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 8 June 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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Pearson

Please note that these worked solutions have neither been provided nor approved by Pearson Education and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

Anything written in green in a cloud doesn't have to be written in the exam.

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

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

$a^x \times a^y = a^{x+y}$

n^8

(1)

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

$a^x / a^y = a^{x-y}$

d is basically d^1

cd^3

(2)

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

$5x > 14$ ← Multiplying both sides by 2 to eliminate the denominator

Dividing both sides by 5 to get x on its own

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

(2)

(Total for Question 1 is 5 marks)

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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.

$s \; d \; t$

This is a distance, speed, time problem so we can start with writing the formula triangle

$\frac{30}{24} + \frac{12}{8}$

From the formula triangle, time = distance/speed. Adding the two times gives the total time

FACT B
°'"

Convert the total time from hours to hours and minutes by pressing the button on the left. 2.75 hours becomes 2°45'0'', which means 2 hours and 45 minutes

2 hours 45 minutes

(Total for Question 2 is 3 marks)

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

Complete the error interval for m.

Add and subtract half of the resolution to get the upper and lower bounds. The resolution is 0.1 as it is to 1 decimal place

$9.35 \leqslant m < 9.45$

(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.

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.

$$\frac{\frac{10 \times 14}{5 \times 9} \times 3}{2} = 4.\dot{6}$$

10 x 14 gives the area of the lawn she wants. 5 x 9 gives the area of the lawn made by 3kg of grass seed. Dividing the areas works out how many lots of the lawn made by 3kg of grass seed the lawn she wants is and therefore gives the lots of 3kg needed. Multiplying this number of lots by 3 works out the mass of grass seed needed. Dividing this by 2 works out how many lots of 2kg the mass of grass seed needed is and therefore how many boxes of grass seed are needed

Yes

The 5 boxes she has is more than the $4.\dot{6}$ needed so she has enough grass seed

(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, as this is only 4.5 boxes, which is less than the $4.\dot{6}$ needed

1kg is half of 2kg so is worth half of one of the original boxes the calculation to the previous question was based on

(1)

(Total for Question 4 is 5 marks)

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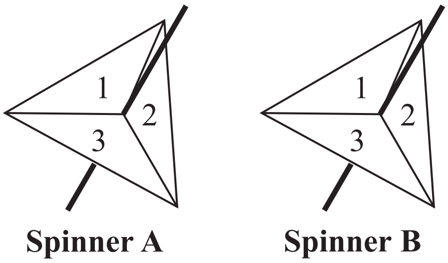
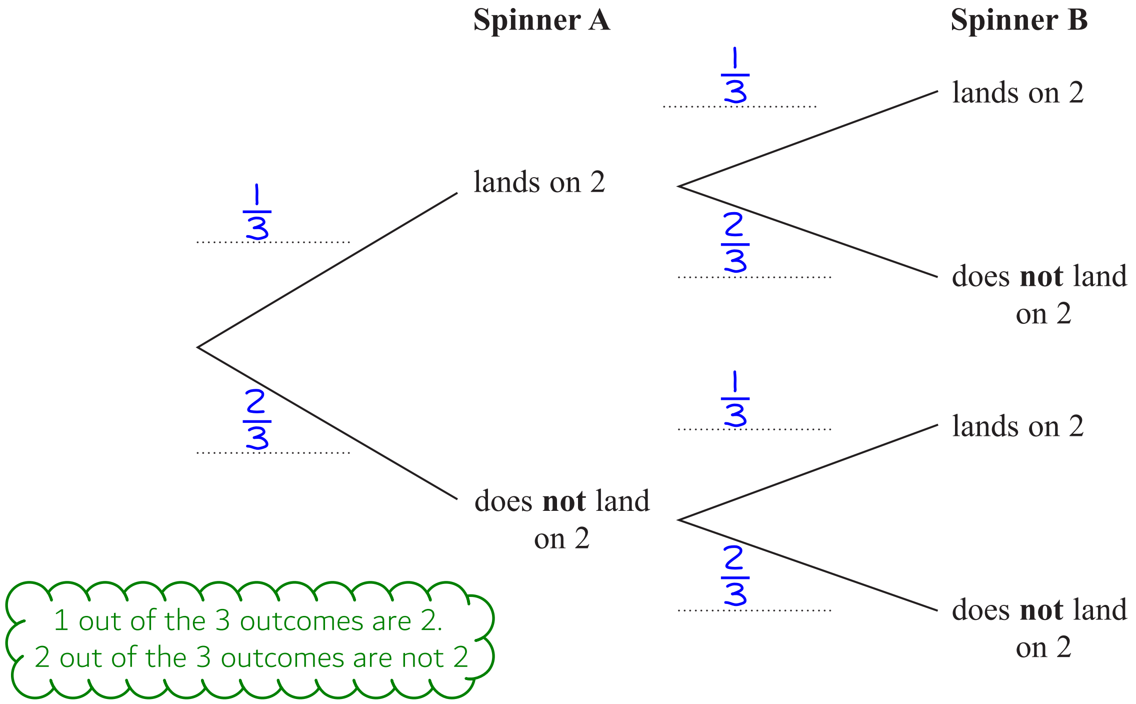
5 Amanda has two fair 3-sided spinners.



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

$\frac{1}{3} \times \frac{2}{3}$ ← AND means to multiply the probabilities

$\frac{2}{9}$

(2)

(Total for Question 5 is 4 marks)

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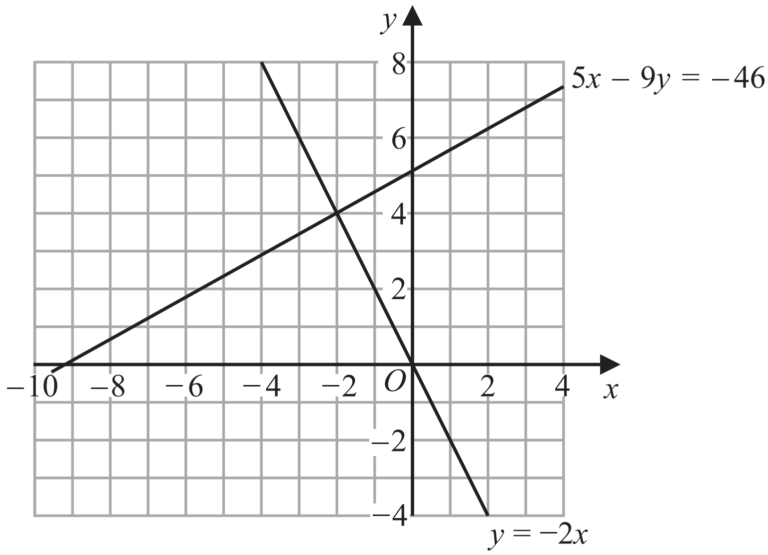
6



(a) Use these graphs to solve the simultaneous equations

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

The solutions are where the graphs cross as the x and y coordinates satisfy both equations at the same time at that point

$x =$ -2

$y =$ 4

(1)

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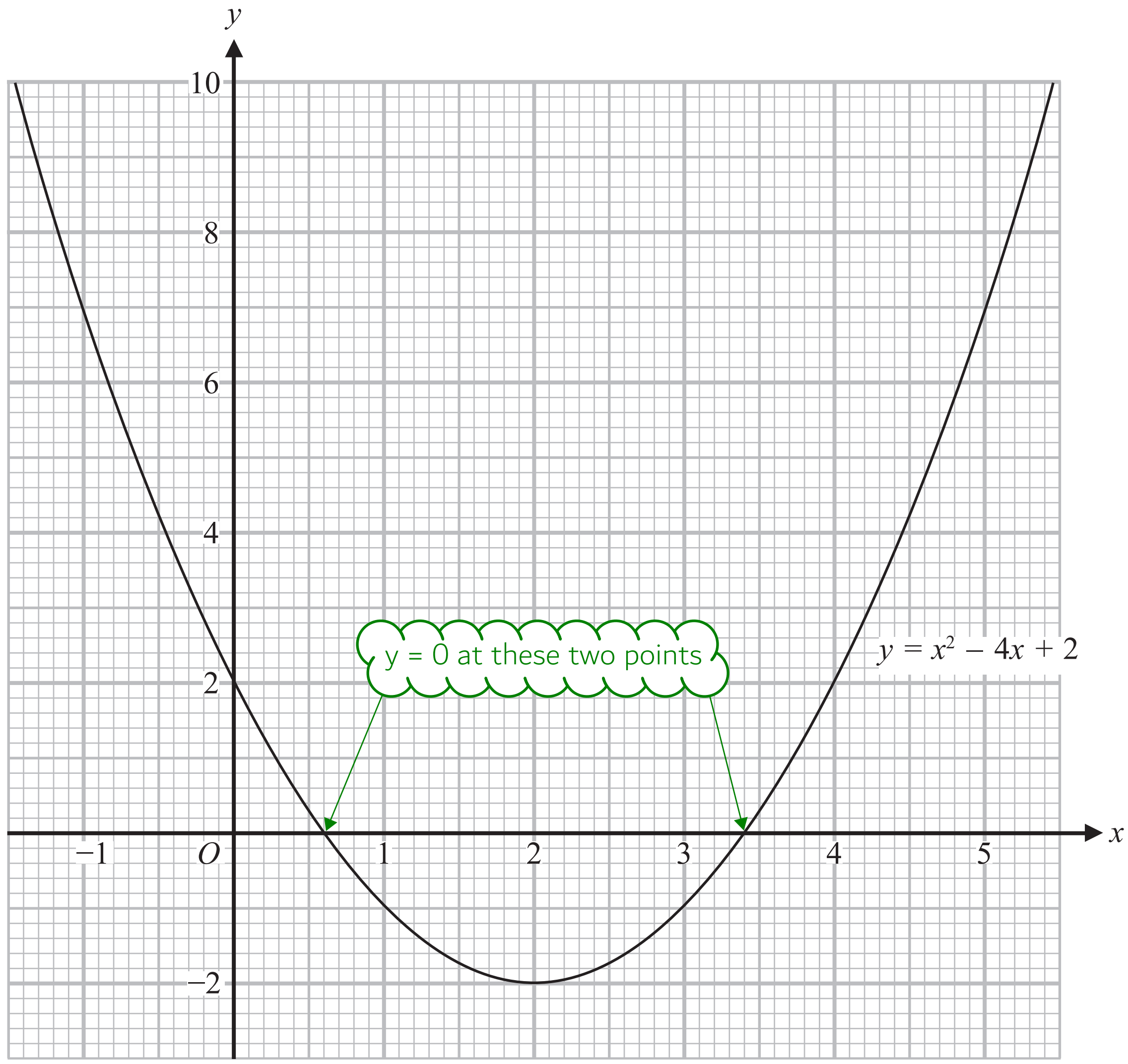


(b) Use this graph to find estimates for the solutions of the quadratic equation $x^2 - 4x + 2 = 0$

$x = 0.6$, $x = 3.4$

(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.

t
m n

Mean = total/number. Writing this as a formula triangle

$$\frac{18 \times 16.2 + 27 \times 16.7}{45}$$

From the formula triangle, total = mean x number. So 18 x 16.2 works out the total age of all the boys and 27 x 16.7 works out the total age of all the girls. Adding these two totals gives the total age of all the boys and girls. To get the mean this needs to be divided by 45

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		

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.

$5x + x = 1 - 0.32 - 0.20$ ← Let x be the probability it will be yellow. The probability it will be red must be 5x. Adding together these two probabilities gives the probability of it being red or yellow, which is equal to 1 - 0.32 - 0.20 as it is certain to get one of the colours so all of the probabilities must add to 1. Subtracting the probabilities for blue and green leaves the probability it will be red or yellow

$6x = 0.48$ ← Simplifying the equation

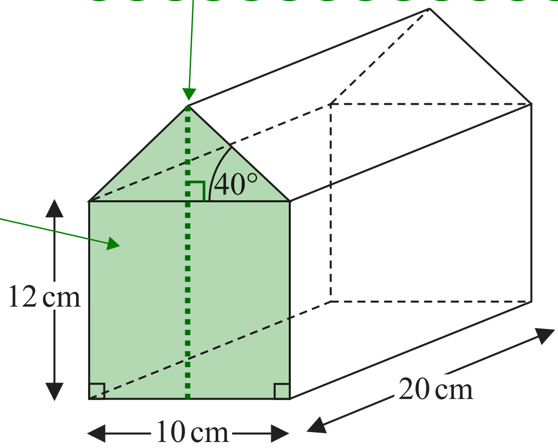
$x = 0.08$ ← Solving the equation by dividing both sides by 6

0.08×300 ← The probability of it being yellow is 0.08 and this is equal to the relative frequency of the yellow counters. So multiplying the probability by the total number of counters gives the number of yellow counters

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.

S Ó H C Á H T Ó Á

Right angled trigonometry can be used to work out the height of the triangle. Writing SOH CAH TOA as formula triangles. We have the adjacent and we are trying to find the opposite so both of these are ticked. Two ticks on the TOA formula triangle means this one can be used

$20(12 \times 10 + \frac{1}{2} \times 10 \times \tan 40 \times 5)$

Volume of prism = cross sectional area x length. The length of the prism is 20cm and is multiplied by the area of the cross section which is left in the bracket. Area of rectangle = length x width, so 12 x 10 works out the area of the rectangle. Area of triangle = 1/2 x base x height. The base of the triangle is 10cm. The height of the triangle is worked out using the the TOA formula triangle. Covering over O, as the height of the triangle is the opposite in the right angled triangle, gives that it is equal to (tan of the angle) x adjacent. The angle is 40 and the adjacent is half of 10 as the line of symmetry cuts the shape in half, which is 5cm. Adding the area of the rectangle and the triangle gives the area of the cross section

2820 cm^3

(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.

$10^5 \times 365 \times 81$

Multiplying the 10^5 by 365 works out approximately how many times a person's heart beats in a year as there are 365 days in a year. Multiplying this by 81 works out approximately how many times a person's heart beats in 81 years

In this case, pressing ENG converts it into standard form

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.

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

This works out the mean mass

4.5×10^{-11} grams

(2)

(Total for Question 10 is 4 marks)

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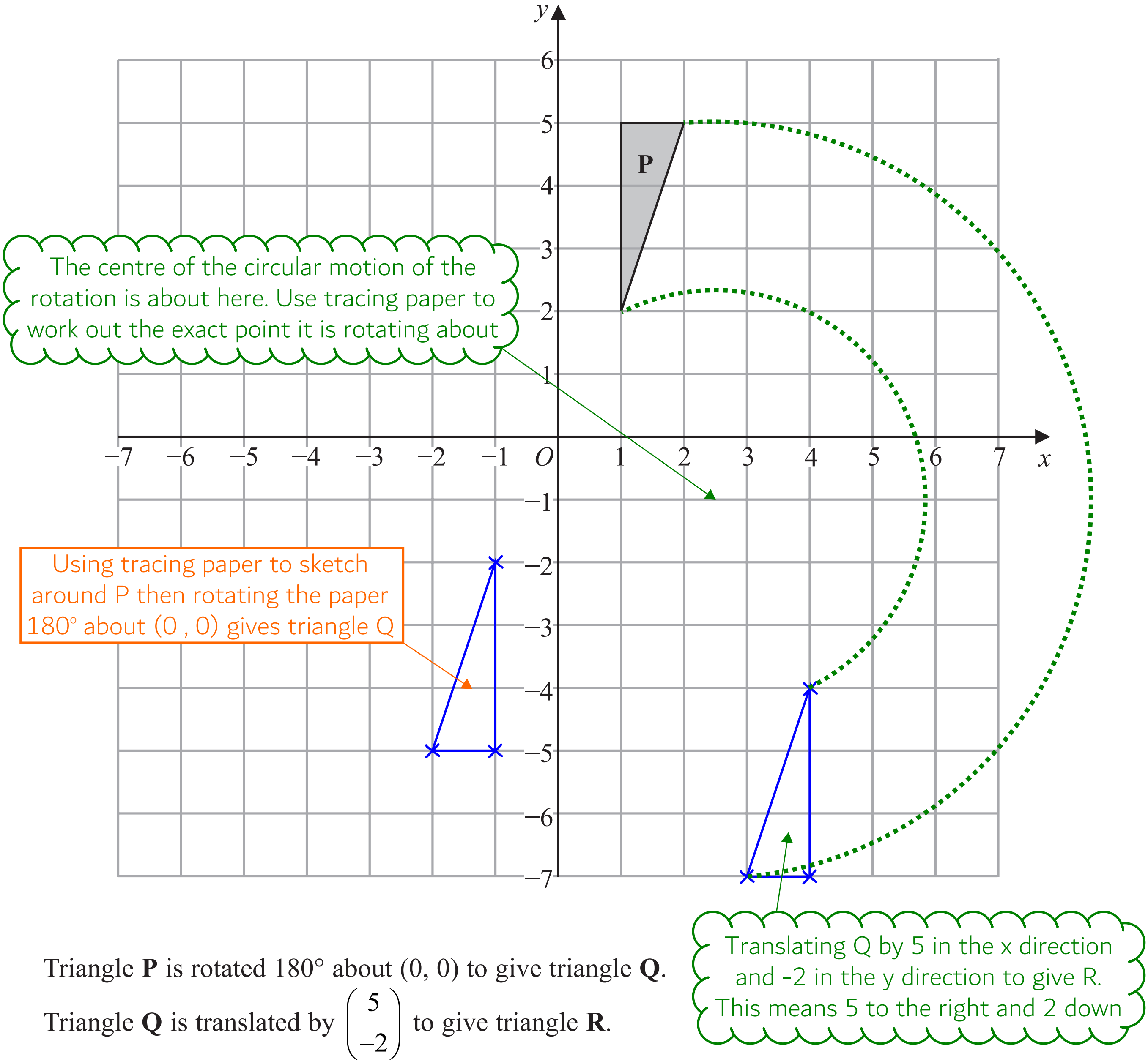
11 The diagram shows a triangle **P** on a grid.



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 by 180° about (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*.

The point which the shapes rotate about does not move

(2.5 , -1)

(1)

(Total for Question 11 is 4 marks)

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

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

To add fractions the denominators need to be the same. A common denominator can be found by multiplying the two denominators. The numerators need to be multiplied by the same as their denominator to keep the fractions equivalent

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

Once the denominators are the same the numerators can be added together and put over the same denominator. Expanding the brackets on the numerators

Collecting like terms on the numerator. The -4x and 4x cancel out and $x^2 + 2x^2 = 3x^2$. Expanding the brackets on the denominator will not make it simpler so it can be left in factorised form, in brackets

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

(3)

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

$2x^2+3x-6x-9$ — Expanding out the first two brackets

$(2x^2-3x-9)(4x+5)$ — Simplifying the expansion then writing it multiplied by the third bracket

$8x^3+10x^2-12x^2-15x-36x-45$ — Expanding out these two brackets

Collecting like terms and simplifying

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

(3)

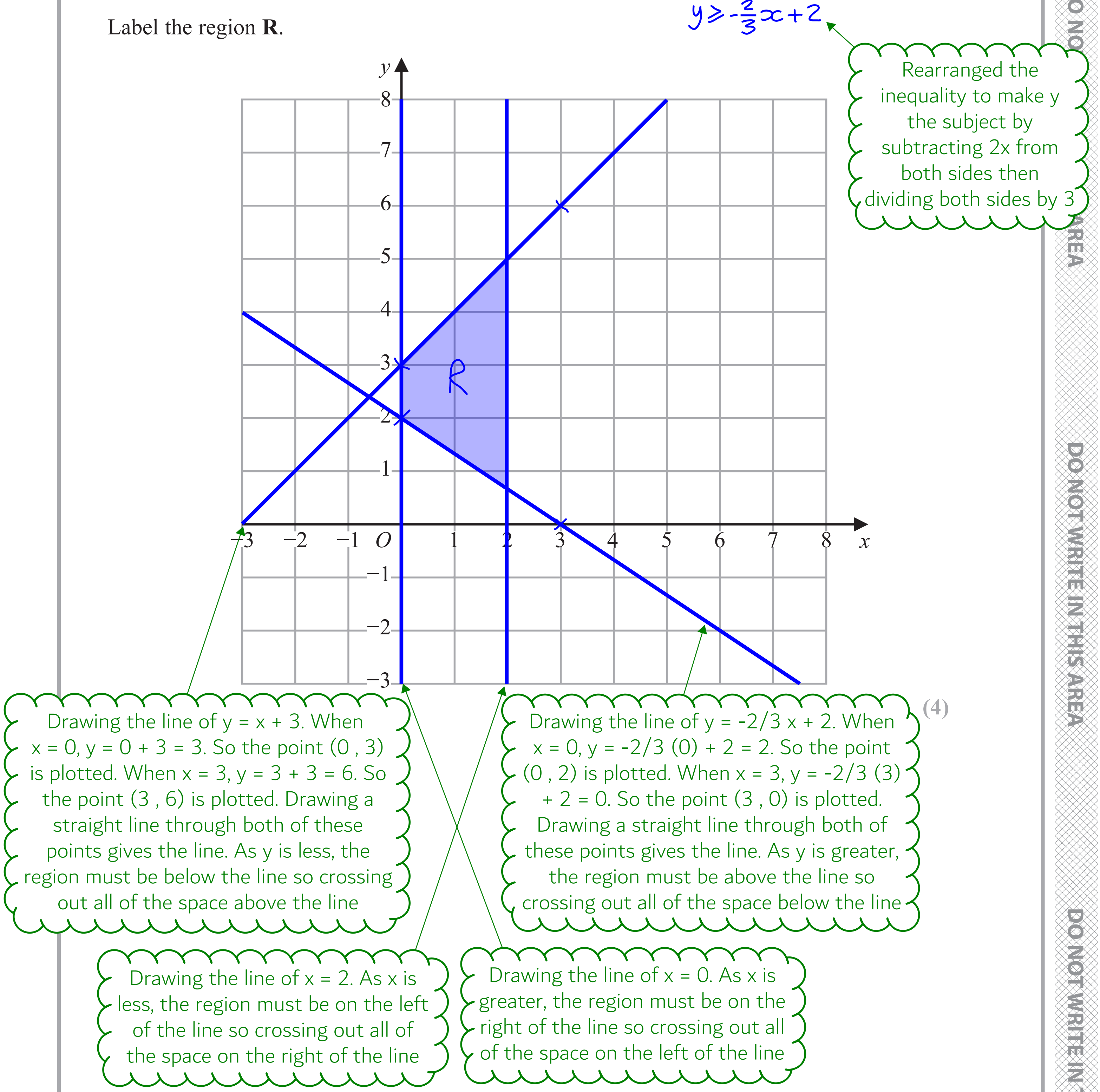
(Total for Question 12 is 6 marks)

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

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

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

Label the region **R**.



(4)

All of the lines are solid lines, not dashed, because they can also be equal. The region not crossed out must be the region

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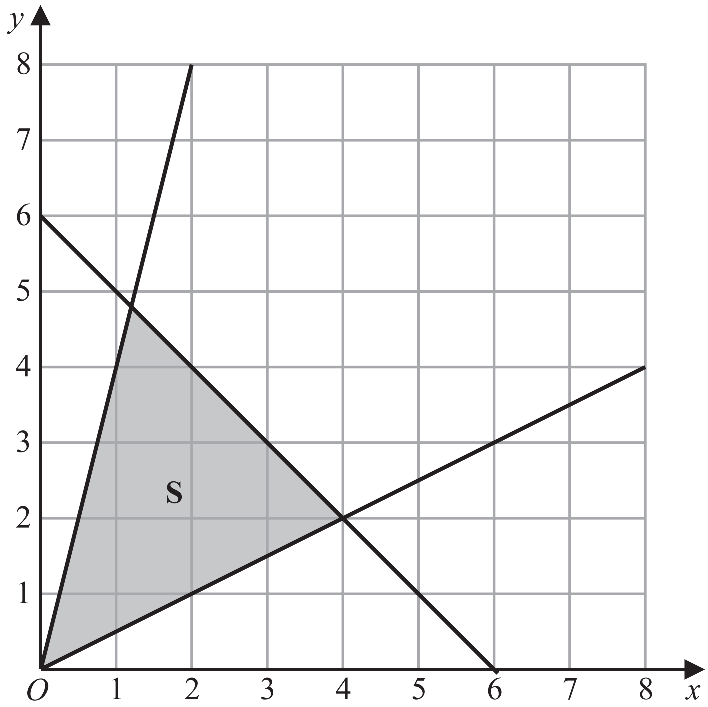
(b) The diagram below shows the region **S** that satisfies the inequalities

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



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, as the line (2 , 4) is on is solid

Values on solid lines are included in the region which satisfies the inequalities. The lines would have to be dashed to not include the values on the lines

(1)

(Total for Question 13 is 5 marks)

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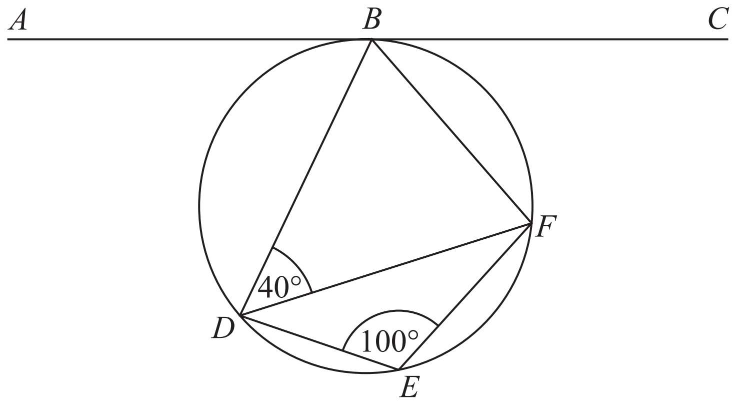
14



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.

180 - 100 = 80
Angle DBF = 80 as opposite angles in a cyclic quadrilateral add to 180 ← DBF is opposite to DEF

180 - 40 - 80 = 60
Angle DFB = 60 as angles in a triangle add to 180 ← DFB was the missing angle in triangle DBF

Angle ABD = 60 due to the alternate segment theorem ← The angle between a tangent and a chord is equal to the interior opposite angle. So angles ABD = DFB

(Total for Question 14 is 4 marks)

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

$x = 0.7\dot{3}$ ← Let x equal to the recurring decimal

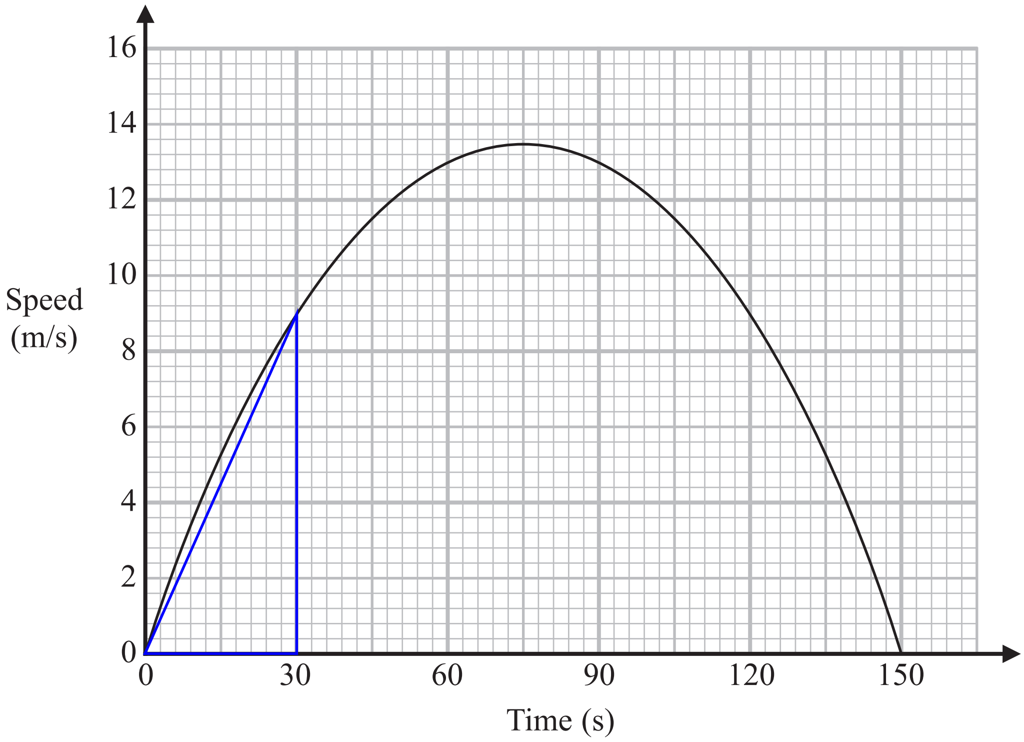
$10x = 7.3\dot{3}$ ← There is one recurring digit so multiplying it by 10 once can line up the recurring digit in the same decimal place

$9x = 6.6$ ← Subtracting x from 10x leaves 9x. The decimals are also subtracted and this eliminates the recurring digit

$x = \frac{6.6}{9} = \frac{11}{15}$ ← Rearranging to express x as a fraction

(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.

$\frac{1}{2} \times 30 \times 9$

The area underneath the line on a speed-time graph is the distance travelled. The shape for the first 30 seconds is almost the triangle drawn underneath so working out its area is an estimate. Area of triangle = 1/2 x base x height

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, as some area wasn't included

(1)

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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.

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

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

(c) Explain why.

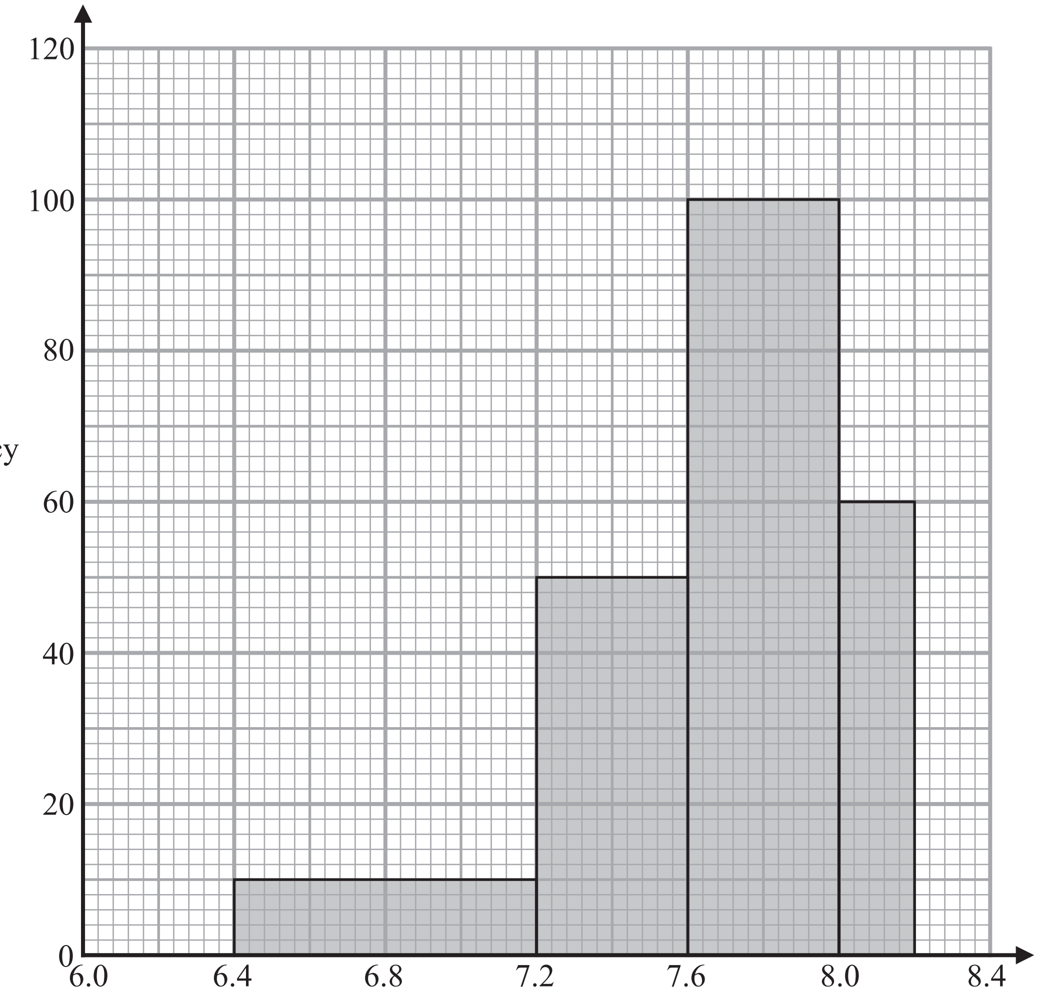
Should have drawn a tangent and worked out its gradient

The gradient is acceleration on a speed-time graph. He has worked out the average acceleration

(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.

$10(7.2-6.4)=8$

$50(7.6-7.2)=20$

$100(8.0-7.6)=40$

$60(8.2-8.0)=12$

Frequency = class width x frequency density. Subtracting the smallest distance from the largest distance for each bar works out the class width

$$\frac{6.8\times8+7.4\times20+7.8\times40+8.1\times12}{8+20+40+12}$$

Mean = total/number. Total is estimated by multiplying the midpoint of each class by its frequency then adding them all together. Number is the total frequency

7.645 m

(Total for Question 17 is 4 marks)

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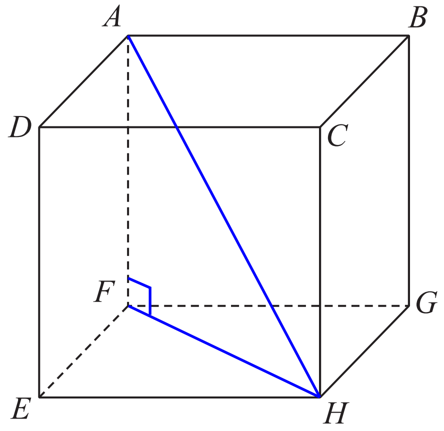
18 The diagram shows a cube.



$AH = 11.3$ 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.

$a^2 + b^2 = c^2$

$c = \sqrt{a^2 + b^2}$

Let x be the length of an edge of the cube. Pythagoras' Theorem can be used to express length FH and then AH in terms of x. Rearranged to make c the subject we need to find the longest side of triangle FEH and then the longest side of triangle AFH

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

$= \sqrt{2x^2}$

First working with triangle FEH. Substituting side FH for c, x for a and x for b

$AH = \sqrt{(\sqrt{2x^2})^2 + x^2}$

Next working with triangle AFH. Substituting side AH for c, FH for a and x for b

$= \sqrt{3x^2} = 11.3 - \frac{0.1}{2}$

Simplifying the expression of AH and setting it equal to the lower bound, which can be found by subtracting half of the resolution

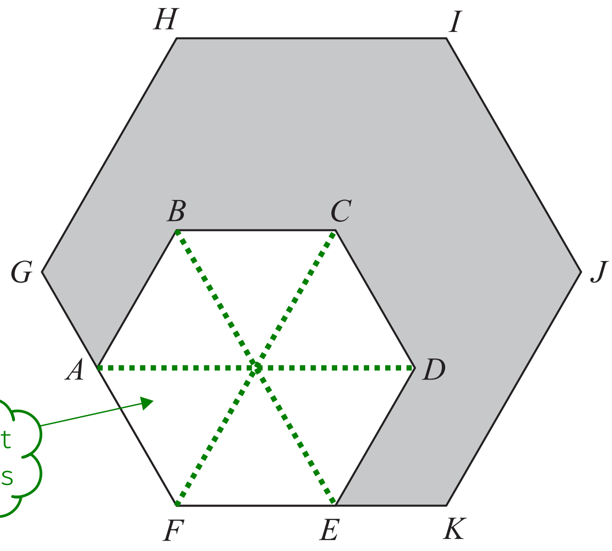
$x = \sqrt{\frac{\left(11.3 - \frac{0.1}{2}\right)^2}{3}}$

Rearranged to make x the subject by squaring both sides, dividing both sides by 3 then square rooting both sides

$\frac{15\sqrt{3}}{4}$ .... cm

(Total for Question 18 is 4 marks)

19



The hexagons can be split into 6 equilateral triangles

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

$$6\left(\frac{1}{2} \times px \times px \times \sin\frac{180}{3}\right) - 6\left(\frac{1}{2} \times x \times x \times \sin\frac{180}{3}\right)$$

Subtracting the smaller hexagon from the larger hexagon leaves the shaded area

Area of hexagon FGHIJK. The area of each of the triangles is found by using the formula 1/2 absinC. a and b are x scaled by p and C is the angle in an equilateral triangle, which is found by dividing the total number of degrees in a triangle, 180, by 3. The area of one triangle is multiplied by 6 to get the area of the hexagon

Area of hexagon ABCDEF. The area of each of the triangles is found by using the formula 1/2 absinC. a and b are x and C is the angle in an equilateral triangle, which is found by dividing the total number of degrees in a triangle, 180, by 3. The area of one triangle is multiplied by 6 to get the area of the hexagon

$$3 \times p^2x^2 \times \frac{\sqrt{3}}{2} - 3 \times x^2 \times \frac{\sqrt{3}}{2}$$

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

(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.

They are all powers of 98. Therefore they can all be multiplied by 98 a number of times to get a higher power of 98. So 98^{91} is a multiple of each of them and is the lowest number which is also a multiple of 98^{91}

98^{91}

(Total for Question 20 is 1 mark)

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

(a) Find the ratio $c : d$

$4c = 3d$

Rearranged to get all of the c terms on one side and the d terms on the other by subtracting c and d from both sides

c could equal to 3 and d could equal to 4 to make the equation work

3:4

(2)

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

(b) Find the ratio $x : y$

$20y^2 + 7y - 6 = 0$

x is greater than 0 so let x be 1. This leaves an equation in terms of y which is then rearranged into the quadratic form

$y = \frac{-7 \pm \sqrt{7^2 - 4 \times 20 \times -6}}{2 \times 20}$

Using the quadratic formula to find y

$y = \frac{2}{5}$, $y = -\frac{3}{4}$

y can't be negative as it is greater than 0 so it can't be -3/4. x could be 1 and when it is y would be 2/5

$1 : \frac{2}{5}$

(3)

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS