1 The table shows the probabilities that a biased dice will land on 2, on 3, on 4 and on 5.

Number on dice	1	2	3	4	5	6
Probability	x	0.1	0.17	0.12	0.09	$3x$

The probability the dice lands on 6 is three times the probability the dice land on 1.

Fred rolls the biased dice 200 times.

Work out an estimate for the total number of times the dice will land on 6.

$$x + 0.1 + 0.17 + 0.12 + 0.09 + 3x = 1$$

$$4x + 0.48 = 1$$

$$4x = 0.52$$

$$x = 0.13 \quad \leftarrow P(1)$$

$$3x = 3 \times 0.13 = 0.39 \quad \leftarrow P(6)$$
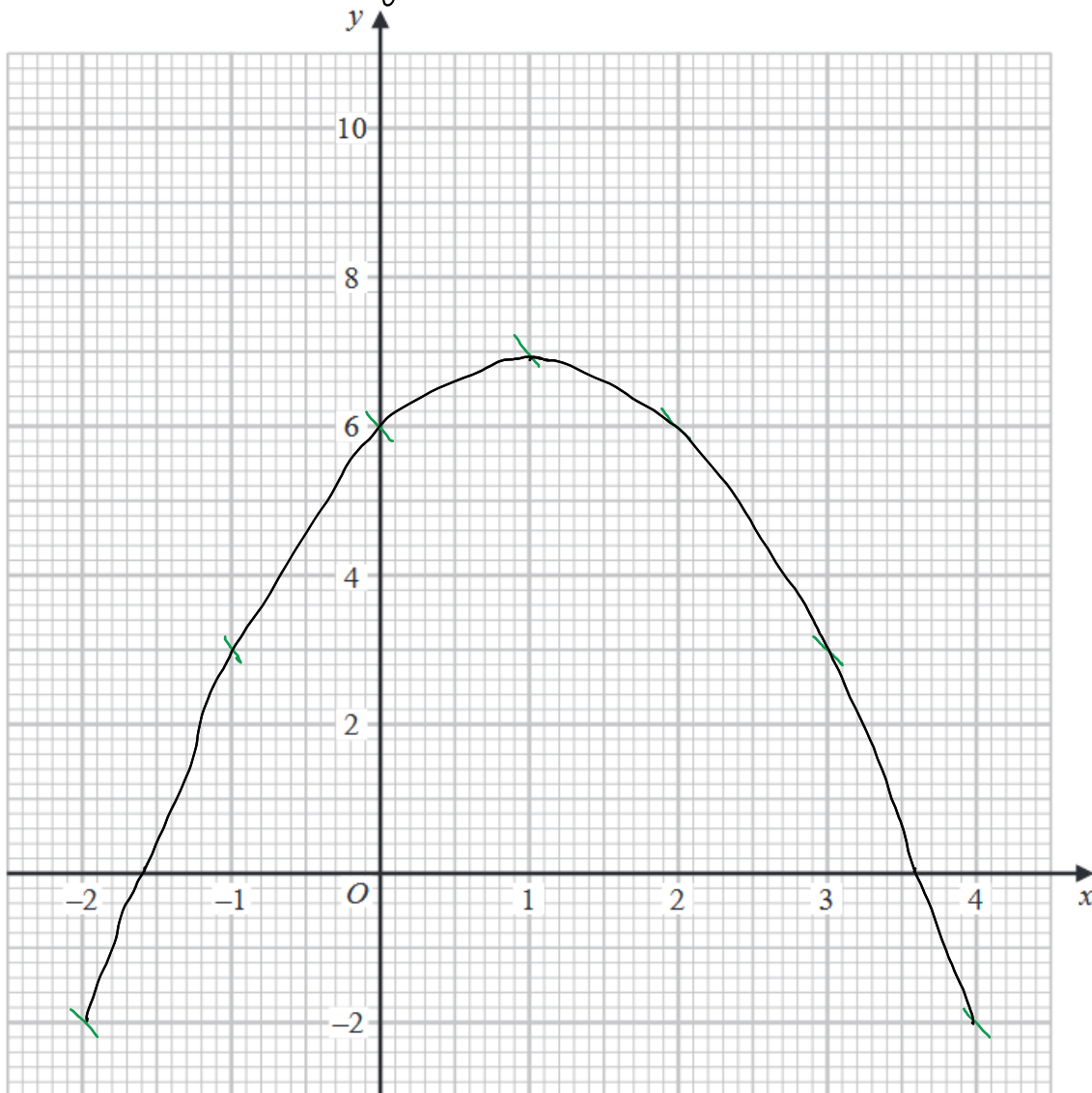
$$200 \times 0.39 = 78$$

78

(Total for Question 1 is 3 marks)

2 (a) Complete the table of values for $y = 2x + 6 - x^2$

x	-2	-1	0	1	2	3	4
y	**-2**	3	**6**	**7**	6	**3**	**-2**

(2)

(b) On the grid, draw the graph of $y = 2x + 6 - x^2$ for values of x from –2 to 4

(c) Use your graph to find estimates of the solutions of the equation $2x + 6 - x^2 = 0$

−1.6 & 3.6

(2)

(Total for Question 2 is 6 marks)

3 Use your calculator to work out $\sqrt{\dfrac{\tan 20° + \sin 25°}{\tan 25° - \sin 20°}}$

(a) Write down all the figures on your calculator display.

2.515706913

(2)

(b) Write your answer to part (a) correct to 2 decimal places.

2.52

(1)

(Total for Question 3 is 3 marks)

4 Work out $(2.16 × 10^{-5}) ÷ (2.5 × 10^{-4})$
Give your answer in standard form.

$$\dfrac{2.16 \times 10^{-5}}{2.5 \times 10^{-4}}$$

$$= 0.0864$$

$$= 8.64 \times 10^{-2}$$

8.64 × 10⁻²

(Total for Question 4 is 2 marks)

5 The density of orange cordial is 1.21 grams per cm^3.

The density of carbonated water is 1.01 grams per cm^3.

An drink with a volume of 280 cm^3 is made by mixing 1 part of orange cordial with 7 parts of carbonated water.

Work out the density of the drink.

$1 + 7 = 8$ parts

$280 \div 8 = 35$

35 cm^3 of cordial

$35 \times 7 = 245$ cm^3 of water

Mass = Density $\times$ Volumn

Cordial Mass $= 1.21 \times 35 = 42.35$

Water Mass $= 1.01 \times 245 = 247.45$

Density $= \dfrac{42.35 + 247.45}{280}$

$= 1.035$

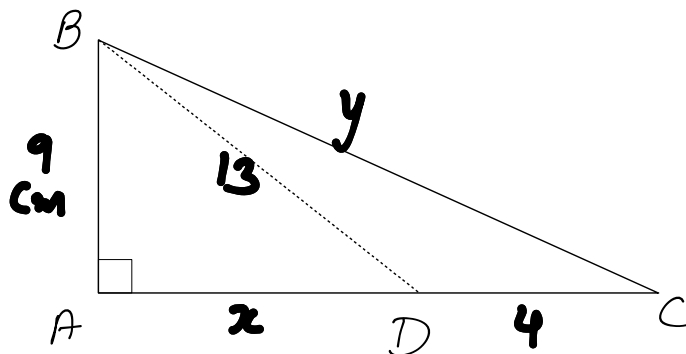.........................1.035......................... g/cm^3

(Total for Question 5 is 4 marks)

Density $= \dfrac{mass}{volumn}$

6 ABC is a right-angled triangle.

The point D lies on the line AC.
AB = 9 cm
BD = 13 cm
CD = 4 cm

Work out the perimeter of triangle ABC.
Give your answer correct to 3 significant figures.

In $\triangle ABD$, $x^2 + 9^2 = 13^2$

$x^2 = 169 - 81$

$x = 9.38$ cm

$AC = 9.38 + 4 = 13.38$ cm

In $\triangle ABC$, $9^2 + 13.38^2 = y^2$

$y = \sqrt{9^2 + 13.38^2}$

$y = 16.13$ cm

Perimeter

$= 9 + 16.13 + 13.38$

$= 38.5$ cm

$\underline{38.5}$ cm

(Total for Question 6 is 4 marks)

7 A number, m, is rounded to 1 decimal place.
The result is 9.4

Complete the error interval for

$0.1 \div 2 = 0.05$
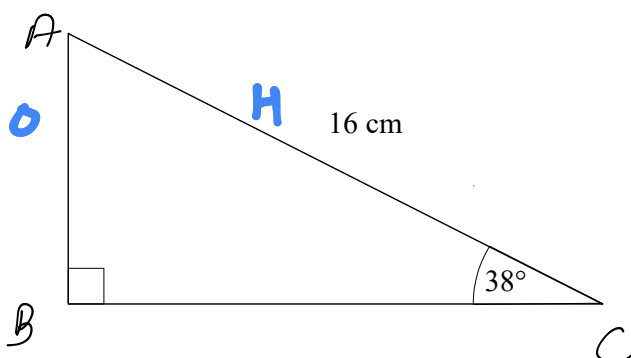
$L \rightarrow 9.4 - 0.05$

$U \rightarrow 9.4 + 0.05$

_____9.35_____ ≤ _____9.45_____

(Total for Question 7 is 2 marks)

8 ABC is a right-angled triangle.

A
O
H   16 cm
38°
B
C

Calculate the length of AB.
Give your answer correct to 2 decimal places.

$\sin \theta = \dfrac{O}{H}$

$\sin 38° = \dfrac{AB}{16}$

$AB = 16 \times \sin 38°$

$= 9.85 \text{ cm}$

_____9.85_____ cm

(Total for Question 8 is 2 marks)

SOH   CAH   TOA

9 Holly recorded the heights, in centimetres, of some girls.
She used her results to work out the information in this table.

$Max = Range + Min$

$= 42 + 144$

$= 186$

Least height	144 cm
Interquartile range	19 cm
Median	161 cm
Upper quartile	174 cm
Range	42 cm

$LQ = UQ - IQR$

$= 174 - 19$

$= 155$

Holly drew this box plot for the information in the table.
The box plot is not fully correct

Height (centimetres)
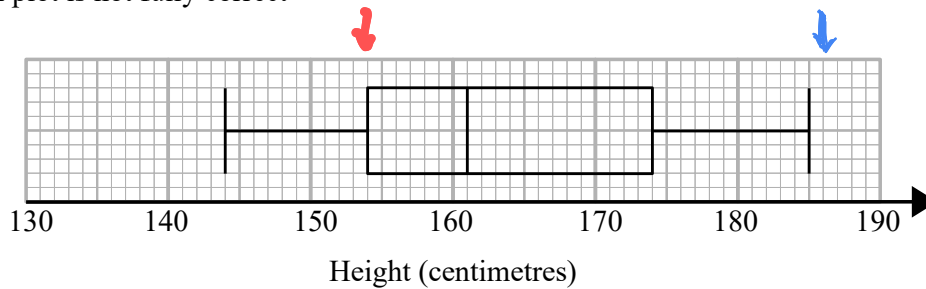
Write down the two things Holly should do to make the box plot fully correct.

1 The lower quartile should be at 155 not 154.

2 The greatest height should be at 186 not 185.

(Total for Question 9 is 2 marks)

10 A group of people did a test.

the number of children who took the test : the number of adults who took the test = 3 : 5

the number of children who passed the test : the number of children who failed the test = 4 : 1

the number of adults who passed the test : the number of adults who failed the test = 7 : 2

What fraction of the people passed the test?
You must show how you get your answer.

(diagram: tree)

4/5 → Pass ←

3/8 Children

1/5 → Fail

5/8 Adult 7/9 → Pass ←

2/9 → Fail
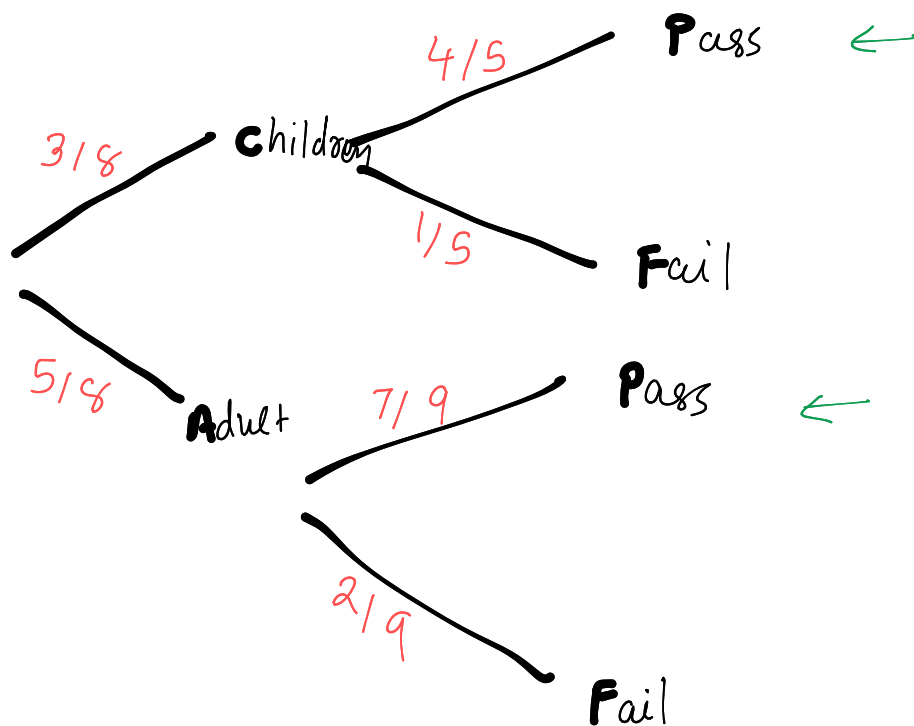
$$\left(\frac{3}{8} \times \frac{4}{5} \right) + \left(\frac{5}{8} \times \frac{7}{9} \right)$$

$$\frac{3}{10} + \frac{35}{72} = \frac{283}{360}$$

$$\frac{283}{360}$$

(Total for Question 10 is 4 marks)

11   Yesterday it took 7 cleaners <u>3 hours and 20 minutes</u> to clean all the rooms in a hotel.

There are only 4 cleaners to clean all the rooms in the hotel today.

Each cleaner is paid <u>£11.50</u> for each hour or part of an hour they work.

How much will each cleaner be paid today?

$$7 \times 3\frac{1}{3} \qquad (\because 20 \text{ mins} = \frac{1}{3} \text{ hour})$$

$$= 7 \times \frac{10}{3} \quad = \frac{70}{3}$$

$$= 23.\dot{3} \text{ hours}$$

$$\frac{23.\dot{3}}{4} = 5.8\dot{3} \text{ hours per cleaner}$$

£   **69**

$$6 \times 11.50 = £69$$

(Total for Question 11 is 3 marks)

12   Megan invested £17500 in a savings account for 3 years.

She was paid <u>3.9% per an</u>num compound interest for each of the <u>first 2 years</u>.
She was paid   % interest for the third year.

Megan had £19307.23 in her savings account at the end of the 3 years.

Work out the value of   .
Give your answer correct to 1 decimal place.

$$17500 \times 1.039^{2} \times x = 19307.23$$
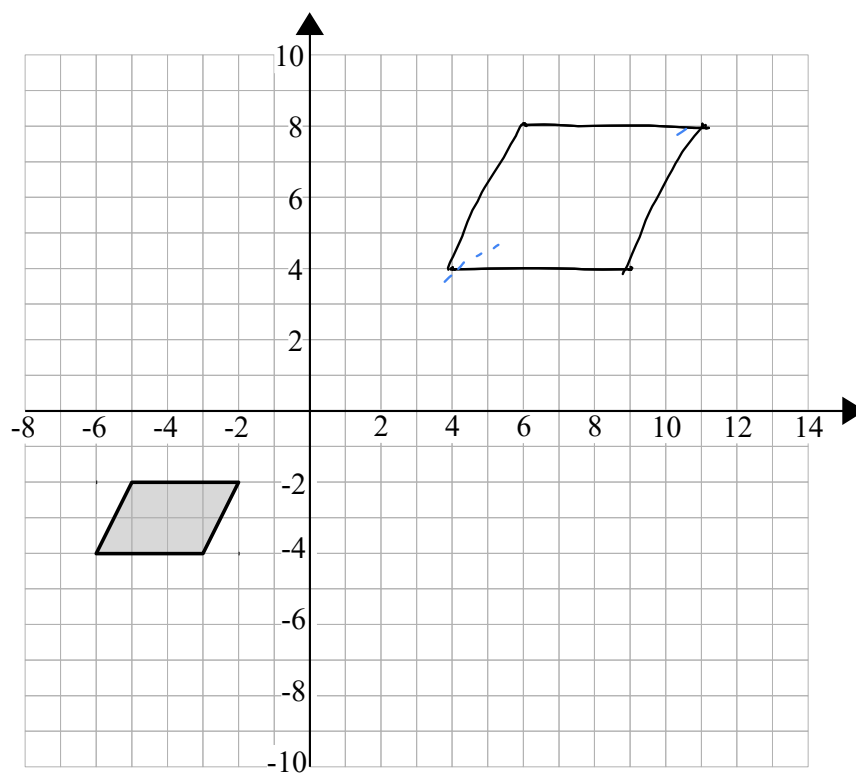
$$x = \frac{19307.23}{17500 \times 1.039^{2}}$$

$$x = 1.022$$

2.2

$$1.022 = 102.2\% = 2.2\uparrow$$

(Total for Question 12 is 3 marks)

13

Enlarge the shaded shape by scale factor –2 with centre of enlargement (0, 0)

(Total for Question 13 is 2 marks)

$$-2 \times \begin{pmatrix} -2 \\ -2 \end{pmatrix} = \begin{pmatrix} 4 \\ 4 \end{pmatrix}$$

$$-2 \times \begin{pmatrix} -6 \\ -4 \end{pmatrix} = \begin{pmatrix} 12 \\ 8 \end{pmatrix}$$

$$-2 \times \begin{pmatrix} -5 \\ -2 \end{pmatrix} = \begin{pmatrix} 10 \\ 4 \end{pmatrix}$$

$$-2 \times \begin{pmatrix} -3 \\ -4 \end{pmatrix} = \begin{pmatrix} 6 \\ 8 \end{pmatrix}$$

14 (a) Write $\dfrac{x^3 - 4x}{3x - 6} \div \dfrac{x^2 - x}{5}$ in the form $\dfrac{ax + b}{cx + d}$ where a, b, c and d are integers.

$$\frac{x(x^2 - 4)}{3(x - 2)} \div \frac{x(x - 1)}{5}$$

$$\frac{x(x - 2)(x + 2)}{3(x - 2)} \times \frac{5}{x(x - 1)}$$

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

$$\frac{5x + 10}{3x - 3}$$

(3)

(b) Express $\dfrac{3}{x - 1} + \dfrac{2x}{x - 2} - 2$ as a single fraction in its simplest form.

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

$$\frac{3x - 6 + 2x^2 - 2x - 2(x^2 - 3x + 2)}{(x - 1)(x - 2)}$$

$$\frac{2x^2 + x - 6 - 2x^2 + 6x - 4}{(x - 1)(x - 2)}$$

$$\frac{7x - 10}{(x - 1)(x - 2)}$$

$$\frac{7x - 10}{(x - 1)(x - 2)}$$

(3)

(Total for Question 14 is 6 marks)

15 (a) Use the iteration formula $x_{n+1} = \sqrt[3]{8 - 3x_n}$ to find the values of x_1, x_2 and x_3

Start with $x_0 = 2$

$$x_1 = \sqrt[3]{8 - 3(2)} = 1.2599\ldots$$

$$x_2 = \sqrt[3]{8 - 3(1.2599\ldots)} = 1.6160\ldots$$

$$x_3 = \sqrt[3]{8 - 3\,(Ans)}$$

1

$x_1 = 1.25992105$

$x_2 = 1.616019822$

$x_3 = 1.466230026$

(3)

The values of x_1, x_2 and x_3 found in part (a) are estimates of the solution of an equation of the form $x^3 + qx + b = 0$ where and are integers.

(b) Find the value of a and the value of b.

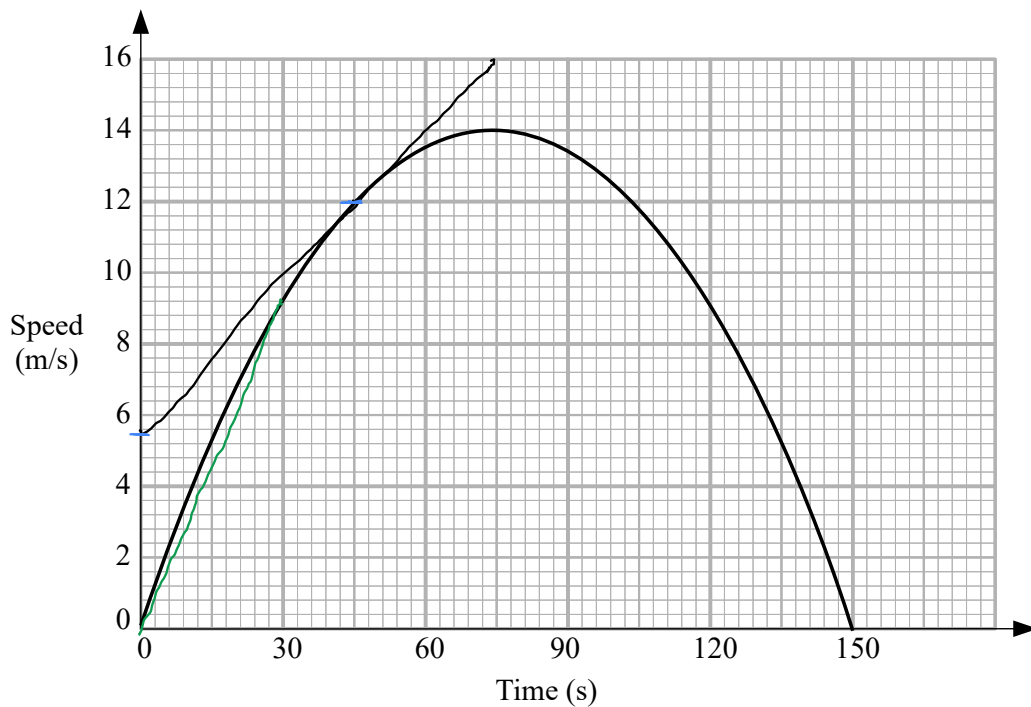$$x = \sqrt[3]{8 - 3x}$$

$$x^3 = 8 - 3x$$

$$x^3 + 3x - 8 = 0$$

$a = 3$

$b = -8$

(1)

(Total for Question 15 is 4 marks)

16   Here is a speed-time graph for a car.

(a) Work out an estimate for the distance the car travelled in the first 30 seconds.

$$\frac{1}{2} \times 9.2 \times 30$$

$$= 15 \times 9.2$$

_____**138**_____ m

(2)

(b) Work out an estimate for the acceleration of the car at time 45 seconds.
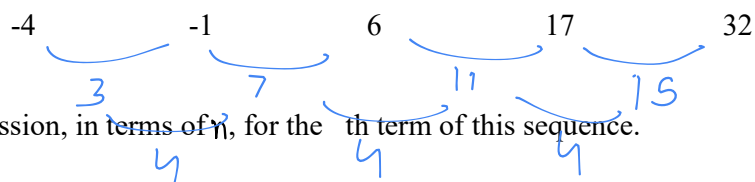
$$(45, 12) \quad (0, 5.8)$$

$$m = \frac{dy}{dx} = \frac{12 - 5.8}{45 - 0}$$

_____**0.137**_____ m/s²

(2)

(Total for Question 16 is 4 marks)

17 Here are the first five terms of a sequence.

$$-4 \qquad -1 \qquad 6 \qquad 17 \qquad 32$$

3   7   11   15

4   4   4

Find an expression, in terms of n, for the nth term of this sequence.

$a = \dfrac{4}{2} = 1$

$2n^2$

original : -4 -1 6 17 32

$2n^2$: 2 8 18 32 50

difference : -6 -9 -12 -15 -18

-3 -3 -3 -3 $\leftarrow$ linear

$-3n - 3$

$2n^2 - 3n - 3 \leftarrow n^{th}$ term

$$2n^2 - 3n - 3$$

(Total for Question 17 is 2 marks)

18 ABC and ADC are triangles.
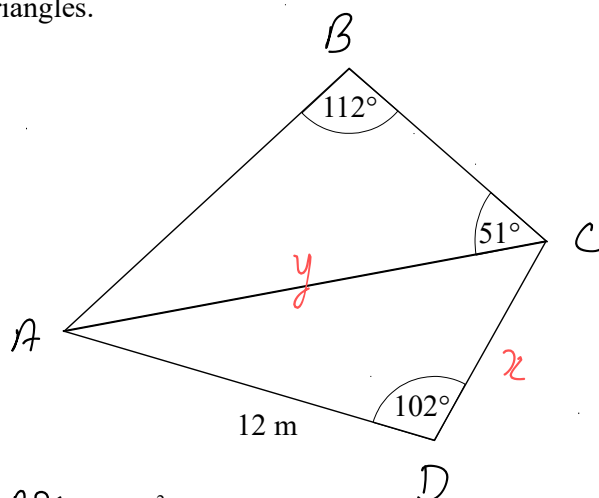
The area of triangle ADC is 58 m²

Work out the length of AB

Give your answer correct to 1 decimal place.

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

$$58 = \frac{1}{2}(12)(x) \sin(102)$$

$$x = \frac{58 \times 2}{12 \times \sin 102} \qquad \therefore x = 9.88 \text{ m}$$

$$y^2 = 12^2 + 9.88^2 - 2(12)(9.88)\cos(102)$$

$$= 290.98$$

$$y = 17.058 \text{ m}$$

$$\frac{AB}{\sin 51} = \frac{17.058}{\sin 112}$$

$$AB = \frac{17.058 \times \sin 51}{\sin 112}$$

14.3 .... m

(Total for Question 18 is 5 marks)

$$= 14.3$$

19   **A**, **B** and **C** are three spheres.

The surface area of sphere **A** is 25 cm³
The surface area of sphere **B** is 36 cm³

The ratio of the radius of sphere **B** to the radius of sphere **C** is 2 : 3

Work out the ratio of the volume of sphere **A** to the volume of sphere **C**.

ASF →
$$A : B$$
$$25 : 36$$
$$\sqrt{25} : \sqrt{36}$$
LSF → $5 : 6$

$A : B$ | $B : C$
$5 : 6$ | $2 : 3$ × 3
      | $6 : 9$

$A : B : C$
LSF → $5 : 6 : 9$
VSF → $5^3 : 6^3 : 9^3$

$125 : 216 : 729$

125 : 729

(Total for Question 19 is 3 marks)

20 The histogram gives information about the heights, in metres, of the trees in a park.
The histogram is incomplete.

Frequency density (y-axis), Height (metres) (x-axis)

Handwritten annotations on histogram: 4, 6, 16, 13, 11
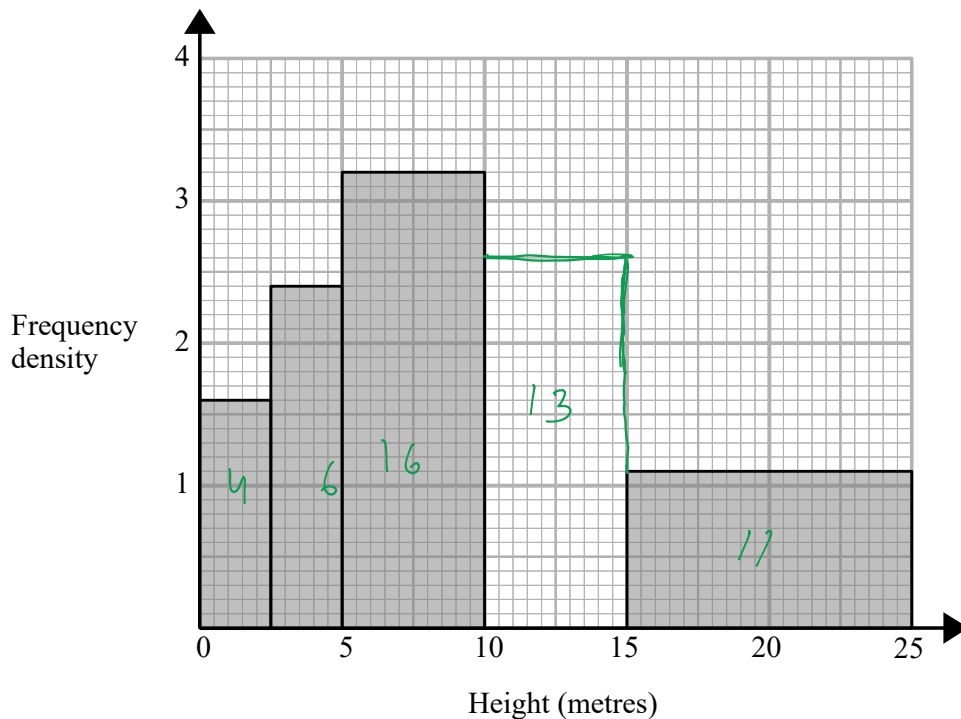
12% of the trees in the park have a height between 2.5 metres and 5 metres.
None of the trees in the park have a height greater than 25 metres.

Complete the histogram

$2.5 \times 1.6 = 4$

$2.5 \times 2.4 = 6$

$5 \times 3.2 = 16$

$10 \times 1.1 = 11$

12% →

6 trees = 12%

∴ 1 tree = 2%

50 tree = 100%

$4 + 6 + 16 + 11 = 37$

$50 - 37 = 13$ trees (Area)

$FD = \frac{13}{5} = 2.6$

(Total for Question 20 is 3 marks)

21   There are 15 counters in a bag.
        There is an equal number of red counters, blue counters and yellow counters in the bag.

        5 R   5 B   5 Y

        There are no other counters in the bag.

        3 counters are taken at random from the bag.

        Work out the probability of taking one counter of each colour.

$$P(RBY) = \frac{5}{15} \times \frac{5}{14} \times \frac{5}{13} = \frac{25}{546}$$

$+$

$$P(RYB) + P(BRY) + P(BYR) +$$

$$P(YRB) + P(YBR)$$

$$= 6 \times \frac{25}{546}$$

$$= \frac{25}{91}$$

22   Solve algebraically the simultaneous equations

$$2x^2 + y^2 = 12$$
$$5x + 2y = 6$$

$$2y = 6 - 5x$$

$$y = \frac{6 - 5x}{2}$$

$$2x^2 + \left(\frac{6 - 5x}{2} \right)^2 = 12$$

$$2x^2 + \frac{36 - 30x - 30x + 25x^2}{4} = 12$$

$$8x^2 + 36 - 60x + 25x^2 = 48$$

$$33x^2 - 60x - 12 = 0 \quad (\text{now} \div 3)$$

$$11x^2 - 20x - 4 = 0$$

$$(11x + 2)(x - 2) = 0$$

$$x = \frac{-2}{11} \qquad\qquad x = 2$$

$$y = \frac{6 - 5\left(\frac{-2}{11}\right)}{2} \qquad y = \frac{6 - 5(2)}{2} = -2$$

$$y = \frac{38}{11}$$

$$(2, -2) \quad \text{or} \quad \left(\frac{-2}{11}, \frac{38}{11} \right)$$
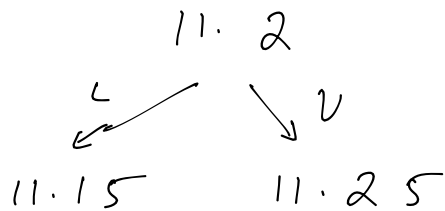
(Total for Question 22 is 5 marks)

23 $d = \frac{1}{5}c^3$

$C = 11.2$ correct to 3 significant figures.
By considering bounds, work out the value of d to a suitable degree of accuracy.
Give a reason for your answer.

11.2

L   V

11.15   11.25

Upper bound $= \frac{1}{5}(11.25)^3$

$= 284.7656\ldots$

Lower bound $= \frac{1}{5}(11.15)^3$

$= 277.2391\ldots$

Both upper & lower bounds
round to 280 when nearest 10
or 2 s.f.

(Total for Question 23 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS