

Langley Park School for Girls
Year 11 Maths Trial Exam March 2021

Higher Tier

PAPER 3H

CALCULATOR



Time: 1 hour 30 minutes

Name _____

MS LTH

Maths Teacher _____

Instructions

- Use black ink or ball-point pen.
- Answer all questions.
- Answer the questions in the spaces provided.
- Calculators may be used.

Information

- There are 21 questions on this paper.
- The total mark for this paper is 80.
- The marks for each question are shown in brackets.

— use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Show all of your working out.
- Check your answers if you have time at the end.

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

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

$$n^{3+5}$$

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

$$= \frac{\cancel{c} \cancel{c} \cancel{d} \cancel{d} \cancel{d} \cancel{d}}{\cancel{c} \cancel{d}}$$

$$= cd^3$$

$$\text{or } c^{3-2} d^{4-1} = cd^3$$

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

$$5x > 14 \quad [\div 5]$$

$$x > \frac{14}{5}$$

$$\text{or } x > 2\frac{4}{5}$$

$$\text{or } x > 2.8$$

(Total for Question 1 is 5 marks)

(2)

$$x > \frac{14}{5}$$

(2)

$$cd^3$$

(1)

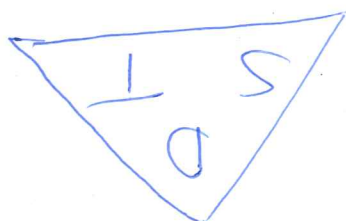
$$n^8$$



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.



$$\begin{aligned} \text{cycle} \\ D &= 30 \\ S &= 24 \end{aligned}$$

$$T = \frac{D}{S}$$

$$= \frac{30}{24}$$

$$= 1.25 \text{ hours}$$

$$1 \text{ hour } 15 \text{ minutes}$$

you can use
the time button
on your calculator
eg: 2.75
= 09.99
2° 45' 0"

$$\begin{aligned} \text{total time} &= 1.25 + 1.5 \\ &= 2.75 \text{ hours} \\ &= 2 \frac{3}{4} \text{ hours} \end{aligned}$$

$$= 1.5 \text{ hours}$$

$$= 1 \frac{1}{2} \text{ hours}$$

$$1 \text{ hour } 30 \text{ minutes}$$

$$T = \frac{D}{S}$$

$$\begin{aligned} D &= 12 \\ S &= 8 \end{aligned}$$

run

(Total for Question 2 is 3 marks)

hours 2 minutes 45

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

Complete the error interval for m .

$$9.35 \leq m < 9.45$$

(Total for Question 3 is 2 marks)





(Total for Question 4 is 5 marks)

(1)

Maisie now has $4 \times 2\text{kg} + 1\text{kg} = 9\text{kg}$ grass seed.
She does not have enough as she needs $9.\dot{3}\text{kg}$

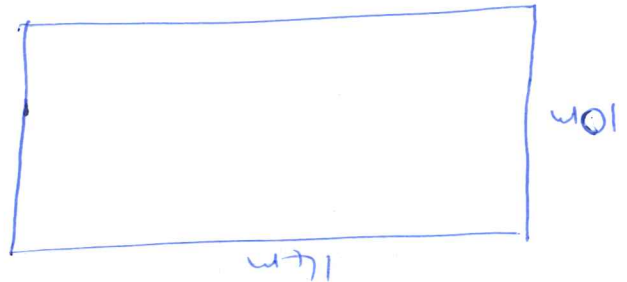
(b) Does this affect whether Maisie has enough grass seed to make her lawn?
Give a reason for your answer.

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

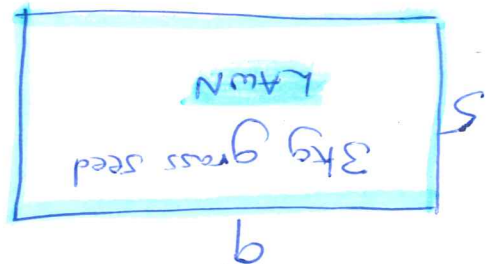
Maisie opens the 5 boxes of grass seed.

Maisie will need $9.\dot{3}\text{kg}$ of grass seed
Boxes needed $= \frac{9.\dot{3}\text{kg}}{2\text{kg}} = 4.\dot{6}$
 $= 4.\dot{6}$ boxes
Maisie will need to use 5 boxes so yes she has enough.
(4)

$$\begin{aligned} \text{Area} &= 10 \times 14 \\ &= 140\text{m}^2 \\ \frac{140\text{m}^2}{15\text{m}^2} &= 9.\dot{3}\text{kg} \end{aligned}$$



Area $= 9 \times 5 = 45\text{m}^2$
 $45\text{m}^2 : 3\text{kg}$ seed
 $15\text{m}^2 : 1\text{kg}$ seed
1kg of grass seed covers 15m^2



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

She has 5 boxes of grass seed.

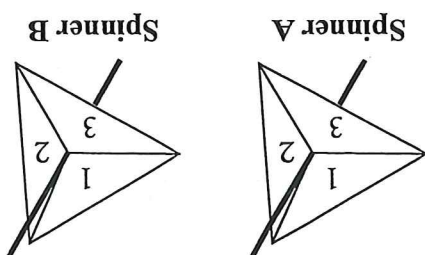
Maisie wants to make a rectangular lawn 10m by 14m.



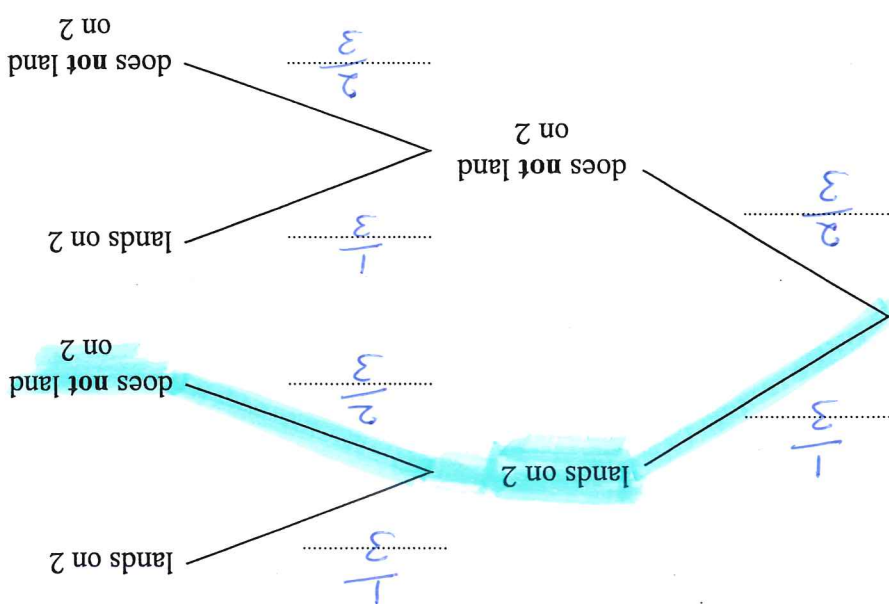
Grass seed is sold in 2 kg boxes.

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

(a) Complete the probability tree diagram.



Spinner B



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

$$\frac{3}{1} \times \frac{3}{2} = \frac{9}{2}$$

$$\frac{9}{2}$$

(Total for Question 5 is 4 marks)





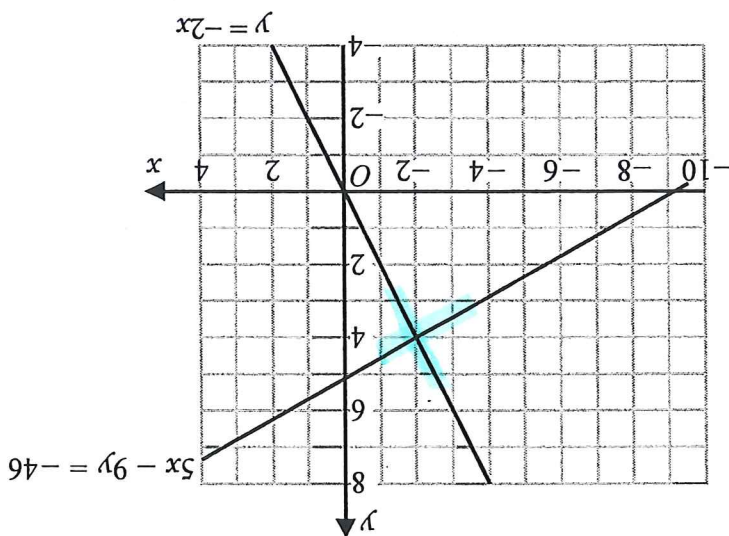
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(a) Use these graphs to solve the simultaneous equations

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



(1)

$$y = 4$$
$$x = -2$$

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P 6 2 2 7 9 A 0 7 2 4

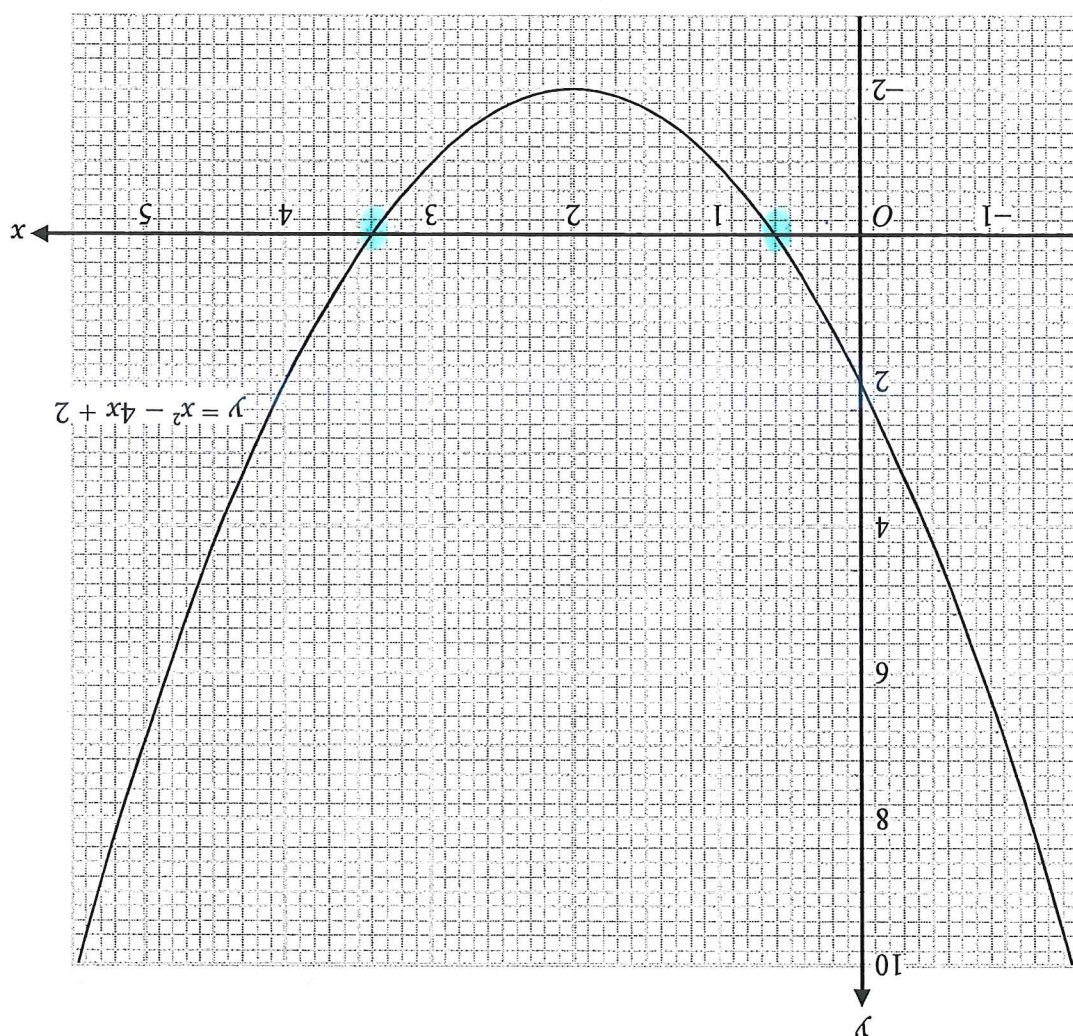
Turn over

7

(Total for Question 6 is 3 marks)

(2)

$$x = 0.6 \quad x = 3.4$$

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

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.

$$\text{Boys} \quad \frac{\text{total age}}{18} = 16.2 \quad [\times 18]$$

$$\text{total age Boys} = 291.6 \text{ years}$$

$$\text{Girls} \quad \frac{\text{total age}}{27} = 16.7 \quad [\times 27]$$

$$\text{total age Girls} = 450.9 \text{ years}$$

$$\text{Overall mean} = \frac{\text{total age boys} + \text{total age girls}}{45}$$

$$= \frac{291.6 + 450.9}{45}$$

$$16.5 \text{ years}$$

(Total for Question 7 is 3 marks)

$$= \frac{742.5}{45} = 16.5$$



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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	Probability
blue	0.32
green	0.20
red	0.4
yellow	0.08

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.

$$0.32 + 0.2 + P(R) + P(Y) = 1$$

$$0.52 + P(R) + P(Y) = 1$$

$$P(R) + P(Y) = 0.48$$

$$\text{Let } P(R) = 5x \text{ and } P(Y) = x$$

$$5x + x = 0.48$$

$$6x = 0.48$$

$$x = 0.08$$

$$\text{So } P(Y) = 0.08 \text{ and } P(R) = 5 \times 0.08 = 0.4$$

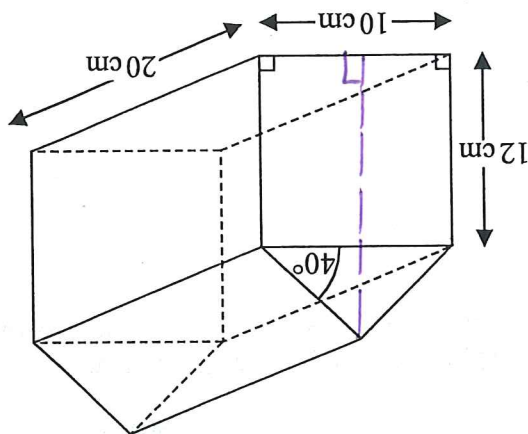
$$300 \text{ counters, Yellow} = 0.08 \times 300 = 24$$

24

(Total for Question 8 is 3 marks)



9 The diagram shows a prism.



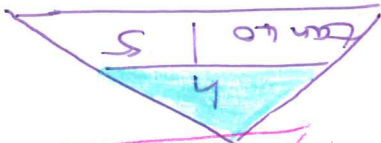
The cross section of the prism has exactly one line of symmetry.

Work out the volume of the prism.

Give your answer correct to 3 significant figures.

$$\text{Volume prism} = \text{Area cross section} \times \text{length}$$

Find height h of triangle so that we can find the area of the whole triangle.



$$h = \tan(40^\circ) \times 5$$

$$= 4.195498 \dots$$

$$\text{Area triangle} = \frac{1}{2} \times 10 \times 4.195498 \dots$$

$$= 20.97749 \dots \text{ cm}^2$$

$$\text{Total area cross section} = 120 \text{ cm}^2 + 20.97749 \dots \text{ cm}^2$$

$$= 140.97749 \dots \text{ cm}^2$$

$$\text{Volume prism} = 140.97749 \dots \times 20$$

$$= 2819.549816$$

$$= 2820 \text{ cm}^3 \text{ (3sf)}$$

(Total for Question 9 is 5 marks)

cm³

2820



P 6 2 2 7 9 A 0 1 0 2 4

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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.

$$10^5 \times 365 \text{ days} \times 81 \text{ years}$$

$$\sqrt{10^5 \times 400 \times 80}$$

$$= 10^5 \times 32000$$

$$= 100000 \times 32000$$

$$= 3200000000$$

$$= 3.2 \times 10^9$$

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.

$$\frac{90}{2 \times 10^{12}}$$

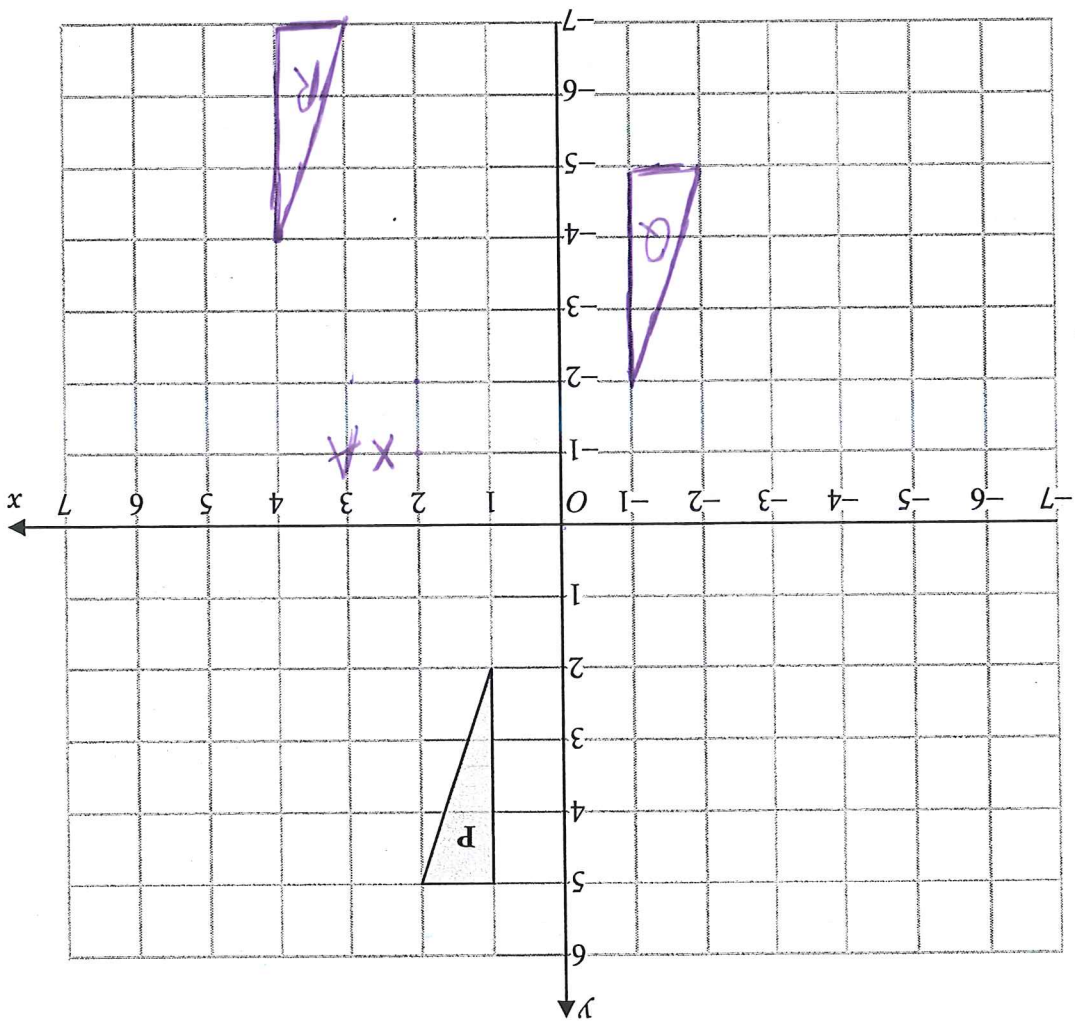
$$\frac{4.5 \times 10^{-11}}{(2)} \text{ grams}$$

(Total for Question 10 is 4 marks)



P 6 2 2 7 9 A 0 1 1 2 4

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° , Centre $(2.5, -1)$

(3)

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

(b) Write down the coordinates of point A.

(1) *doesn't move when transformed by this rule*
2.5, -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.

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

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

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

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

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

(3)

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

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

$$= 8x^2 + 10x + 12x + 15$$

$$= 8x^2 + 22x + 15$$

$$(x-3)(8x^2 + 22x + 15)$$

$$= 8x^3 + 22x^2 + 15x - 24x^2 - 66x - 45$$

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

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

(3)

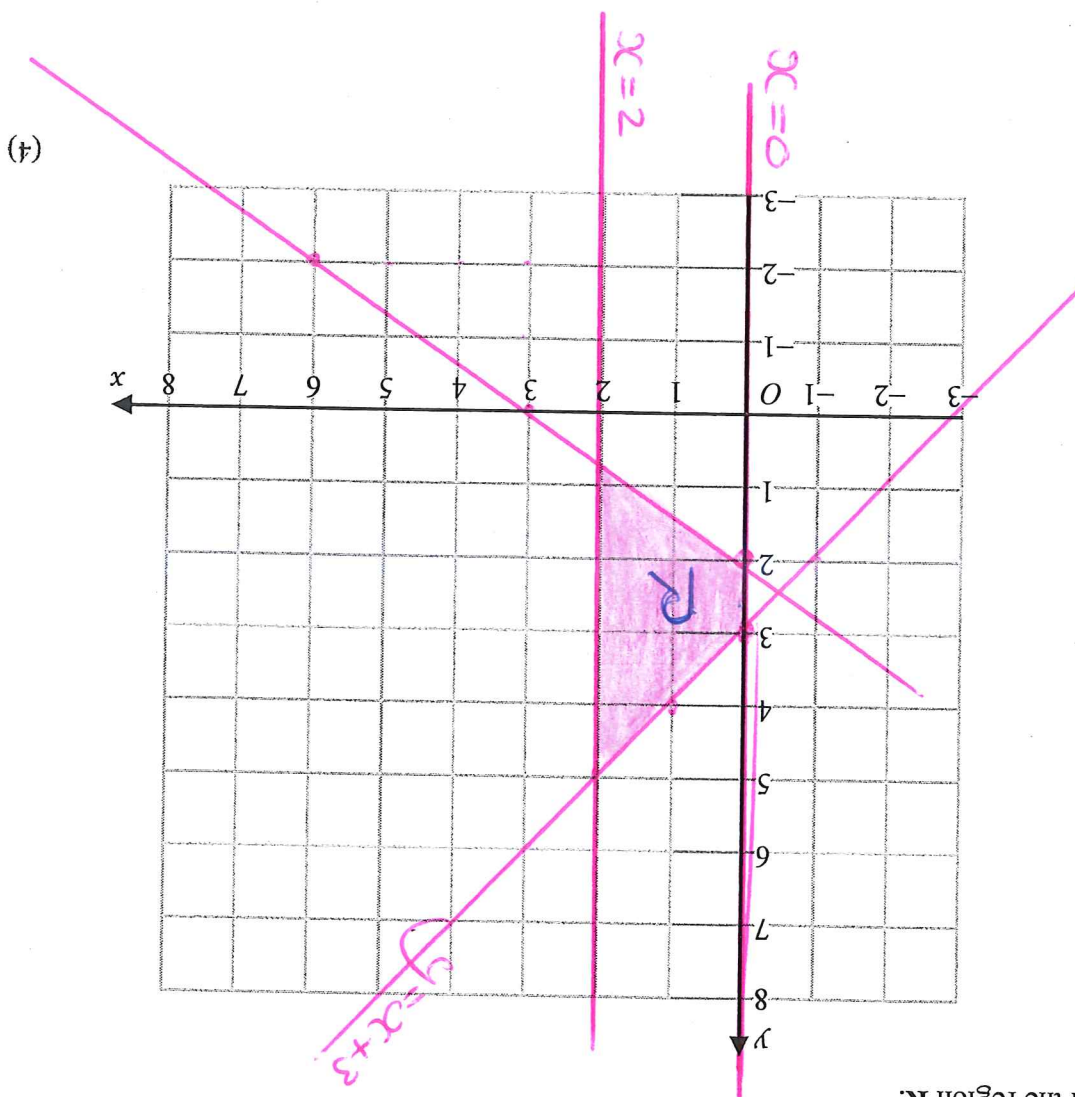
(Total for Question 12 is 6 marks)



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

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

Label the region R.



(4)

y-intercept at 2
gradient $-\frac{2}{3}$ rise

$$2x + 3y = 6$$

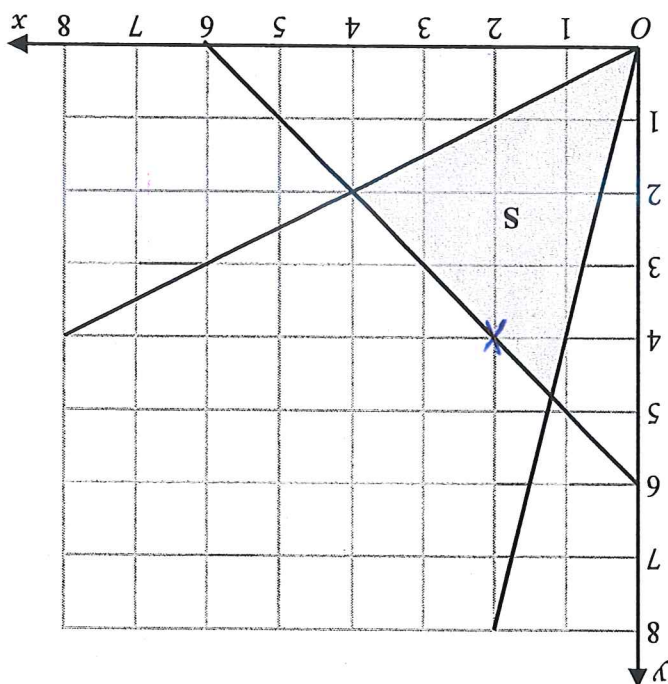
$$3y = -2x + 6$$

$$y = -\frac{2}{3}x + 2$$



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

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



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.

No he is not correct. The point $(2, 4)$ lies on the line $x + y = 6$ and this is included since it must satisfy $x + y \leq 6$ not $x + y < 6$

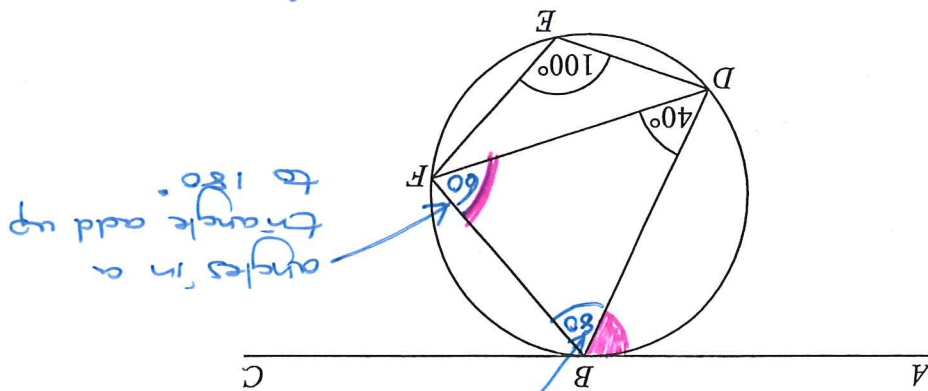
(1)

(Total for Question 13 is 5 marks)



P 6 2 2 7 9 A 0 1 5 2 4

opposite angles in a cyclic quadrilateral add up to 180°



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.

$$\text{angle } ABD = 60$$

alternate segment theorem

(Total for Question 14 is 4 marks)



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15 Prove algebraically that $0.\overline{73}$ can be written as $\frac{11}{15}$

$0.\overline{73} = 0.733333\ldots$
 one digit recurs so $\times 10$
 Let $x = 0.\overline{73}$ and $10x = 7.\overline{3}$

$$10x = 7.\overline{33333}\ldots$$

$$x = 0.\overline{73333}\ldots$$

$$9x = 6.6$$

$$x = 6.6 \times 10$$

$$9 \times 10$$

$$x = 6.6 \div 3$$

$$90 \div 3$$

$$= 2.2$$

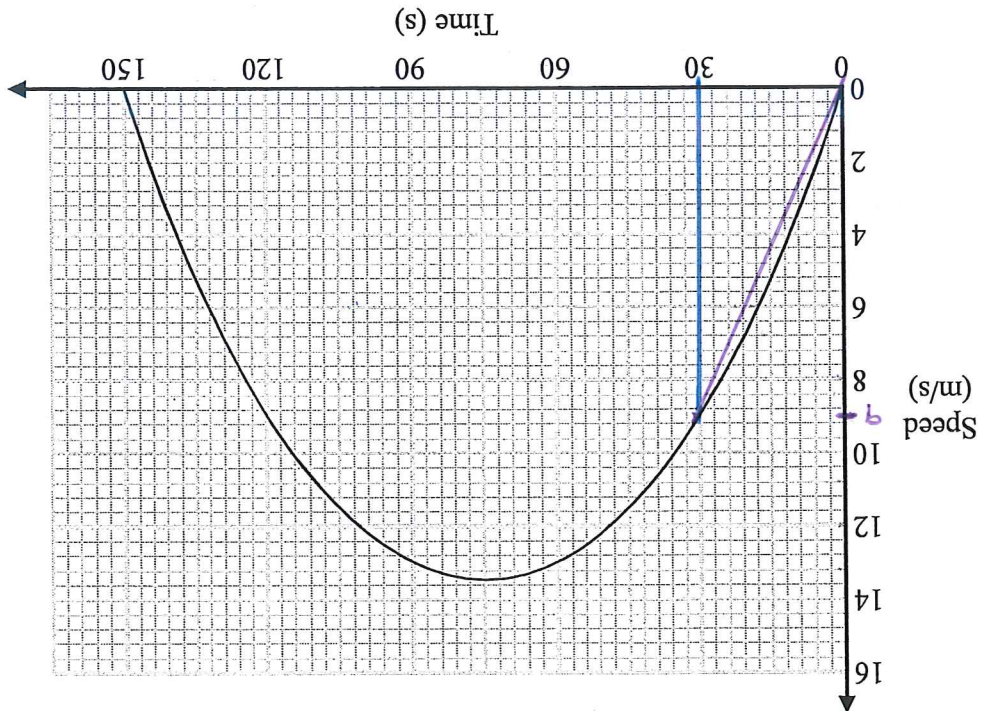
$$30 \div 2$$

$$= \frac{11}{15}$$

(Total for Question 15 is 2 marks)

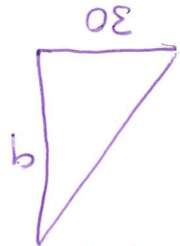


16 Here is a speed-time graph for a car.



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

$$\approx \frac{30 \times 9}{2}$$



(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 chord drawn is under

the curve so there is some area not

included between the triangle and the curve

(1)

(2)

135 m

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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.

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

$$= 13 \div 60$$

$$= 0.216 \text{ m/s}^2$$

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

(c) Explain why.

Julian should draw a tangent to the curve at 60 seconds and then find the gradient of this line

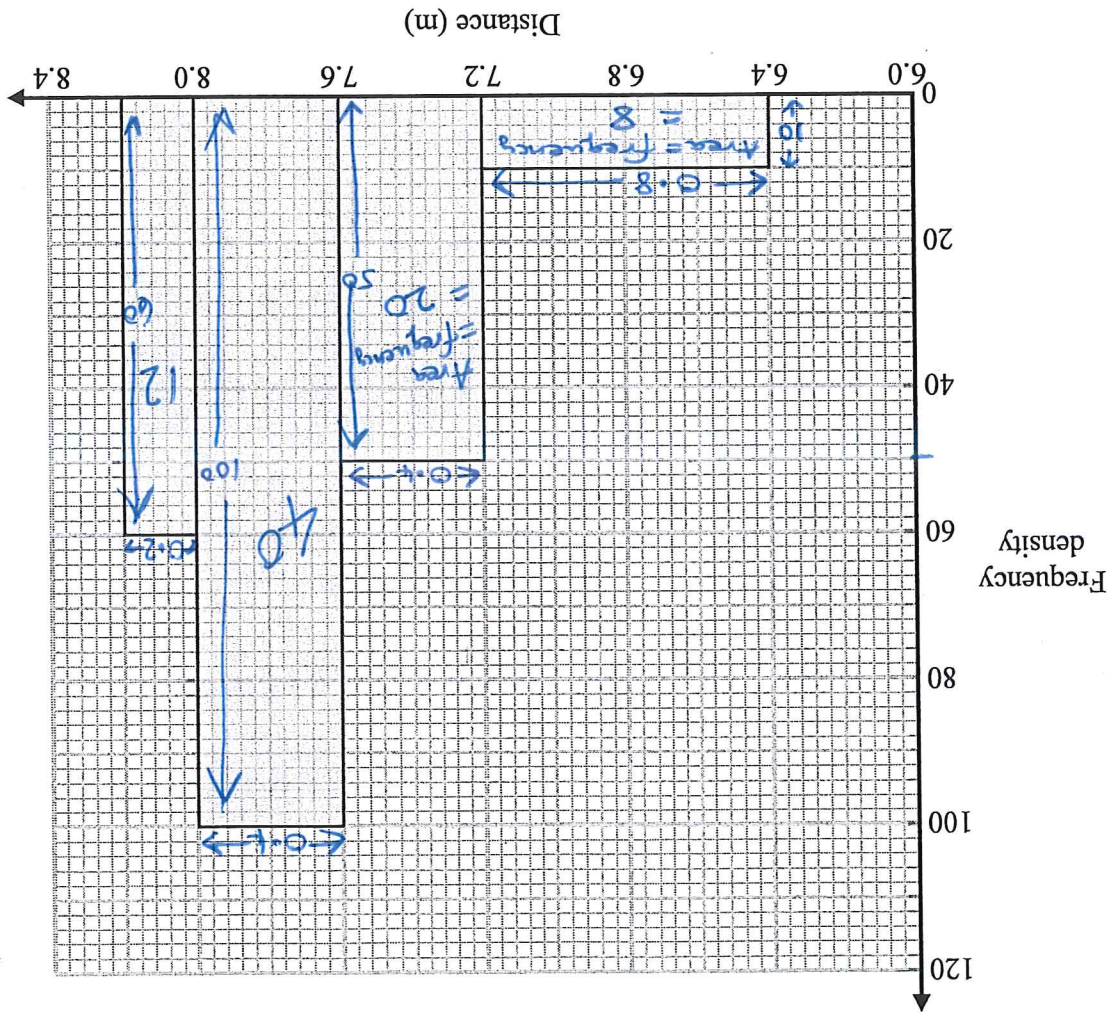
(1)

(Total for Question 16 is 4 marks)



Turn over

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



Calculate an estimate for the mean distance.

Distance jumped	mid point	frequency
6.4 - 7.2	6.8	8
7.2 - 7.6	7.4	20
7.6 - 8.0	7.8	40
8.0 - 8.4	8.2	12

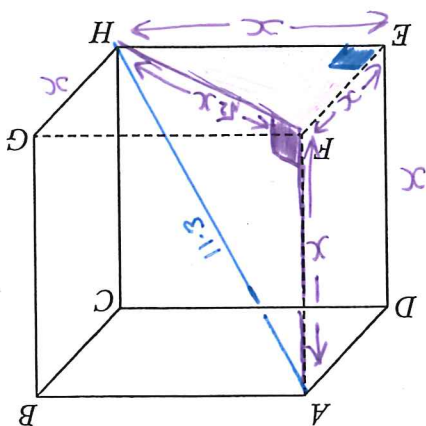
$$\text{mean} \approx \frac{6.8 \times 8 + 7.4 \times 20 + 7.8 \times 40 + 8.2 \times 12}{80}$$

$$= 7.645 \text{ m}$$

(Total for Question 17 is 4 marks)

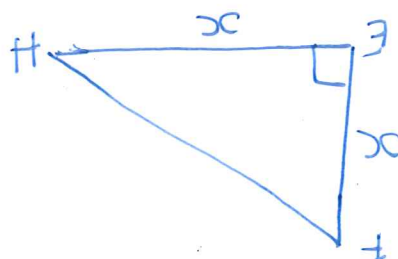


18 The diagram shows a cube.

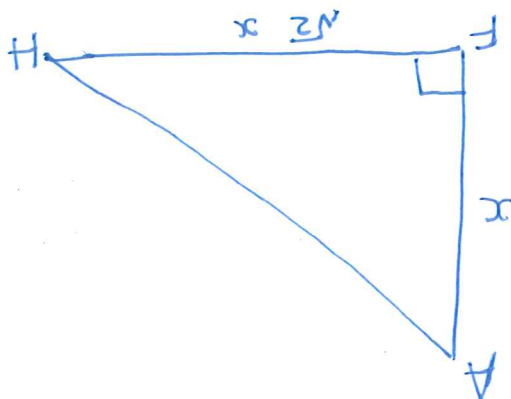
 $AH = 11.3 \text{ cm}$ correct to the nearest mm.

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

You must show all your working.



$$\begin{aligned} &= \sqrt{2x^2} \\ &= \sqrt{x^2 + x^2} \end{aligned}$$



$$\sqrt{x^2 + 2x^2} = \sqrt{3x^2}$$

Lower bound of $HH = 11.25$

$$\begin{aligned} \sqrt{3x^2} &= 11.25 \\ 3x^2 &= 126.5625 \\ x^2 &= 42.1875 \\ x &= 6.475190528 \end{aligned}$$

$$x = 6.495190528$$
$$x^2 = 42.1875$$
$$3x^2 = 126.5625$$

[square
T. 3

6.495 (3dp) cm

(Total for Question 18 is 4 marks)



(Total for Question 19 is 4 marks)

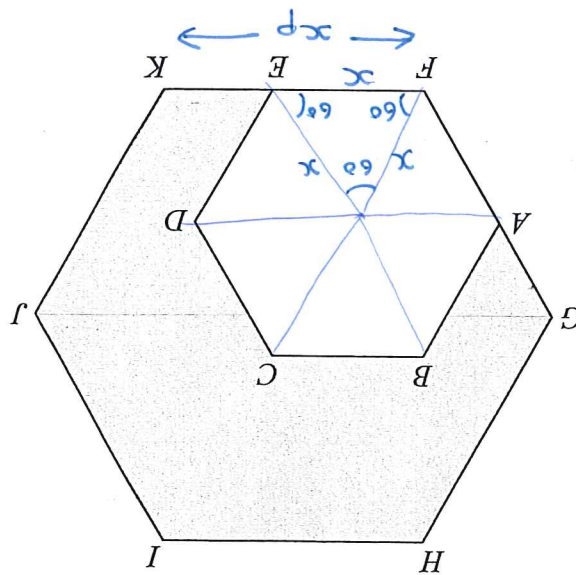
$$\begin{aligned} \text{Shaded region Area} &= \frac{3\sqrt{3}}{2} x^2 p^2 - \frac{3\sqrt{3}}{2} x^2 \\ &= \frac{3\sqrt{3}}{2} x^2 p^2 \end{aligned}$$

$$\text{Area large hexagon} = 6 \times \frac{1}{2} \times x p \times x p \times \sin 60^\circ$$

$$\begin{aligned} \text{Area small hexagon} &= 6 \times \frac{1}{2} \times x \times x \times \sin 60^\circ \\ \text{Shaded Area} &= \text{Area large hexagon} - \text{Area small hexagon} \end{aligned}$$

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

$ABCDEF$ is a regular hexagon with sides of length x . This hexagon is enlarged, centre F , by scale factor p to give hexagon $F GH I J K$.



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

A hexagon
split into
six identical
equilateral
triangles

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20 Here is a list of five numbers.

- 9853
- 9864
- 9873
- 9888
- 9891

Find the lowest common multiple of these five numbers.

98⁹¹ is the biggest number here and is a multiple of all other multiples of 98
Therefore 98⁹¹ is the LCM

98⁹¹

(Total for Question 20 is 1 mark)





TOTAL FOR PAPER IS 80 MARKS

(Total for Question 21 is 5 marks)

(3)

$$5:2$$

$$x:y = 5:2$$

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

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

$$[\div y]$$

$$\begin{aligned} 2x - 5y &= 0 \\ 2x &= 5y \\ x &= \frac{5}{2}y \end{aligned}$$

$$\begin{bmatrix} 3x + 4y \\ 2x - 5y \end{bmatrix} \begin{matrix} -15y + 8xy = -7xy \\ -15y + 8xy = -7xy \end{matrix}$$

$$x > 0 \text{ and } y > 0$$

$$x = -\frac{4y}{3}$$

$$3x + 4y = 0$$

$$\begin{aligned} 6x^2 - 7xy + 20y^2 &= 0 \\ 6x^2 - 7xy - 20y^2 &= 0 \\ (3x + 4y)(2x - 5y) &= 0 \end{aligned}$$

(b) Find the ratio $x:y$

$$6x^2 = 7xy + 20y^2 \text{ where } x > 0 \text{ and } y > 0$$

(2)

$$3:4$$

$$3:4$$

$$c:d$$

or

$$4:3 = d:c$$

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

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

$$4c = 3d$$

(a) Find the ratio $c:d$

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

$$[-c \text{ and } -d]$$

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