

**Dr Oliver Mathematics**  
**GCSE Mathematics**  
**2020 Paper 3H: Calculator**  
**1 hour 30 minutes**

The total number of marks available is 80.

You must write down all the stages in your working.

1. (a) Simplify (1)

$$n^3 \times n^5.$$

- (b) Simplify (2)

$$\frac{c^3d^4}{c^2d}.$$

- (c) Solve (2)

$$\frac{5x}{2} > 7.$$

2. Andy cycles a distance of 30 km at an average speed of 24 km/h. (3)  
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.

3. A number,  $m$ , is rounded to 1 decimal place. The result is 9.4. (2)

Complete the error interval for  $m$ .

4. Maisie knows that she needs 3 kg of grass seed to make a rectangular lawn 5 m by 9 m.

Grass seed is sold in 2 kg boxes.

Maisie wants to make a rectangular lawn 10 m by 14 m.

She has 5 boxes of grass seed.

- (a) Has Maisie got enough grass seed to make a lawn 10 m by 14 m? (4)  
You must show all your working.

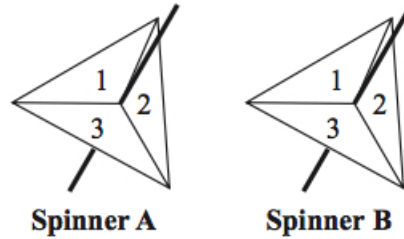
Maisie opens the 5 boxes of grass seed.

She finds that 4 of the boxes contain 2 kg of grass seed.

The other box contains 1 kg of grass seed.

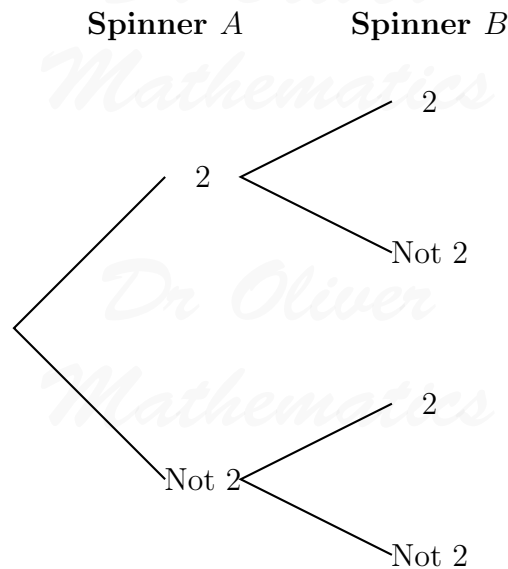
- (b) Does this affect whether Maisie has enough grass seed to make her lawn?  
Give a reason for your answer. (1)

5. Amanda has two fair 3-sided spinners.



Amanda spins each spinner once.

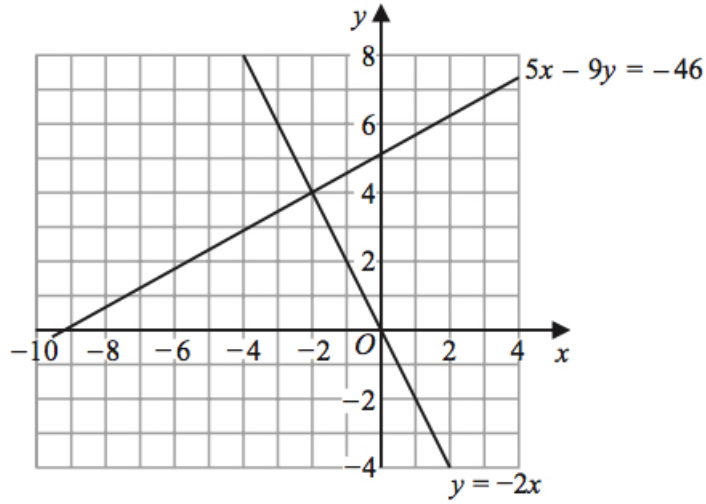
- (a) Complete the probability tree diagram. (2)



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

6. Here is a graph.

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(a) Use these graphs to solve the simultaneous equations

(1)

$$5x - 9y = -46y \qquad = -2x.$$

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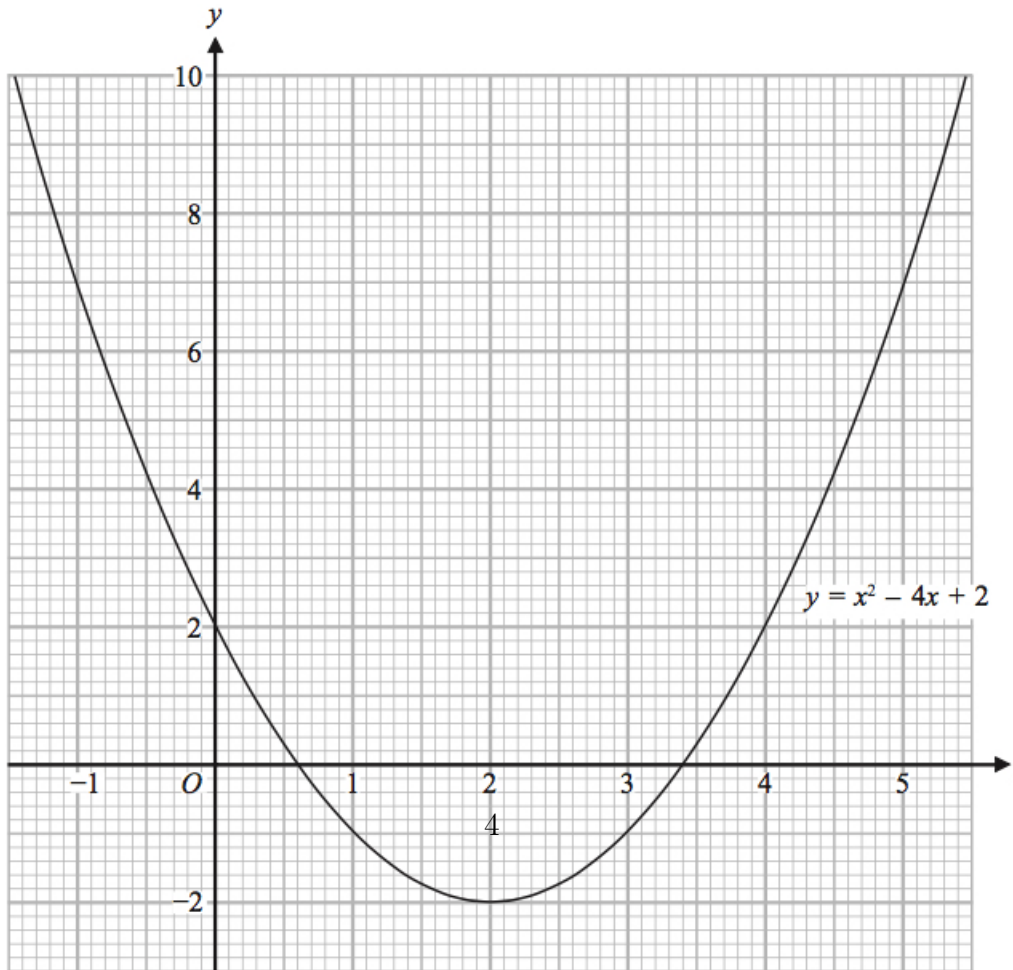
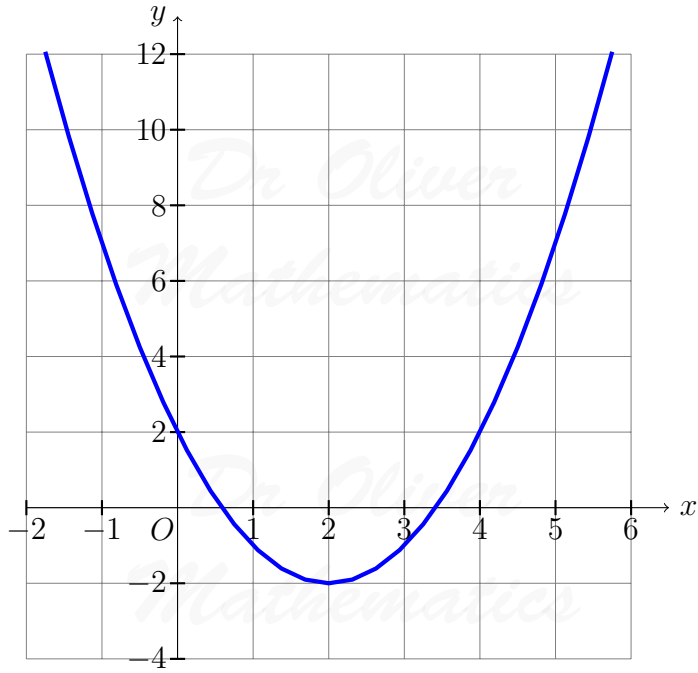
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Here is another graph.



- (b) Use this graph to find estimates for the solutions of the quadratic equation (2)

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

7. There is a total of 45 boys and girls in a choir. (3)

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.

8. There are some counters in a bag. (3)

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.

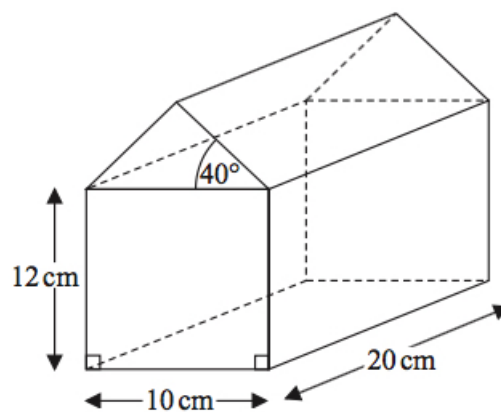
Colour	Blue	Green	Red	Yellow
Probability	0.32	0.20		

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.

9. The diagram shows a prism. (5)



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.

10. A person's heart beats approximately  $10^5$  times each day.

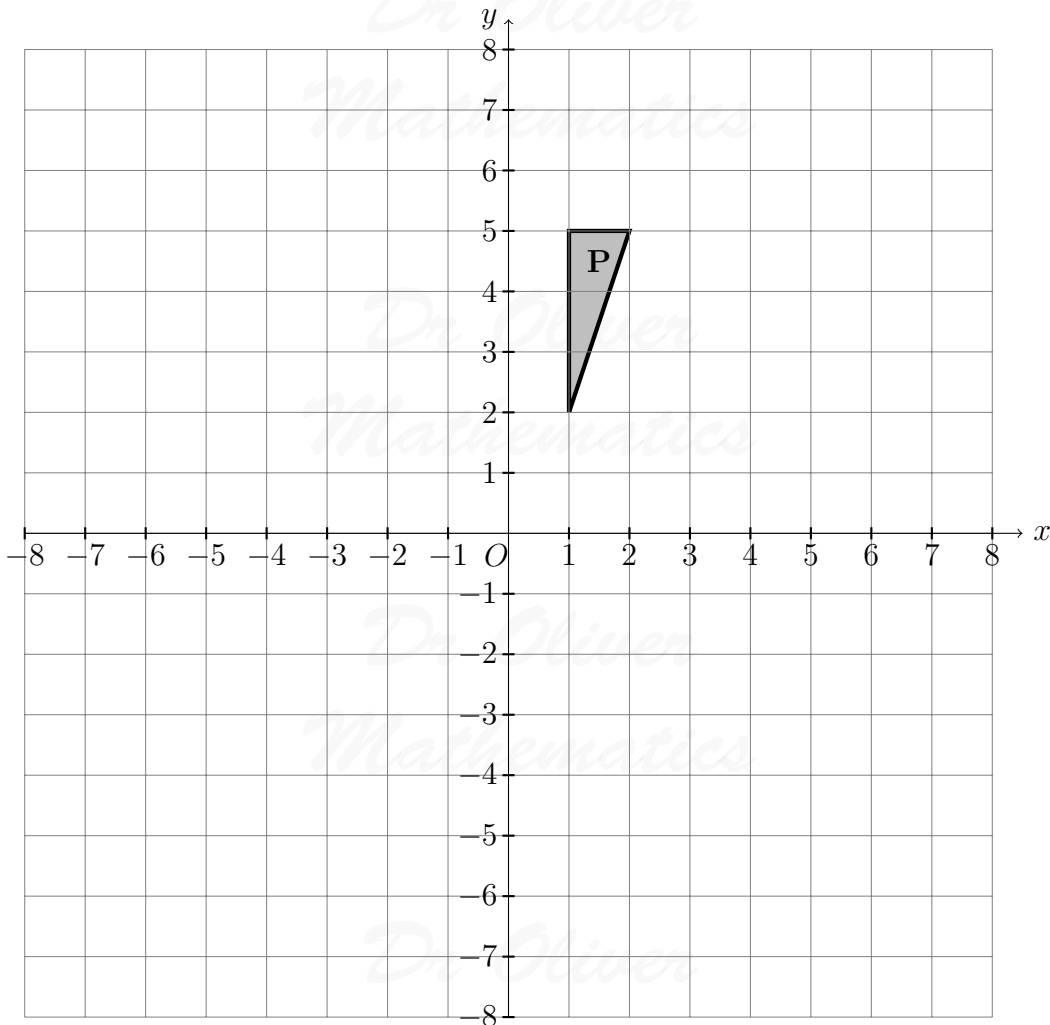
A person lives for approximately 81 years.

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

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

- (b) Work out the average mass of 1 red blood cell. (2)  
Give your answer in standard form.

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



Triangle **P** is rotated  $180^\circ$  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**. (3)

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

- (b) Write down the coordinates of point *A*. (1)

12. (a) Express (3)

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

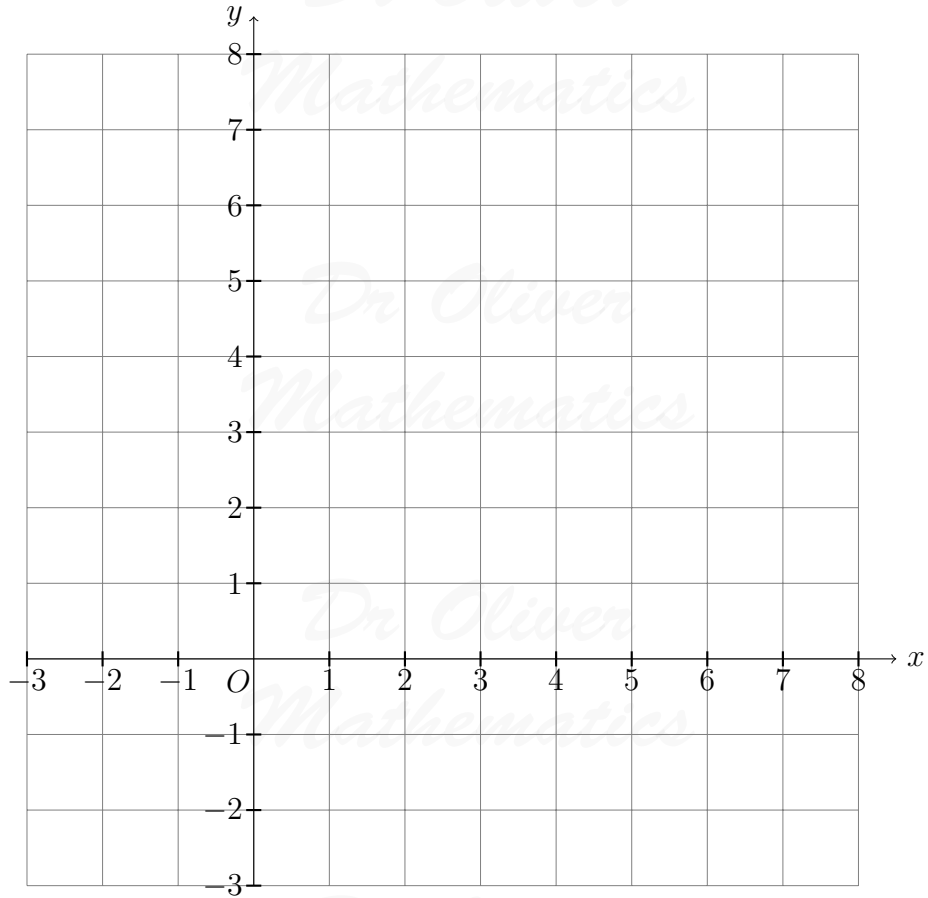
as a single fraction in its simplest form.

- (b) Expand and simplify (3)

$$(x-3)(2x+3)(4x+5).$$

13. (a) On the grid show, by shading, the region that satisfies all these inequalities. (4)

$$x \geq 0 \quad x \leq 2 \quad y \leq x + 3 \quad 2x + 3y \geq 6.$$

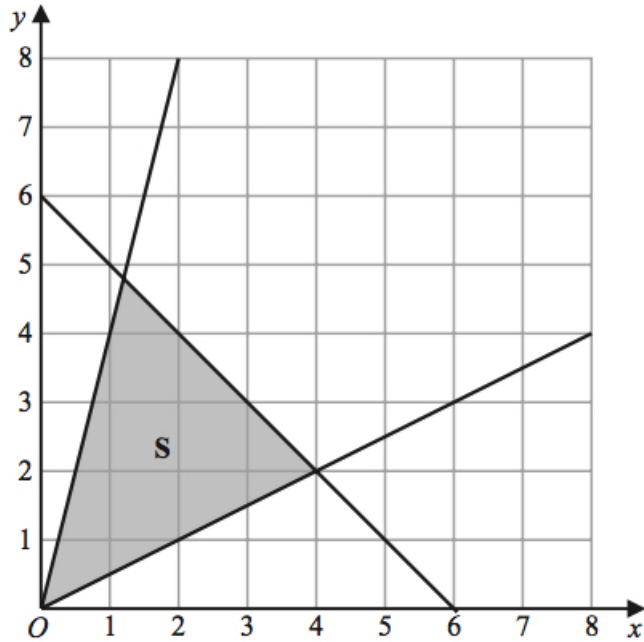


Label the region **R**.

- (b) The diagram below shows the region **S** that satisfies the inequalities: (1)

$$y \leq 4x \quad y \geq \frac{1}{2}x \quad x + y \leq 6.$$





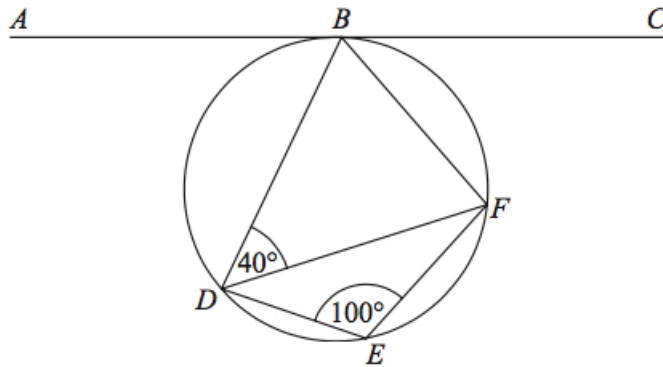
Geoffrey says that the point with coordinates (2, 4) does not satisfy all the inequalities because it does not lie in the shaded region.

Is Geoffrey correct?

You must give a reason for your answer.

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

(4)



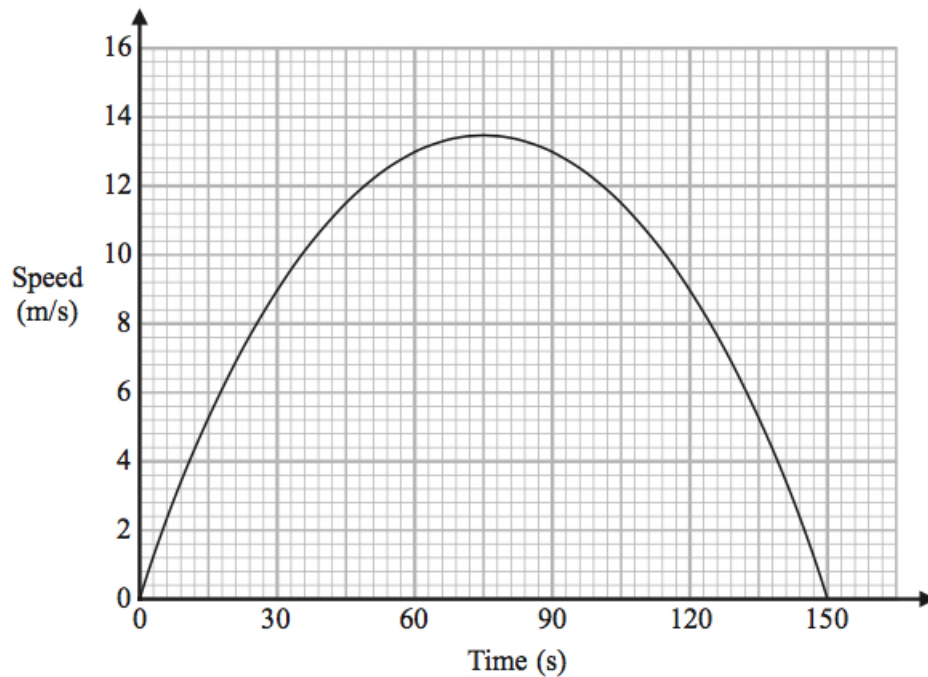
Find the size of angle  $ABD$ .

You must give a reason for each stage of your working.

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

(2)

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. (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? (1)  
Give a reason for your answer.

Julian used the graph to answer this question.

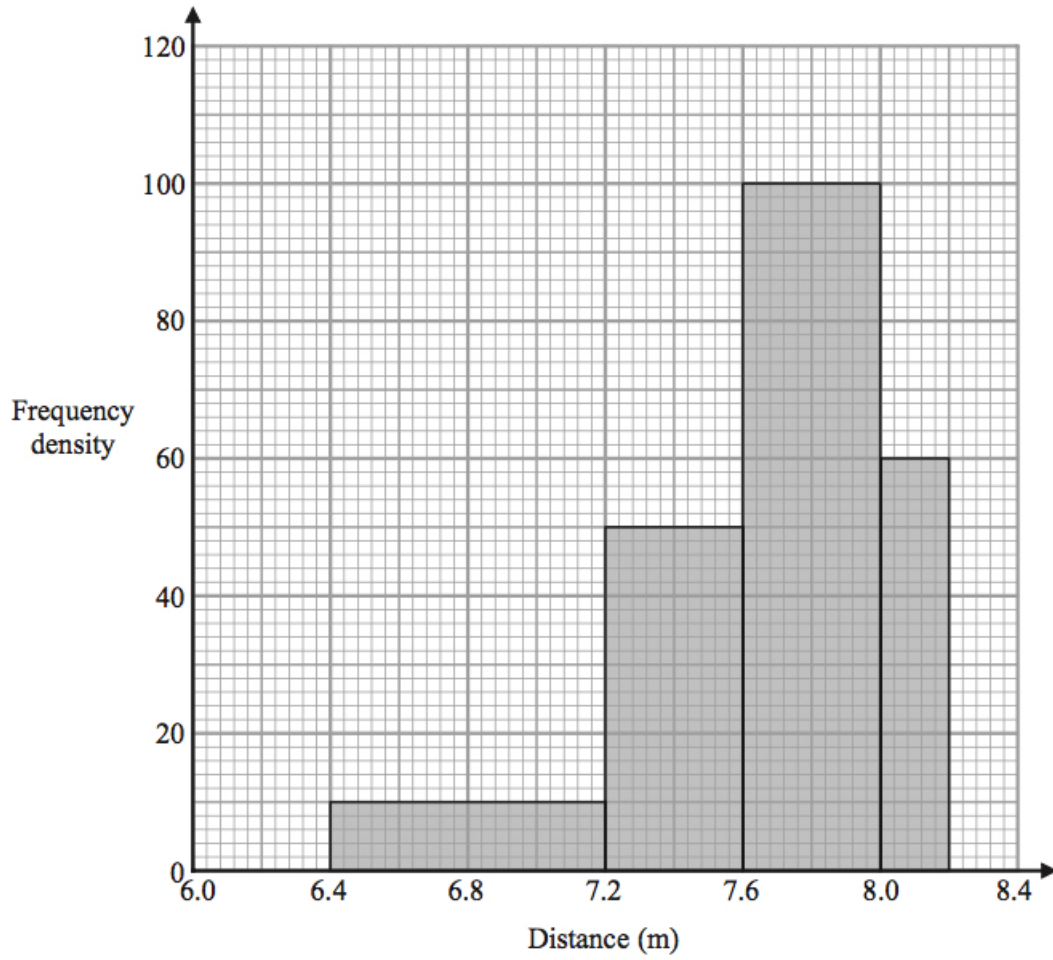
Work out an estimate for the acceleration of the car at time 60 seconds.

Here is Julian's working.

$$\begin{aligned} \text{acceleration} &= \text{speed} \div \text{time} \\ &= 13 \div 60 \\ &= 0.21\dot{6} \text{ m/s}^2. \end{aligned}$$

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

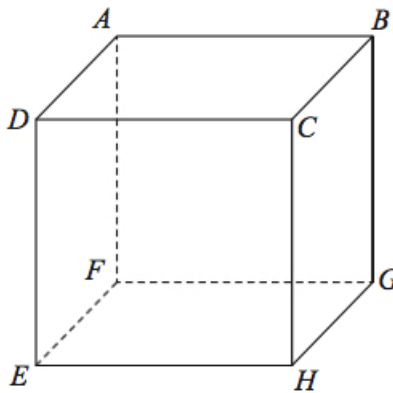
- (c) Explain why. (1)
17. The histogram gives information about the distances 80 competitors jumped in a long jump competition. (4)



Calculate an estimate for the mean distance.

18. The diagram shows a cube.

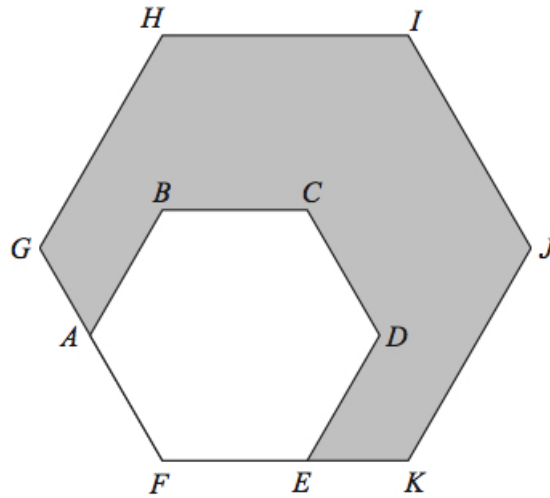
(4)



$AH = 11.3$  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.

19.  $ABCDEF$  is a regular hexagon with sides of length  $x$ . (4)  
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

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

20. Here is a list of five numbers. (1)

$$98^{53} \quad 98^{64} \quad 98^{73} \quad 98^{88} \quad 98^{91}.$$

Find the lowest common multiple of these five numbers.

21.  $5c + d = c + 4d$ . (2)  
(a) Find the ratio  $c : d$ .

$$6x^2 = 7xy + 20y^2,$$

where  $x > 0$  and  $y > 0$ .

- (b) Find the ratio  $x : y$ . (3)