

Write your name here

Surname

Other names

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

Centre Number

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Candidate Number

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Mathematics

Paper 2 (Calculator)

Higher Tier

Thursday 7 June 2018 – Morning
Time: 1 hour 30 minutes

Paper Reference

1MA1/2H

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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.CG Maths.
Worked Solutions



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 should be written in the exam.

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

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 $m^3 \times m^4$

$a^x \times a^y = a^{x+y}$, so the indices should be added

$$m^7$$

(1)

(b) Simplify $(5np^3)^3$

Everything in the bracket is raised to the power of 3. $(a^x)^y = a^{xy}$, so the indices should be multiplied.

$$125n^3p^9$$

(2)

(c) Simplify $\frac{32q^9r^4}{4q^3r}$

$32/4 = 8$. $a^x/a^y = a^{x-y}$, so the indices should be subtracted. $r = r^1$

$$8q^6r^3$$

(2)

(Total for Question 1 is 5 marks)

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- 2 (a) Find the lowest common multiple (LCM) of 40 and 56

40, 80, 120, 160, 200, 240, 280
 56, 112, 168, 224, 280

Using table mode on the calculator. Define $f(x) = 40x$ and define $g(x) = 56x$. Start: 1. End: 30. Step: 1. This lists out the first 30 multiples of 40 and 56. Looking through both lists until the lowest number in both lists is found, which is 280

Newer Casio calculators can work out the LCM without having to do this method

280

(2)

$$A = 2^3 \times 3 \times 5$$

$$B = 2^2 \times 3 \times 5^2$$

- (b) Write down the highest common factor (HCF) of A and B .

$$2^2 \times 3 \times 5$$

The HCF is the lowest power of each prime number in both of the product of prime factors multiplied together. 2^2 is lower than 2^3 , 3 is the same in both and 5 is lower than 5^2

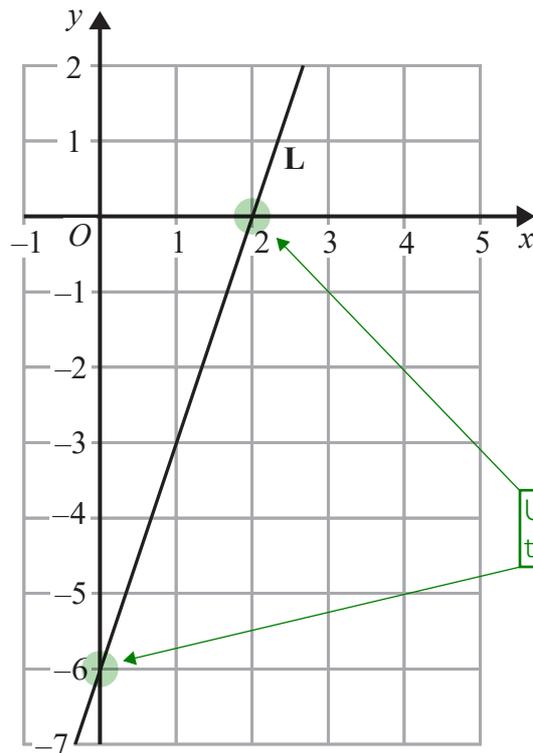
Newer Casio calculators can work out the HCF without having to do this method

60

(1)

(Total for Question 2 is 3 marks)

3 The line **L** is shown on the grid.



Find an equation for **L**.

$$\frac{6}{2}$$

Gradient = (change in y)/(change in x). The change in y from -6 to 0 is 6 and the change in x from 0 to 2 is 2. So the gradient is 3

$y = mx + c$ is the general equation of a straight line, where m is the gradient and c is the y -intercept. The y -intercept is -6 as this is the y -coordinate where the line crosses the y -axis

$$y = 3x - 6$$

(Total for Question 3 is 3 marks)

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4 Raya buys a van for £8500 plus VAT at 20%

Raya pays a deposit for the van.

She then pays the rest of the cost in 12 equal payments of £531.25 each month.

Find the ratio of the deposit Raya pays to the total of the 12 equal payments.

Give your answer in its simplest form.

$$\frac{20}{100} \times 8500$$

Putting the 20% over 100 converts it to a fraction, which when multiplied by the £8500 finds that 20% of £8500 is £1700

$$8500 + 1700 = 10200$$

Adding the value of the 20% VAT to the original £8500 works out that the van costs £10200 including the VAT

$$531.25 \times 12 = 6375$$

Multiplying the £531.25 monthly payment by the 12 equal payments works out that the total of the 12 equal payments is £6375

$$10200 - 6375$$

Subtracting the total of the equal payments from the cost of the van works out that the deposit is £3825

$$3825 : 6375$$

Expressing the ratio of the deposit to the total of the 12 equal payments

Entering the fraction 3825/6375 into the calculator simplifies it to 3/5. So the ratio simplifies to 3 : 5 as ratios simplify in a similar way to fractions

3 : 5

(Total for Question 4 is 5 marks)

- 5 (a) Complete the table of values for $y = x^2 - x - 6$

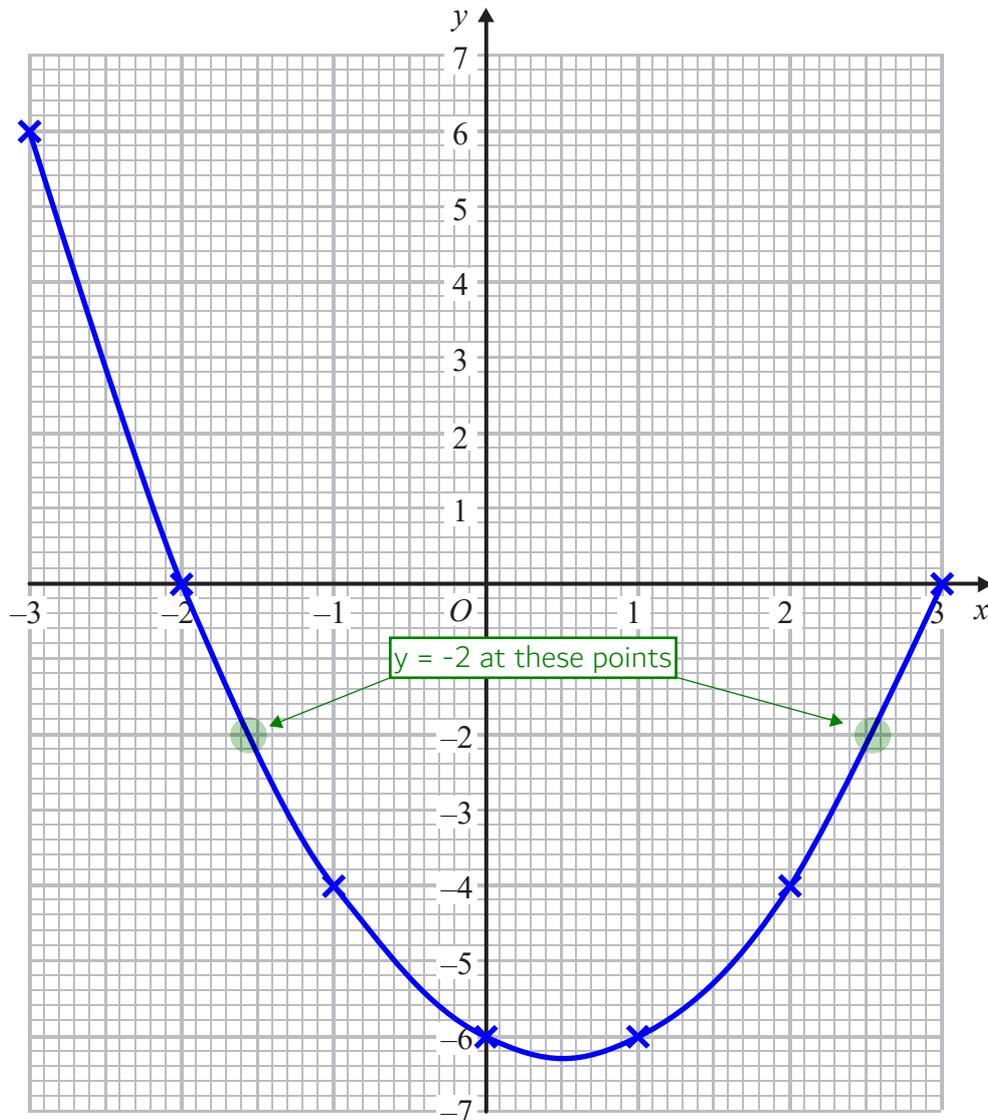
x	-3	-2	-1	0	1	2	3
y	6	0	-4	-6	-6	-4	0

Using table mode on the calculator. Define $f(x) = x^2 - x - 6$.
Start: -3. End: 3. Step: 1. This completes the table of values

(2)

- (b) On the grid, draw the graph of $y = x^2 - x - 6$ for values of x from -3 to 3

(2)



Plotting the points from the table of values then joining them up with a curve

(c) Use your graph to find estimates of the solutions to the equation $x^2 - x - 6 = -2$

y has been replaced with -2 in the equation so it is basically asking what x is when $y = -2$

2.55, -1.55

(2)

(Total for Question 5 is 6 marks)

6 A force of 70 newtons acts on an area of 20 cm^2

The force is increased by 10 newtons.

The area is increased by 10 cm^2

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

Helen says,

“The pressure decreases by less than 20%”

Is Helen correct?

You must show how you get your answer.

$$\frac{20}{100} \times \frac{70}{20} = 0.7$$

Putting the force of 70 newtons over the area of 20 cm^2 expresses the original pressure. Putting the 20% over 100 converts it to a fraction, which finds that 20% of the original pressure is 0.7 newtons/cm^2 when multiplied

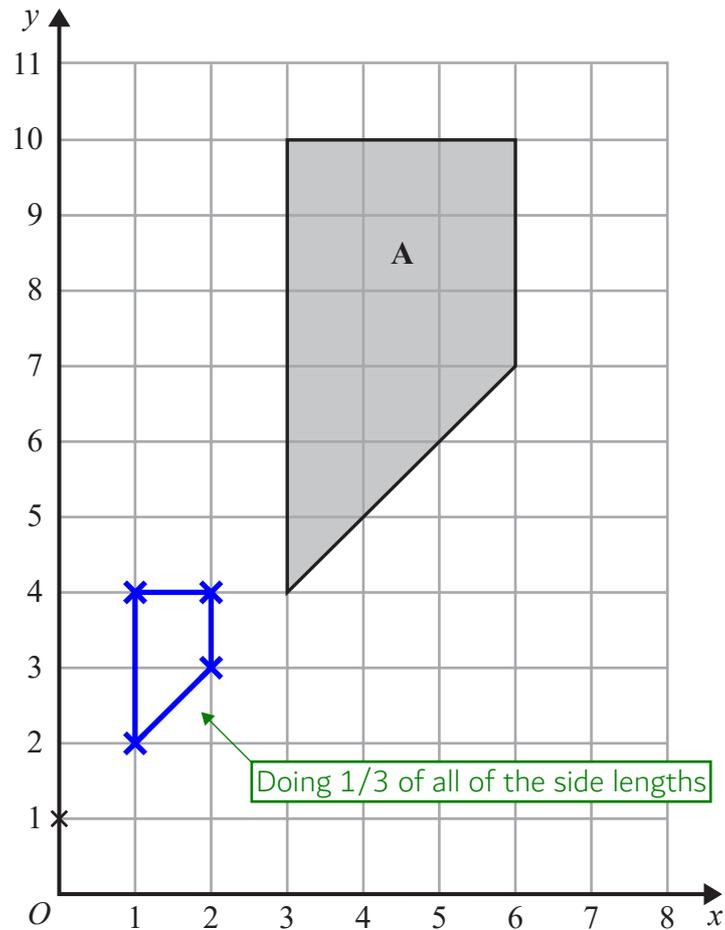
$$\frac{70}{20} - \frac{80}{30} = 0.8\dots$$

The force increases to 80 newtons and the area increases to 30 cm^2 . Putting the 80 newtons over the 30 cm^2 expresses the new pressure. Subtracting the new pressure from the original pressure works out that the difference is $0.8\dots \text{ newtons/cm}^2$, which must be what the original pressure decreases by

No

The pressure decreased by $0.8\dots \text{ newtons/cm}^2$, which is not less than than the 0.7 newtons/cm^2 (20% of the original pressure)

(Total for Question 6 is 3 marks)



Enlarge shape A by scale factor $\frac{1}{3}$ centre (0, 1)

$$\begin{pmatrix} 3 \\ 3 \end{pmatrix} \times \frac{1}{3} = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$

Multiplying the vector from the centre of enlargement to the closest corner by the scale factor works out the new vector to the closest corner. It was 3 in the x-direction and 3 in the y-direction. It is now 1 in the x-direction and 1 in the y-direction

(Total for Question 7 is 2 marks)

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8 60 people were asked if they prefer to go on holiday in Britain or in Spain or in Italy.

38 of the people were male.

11 of the 32 people who said Britain were female.

8 males said Italy.

12 people said Spain.

One of the females is chosen at random.

What is the probability that this female said Spain?

	B	S	I	
M			8	38
F	11	3	8	22
	32	12	16	60

Doing a two-way-table to organise the information and work out what is needed. M: male. F: female. B: Britain. S: Spain. I: Italy. The totals are at the ends. It is not necessary to complete the whole table

3 out of the 22 females said Spain

$$\frac{3}{22}$$

(Total for Question 8 is 4 marks)

9 Jean invests £12 000 in an account paying compound interest for 2 years.

In the first year the rate of interest is $x\%$

At the end of the first year the value of Jean's investment is £12 336

In the second year the rate of interest is $\frac{x}{2}\%$

What is the value of Jean's investment at the end of 2 years?

$$12336 - 12000$$

Subtracting the £12000 from the £12336 works out that there was £336 interest in the first year

$$\frac{336}{12000} \times 100$$

Putting the £336 interest over the original £12000 expresses the interest as a fraction. Multiplying this by 100 converts it to the percentage 2.8%

$$\frac{2.8}{2}$$

Putting the rate of interest in the first year (which is x) over 2 finds that the rate of interest in the second year is 1.4%

$$\frac{1.4}{100} \times 12336$$

Putting the 1.4% over 100 converts it to a fraction, which when multiplied by the £12336 finds that 1.4% of £12336 is £172.70 (to the nearest penny), which is the interest received in the second year

$$12336 + 172.70$$

Adding the interest received in the second year to the £12336 at the end of the first year works out that the investment is worth £12508.70 at the end of the 2 years

£ 12508.70

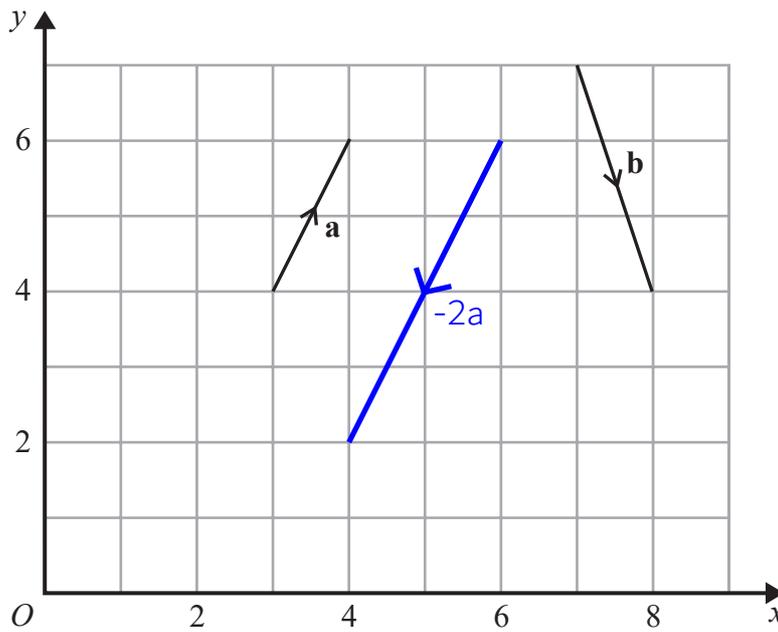
(Total for Question 9 is 4 marks)

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10 The vector **a** and the vector **b** are shown on the grid.



(a) On the grid, draw and label vector $-2\mathbf{a}$

Twice as large as **a** in the opposite direction

(1)

(b) Work out $\mathbf{a} + 2\mathbf{b}$ as a column vector.

$1 + 2(1)$

Working out that the x-component is 3. **a** goes 1 in the x-direction and **b** goes 1 in the x-direction. Substituting these into $\mathbf{a} + 2\mathbf{b}$

$2 + 2(-3)$

Working out that the y-component is -4. **a** goes 2 in the y-direction and **b** goes -3 in the y-direction. Substituting these into $\mathbf{a} + 2\mathbf{b}$

$$\begin{pmatrix} 3 \\ -4 \end{pmatrix}$$

(2)

(Total for Question 10 is 3 marks)

11 f and g are functions such that

$$f(x) = \frac{2}{x^2} \quad \text{and} \quad g(x) = 4x^3$$

(a) Find $f(-5)$

$$\frac{2}{(-5)^2} \leftarrow \text{Substituting } -5 \text{ for } x \text{ in } f(x)$$

$$\frac{2}{25}$$

(1)

(b) Find $fg(1)$

$$4(1)^3 \leftarrow \text{Substituting } 1 \text{ for } x \text{ in } g(x) \text{ finds that } g(1) = 4$$

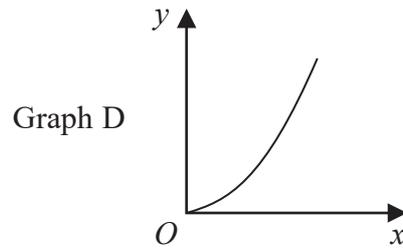
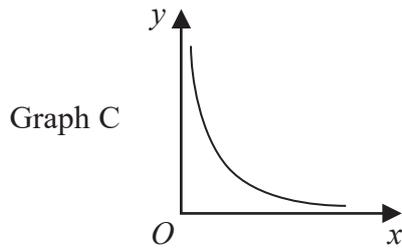
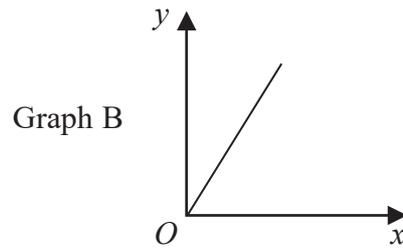
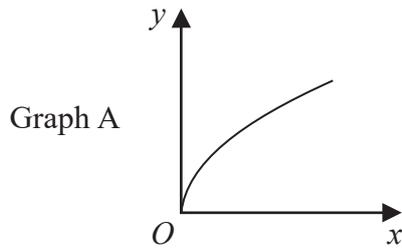
$$\frac{2}{4^2} \leftarrow \text{Substituting the } 4 \text{ for } x \text{ in } f(x) \text{ finds that the composite function } fg(1) = 1/8$$

$$\frac{1}{8}$$

(2)

(Total for Question 11 is 3 marks)

12



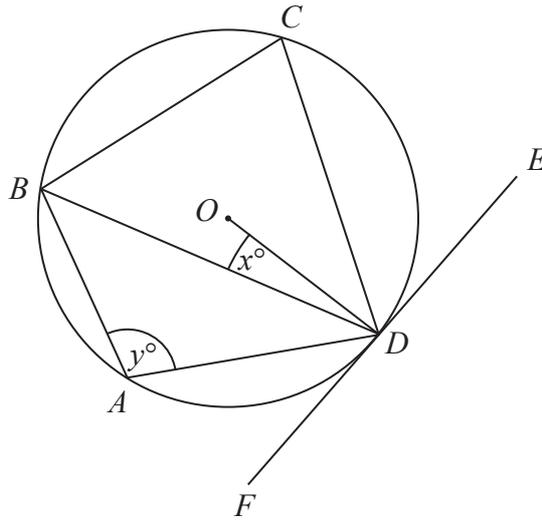
The graphs of y against x represent four different types of proportionality.

Match each type of proportionality in the table to the correct graph.

Type of proportionality	Graph letter
$y \propto x$	B
$y \propto x^2$	D
$y \propto \sqrt{x}$	A
$y \propto \frac{1}{x}$	C

(Total for Question 12 is 2 marks)

Using table mode on the calculator. Define $f(x)$ = the right side of each of the types of proportionality (for example $f(x) = x$ for the 1st type of proportionality. Start: 0. End: 5. Step: 1. This gives a table of values for each and makes it easier to visualise what they look like



A, B, C and D are points on the circumference of a circle, centre O .
 FDE is a tangent to the circle.

- (a) Show that $y - x = 90$
 You must give a reason for each stage of your working.

Angle $ODE = 90^\circ$ as the angle between a radius and tangent is 90° ← OD is a radius and DE is a tangent

Angle $BDE = (90 + x)^\circ$ ← Adding angle ODE and angle BDO gives angle BDE

Angle $BAD = (90 + x)^\circ$ due to the alternate segment theorem

The angle between tangent DE and chord BD (which is angle BDE) is equal to the interior opposite angle (the angle in the triangle BAD opposite the chord)

So $y = 90 + x$ ← Angle BAD is both y and $(90 + x)^\circ$ so these must be equal

$y - x = 90$ ← Subtracting x from both sides

(3)

Dylan was asked to give some possible values for x and y .

He said,

“ y could be 200 and x could be 110, because $200 - 110 = 90$ ”

- (b) Is Dylan correct?

You must give a reason for your answer.

No as y has to be less than 180° as it is in a triangle

(1)

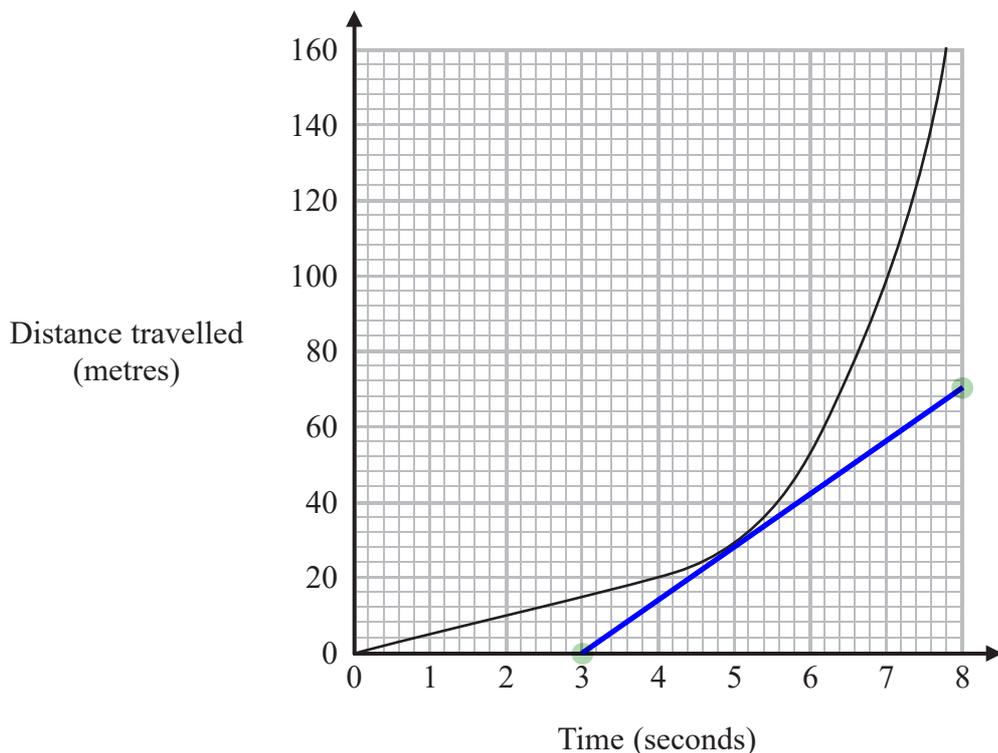
(Total for Question 13 is 4 marks)

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14 The distance-time graph shows information about part of a car journey.



Use the graph to estimate the speed of the car at time 5 seconds.

$$\frac{70 - 0}{8 - 3}$$

The gradient is the speed on a distance-time graph (as speed = (change in distance)/(change in time)). Drawing a tangent at 5 seconds and working out its gradient estimates the gradient at 5 seconds. Gradient = (change in y)/(change in x). Picking the two end points of the line as these are easy to read and are far apart from each other. y changes from 0 to 70 so 70 - 0 expresses the change in y. x changes from 3 to 8 so 8 - 3 expresses the change in x

..... 14 m/s

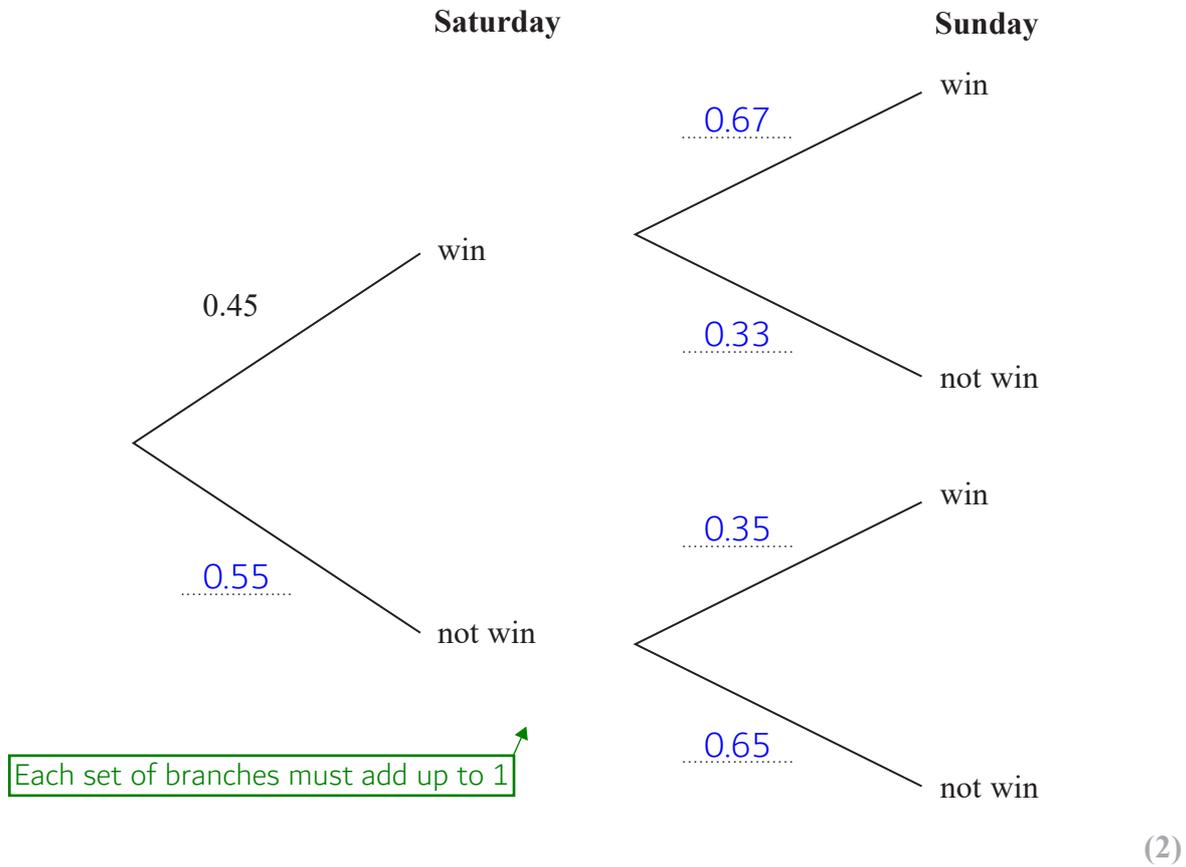
(Total for Question 14 is 3 marks)

- 15 A darts team is going to play a match on Saturday and on Sunday.
The probability that the team will win on Saturday is 0.45

If they win on Saturday, the probability that they will win on Sunday is 0.67

If they do **not** win on Saturday, the probability that they will win on Sunday is 0.35

- (a) Complete the probability tree diagram.



- (b) Find the probability that the team will win exactly one of the two matches.

$$0.45 \times 0.33 + 0.55 \times 0.35$$

Win AND not win OR not win AND win. AND means to multiply the probabilities. OR means to add the probabilities

..... 0.341

(3)

(Total for Question 15 is 5 marks)

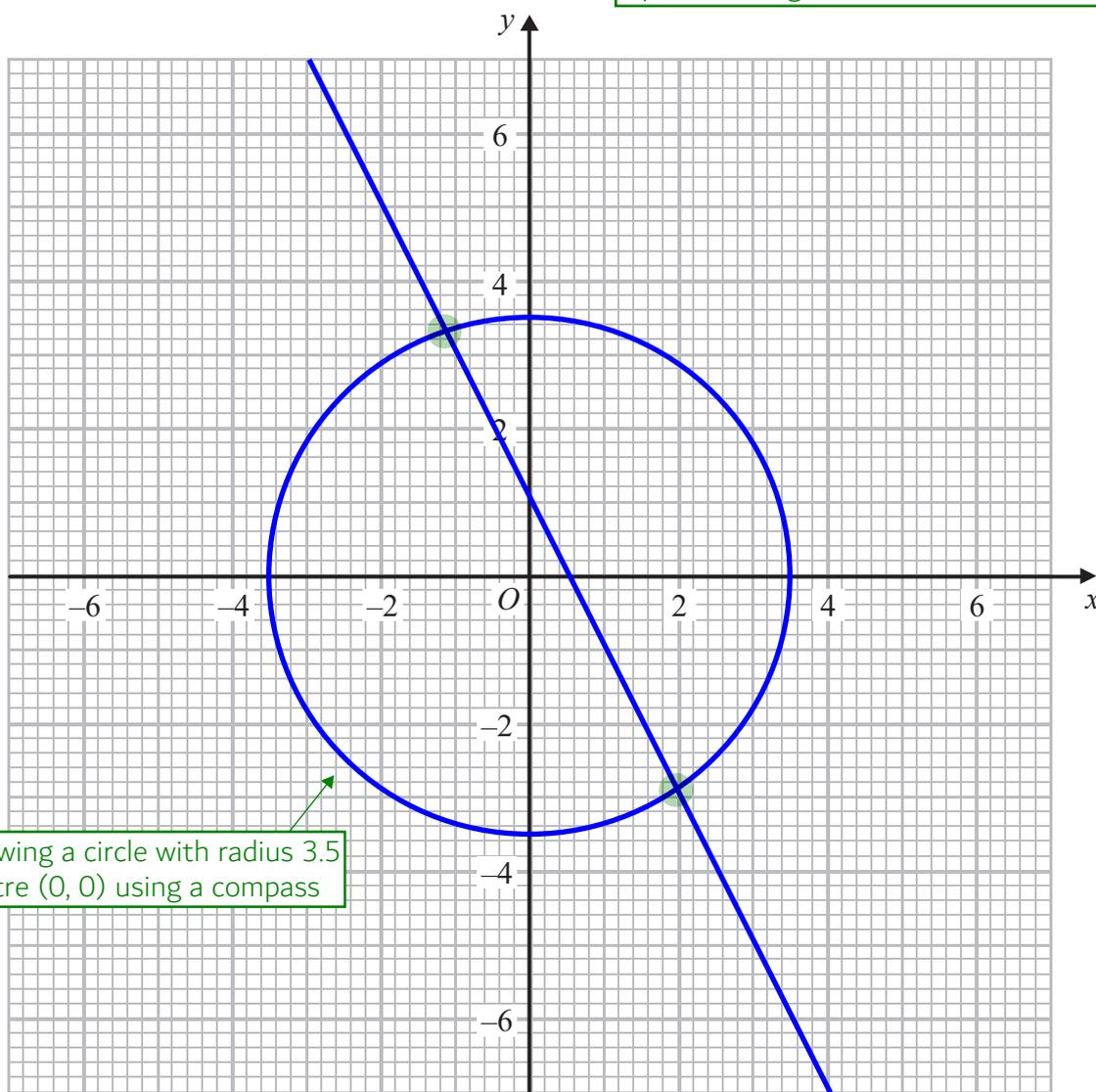
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16 (a) On the grid, draw the graph of $x^2 + y^2 = 12.25$

The general equation of a circle with its centre at $(0, 0)$ is $x^2 + y^2 = \text{radius}^2$. So $\text{radius}^2 = 12.25$ then square rooting both sides finds that $\text{radius} = 3.5$



Drawing a circle with radius 3.5 centre $(0, 0)$ using a compass

Each small box on both scales is worth 0.2

(2)

(b) Hence find estimates for the solutions of the simultaneous equations

$$\begin{aligned} x^2 + y^2 &= 12.25 \\ 2x + y &= 1 \end{aligned}$$

The estimates for the solutions of the simultaneous equations are where the two graphs cross. Reading to the nearest half a box

$y = 1 - 2x$

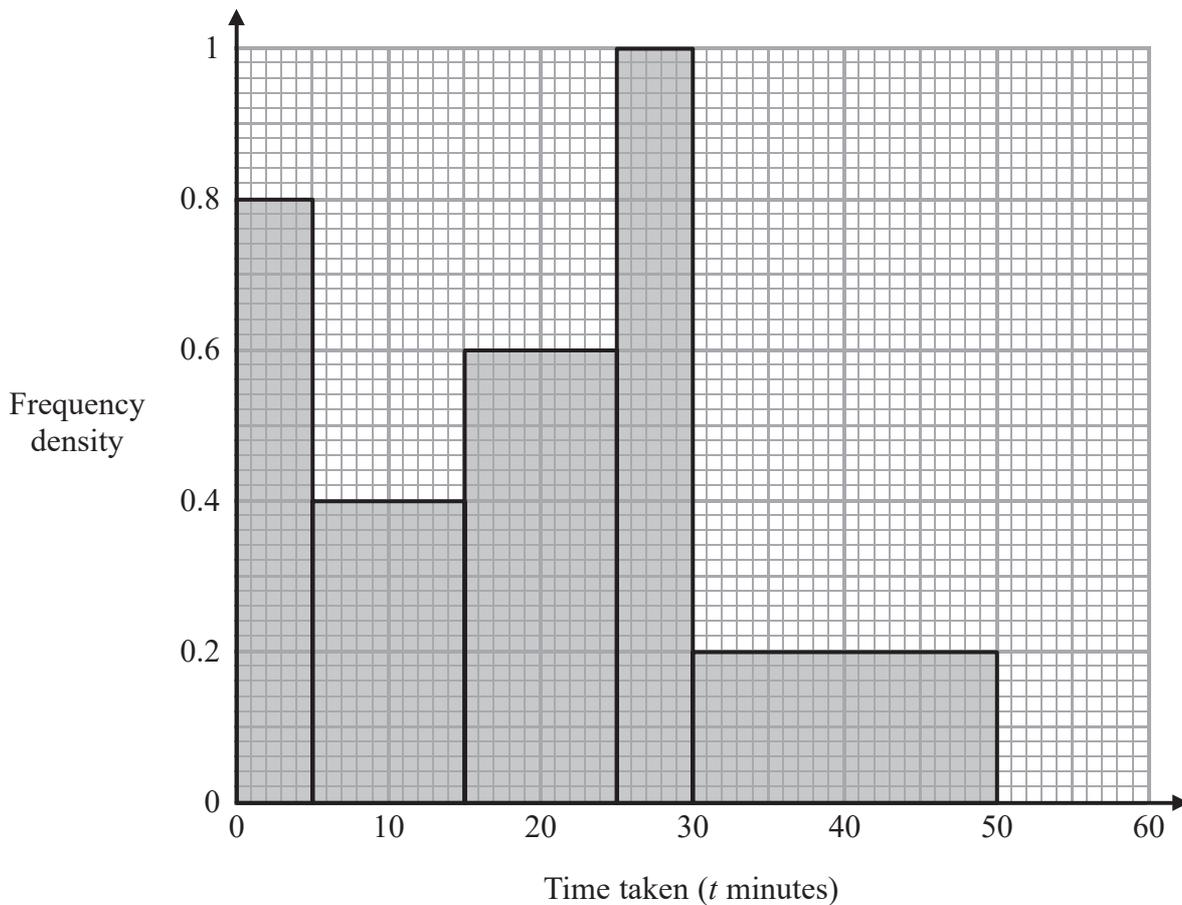
Subtracting $2x$ from both sides of the 2nd equation gets y on its own. This graph can be drawn using table mode on the calculator. Define $f(x) = 1 - 2x$. Start: -6 . End: 6 . Step: 1 . This gives a table of values and the points from this can be plotted and joined up with a straight line

$$\begin{aligned} x &= -1.2 & \text{or} & & x &= 2 \\ y &= 3.3 & & & y &= -2.9 \end{aligned}$$

(3)

(Total for Question 16 is 5 marks)

17 The histogram shows information about the times taken by some students to finish a puzzle.



(a) Complete the frequency table for this information.

Time taken (t minutes)	Frequency
$0 < t \leq 5$	4
$5 < t \leq 15$	4
$15 < t \leq 25$	6
$25 < t \leq 30$	5
$30 < t \leq 50$	4

(2)

Frequency on a histogram is represented by the area of each bar. Area of rectangle = base \times height. The base is the class width, which is how wide each bar is. The height is the frequency density.

For example for the 2nd bar: the class width is 10 as this is the difference between 5 and 15. The frequency density is 0.4. Then $10 \times 0.4 = 4$

(b) Find an estimate for the lower quartile of the times taken to finish the puzzle.

$$4 + 4 + 6 + 5 + 4 \leftarrow \text{Adding the frequencies works out that there were 23 students in total}$$

$$\frac{23 + 1}{4} \leftarrow \text{Using } (n + 1)/4, \text{ where } n \text{ is the number of students works out that the 6th student is the lower quartile}$$

$$6 - 4 \leftarrow \text{Putting them in order then counting to the 6th would find the lower quartile. Counting the 4 in the 1st interval works out that there is another 2 to count}$$

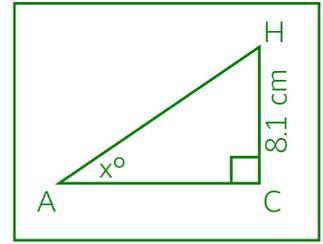
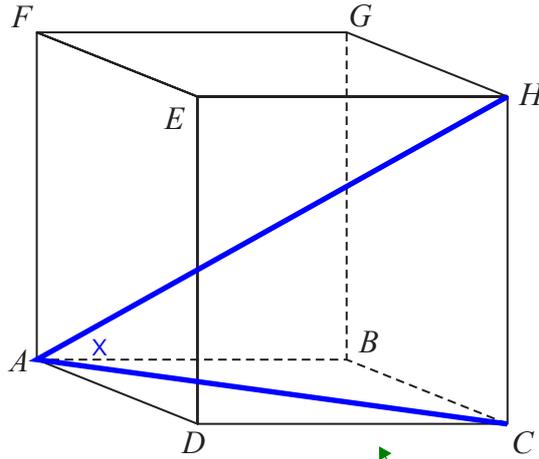
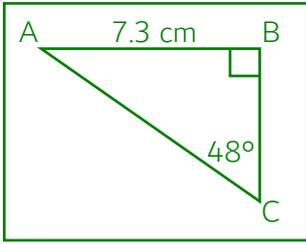
$$\frac{2}{4} = \frac{1}{2} \leftarrow \text{The lower quartile must be in the 2nd interval as the next 4 cannot be counted to get to the next interval. So as there was 2 more to count, the lower quartile will be 2 out of the 4 from the start, which can be estimated to be } 2/4 \text{ or } 1/2 \text{ of the way through the 2nd interval}$$

1/2 way through the 2nd interval is 10 minutes

..... 10 minutes
(2)

(Total for Question 17 is 4 marks)

18 $ABCDEFGH$ is a cuboid.



$AB = 7.3$ cm
 $CH = 8.1$ cm
 Angle $BCA = 48^\circ$

Drawing on lines AH and AC form the angle between AH and the plane ABCD

Find the size of the angle between AH and the plane ABCD.
 Give your answer correct to 1 decimal place.

SOHCAHTOA

Using right-angled trigonometry in triangle ABC. Ticking O as AB is the opposite and ticking H as it is useful to find the hypotenuse AC. There are two ticks on the SOH formula triangle so this one can be used

$$\frac{7.3}{\sin 48} = 9.8\dots$$

Covering H in the SOH formula triangle finds that hypotenuse = opposite/sin of the angle. So the hypotenuse AC is 9.8... cm

SOHCAHTOA

Using right-angled trigonometry in triangle ACH. Ticking O as CH is the opposite and ticking A as AC is the adjacent. There are two ticks on the TOA formula triangle so this one can be used

$$\tan x = \frac{8.1}{9.8\dots}$$

Covering T in the TOA formula triangle finds that tan of the angle = opposite/adjacent

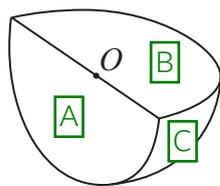
Doing the inverse tan of both sides get the angle x on its own. 39.50... is rounded to 1 decimal place

39.5

(Total for Question 18 is 4 marks)

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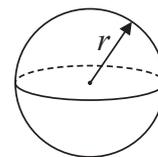
19 Shape S is one quarter of a solid sphere, centre O .



Shape S

$$\text{Volume of sphere} = \frac{4}{3}\pi r^3$$

$$\text{Surface area of sphere} = 4\pi r^2$$



The volume of S is $576\pi \text{ cm}^3$

Find the surface area of S.

Give your answer correct to 3 significant figures.

You must show your working.

$$\frac{1}{4} \times \frac{4}{3} \pi r^3 = 576\pi \leftarrow \text{Doing } 1/4 \text{ of the volume of the whole sphere expresses the volume of S. This must be equal the value of the volume } 576\pi \text{ cm}^3$$

$$r^3 = 1728 \leftarrow \text{Dividing both sides by } 1/4, 4/3 \text{ and } \pi \text{ gets } r^3 \text{ on its own}$$

$$r = 12 \leftarrow \text{Cube rooting both sides gets } r \text{ on its own. So the radius is } 12 \text{ cm}$$

$$\frac{1}{2} \pi \times 12^2 = 72\pi \leftarrow \text{Area of circle} = \pi \times \text{radius}^2. \text{ Doing half of this works out that the area of the semicircles A and B are each } 72\pi \text{ cm}^2$$

$$\frac{1}{4} \times 4\pi \times 12^2 = 144\pi \leftarrow \text{Doing } 1/4 \text{ of the surface area of a sphere works out that the curved face C has area } 144\pi \text{ cm}^2$$

$$72\pi + 72\pi + 144\pi \leftarrow \text{Adding the areas of A, B and C works out the surface area}$$

904.7... is rounded to 3 significant figures

905..... cm²

(Total for Question 19 is 5 marks)

20 Martin did this question.

Rationalise the denominator of $\frac{14}{2 + \sqrt{3}}$

Here is how he answered the question.

$$\begin{aligned} \frac{14}{2 + \sqrt{3}} &= \frac{14 \times (2 - \sqrt{3})}{(2 + \sqrt{3})(2 - \sqrt{3})} \\ &= \frac{28 - 14\sqrt{3}}{4 + 2\sqrt{3} - 2\sqrt{3} + 3} \leftarrow \text{The brackets have been expanded incorrectly} \\ &= \frac{28 - 14\sqrt{3}}{7} \\ &= 4 - 2\sqrt{3} \end{aligned}$$

Martin's answer is wrong.

(a) Find Martin's mistake.

$$\sqrt{3} \times -\sqrt{3} = -3$$

(1)

Sian did this question.

Rationalise the denominator of $\frac{5}{\sqrt{12}}$

Here is how she answered the question.

$$\begin{aligned} \frac{5}{\sqrt{12}} &= \frac{5\sqrt{12}}{\sqrt{12} \times \sqrt{12}} \\ &= \frac{5 \times 3\sqrt{2}}{12} \\ &= \frac{5\sqrt{2}}{4} \end{aligned}$$

Sian's answer is wrong.

(b) Find Sian's mistake.

$$\sqrt{12} = 2\sqrt{3} \leftarrow \sqrt{12} = \sqrt{4 \times 3} = 2\sqrt{3}$$

(1)

(Total for Question 20 is 2 marks)

g/cm^3 means to divide the mass in g by the volume in cm^3

- 21 Jackson is trying to find the density, in g/cm^3 , of a block of wood.
The block of wood is in the shape of a cuboid.

He measures

the length as 13.2 cm, correct to the nearest mm
the width as 16.0 cm, correct to the nearest mm
the height as 21.7 cm, correct to the nearest mm

1 mm is 0.1 cm

He measures the mass as 1970 g, correct to the nearest 5 g.

By considering bounds, work out the density of the wood.
Give your answer to a suitable degree of accuracy.

You must show all your working and give a reason for your final answer.

$$\frac{\left(1970 - \frac{5}{2}\right)}{\left(13.2 + \frac{0.1}{2}\right)\left(16.0 + \frac{0.1}{2}\right)\left(21.7 + \frac{0.1}{2}\right)} = 0.4253677546$$

This works out the lower bound of the density. Dividing the lower bound of the mass in g by the upper bound of the volume in cm^3 . The lower bound of the mass is expressed by subtracting half of the resolution (which is 5 g as this is what it is to the nearest) from the 1970 g. The upper bound of the volume is expressed by multiplying the upper bounds of the length, width and height. The upper bound of these lengths is expressed by adding half of the resolution (which is 0.1 as this is what it is to the nearest) to each length

$$\frac{\left(1970 + \frac{5}{2}\right)}{\left(13.2 - \frac{0.1}{2}\right)\left(16.0 - \frac{0.1}{2}\right)\left(21.7 - \frac{0.1}{2}\right)} = 0.4343828506$$

This works out the upper bound of the density. Dividing the upper bound of the mass in g by the lower bound of the volume in cm^3 . The upper bound of the mass is expressed by adding half of the resolution (which is 5 g as this is what it is to the nearest) to the 1970 g. The lower bound of the volume is expressed by multiplying the lower bounds of the length, width and height. The lower bound of these lengths is expressed by subtracting half of the resolution (which is 0.1 as this is what it is to the nearest) from each length

0.43 g/cm^3 as both the upper and lower bound round to this to 2 decimal places

(Total for Question 21 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS