Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number | | | | | |

Candidate Number | | | | |

Monday 9 November 2020

Morning (Time: 1 hour 30 minutes) | Paper Reference **1MA1/3H**

Mathematics

Paper 3 (Calculator)
Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator. Tracing paper may be used.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- You must **show all your working**.
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- **Calculators may be used.**
- If your calculator does not have a π button, take the value of π to be 3.142 unless the question instructs otherwise.

Information

- 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.
- Check your answers if you have time at the end.

Turn over ▶

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1/1/1/1/

P 6 2 2 7 9 A 0 1 2 4

Pearson

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

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

$n^3 \times n^5 = n^{(3+5)}$

$= n^8$ (1)

$x^a \times x^b = x^{(a+b)}$

n^8

(1)

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

$\frac{c^3d^4}{c^2d} = c^{(3-2)}d^{(4-1)}$ (1)

$= cd^3$ (1)

$\frac{x^a}{x^b} = x^{(a-b)}$

cd^3

(2)

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

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

$5x > 7(2)$

$5x > 14$ (1)

$x > \frac{14}{5}$ (1)

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

(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.

Time taken = $\frac{\text{Distance}}{\text{speed}}$

Cycling time = $\frac{30 \text{ km}}{24 \text{ km/h}}$

= 1.25 h (1)

Running time = $\frac{12 \text{ km}}{8 \text{ km/h}}$

= 1.5 h

Total time = 1.25 h + 1.5 h (1)

= 2.75 h

≈ 2 hr (0.75 hr × 60) min

= 2 hr 45 min ✱(1)

2 hours 45 minutes

(Total for Question 2 is 3 marks)

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

Complete the error interval for m.

Error interval = $\frac{0.1}{2}$ = 0.05

Upper interval = 9.4 + 0.05

= 9.45

Lower interval = 9.4 − 0.05

= 9.35

9.35 (1) $\leqslant m <$ 9.45 (1)

(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.

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?
You must show all your working.

Area of lawn for 3 kg of grass seeds : $5\text{ m} \times 9\text{ m}$
$= 45\text{ m}^2$ (1)

Area of lawn Maisie wants to make : $10\text{ m} \times 14\text{ m}$
$= 140\text{ m}^2$

Grass seeds Maisie has : $5 \times 2\text{ kg}$
$= 10\text{ kg}$

$$\frac{\text{Grass seeds for } 140\text{ m}^2 \text{ lawn}}{3\text{ kg}} = \frac{140\text{ m}^2}{45\text{ m}^2}$$ (1)

$= 3.111\ (3\text{ kg})$ (1)
$= 9.333\text{ kg}$

∴ Yes, Maisie has enough grass seeds. (1) **(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.

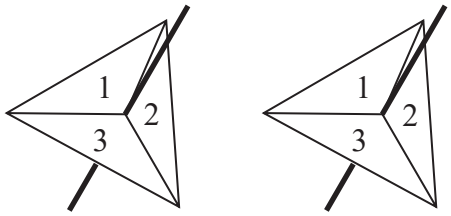
Yes, this will affect Maisie as she only has 9 kg of grass seeds now. Less than required amount of 9.333 kg. (1)

$(4 \times 2) + 1 = 9\text{ kg}$

(1)

(Total for Question 4 is 5 marks)

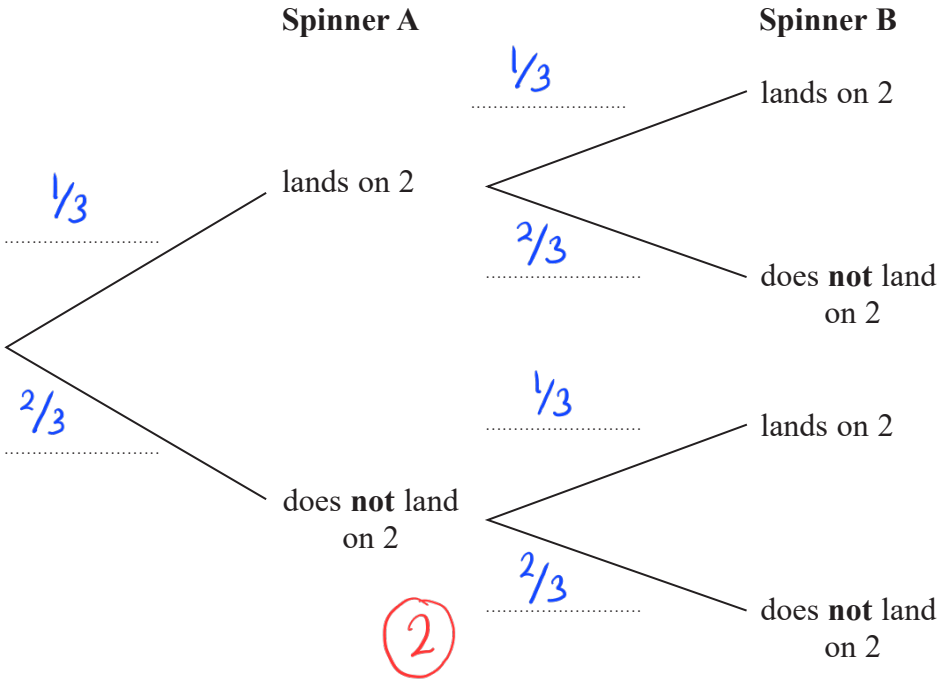
5 Amanda has two fair 3-sided spinners.



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

$= 1/3 \times 2/3$ (1)

Horizontal path in probability tree = multiply the probability

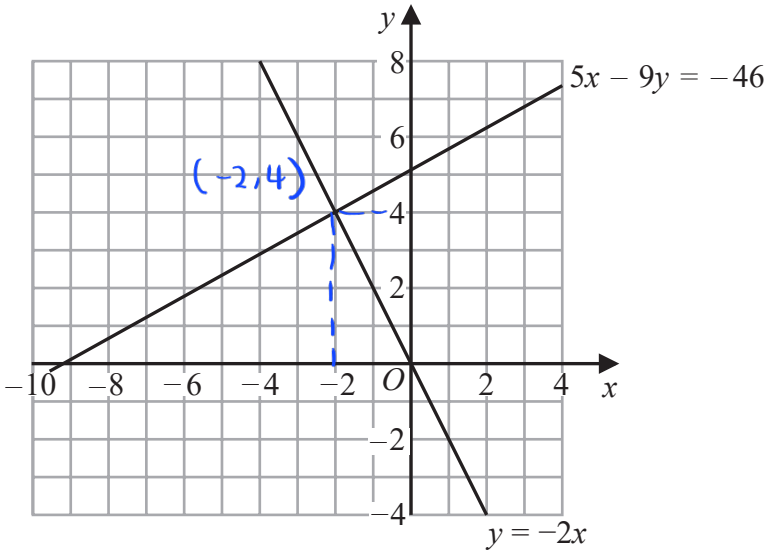
$\therefore 2/9$ (1)

$2/9$

(2)

(Total for Question 5 is 4 marks)

6



(a) Use these graphs to solve the simultaneous equations

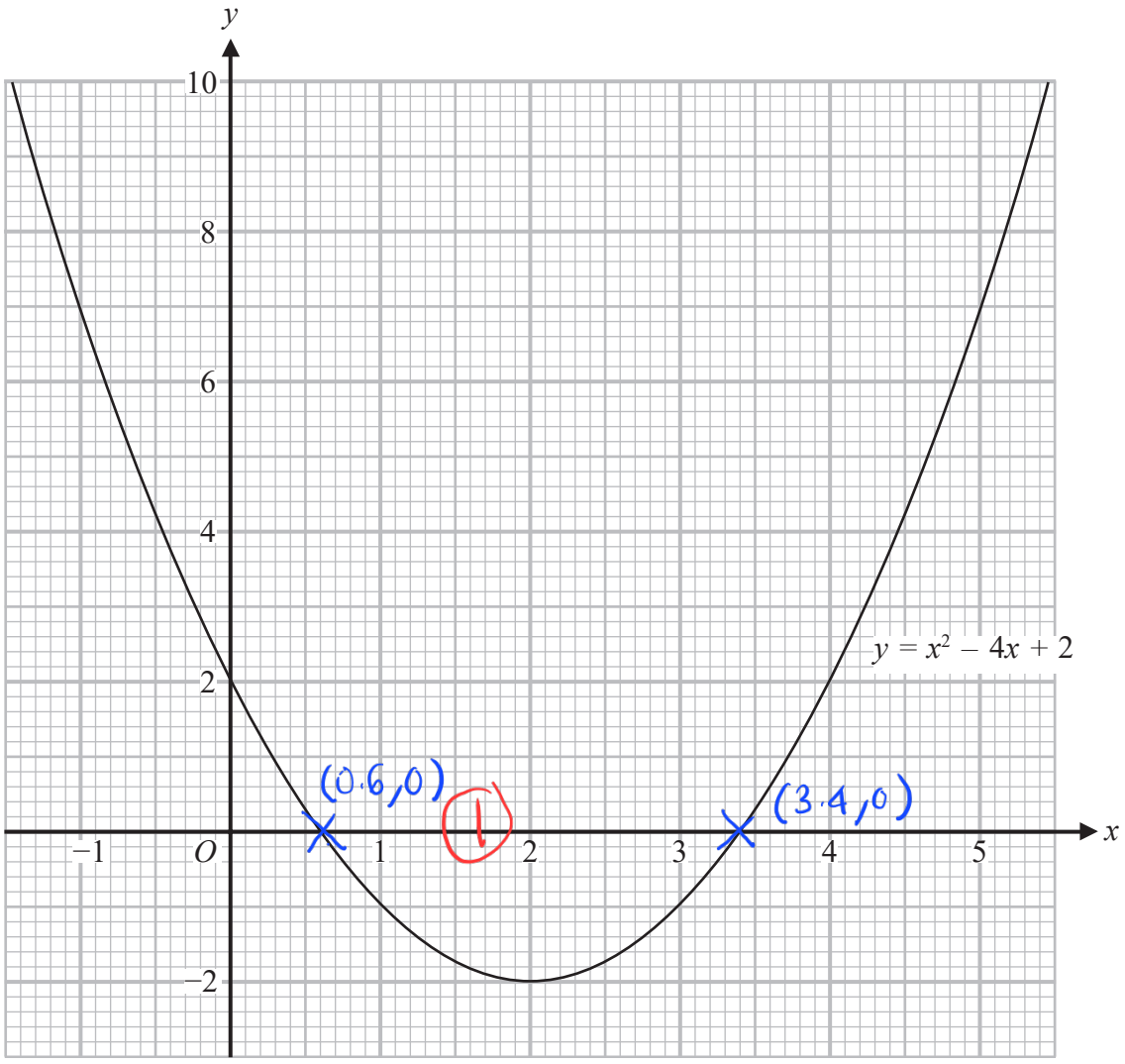
$$5x - 9y = -46$$
$$y = -2x$$

Find the point of intersection.

$x =$ −2 (1)

$y =$ 4

(1)



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

1 small box = 0.1

$x = 0.6$, $x = 3.4$

(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.

Total age of boys = 18 x 16.2 years
= 291.6 years

Total age of girls = 27 x 16.7 years
= 450.9 years

Total age of boys and girls = 291.6 years + 450.9 years
= 742.5 years (1)

Mean of boys and girls = $\frac{742.5 \text{ years}}{45}$ (1)

= 16.5 years (1)

16.5 .....years

(Total for Question 7 is 3 marks)

Mean age of boys and girls = $\frac{\text{Total age of boys and girls}}{\text{Total number of boys and girls}}$

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		

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.

Total probability = 1

probability red $P(R) = 5P(Y)$ → 5x probability yellow

$P(R+Y) = 1 - (0.32 + 0.20)$

$= 0.48$ (1)

$6P(Y) = 0.48$

$P(Y) = 0.48 \div 6$

$P(Y) = 0.08$ (1)

$P(R+Y) = P(R) + P(Y)$
$= 5P(Y) + P(Y)$
$= 6P(Y)$

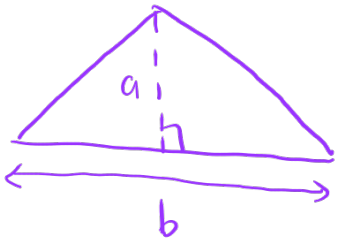
Number of yellow counters : 0.08×300 ← Total counters

$= 24$ (1)

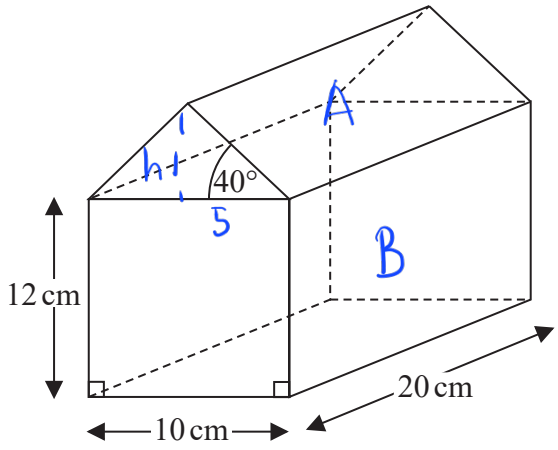
24

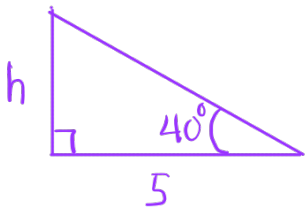
(Total for Question 8 is 3 marks)

9 The diagram shows a prism.

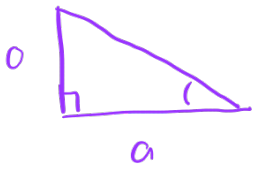


Area $= \frac{1}{2}ab$





$\tan\theta = \frac{O}{A}$



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.

Height of triangle = $h = 5\tan 40^\circ$ (1)

$= 4.195$ cm (1)

Cross section of triangle x height

Volume of A $= \left(\frac{1}{2} \times (5+5) \times 4.195\right) \times (20)$

$= \frac{1}{2} \times 10 \times 4.195 \times 20$

$= 419.5\ cm^3$ (1)

Volume of B $= 12 \times 10 \times 20$

$= 2400\ cm^3$ (1)

Total volume $= 419.5 + 2400$

$= 2819.5\ cm^3$

$= 2820\ cm^3$ (3 s.f.) 2820 (1)

..... 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.

1 yr = 365 days

heart beat/day × 365 days × 81 yrs

Person's heart beat in a lifetime : $10^5 \times 365 \times 81$ (1)

$= 2956500000$

3.0 = 2sf

3 = 1sf

$= 3.0 \times 10^9$ (2 s.f.)

(1) 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.

Average mass of 1 red blood cell : $\frac{90\text{ g}}{2 \times 10^{12}}$ (1)

$= 4.5 \times 10^{-11}$ g (1)

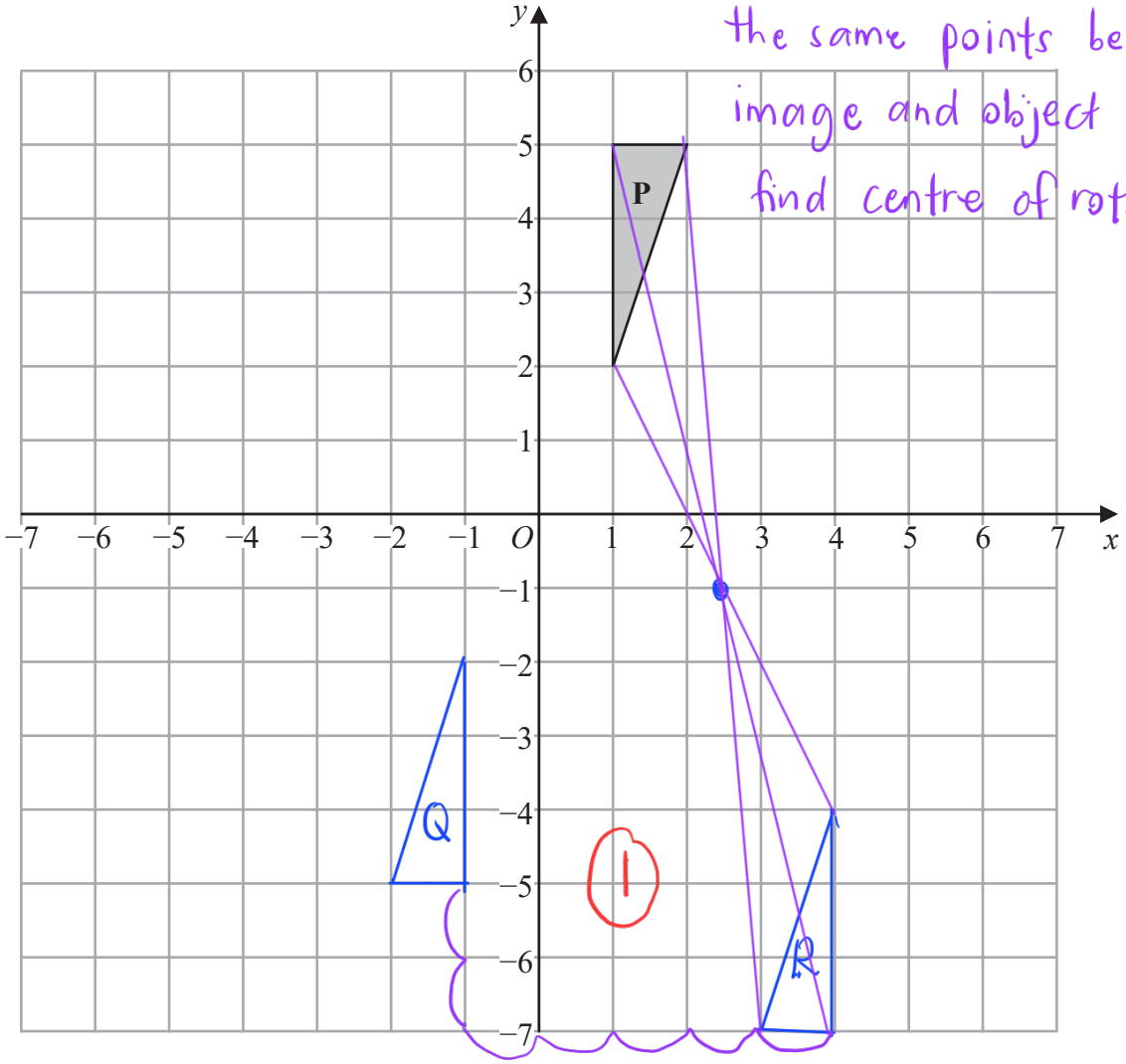
4.5×10^{-11} grams

(2)

(Total for Question 10 is 4 marks)

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

Draw lines to connect the same points between image and object to find centre of rotation



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

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

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

Rotation 180° with centre of rotation (2.5, −1)

2

(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

(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.

$\frac{x}{x+2} + \frac{2x}{x-4}$ (Multiply denominators with each other)

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

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

$= \frac{3x^2}{(x+2)(x-4)}$ (1)

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

(3)

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

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

$= (2x^2 - 3x - 9)(4x + 5)$ (1)

$= 8x^3 + 10x^2 - 12x^2 - 15x - 36x - 45$ (1)

$= 8x^3 - 2x^2 - 51x - 45$ (1)

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

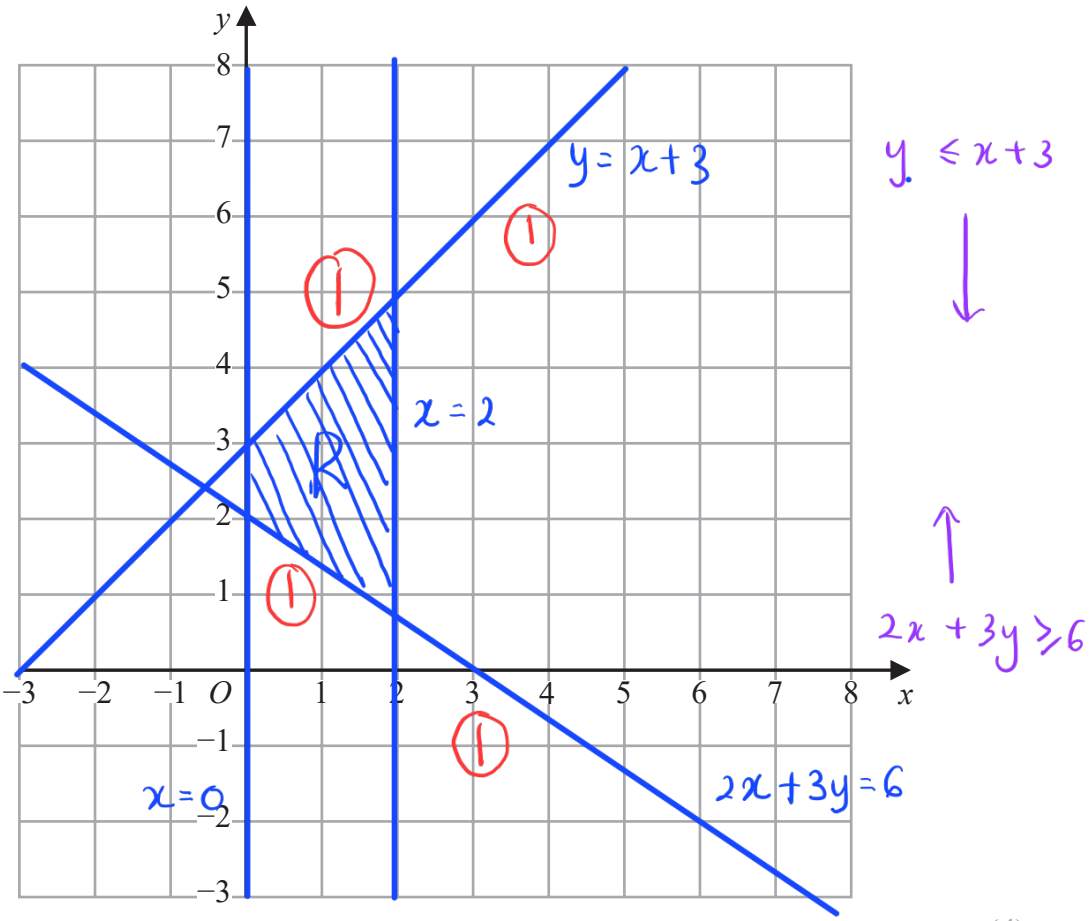
(3)

(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**.



y ⩽ x + 3

2x + 3y ⩾ 6

x ⩾ 0 →

← x ⩽ 2

(4)

Tips : How to draw your lines

y ⩾ mx + c →

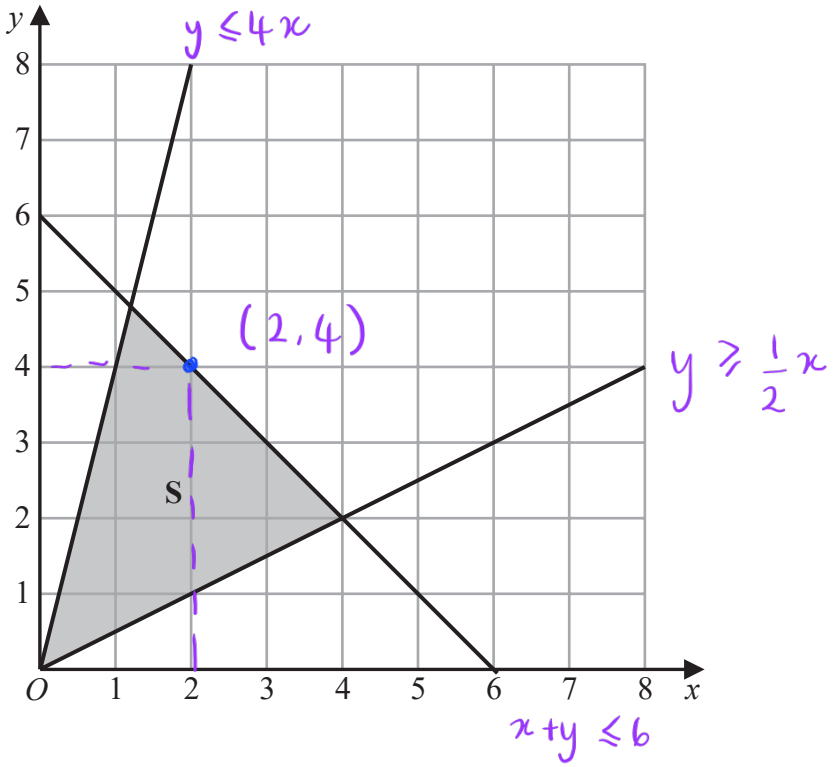
y ⩽ mx + c

y > mx + c →

y < mx + c

(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. Because point (2,4) satisfy the $x + y \leq 6$ inequalities. (1)

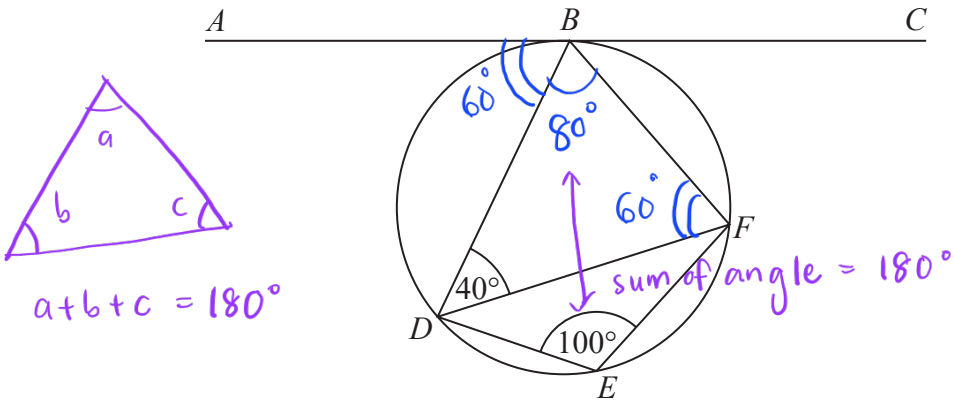
(1)

(Total for Question 13 is 5 marks)

The point is on the line with inequality symbol of $\leq$, so it is included in the shaded region.

If the point lies on a line with inequality symbol $<$ or $>$, it won't be included in the shaded region.

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.

$\angle DBF = 180^\circ - 100^\circ$

$= 80^\circ$ (1)

(opposite angle of cyclic quadrilateral adds up to 180°)

$\angle BFD = 180^\circ - 40^\circ - 80^\circ$

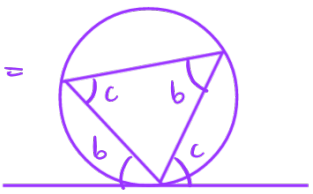
$= 60^\circ$ (1)

(angle in triangle adds up to 180°)

$\angle ABD = 60^\circ$ (1)

(alternate segment theorem) (1)

Alternate segment theorem =



(Total for Question 14 is 4 marks)

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

$x = 0.7\dot{3}$

$x = 0.7333\ldots$ — (1)

$10x = 7.333\ldots$ — (2)

(1)

(2) − (1)

$10x - x = 7.333\ldots - 0.7333\ldots$

$9x = 6.6$ — multiply 10 on both sides to remove decimal point

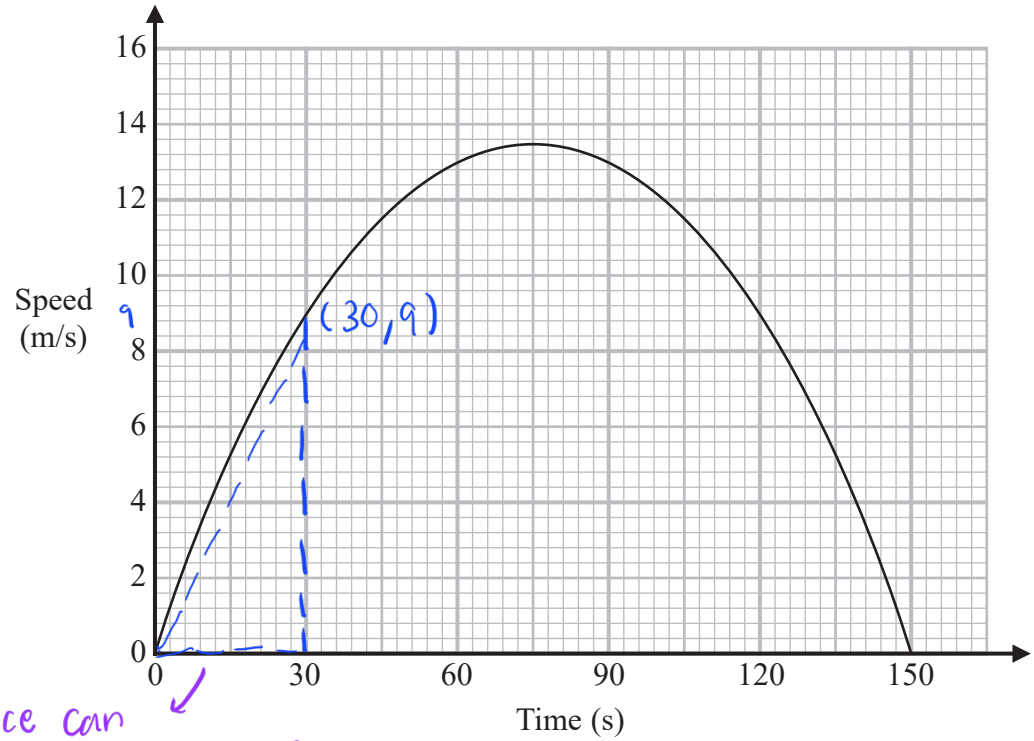
$90x = 66$

$x = \frac{66}{90}$

$= \frac{11}{15}$ (1)

(Total for Question 15 is 2 marks)

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



Distance can be estimated by finding the area of the triangle

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

Distance = 0.5 x 9 m/s x 30 s (1)

= 135 m (1)

Area of triangle = $\frac{1}{2} \times h \times l$

135 m

(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. Because area between triangle and curve are not included. (1)

(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.

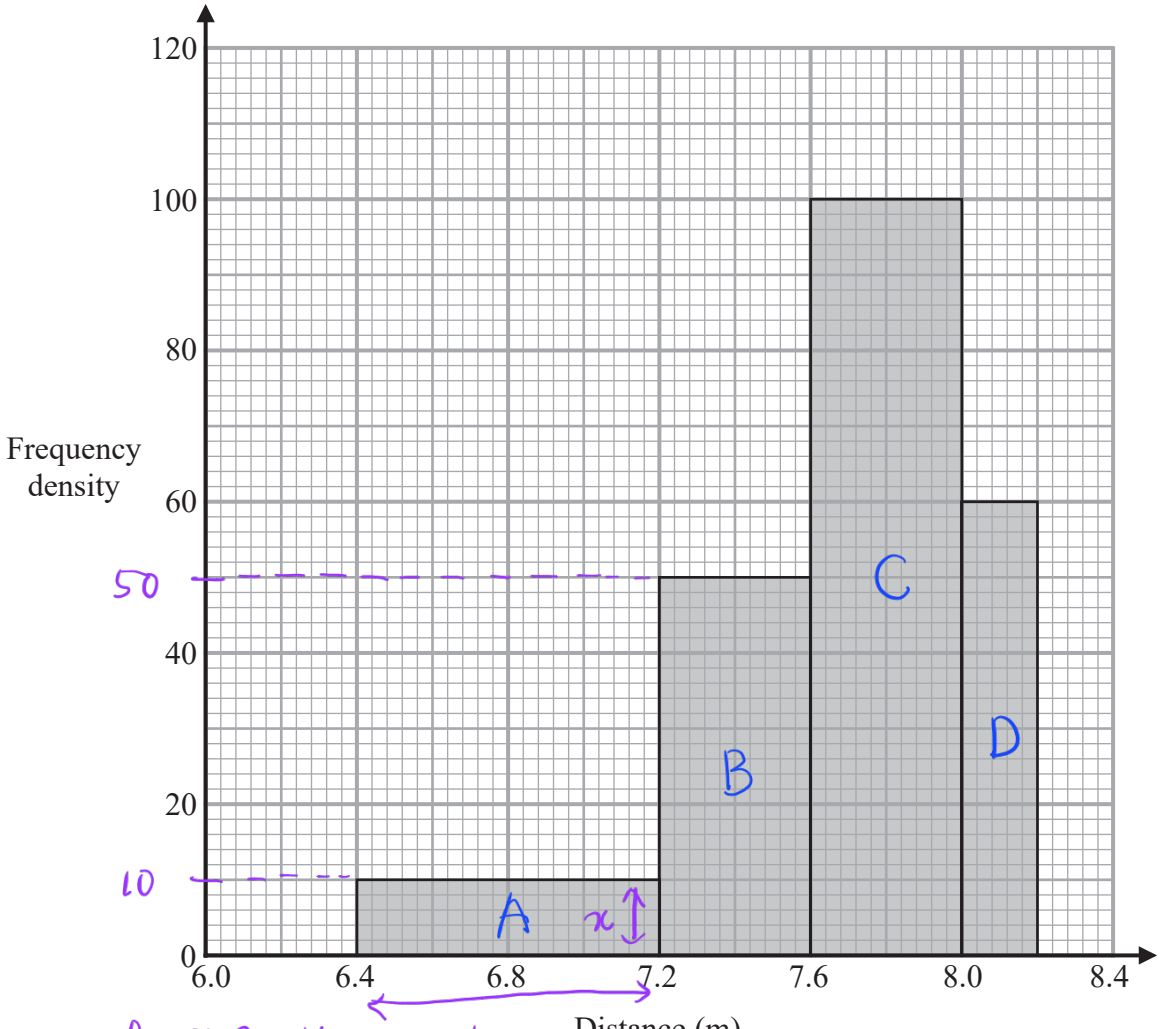
(c) Explain why.

His method only gives average acceleration. He needs to find the tangent at 60 seconds and the gradient of the tangent is the estimate of acceleration. (1)

(1)

(Total for Question 16 is 4 marks)

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



Frequency A = x × y

Calculate an estimate for the mean distance.

Frequency A = (7.2 − 6.4)(10) = 8 (1)

Frequency B = (7.6 − 7.2)(50) = 20

Frequency C = (8.0 − 7.6)(100) = 40

Frequency D = (8.2 − 8.0)(60) = 12 (1)

Mean distance = $\dfrac{(8 \times 6.8) + (20 \times 7.4) + (40 \times 7.8) + (12 \times 8.1)}{80}$ (1)

mean distance = $\dfrac{\Sigma(\text{midpoint} \times \text{Frequency})}{\text{Total frequency}}$

$= \dfrac{611.6}{80}$

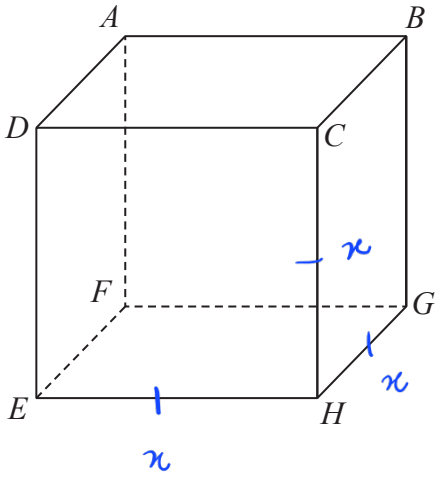
$= 7.645$ (1)

7.645

..... m

(Total for Question 17 is 4 marks)

18 The diagram shows a cube.



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.

Error interval for 1 dp = $\frac{0.1}{2}$ = 0.05

Lower bound for AH = 11.3 − 0.05

= 11.25 cm (1)

(length of a diagonal)^2 = (length)^2 + (width)^2 + (height)^2

$AH^2 = x^2 + x^2 + x^2$ (1) cube = equal sides

$11.25^2 = 3x^2$ (1)

$x = 6.495$ (1)

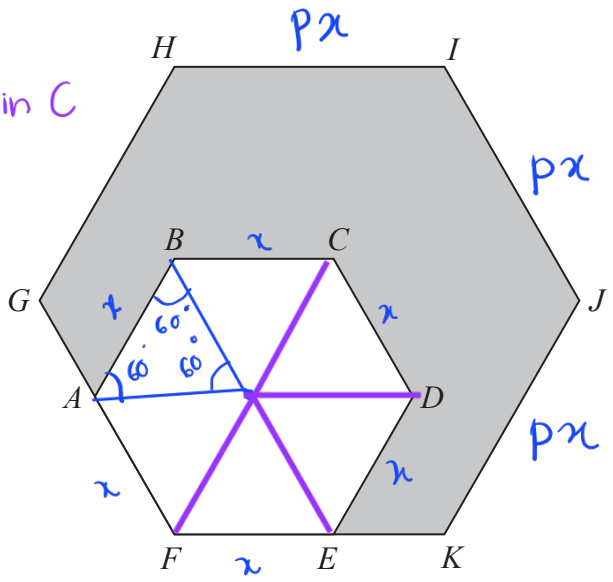
6.495

..... cm

(Total for Question 18 is 4 marks)

19

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



1 hexagon = 6 equilateral triangle

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 of equilateral triangle : $\frac{1}{2} \times x^2 \times \sin 60°$ (1)

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

Area of small hexagon $= 6 \times \frac{x^2\sqrt{3}}{4}$

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

Area of large hexagon $= \frac{3(px)^2\sqrt{3}}{2}$

length of large hexagon is px

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

Area of shaded region $= \frac{3p^2x^2\sqrt{3}}{2} - \frac{3x^2\sqrt{3}}{2}$

↓

Area of large hexagon − Area of small hexagon

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

(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} (1)

(Total for Question 20 is 1 mark)

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

(a) Find the ratio $c : d$

$5c + d = c + 4d$

$4c = 3d$ (1) — Put like terms on one side

$\frac{c}{d} = \frac{3}{4}$ (1)

↳ can also be written as $c : d$ and $3 : 4$

$3 : 4$

(2)

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

(b) Find the ratio $x : y$

$6x^2 - 7xy - 20y^2 = 0$ (1)

Let $x = 5$ (you can substitute x with any value > 0)

$6(5)^2 - 7(5)y - 20y^2 = 0$

$20y^2 + 35y - 150 = 0$ (1)

$y = 2$

$x = y$

$5 = 2$

$5 : 2$ (1)

(3)

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS