1 (a) Simplify $n^3 \times n^5$

n^8

(1)

(b) Simplify $\frac{c^3d^4}{c^2d}$

cd^3

(2)

(c) Solve $\frac{5x}{2} > 7$

$\times 2 \quad \times 2$

$5x > 14$

$\div 5 \quad \div 5$

$x > 2.8$

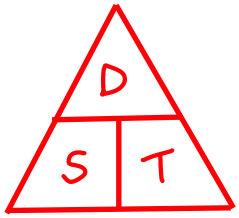
$x > 2.8$

(2)

(Total for Question 1 is 5 marks)

2 Andy cycles a distance of 30 km at an average speed of 24 km/h.
He then runs a distance of 12 km at an average speed of 8 km/h.

Work out the total time Andy takes.
Give your answer in hours and minutes.



Cycle

$S = 24\text{ km/h}$

$D = 30\text{ km}$

$T = 1.25$

Run

$S = 8\text{ km/h}$

$D = 12\text{ km}$

$T = 1.5$

$1.25 + 1.5 = 2.75$

$= 2\text{ hours } 45\text{ mins}$

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

Complete the error interval for m.

9.35 $\leqslant m <$ 9.45

(Total for Question 3 is 2 marks)

4 Maisie knows that she needs 3 kg of grass seed to make a rectangular lawn 5 m by 9 m. $(45m^2)$

Grass seed is sold in 2 kg boxes.

Maisie wants to make a rectangular lawn 10 m by 14 m. $(140m^2)$
She has 5 boxes of grass seed.

(a) Has Maisie got enough grass seed to make a lawn 10 m by 14 m?
You must show all your working.

÷45 ↓ 3kg = $45m^2$ ↓ ÷45
↓ 0.06kg = $1m^2$ ↓
×140 ↓ 9.3kg = $140m^2$ ↓ ×140

5 boxes x 2kg = 10kg (needs 9.3kg)

Yes, she has enough

(4)

Maisie opens the 5 boxes of grass seed.

She finds that 4 of the boxes contain 2 kg of grass seed.
The other box contains 1 kg of grass seed.

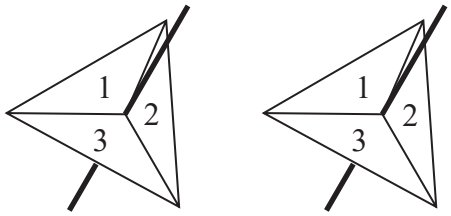
(b) Does this affect whether Maisie has enough grass seed to make her lawn?
Give a reason for your answer.

4 x 2 = 8kg + 1kg = 9kg
She will not have enough

(1)

(Total for Question 4 is 5 marks)

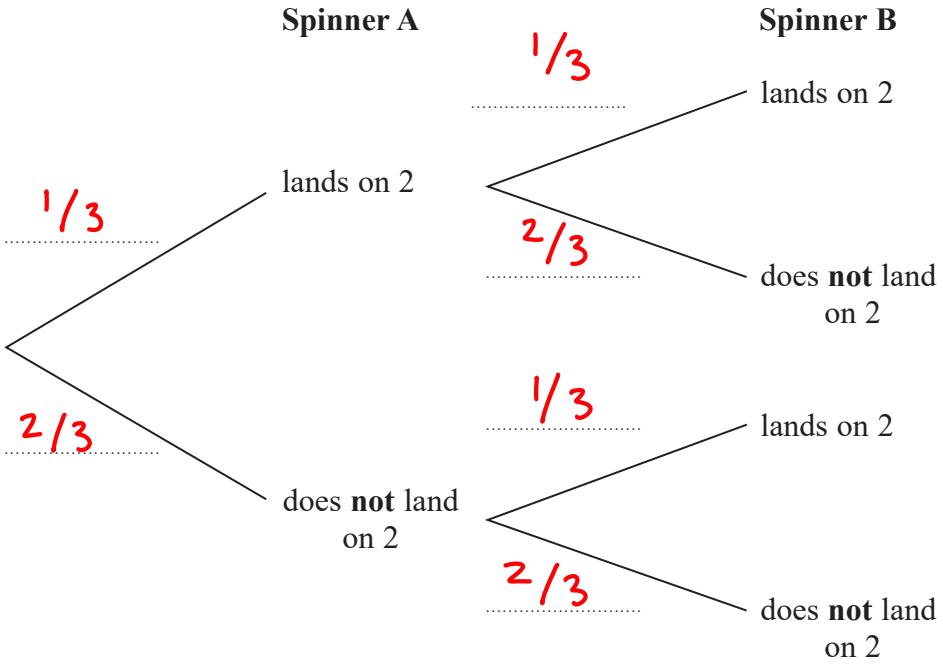
5 Amanda has two fair 3-sided spinners.



Spinner A **Spinner B**

Amanda spins each spinner once.

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Spinner A lands on 2 and Spinner B does **not** land on 2

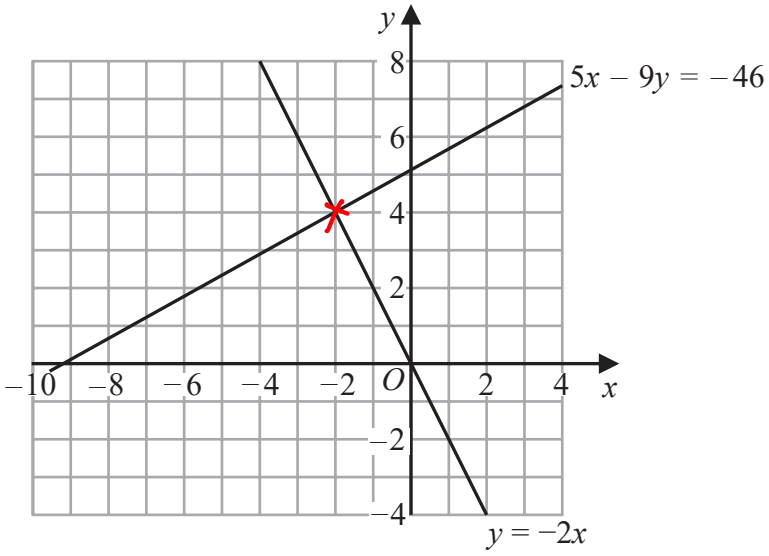
$P(2, 2') = \frac{1}{3} \times \frac{2}{3} = \frac{2}{9}$

$\frac{2}{9}$

(2)

(Total for Question 5 is 4 marks)

6



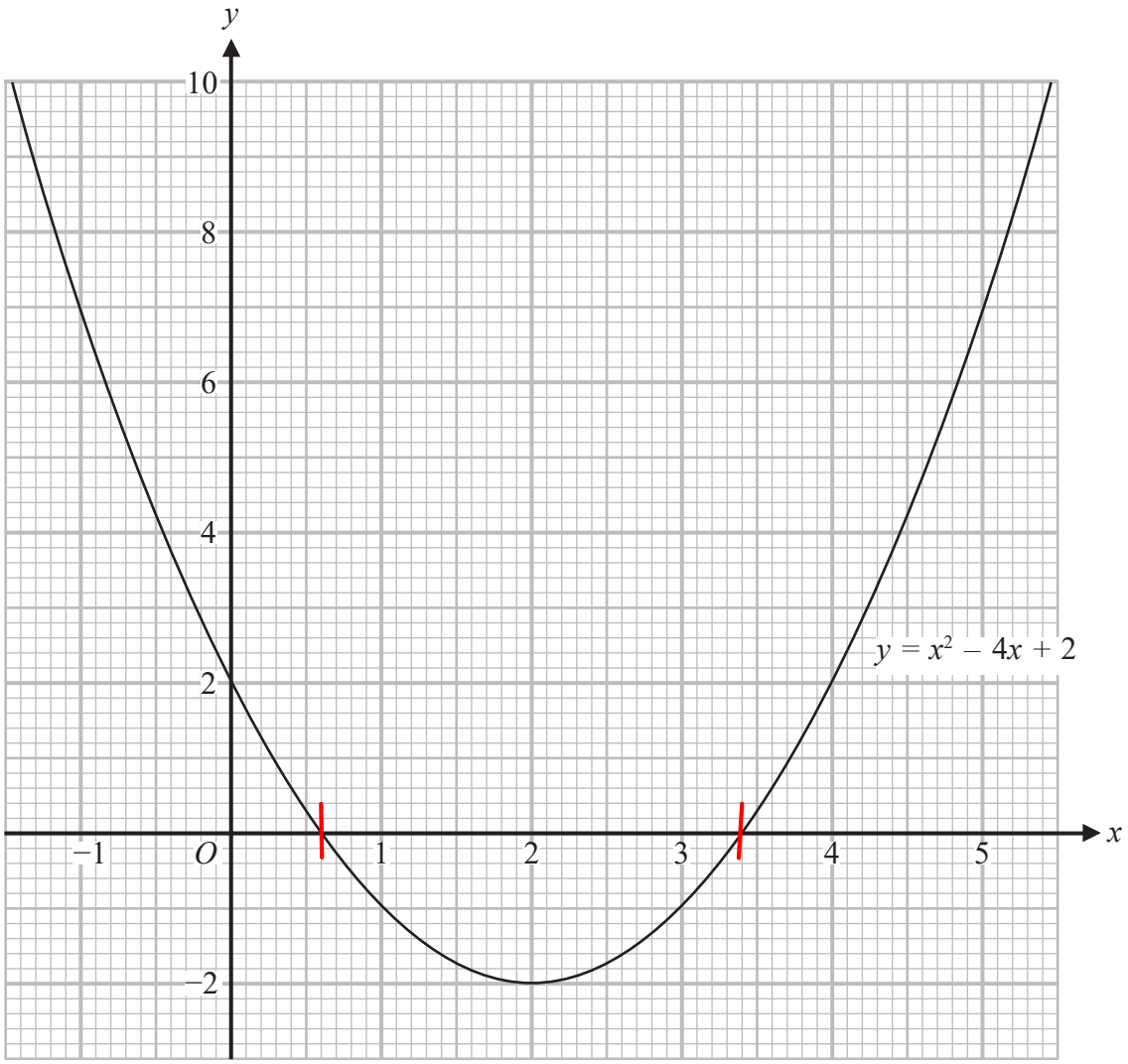
(a) Use these graphs to solve the simultaneous equations

$$5x - 9y = -46$$
$$y = -2x$$

$x =$ -2

$y =$ 4

(1)



(b) Use this graph to find estimates for the solutions of the quadratic equation $x^2 - 4x + 2 = 0$

0.6 and 3.4
(0.55-0.65 and 3.35-3.45) (2)

(Total for Question 6 is 3 marks)

7 There is a total of 45 boys and girls in a choir.

The mean age of the 18 boys is 16.2 years.
The mean age of the 27 girls is 16.7 years.

Calculate the mean age of all 45 boys and girls.

$18 \times 16.2 = 291.6$

$27 \times 16.7 = 450.9$ +

742.5

$742.5 \div 45 = 16.5$

16.5 years

(Total for Question 7 is 3 marks)

8 There are some counters in a bag.
The counters are blue or green or red or yellow.

The table shows the probabilities that a counter taken at random from the bag will be blue or will be green.

Colour	blue	green	red	yellow
Probability	0.32	0.20	0.40 (5x)	0.08 (x)

The probability that a counter taken at random from the bag will be red is five times the probability that the counter will be yellow.

There are 300 counters in the bag.

Work out the number of yellow counters in the bag.

$0.32 + 0.20 = 0.52$

$1 - 0.52 = 0.48$

$5x + x = 0.48$

$6x = 0.48$

$\div 6 \quad \div 6$

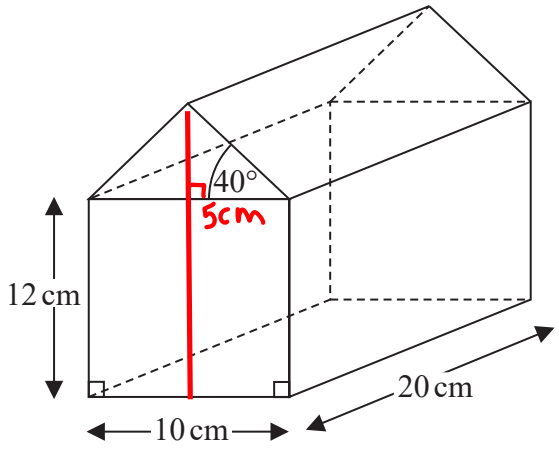
$x = 0.08$

$0.08 \times 300 = 24$

24

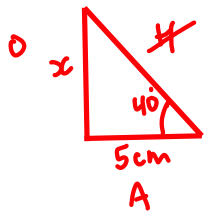
(Total for Question 8 is 3 marks)

9 The diagram shows a prism.



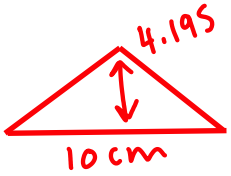
The cross section of the prism has exactly one line of symmetry.

Work out the volume of the prism.
Give your answer correct to 3 significant figures.



SOH CAH TOA

Tan(40) x 5 = 4.195



$\frac{10 \times 4.195}{2} = 20.977\text{cm}^2$

$10 \times 12 = 120\text{cm}^2$

Area cross section = 120 + 20.977
= 140.977cm^2

140.977 x 20 = 2819.54..

2820 cm³

(Total for Question 9 is 5 marks)

10 A person's heart beats approximately 10^5 times each day.
A person lives for approximately 81 years.

(a) Work out an estimate for the number of times a person's heart beats in their lifetime.
Give your answer in standard form correct to 2 significant figures.

365 days × 81 years = 29565 days

29565×10^5

$= 2.9565 \times 10^9$

3.0×10^9

(2)

2×10^{12} red blood cells have a total mass of 90 grams.

(b) Work out the average mass of 1 red blood cell.
Give your answer in standard form.

$\div 2 \times 10^{12}$ ↓ 2×10^{12} cells = 90g

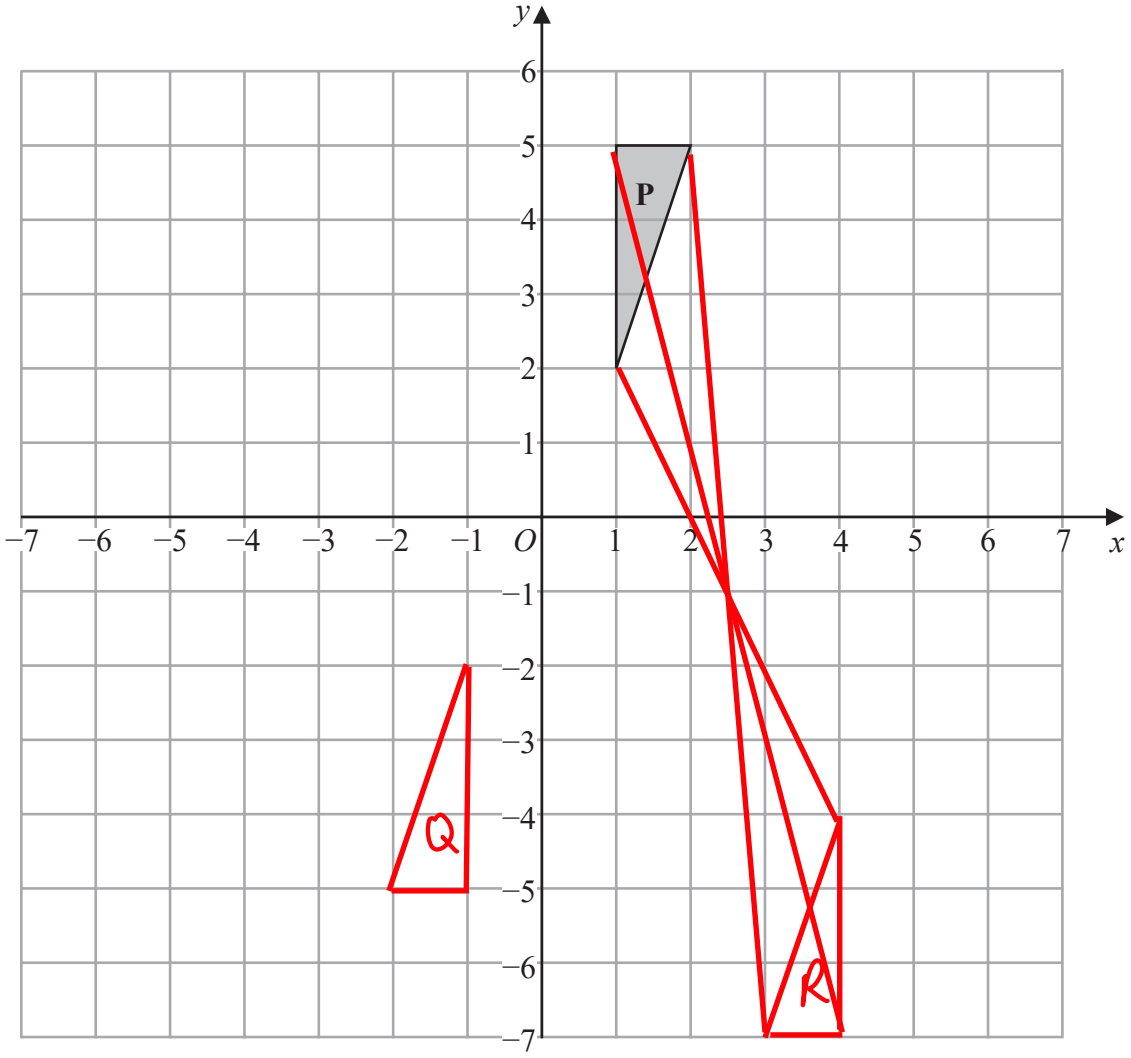
1 cell = 4.5×10^{-11} ↓ $\div 2 \times 10^{12}$

4.5×10^{-11} grams

(2)

(Total for Question 10 is 4 marks)

11 The diagram shows a triangle **P** on a grid.



Triangle **P** is rotated 180° about (0, 0) to give triangle **Q**.

Triangle **Q** is translated by $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ to give triangle **R**.

(a) Describe fully the single transformation that maps triangle **P** onto triangle **R**.

Rotation 180° about the point (2.5, -1)

.....

.....

(3)

Under the transformation that maps triangle **P** onto triangle **R**, the point A is invariant.

(b) Write down the coordinates of point A.

(2.5 , -1)

(1)

(Total for Question 11 is 4 marks)

12 (a) Express $\frac{x}{x+2} + \frac{2x}{x-4}$ as a single fraction in its simplest form.

Tip: To add fractions the denominators must be the same

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

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

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

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

(3)

(b) Expand and simplify $(x - 3)(2x + 3)(4x + 5)$

Tip: First multiply out the first two brackets as normal

$$= 2x^2 + 3x - 6x - 9$$

$$= 2x^2 - 3x - 9$$

Tip: Multiply the $2x^2$ by everthing in the second bracket, then repeat for the $-3x$, and then for the -9

$$(2x^2 - 3x - 9)(4x + 5)$$

$$= 8x^3 + 10x^2 - 12x^2 - 15x - 36x - 45$$

$$= 8x^3 - 2x^2 - 51x - 45$$

$8x^3 - 2x^2 - 51x - 45$

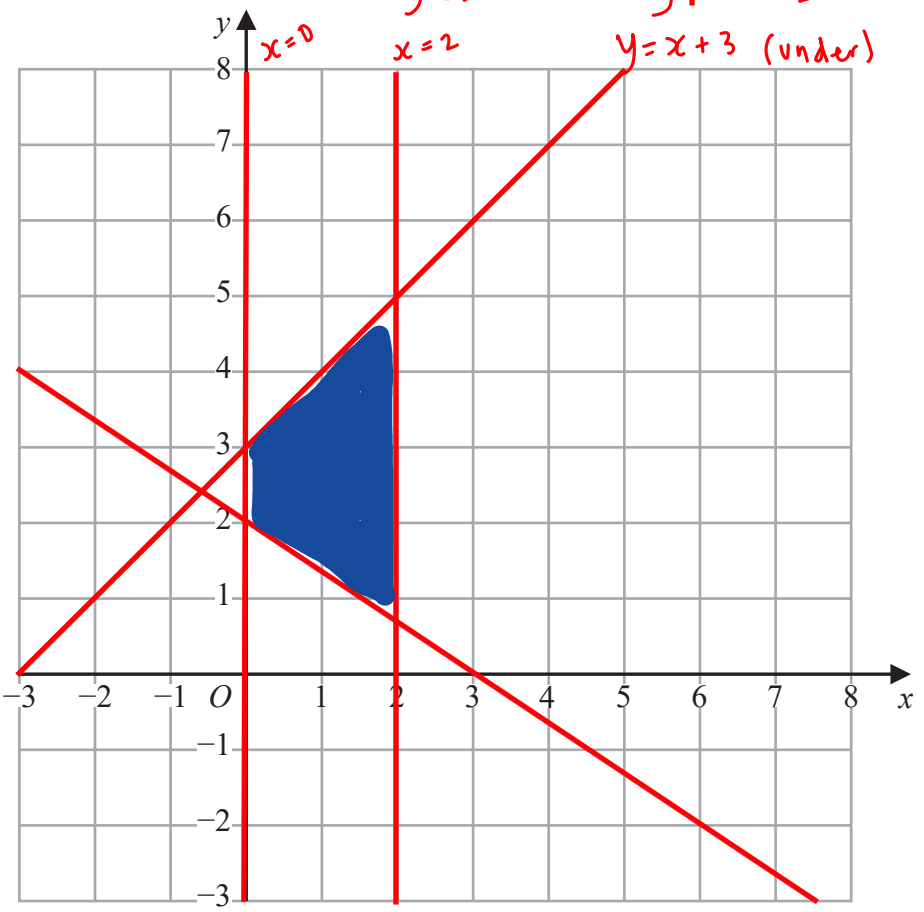
(3)

(Total for Question 12 is 6 marks)

13 (a) On the grid show, by shading, the region that satisfies all these inequalities.

$x \geqslant 0$ $x \leqslant 2$ $y \leqslant x + 3$ $2x + 3y \geqslant 6$

Label the region **R**.



R (4)

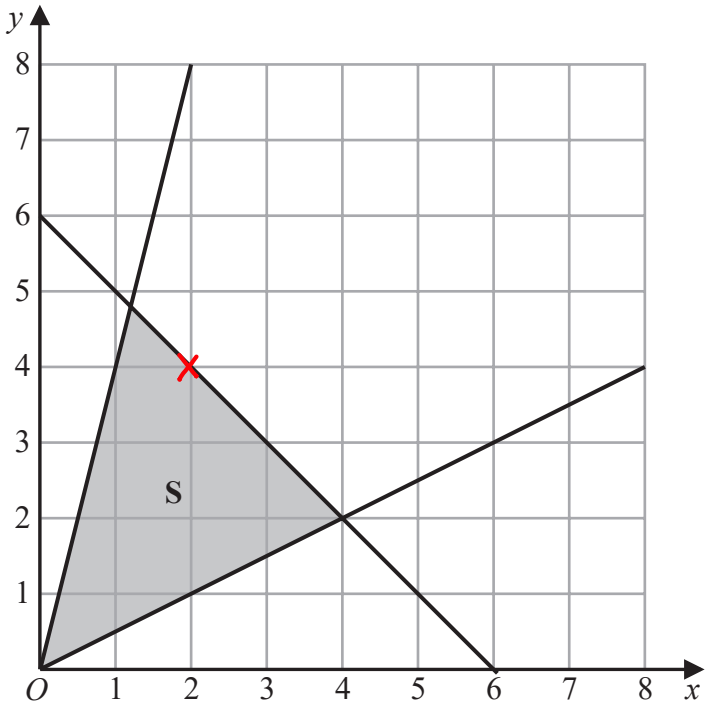
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) The diagram below shows the region **S** that satisfies the inequalities

$$y \leqslant 4x \qquad y \geqslant \frac{1}{2}x \qquad x + y \leqslant 6$$



Geoffrey says that the point with coordinates (2, 4) does not satisfy all the inequalities because it does not lie in the shaded region.

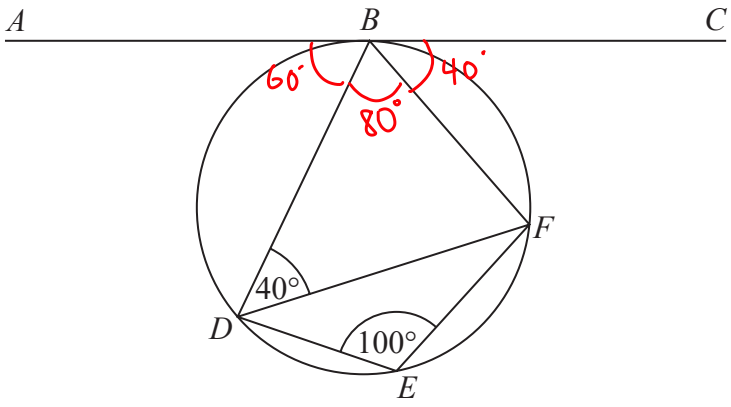
Is Geoffrey correct?
You must give a reason for your answer.

No, it is on a solid line so it does satisfy x + y ≤ 6

(1)

(Total for Question 13 is 5 marks)

14



Points B, D, E and F lie on a circle.
ABC is the tangent to the circle at B.

Find the size of angle ABD.
You must give a reason for each stage of your working.

$\angle CBF = 40°$ using the alternate segment theorem

$\angle DBF = 80°$ because opposite angles in a quadrilateral add to 180°

$\angle ABD = 60°$ because angles on a straight line add to 180°

(Total for Question 14 is 4 marks)

15 Prove algebraically that $0.7\dot{3}$ can be written as $\frac{11}{15}$

Tip: If there is one recurring digit multiply by 10, if there are two recurring digits multiply by 100, if there are three recurring digits multiply by 1000.

Let $x = 0.7\dot{3}$

$10x = 7.\dot{3}$ (6)

$- \quad x = 0.7\dot{3}$

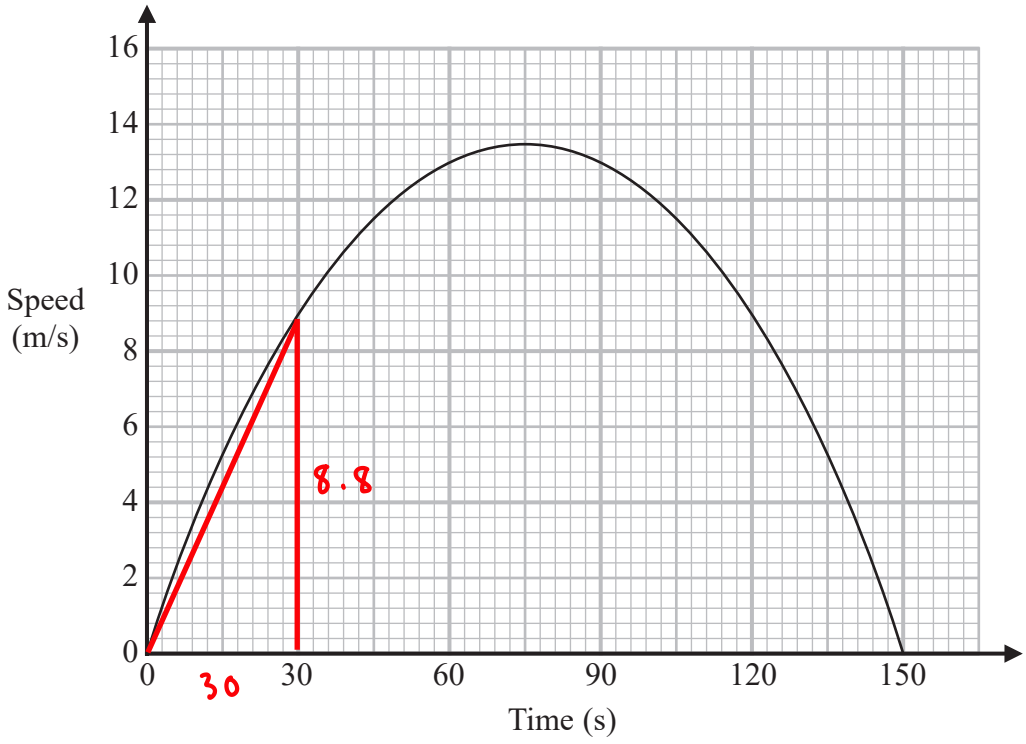
$9x = 6.6$

$\div 9 \quad \div 9$

$x = \frac{6.6}{9} = \frac{66}{90} = \frac{11}{15}$ ($\div 6$)

(Total for Question 15 is 2 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.

$\frac{1}{2} \times 8.8 \times 30$

132 ..... m

(129 to 160) **(2)**

(b) Is your answer to part (a) an underestimate or an overestimate of the actual distance the car travelled in the first 30 seconds?
Give a reason for your answer.

Underestimate, the area between the triangle and curve has not been included

.....

.....

.....

(1)

Julian used the graph to answer this question.

Work out an estimate for the acceleration of the car at time 60 seconds.

Here is Julian's working.

$$\text{acceleration} = \text{speed} \div \text{time}$$

$$= 13 \div 60$$

$$= 0.21\dot{6} \text{ m/s}^2$$

Julian's method does not give a good estimate of the acceleration at time 60 seconds.

(c) Explain why.

He has not drawn a tangent

.....

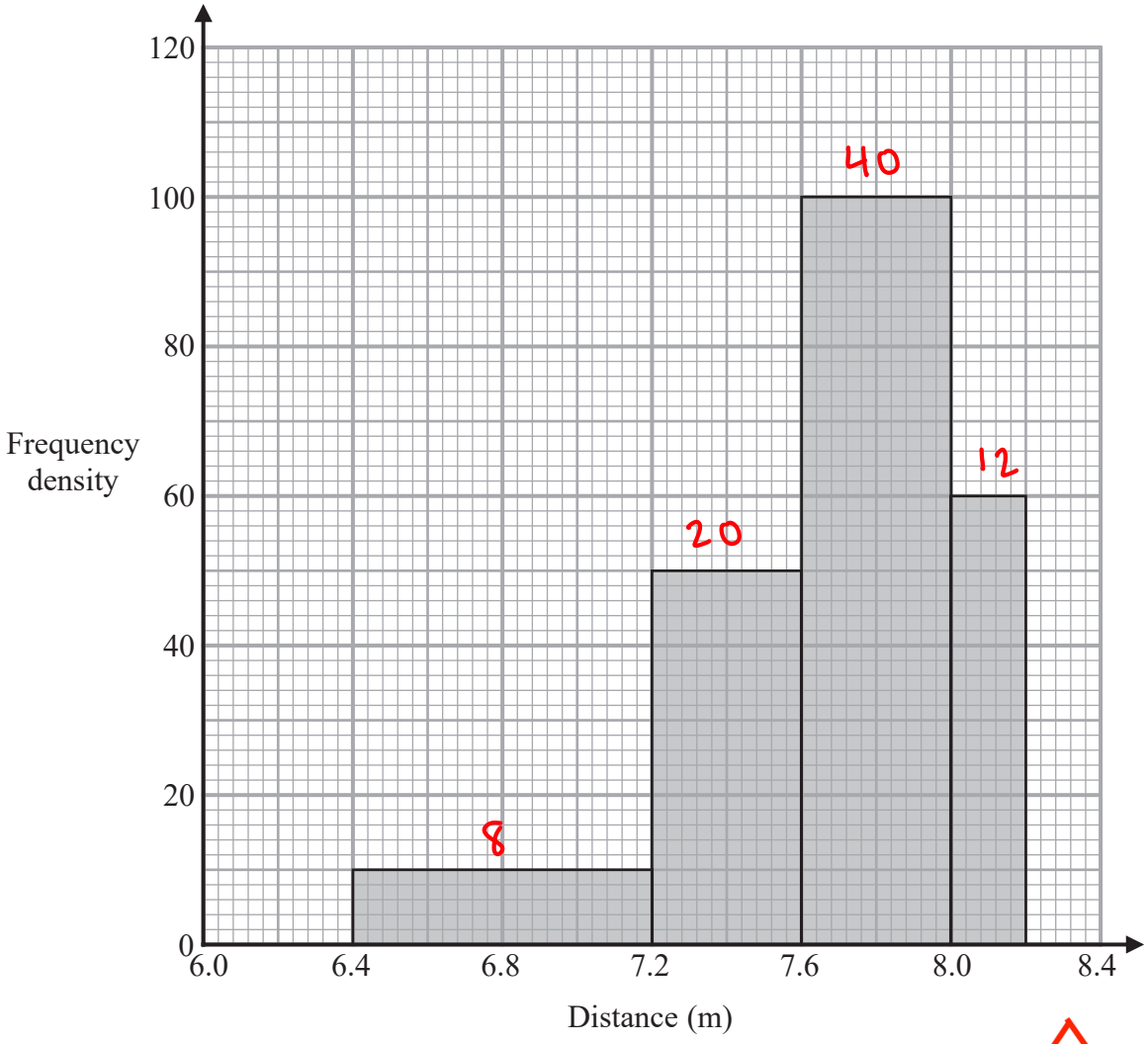
.....

.....

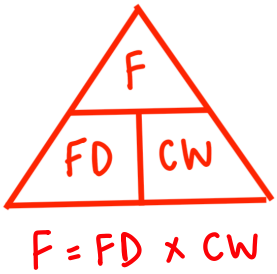
(1)

(Total for Question 16 is 4 marks)

17 The histogram gives information about the distances 80 competitors jumped in a long jump competition.



Calculate an estimate for the mean distance.



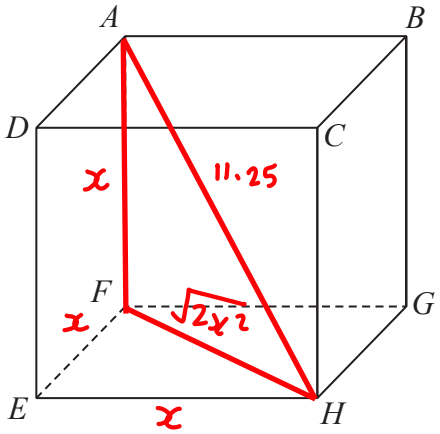
Distance	Frequency	
6.4 - 7.2 (6.8)	8	54.4
7.2 - 7.6 (7.4)	20	148
7.6 - 8 (7.8)	40	312
8 - 8.2 (8.1)	12	97.2
	80	611.6

611.6 ÷ 80 = 7.645

7.645 m

(Total for Question 17 is 4 marks)

18 The diagram shows a cube.



LB = 11.25 UB = 11.35

AH = 11.3 cm correct to the nearest mm.

Calculate the lower bound for the length of an edge of the cube.
You must show all your working.

$x^2 + x^2 = 2x^2$

$FH = \sqrt{2x^2}$

$x^2 + \sqrt{2x^2}^2 = 11.25^2$

$x^2 + 2x^2 = 11.25^2$

$3x^2 = 126.5625$

$\div 3 \quad \div 3$

$x^2 = 42.1875$

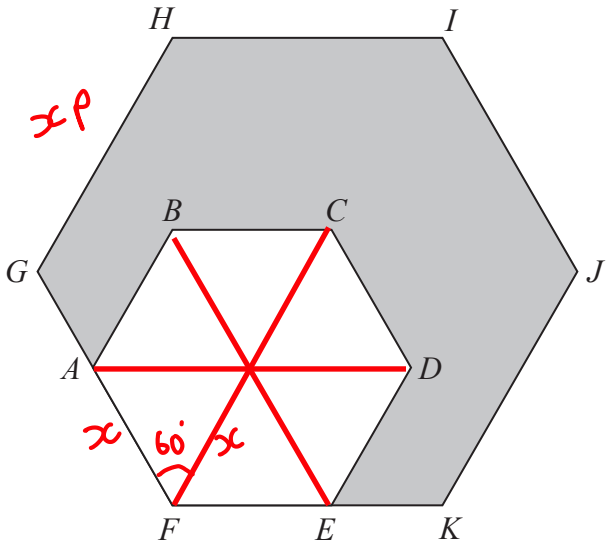
$\sqrt{\ } \quad \sqrt{\ }$

$x = 6.4951\ldots$

6.495 ..... cm

(Total for Question 18 is 4 marks)

19



Length SF = p

Area SF = p^2

ABCDEF is a regular hexagon with sides of length x.
This hexagon is enlarged, centre F, by scale factor p to give hexagon *FGHIJK*.

Show that the area of the shaded region in the diagram is given by $\frac{3\sqrt{3}}{2}(p^2 - 1)x^2$

Area Smaller:

1 triangle = $\frac{1}{2}ab\sin C = \frac{1}{2} \times x \times x \times \sin(60)$

$= \frac{\sqrt{3}}{4}x^2$

$\frac{\sqrt{3}}{4}x^2 \times 6 = \frac{3\sqrt{3}}{2}x^2$

Area larger = $\frac{3\sqrt{3}}{2}x^2 \times p^2 = \frac{3\sqrt{3}}{2}p^2x^2$

Shaded area = $\frac{3\sqrt{3}}{2}p^2x^2 - \frac{3\sqrt{3}}{2}x^2$

$= \frac{3\sqrt{3}}{2}x^2(p^2-1)$ OR $\frac{3\sqrt{3}}{2}(p^2-1)x^2$

(Total for Question 19 is 4 marks)

20 Here is a list of five numbers.

98^{53} 98^{64} 98^{73} 98^{88} 98^{91}

Find the lowest common multiple of these five numbers.

98^{91}

(Total for Question 20 is 1 mark)

21 $5c + d = c + 4d$

(a) Find the ratio $c : d$

Tip: Make c or d the subject of the equation

$5c + d = c + 4d$

$-c \quad\quad -c$

$4c + d = 4d$

$-d \quad\quad -d$

$4c = 3d$

$\div 4 \quad\quad \div 4$

$c = \frac{3}{4}d$

$c : d$

$\frac{3}{4} : 1$ (×4)

$3 : 4$

$3 : 4$

(2)

$6x^2 = 7xy + 20y^2$ where $x > 0$ and $y > 0$

(b) Find the ratio $x : y$

$6x^2 = 7xy - 20y^2$

$+7 \quad\quad -120$

$6x^2 - 7xy - 20y^2 = 0$

15 and 8

$6x^2 - 15xy + 8xy + 20y^2 = 0$

$3x(2x - 5y) + 4y(2x - 5y) = 0$

$(3x + 4y)(2x - 5y) = 0$

$x = \frac{-4y}{3}$ ✗ or $x = \frac{5y}{2}$ ✓

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

$x : y$

$\frac{5}{2} : 1$ (×2)

$5 : 2$ (×2)

$5 : 2$

(3)

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS