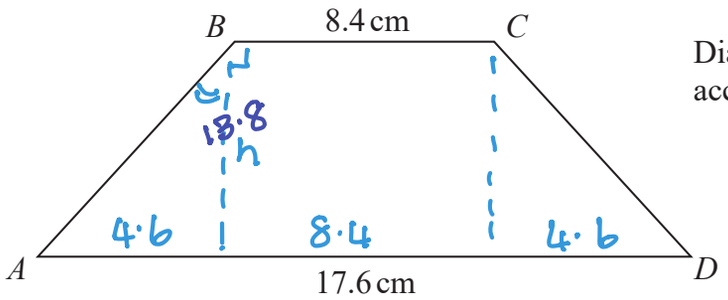

Diagram **NOT** accurately drawn

The trapezium has exactly one line of symmetry.

$BC = 8.4\,\text{cm}$
$AD = 17.6\,\text{cm}$

The trapezium has area $179.4\,\text{cm}^2$

Work out the size of angle ABC.
Give your answer correct to 1 decimal place.

$17.6 - 8.4$
$= 9.2$
$9.2 \div 2 = 4.6$

$\text{Area} = 179.4 = \frac{1}{2}(8.4 + 17.6) \times h$

$2 \times 179.4 = 26h$

$h = 13.8$

$\tan x = \frac{4.6}{13.8}$

$x = \tan^{-1} \frac{4.6}{13.8}$

$= 18.4349..$

$A\hat{B}C = 18.43.. + 90$

$= 108.4349...$
$\uparrow$
(1 dp)

108.4 °

(Total for Question 11 is 6 marks)

12 Solve the simultaneous equations

$$\begin{aligned} &(1)\quad 7x - 2y = 34 \quad \times 5 \\ &(2)\quad 3x + 5y = -3 \quad \times 2 \end{aligned}$$

Show clear algebraic working.

$35x - 10y = 170$

$6x + 10y = -6$

$41x = 164$

$x = \frac{164}{41}$

$= 4$

sub in (1)

$7 \times 4 - 2y = 34$

$28 - 34 = 2y$

$2y = -6$

$y = -3$

$x =$ 4

$y =$ -3

(Total for Question 12 is 4 marks)

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

13 Jan invests \$8000 in a savings account.
The account pays compound interest at a rate of x% per year.

At the end of 6 years, there is a total of \$8877.62 in the account.

Work out the value of x.
Give your answer correct to 2 decimal places.

$$8000 \times \left(\frac{100+x}{100}\right)^6 = 8877.62$$

$$\frac{100+x}{100} = \sqrt[6]{\frac{8877.62}{8000}}$$

$$= 1.0175...$$

$$x = (1.0175.. \times 100) - 100$$

$$= 1.75$$

$x =$ 1.75

(Total for Question 13 is 3 marks)

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

14 F is inversely proportional to the square of v.

Given that $F = 6.5$ when $v = 4$

find a formula for F in terms of v.

$F \propto \frac{1}{v^2}$ $\quad F = \frac{k}{v^2}$ $\quad 6.5 \times 4^2 = k$

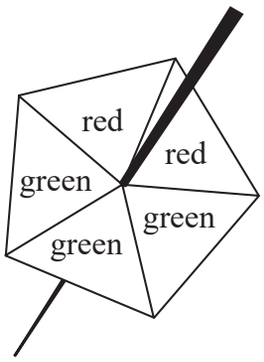
$k = 104$

$\therefore \quad F = \frac{104}{v^2}$

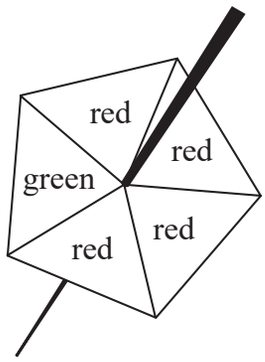
$F = \frac{104}{v^2}$

(Total for Question 14 is 3 marks)

15 Harry has two fair 5-sided spinners.



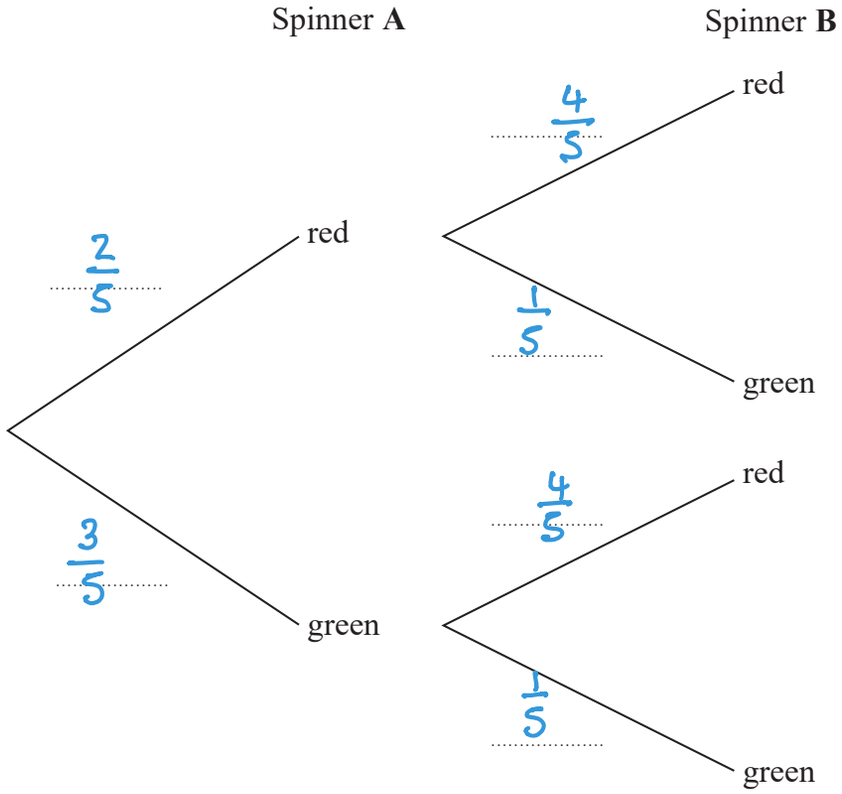
Spinner **A**



Spinner **B**

Harry is going to spin each spinner once.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that at least one of the spinners will land on green.

$P(R,G) + P(G,R) + P(G,G)$

$= \frac{2}{5} \times \frac{1}{5} + \frac{3}{5} \times \frac{4}{5} + \frac{3}{5} \times \frac{1}{5}$

$= \frac{2}{25} + \frac{12}{25} + \frac{3}{25}$

$\frac{17}{25}$

(3)

(Total for Question 15 is 5 marks)

16

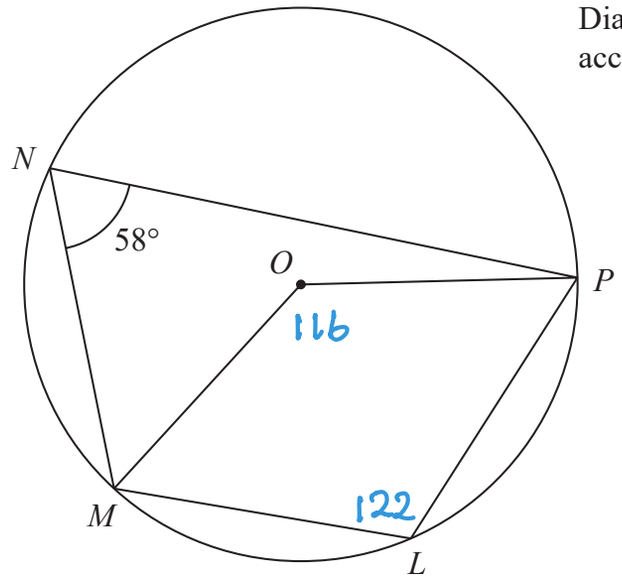


Diagram **NOT** accurately drawn

L, *M*, *N* and *P* are points on a circle, centre *O*

Angle *MNP* = 58°

(a) (i) Find the size of angle *MLP*

180 - 58 = 122

122 °

(ii) Give a reason for your answer.

opposite angles in a cyclic quadrilateral add up to 180

(2)

(b) Find the size of the reflex angle *MOP*

58 x 2 = 116

360 - 116 = 244

244 °

(2)

(Total for Question 16 is 4 marks)

17 A metal block has a mass of 5 kg, correct to the nearest 50 grams.
The block has a volume of (1.84×10^{-3}) m^3, correct to 3 significant figures.

Work out the upper bound for the density of the block.
Give your answer in kg/m^3 correct to 1 decimal place.
Show your working clearly.

$m = 5000g$ ↗ 5025 ↘ 4975

Volume $= 1.84 \times 10^{-3}$ ↗ 1.845×10^{-3} ↘ 1.835×10^{-3}

$D = \frac{m \uparrow}{V \downarrow}$

$= \frac{5025}{1.835 \times 10^{-3}}$

$= 2738419.619$ g/m^3

$\div 1000 = 2738.419$

2738.4 kg/m^3

units!

(Total for Question 17 is 4 marks)

DO NOT WRITE IN THIS AREA

P 6 2 6 5 2 A 0 1 9 2 8

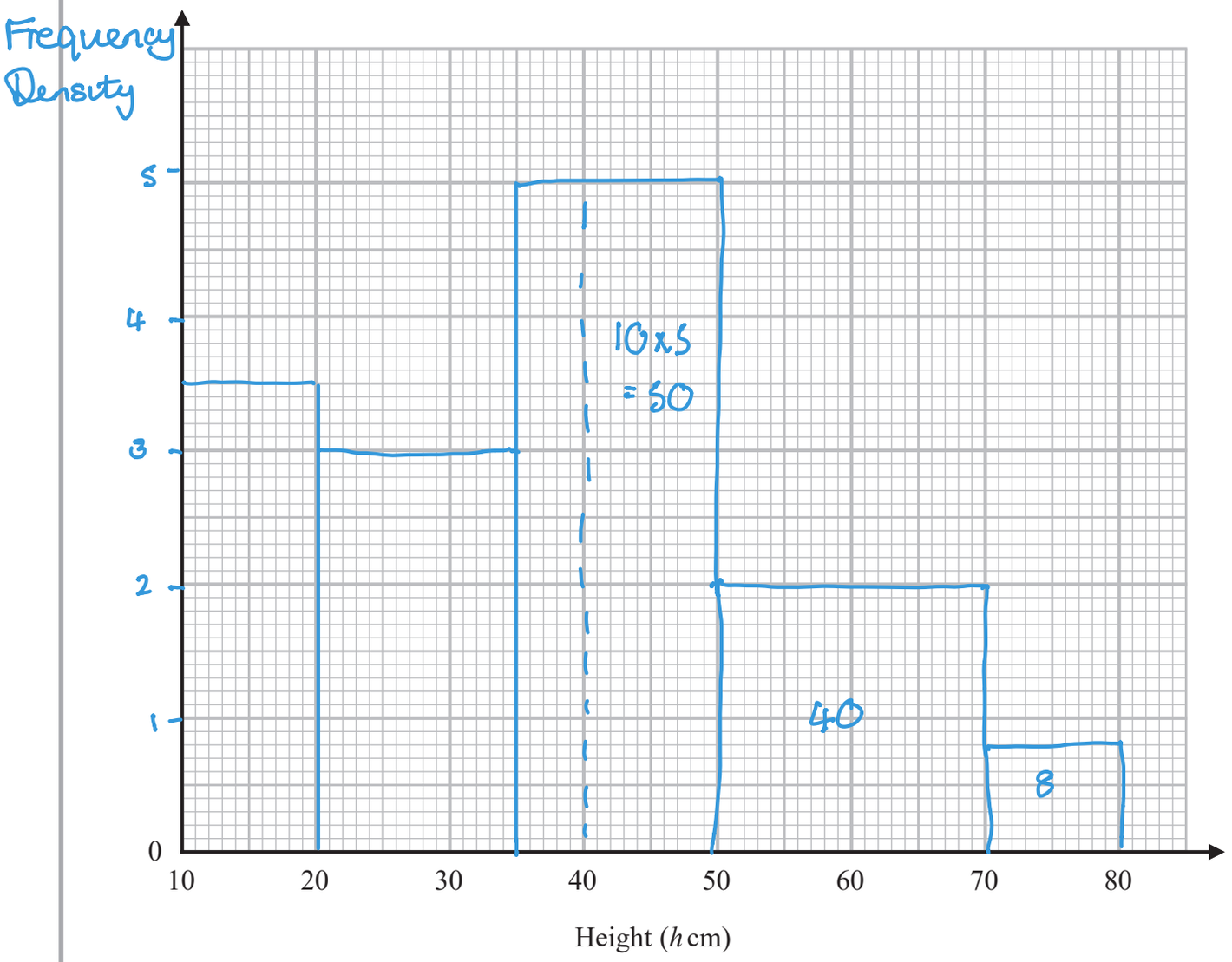
Turn over

18 The table gives information about the heights, in centimetres, of some plants.

F. density
35 ÷ 10 = 3.5
45 ÷ 15 = 3
75 ÷ 15 = 5
40 ÷ 20 = 2
8 ÷ 10 = 0.8

Height (h cm)	Frequency
$10 < h \leqslant 20$	35
$20 < h \leqslant 35$	45
$35 < h \leqslant 50$	75
$50 < h \leqslant 70$	40
$70 < h \leqslant 80$	8

(a) On the grid, draw a histogram for this information.



(3)

(b) Work out an estimate for the number of these plants with a height greater than 40 cm.

$50 + 40 + 8 = 98$

98

(2)

(Total for Question 18 is 5 marks)

19 Without using a calculator, rationalise the denominator of $\frac{6}{3-\sqrt{7}}$

Simplify your answer.
You must show each stage of your working.

$$\frac{6}{3-\sqrt{7}} \times \frac{3+\sqrt{7}}{3+\sqrt{7}}$$

$$= \frac{18+6\sqrt{7}}{9-7}$$

$$= \frac{18+6\sqrt{7}}{2}$$

$$= \frac{18}{2} + \frac{6\sqrt{7}}{2}$$

$$= 9 + 3\sqrt{7}$$

$9 + 3\sqrt{7}$

(Total for Question 19 is 3 marks)

20 **R** and **S** are two similar solid shapes.

Shape **R** has surface area 108 cm^2 and volume 135 cm^3
Shape **S** has surface area 300 cm^2

Work out the volume of shape **S**.

R S

area 108 300

area SF = $\frac{25}{9}$

length SF = $\frac{5}{3}$

Vol SF = $\left(\frac{5}{3}\right)^3 = \frac{125}{27}$

Vol S = $135 \times \frac{125}{27}$

$= 625$

625 ..... cm^3

(Total for Question 20 is 3 marks)

21 Express

$$\frac{1}{3x-2} \times \frac{9x^2-4}{3x^2-13x-10} - \frac{7}{x-1}$$

as a single fraction in its simplest form.

$(9x^2-4) = (3x+2)(3x-2)$

$(3x^2-13x-10) = (3x+2)(x-5)$

so:- $\dfrac{(3x+2)(3x-2)}{(3x-2)(3x+2)(x-5)} - \dfrac{7}{x-1}$

$= \dfrac{(x-1) - 7(x-5)}{(x-5)(x-1)}$

$= \dfrac{x-1-7x+35}{(x-5)(x-1)}$

$= \dfrac{34+6x}{(x-5)(x-1)}$

$= \dfrac{2(17+3x)}{(x-5)(x-1)}$

$\dfrac{2(17+3x)}{(x-5)(x-1)}$

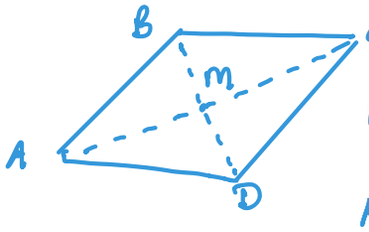
(Total for Question 21 is 5 marks)

22 $ABCD$ is a rhombus.

The diagonals, AC and BD, intersect at the point M.
The coordinates of M are $(6, -11)$

The points A and C both lie on the line with equation $2y + 7x = 20$

Find the exact coordinates of the point where the line through B and D intersects the y-axis.



$M = (6, -11)$

$AC = ?$ $\quad 2y = -7x + 20$

$y = -\frac{7}{2}x + 10$

gradient $BD = \frac{2}{7}$

line BD $\quad y = \frac{2}{7}x + c$

$x = 6$
$y = -11$ $\quad -11 = \frac{2}{7} \times 6 + c$

$-11 - \frac{12}{7} = c$

$c = -\frac{89}{7}$

$y = \frac{2}{7}x - \frac{89}{7}$

intersects y axis when $x = 0$ $y = -\frac{89}{7}$

(0 , $-\frac{89}{7}$)

(Total for Question 22 is 4 marks)

23 Curve **C** has equation $y = px^3 - mx$ where p and m are positive integers.

Find the range of values of x, in terms of p and m, for which the gradient of **C** is negative.

$$\frac{dy}{dx} = 3px^2 - m$$

$$3px^2 - m < 0$$

$$x < \pm\sqrt{\frac{m}{3p}}$$

$$-\sqrt{\frac{m}{3p}} < x < \sqrt{\frac{m}{3p}}$$

(Total for Question 23 is 4 marks)

24 Here are the first five terms of an arithmetic sequence.

8 , 15 , 22 , 29 , 36

Work out the sum of all the terms from the 50th term to the 100th term inclusive.

$S_{100} = \frac{100}{2}(2\times 8 + (100-1)\times 7) = 35450$

$S_{50} = \frac{50}{2}(2\times 8 + (50-1)\times 7) = 8975$ ×

need S_{49}

$S_{49} = \frac{49}{2}(2\times 8 + (49-1)\times 7) = 8624$

$35450 - 8624$

$= 26826$

26826

(Total for Question 24 is 4 marks)

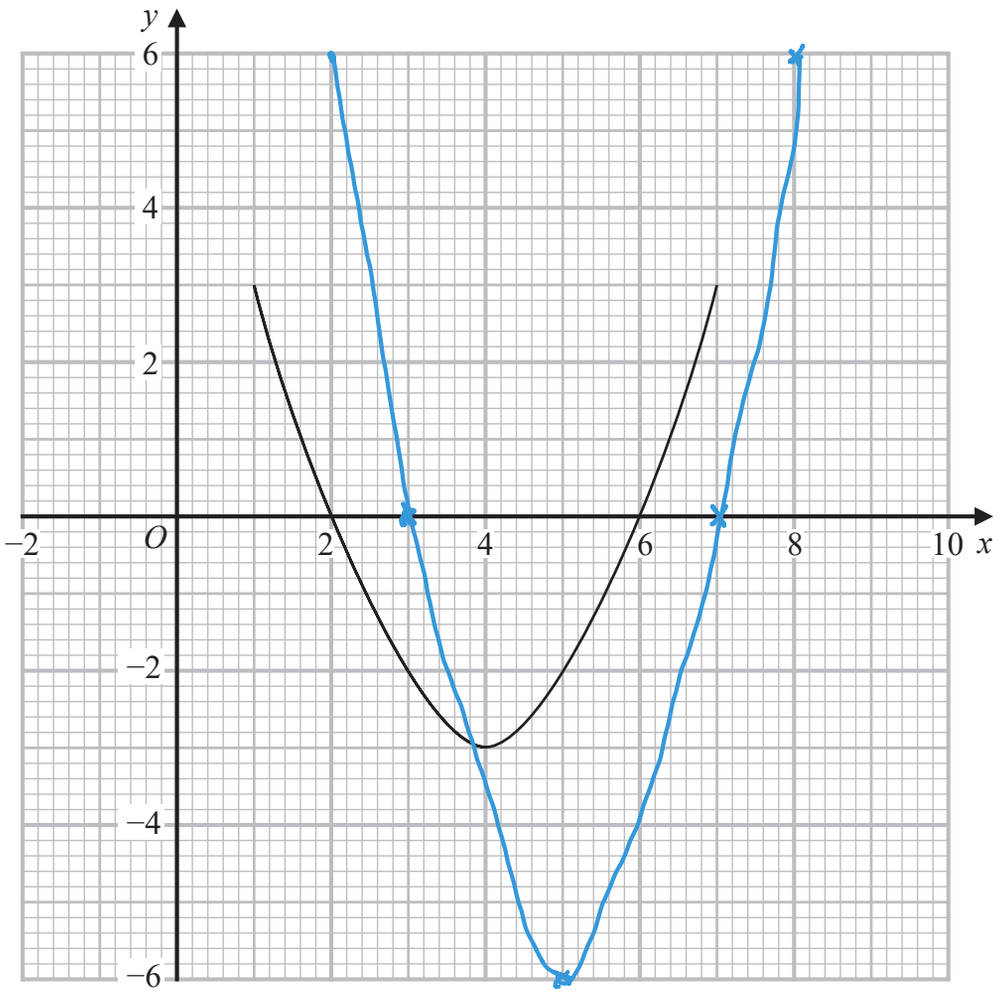
25 The curve with equation $y = g(x)$ is transformed to the curve with equation $y = -g(x)$ by the single transformation **T**.

(a) Describe fully the transformation **T**.

Reflection in the line $y = 0$

(1)

The diagram shows the graph of $y = f(x)$



(b) On the grid, draw the graph of $y = 2f(x - 1)$

(2)

(Total for Question 25 is 3 marks)

TOTAL FOR PAPER IS 100 MARKS