

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

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

Time 1 hour 30 minutes **Paper reference** **1MA1/2H**

Mathematics

PAPER 2 (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.
- 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.

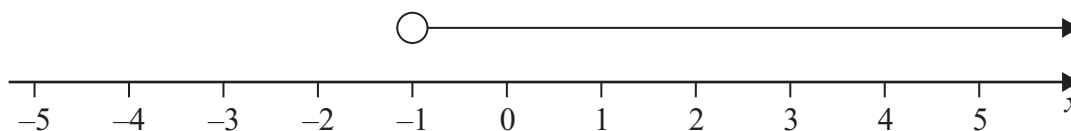
If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

- 1 (a) Write down the inequality shown on this number line.

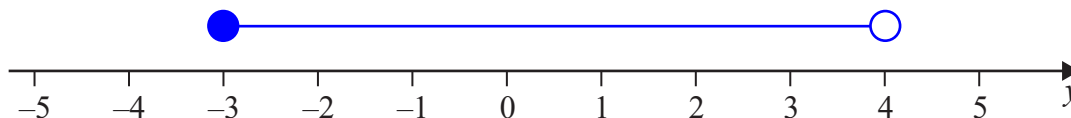


x is greater than -1 as the arrow goes to the right of -1 .
It cannot be equal to -1 as the circle is not shaded in

$$x > -1$$

(1)

- (b) On the number line below, show the inequality $-3 \leq y < 4$



Putting circles above -3 and 4 . Shading in the one above -3 as it can be equal. Putting a line between these as y is greater than 3 and less than 4

(2)

(Total for Question 1 is 3 marks)

2 (a) Find the Highest Common Factor (HCF) of 60 and 84

$2^2 \times 3 \times 5$ ← Using the calculator to express 60 as a product of prime factors

$2^3 \times 3 \times 7$ ← Using the calculator to express 84 as a product of prime factors

$2^2 \times 3$ ← The lowest power of each prime in both lists multiplied together gives the HCF

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

12

(2)

(b) Find the Lowest Common Multiple (LCM) of 24 and 40

$2^3 \times 3$ ← Using the calculator to express 24 as a product of prime factors

$2^3 \times 5$ ← Using the calculator to express 40 as a product of prime factors

$2^3 \times 3 \times 5$ ← The highest power of each prime in both lists multiplied together gives the LCM

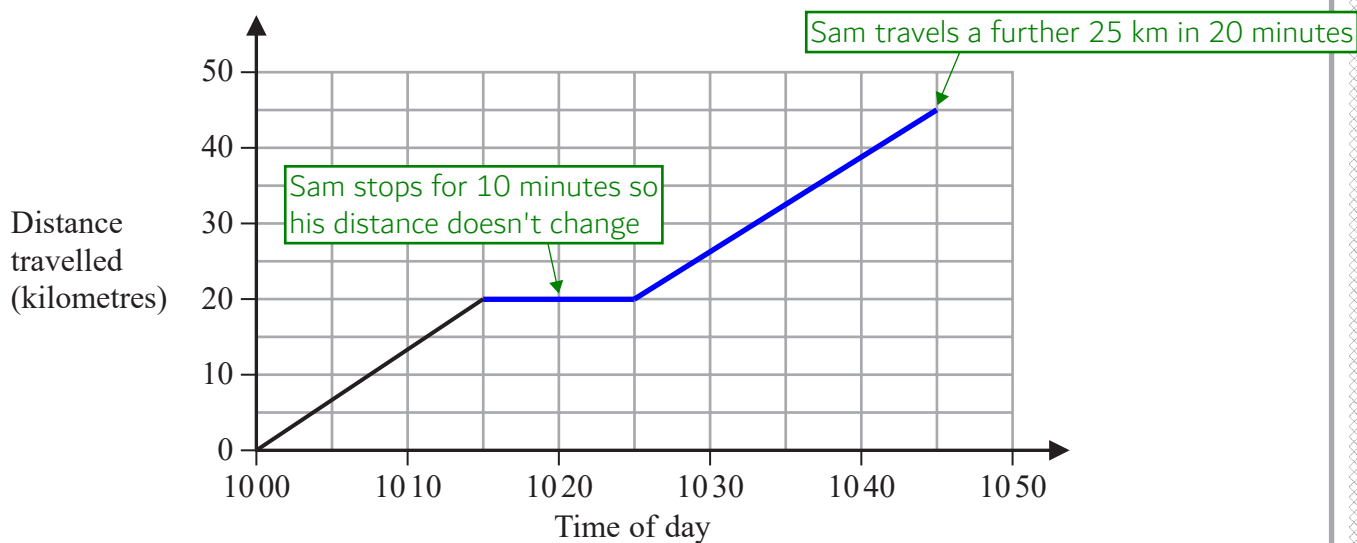
Newer Casio calculators can work out the LCM without having to do this method

120

(2)

(Total for Question 2 is 4 marks)

- 3 Sam drives his car on a journey.
Here is the travel graph for the first 15 minutes of his journey.



- (a) Work out Sam's speed, in km/h, for the first 15 minutes of his journey.

$$20 \div \frac{15}{60}$$

km/h means to divide the distance travelled in km by the time taken in hours. 20 km is travelled in 15 minutes. There are 60 minutes in an hour so putting the 15 minutes over 60 converts it to hours

80 km/h
(2)

At 10 15 Sam stops for 10 minutes and then drives for 20 minutes at a speed of 75 km/h.

- (b) On the grid, complete the travel graph for Sam's journey.

$\begin{matrix} d \\ s \quad t \end{matrix}$

Writing a formula triangle for distance, speed, time

$$75 \times \frac{20}{60} = 25$$

Covering d in the formula triangle finds that distance = speed $\times$ time. There are 60 minutes in an hour so putting the 20 minutes over 60 converts it to hours. This needs to be done as hours is involved in km/h

(3)

(Total for Question 3 is 5 marks)

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

x	-2	-1	0	1	2	3	4
y	10	5	2	1	2	5	10

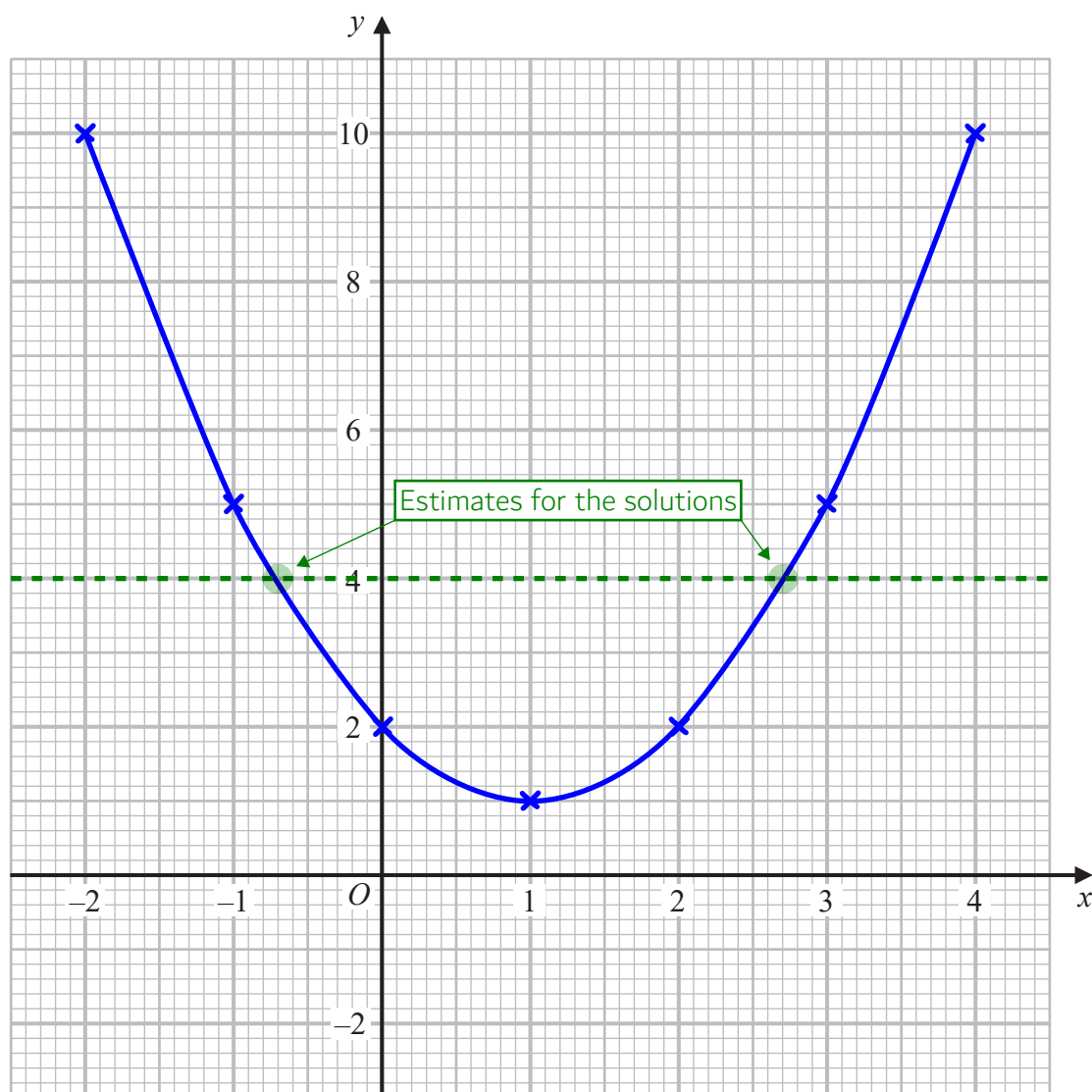
(2)

Using table mode on the calculator. Define $f(x) = x^2 - 2x + 2$. Table range start: -2, end: 4, step: 1

- (b) On the grid, draw the graph of $y = x^2 - 2x + 2$ for values of x from -2 to 4

(2)

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



- (c) Use your graph to find estimates of the solutions of the equation $x^2 - 2x + 2 = 4$

y has been changed to 4. So it is asking what x is when $y = 4$

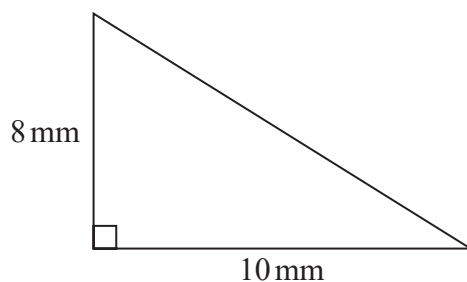
$$x = -0.7$$

$$x = 2.7$$

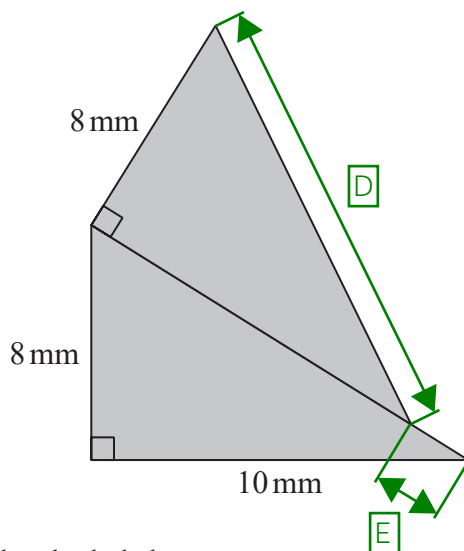
(2)

(Total for Question 4 is 6 marks)

5 Here is a right-angled triangle.



The shaded shape below is made from two of these triangles.



Work out the perimeter of the shaded shape.

Give your answer correct to 3 significant figures.

$$8^2 + 10^2 = c^2$$

Pythagoras' Theorem can be used to find side D. $a^2 + b^2 = c^2$, where a and b are the shorter sides and c is the longest side

$$c = \sqrt{164}$$

Square rooting both sides get c on its own. So side D is 12.8... cm

$$12.8... - 10$$

Subtracting the 10 cm from 12.8... cm finds that side E is 2.8... cm

$$10 + 8 + 8 + 12.8... + 2.8...$$

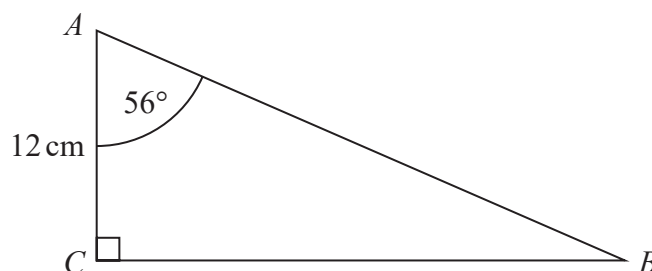
Adding all of the outside sides gives the perimeter

Giving 41.61... to 3 significant figures

41.6 mm

(Total for Question 5 is 4 marks)

- 6 ABC is a right-angled triangle.



- (a) Work out the length of BC .
Give your answer correct to 1 decimal place.

SOHCAHTOA

Right-angled trigonometry can be used to work out side BC .

Ticking A as the 56° is the angle and O as BC is the opposite. The TOA formula triangle can be used as it has two ticks

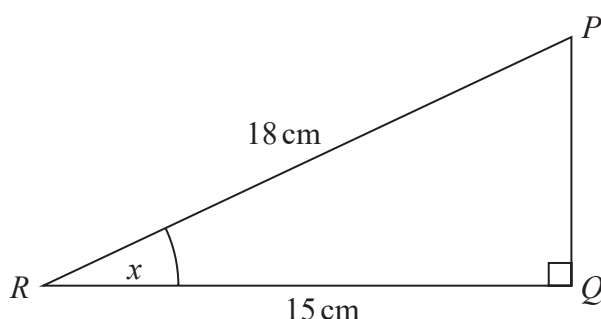
$$\tan 56 \times 12$$

Covering O in the TOA formula triangle finds that opposite = tan of the angle $\times$ adjacent

17.79... is given to 1 decimal place

17.8 cm
(2)

PQR is a right-angled triangle.



- (b) Work out the size of the angle marked x .
Give your answer correct to 1 decimal place.

SOHCAHTOA

Right-angled trigonometry can be used to work out angle x . Ticking H as the 18 cm is the hypotenuse and ticking A as the 15 cm is the adjacent. There are two ticks on the CAH formula triangle so this can be used

$$\cos x = \frac{15}{18}$$

Covering C in the CAH formula triangle finds that cos of the angle = adjacent/hypotenuse

Doing the inverse cos of both sides gets x on its own. $33.55...$ is given correct to 1 decimal place

33.6 $^\circ$
(2)

(Total for Question 6 is 4 marks)

- 7 Liquid **A** has a density of 1.8 g/cm^3
Liquid **B** has a density of 1.2 g/cm^3

80 cm^3 of liquid **A** is mixed with 40 cm^3 of liquid **B** to make 120 cm^3 of liquid **C**.

Work out the density of liquid **C**.

$d \begin{smallmatrix} m \\ v \end{smallmatrix}$ ←

Writing a formula triangle for density, mass, volume

$1.8 \times 80 = 144$ ←

Covering m in the formula triangle finds that mass = density $\times$ volume.
So the mass of liquid A is 144 g

$1.2 \times 40 = 48$ ←

Covering m in the formula triangle finds that mass = density $\times$ volume.
So the mass of liquid B is 48 g

$144 + 48$ ←

Adding the mass of liquid A and the mass of liquid B finds that the mass of liquid C is 192 g

$192 \div 120$ ←

Covering d in the formula triangle finds that density = mass $\div$ volume

..... 1.6 g/cm^3

(Total for Question 7 is 3 marks)

- 8 The grouped frequency table gives information about the time, in minutes, taken by 50 people to solve a puzzle.

Time (t minutes)	Frequency
$0 < t \leq 10$	5
$10 < t \leq 20$	8
$20 < t \leq 30$	12
$30 < t \leq 40$	15
$40 < t \leq 50$	7
$50 < t \leq 60$	3

Brian was asked to draw a cumulative frequency table for this information.

This is the table that Brian drew.

Time (t minutes)	Cumulative frequency
$0 < t \leq 10$	5
$10 < t \leq 20$	13
$20 < t \leq 30$	25
$30 < t \leq 40$	40
$40 < t \leq 50$	47
$50 < t \leq 60$	50

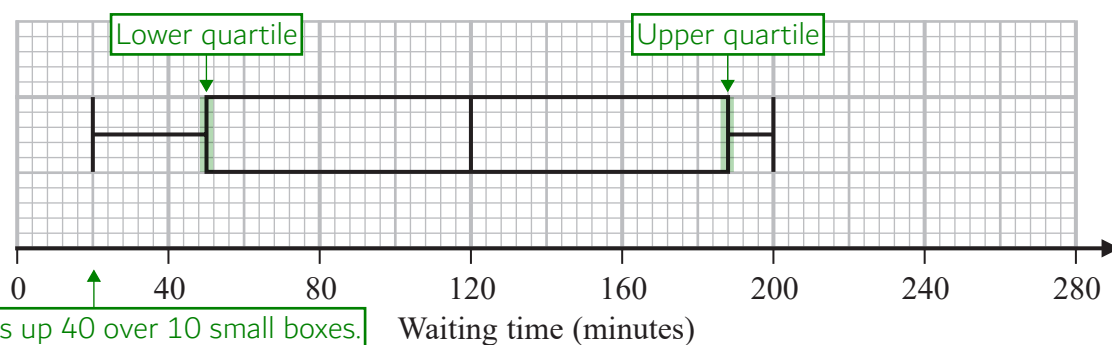
Write down **one** thing that is wrong with this cumulative frequency table.

The intervals are wrong

They should all start with 0. For example the second interval should be $0 < t \leq 20$

(Total for Question 8 is 1 mark)

- 9 The box plot shows information about the length of time, in minutes, some people waited to see a doctor at a hospital on Monday.



- (a) Work out the interquartile range of the information in the box plot.

$188 - 50$ ← Interquartile range = upper quartile - lower quartile

138 minutes
(2)

Becky says,

“50% of the people waited for at least 2 hours.”

- (b) Is Becky correct?
Explain why.

Yes as the median is 2 hours

There are 60 minutes in an hour and $120 \div 60 = 2$ so 120 minutes is 2 hours. The median is halfway through the data and 50% is half

(1)

The table gives information about the length of time, in minutes, some people waited to see a doctor at the same hospital on Tuesday.

	Waiting time (minutes)
Shortest time	20
Lower quartile	50
Median	100
Upper quartile	140
Longest time	210

Becky was asked to compare the distribution of the lengths of times people waited on Monday with the distribution of the lengths of times people waited on Tuesday.

She wrote,
“People had to wait longer on Tuesday than on Monday.”

(c) Give **one** reason why Becky may be wrong.

The median is lower on Tuesday

So on average, the people did not have to wait longer on Tuesday than on Monday

(1)

(Total for Question 9 is 4 marks)

- 10 Louise invests £x in Better Investments for 3 years.
Sadiq invests £x in County Bank for 3 years.

Better Investments

Compound Interest

2.5% per annum

County Bank

Compound Interest

2% per annum for the first two years
3.5% per annum for each extra year

At the end of the 3 years, the value of Louise's investment is £344 605

Work out the value of Sadiq's investment at the end of the 3 years.

$$\frac{100 + 2.5}{100} = 1.025$$

$$\frac{100 + 2}{100} = 1.02$$

$$\frac{100 + 3.5}{100} = 1.035$$

Converting the percentage increases into decimal multipliers by adding the percentages to 100% then putting them over 100

$$x \times 1.025^3 = 344605$$

Increasing the £x by 2.5% 3 times gives £344605

$$x = 320000$$

Dividing both sides by 1.025^3 finds that x is £320000

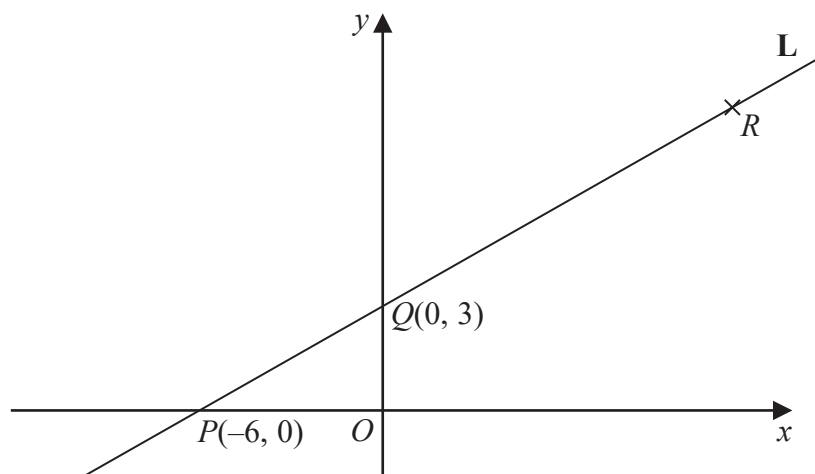
$$320000 \times 1.02^2 \times 1.035$$

Increasing the £x by 2% 2 times then increasing by 3.5% 1 time

£ 344580.48

(Total for Question 10 is 4 marks)

11 Here is a sketch of the line L.



The points $P(-6, 0)$ and $Q(0, 3)$ are points on the line L.

The point R is such that PQR is a straight line and $PQ:QR = 2:3$

(a) Find the coordinates of R.

$$6 \div 2$$

$$3 \times 3$$

$$0 + 9$$

The distance from P to Q in the x-direction is 6, which is represented by 2 parts of the ratio. So dividing 6 by 2 finds that 1 part of the ratio is worth 3. Multiplying the value of 1 part of the ratio by 3 finds that the distance from Q to R is 9 in the x-direction. Adding this 9 to the x-coordinate of Q finds that the x-coordinate of R is 9

$$3 \div 2$$

$$1.5 \times 3$$

$$3 + 4.5$$

Doing similar for the y-direction

(.....9.....,7.5.....)
(2)

(b) Find an equation of the line that is perpendicular to L and passes through Q.

$$-1 \div \frac{3}{6}$$

Gradient = rise/run. The rise from P to Q is 3 and the run from P to Q is 6. So the gradient of L is $3/6$. Doing the negative reciprocal of this (by doing -1 divided by) finds that the gradient of the line perpendicular to L is -2

The general equation of a straight line is $y = mx + c$, where m is the gradient and c is the y-intercept. The gradient of the perpendicular line passing through Q has a gradient of -2 and y-intercept of 3 (as it goes through the y-axis with a y-coordinate of 3)

$$y = -2x + 3$$

(3)

(Total for Question 11 is 5 marks)

12 Expand and simplify $(x - 2)(3x + 2)(2x + 3)$

$$3x^2 + 2x - 6x - 4 \quad \leftarrow \text{Expanding the first two brackets}$$

$$(3x^2 - 4x - 4)(2x + 3) \quad \leftarrow \text{Collecting like terms and writing the third bracket}$$

$$6x^3 + 9x^2 - 8x^2 - 12x - 8x - 12 \quad \leftarrow \text{Expanding}$$

Collecting like terms

$$6x^3 + x^2 - 20x - 12$$

(Total for Question 12 is 3 marks)

13 In a school there are 16 teachers and 220 students.
Of these students 120 are girls and 100 are boys.

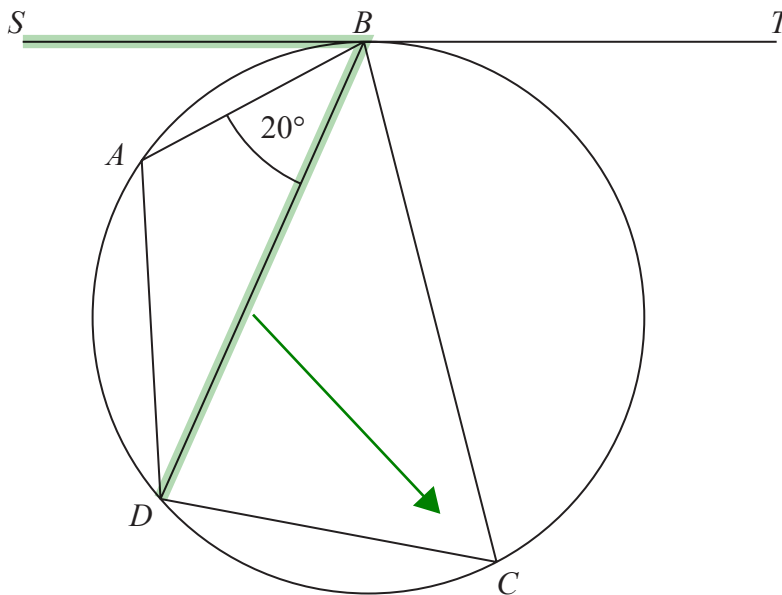
One teacher, one girl and one boy are going to be chosen to represent the school.

Work out the number of different ways there are to choose one teacher, one girl and one boy.

$$16 \times 120 \times 100 \quad \leftarrow \text{Using the product rule for counting. Multiplying the number of possibilities for each individual event gives the total number of possibilities}$$

$$192000$$

(Total for Question 13 is 2 marks)



A , B , C and D are four points on a circle.
 SBT is a tangent to the circle.
 Angle $ABD = 20^\circ$

the size of angle BAD : the size of angle $BCD = 3 : 1$

Find the size of angle SBA .
 Give a reason for each stage of your working.

$$180 \div 4$$

Angle $BCD = 45^\circ$ as opposite angles in a cyclic quadrilateral add up to 180°

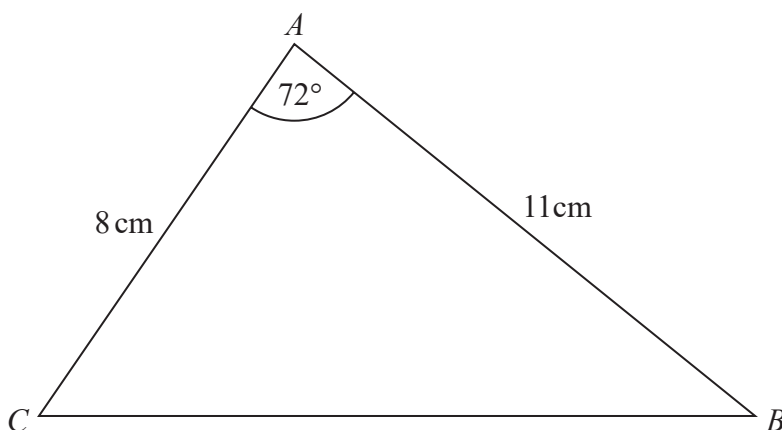
$3 + 1 = 4$ parts in total in the ratio, which represent 180° as angles BAD and BCD are opposite angles in a cyclic quadrilateral so must be 180° in total.
 Dividing the 180° by 4 works out that 1 part represents 45° , which is angle BCD

Angle $SBD = 45^\circ$ due to the alternate segment theorem

The alternate segment theorem is that the angle between a tangent and a chord is equal to the interior opposite angle. Angle SBD (highlighted in the diagram) is the angle between the tangent SB and the chord BD . Angle BCD is the interior opposite angle

$45 - 20$ ← Angle SBA can be found by subtracting angle ABD from angle SBD

15 Here is triangle ABC .



- (a) Find the length of BC .
Give your answer correct to 3 significant figures.

$$CB^2 = 8^2 + 11^2 - 2 \times 8 \times 11 \times \cos 72$$

It is not a right angled triangle so Pythagoras' theorem and right angled trigonometry cannot be used. There is not at least two opposite pairs of sides and angles and no other angles can be easily worked out so the sine rule cannot be used. The cosine rule should be used. $a^2 = b^2 + c^2 - 2bccosA$

$$CB = \sqrt{130.6...}$$

← Square rooting both sides eliminates the square on the left

11.42... is given correct to 3 significant figures

$$\dots\dots\dots 11.4 \dots\dots\dots \text{ cm}$$

(3)

- (b) Find the area of triangle ABC .
Give your answer correct to 3 significant figures.

$$\frac{1}{2} \times 8 \times 11 \times \sin 72$$

Area of triangle = $\frac{1}{2} ab \sin C$, where a and b are two sides and C is the angle between them

41.84... is given correct to 3 significant figures

$$\dots\dots\dots 41.8 \dots\dots\dots \text{ cm}^2$$

(2)

(Total for Question 15 is 5 marks)

- 16 (a) Use the iteration formula $x_{n+1} = \sqrt[3]{10 - 2x_n}$ to find the values of x_1 , x_2 and x_3
Start with $x_0 = 2$

$$x_1 = \sqrt[3]{10 - 2(2)} \leftarrow \text{Substituting } x_0 \text{ for } x_n \text{ in the iteration formula finds } x_1$$

$$x_2 = \sqrt[3]{10 - 2(1.81\dots)} \leftarrow \text{Substituting } x_1 \text{ for } x_n \text{ in the iteration formula finds } x_2$$

$$x_3 = \sqrt[3]{10 - 2(1.85\dots)} \leftarrow \text{Substituting } x_2 \text{ for } x_n \text{ in the iteration formula finds } x_3$$

$$x_1 = \dots\dots\dots 1.82$$

$$x_2 = \dots\dots\dots 1.85$$

$$x_3 = \dots\dots\dots 1.85$$

(3)

The values of x_1 , x_2 and x_3 found in part (a) are estimates of the solution of an equation of the form $x^3 + ax + b = 0$ where a and b are integers.

- (b) Find the value of a and the value of b .

$$x = \sqrt[3]{10 - 2x} \leftarrow \text{This must be what the iterative formula is from}$$

$$x^3 = 10 - 2x \leftarrow \text{Cubing both sides eliminates the cube root on the right}$$

$$x^3 + 2x - 10 = 0 \leftarrow \text{Adding } 2x \text{ and subtracting } 10 \text{ from both sides gets it in the right form}$$

$\uparrow$
a

$\uparrow$
b

$$a = \dots\dots\dots 2$$

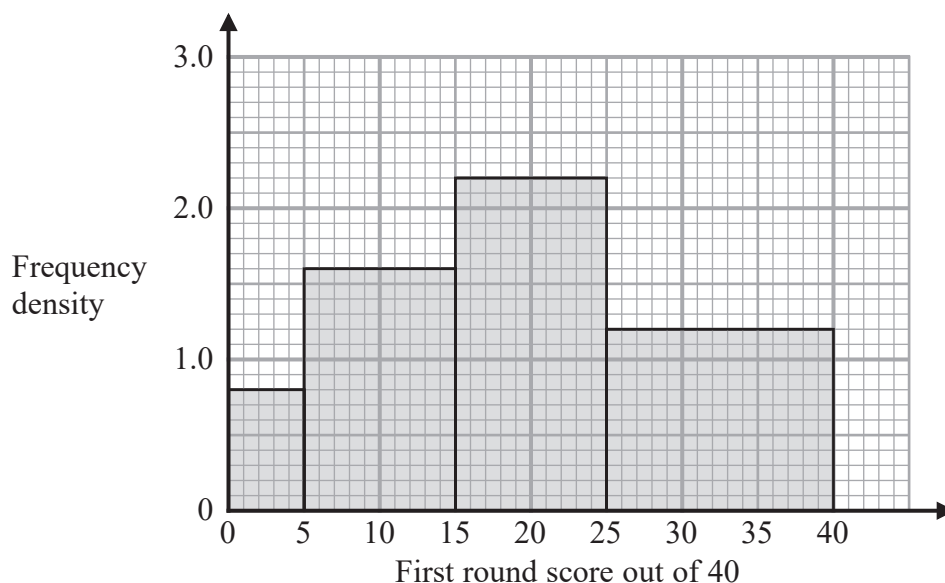
$$b = \dots\dots\dots -10$$

(1)

(Total for Question 16 is 4 marks)

17 Some people took part in the first round of a competition.

The histogram gives information about the scores of these people in the first round.



20% of the people got a score high enough for them to qualify for the second round.

Work out an estimate for the score needed to qualify for the second round.

You must show all your working.

$$5 \times 0.8 = 4$$

$$10 \times 1.6 = 16$$

$$10 \times 2.2 = 22$$

$$15 \times 1.2 = 18$$

Frequency is the area of each bar on a histogram. Area of rectangle = base $\times$ height

$$4 + 16 + 22 + 18$$

Adding all the frequencies of each bar finds that there are 60 people in total

$$\frac{20}{100} \times 60$$

Putting 20% over 100 converts it to a fraction. Doing this fraction of the 60 people finds that 20% of the people is 12

$$18 - 12$$

Subtracting the 12 from the 18 people in the last bar finds that the top 20% of people start from 6 of the way through the last bar

$$\frac{6}{18} \times 15$$

$\frac{6}{18}$ expresses the fraction of the way through the last bar the top 20% of people start from. Doing this fraction of the class width of the last bar estimates that the top 20% of people start from a score of 5 through the last bar

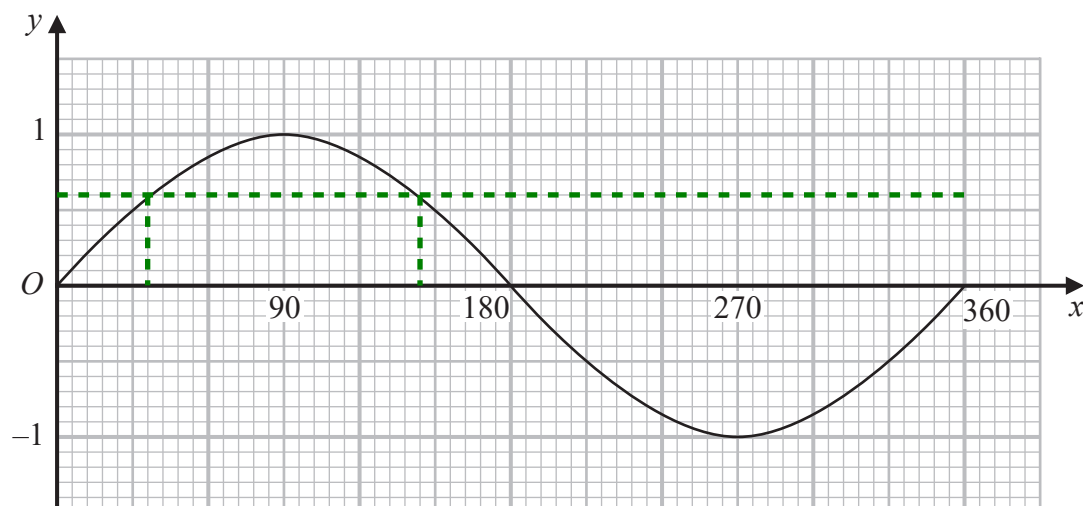
$$25 + 5$$

Adding the 5 to the 25 at the start of the last bar estimates the score needed to qualify

30

(Total for Question 17 is 4 marks)

18 Here is a graph of $y = \sin x^\circ$ for $0 \leq x \leq 360$



(a) Using this graph, find estimates of all **four** solutions of

$$\sin x^\circ = 0.6 \quad \text{for } 0 \leq x \leq 720$$

From the graph, the values of x within $0 \leq x \leq 360$ are 36 and 144. The scale goes up 90 over 15 small boxes. $90 \div 15 = 6$ so each small box is worth 6. The graph repeats from $360 \leq x \leq 720$ so adding 360 to each of the first solutions works out the solutions within this range

$$\begin{aligned} x &= 36 \\ x &= 144 \\ x &= 396 \\ x &= 504 \end{aligned}$$

(2)

The graph of $y = \sin x^\circ$ is reflected in the x -axis.

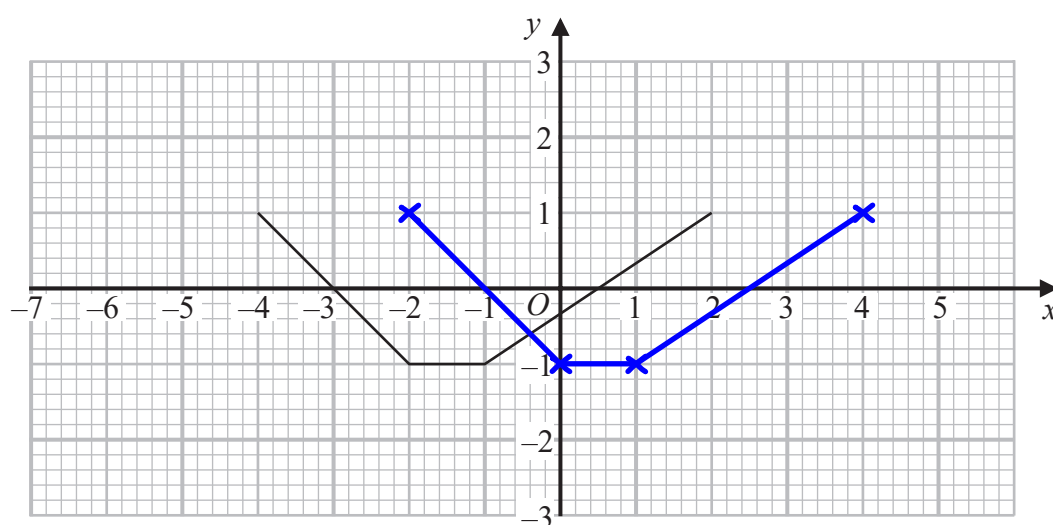
(b) Write down an equation of the reflected graph.

$y = -f(x)$ is a reflection in the x -axis as all of the positive values become negative and all of the negative values become positive

$$y = -\sin x^\circ$$

(1)

Here is a graph of $y = f(x)$



(c) On the grid, draw the graph of $y = f(x - 2)$

The graph translates 2 to the right as the same values are got to 2 later

(1)

(Total for Question 18 is 4 marks)

19 A, B and C are three spheres.

The volume of sphere A is 125 cm^3

The volume of sphere B is 27 cm^3

The ratio of the radius of sphere B to the radius of sphere C is 1 : 2

Work out the ratio of the surface area of sphere A to the surface area of sphere C.

	A	B	C
$\text{cm}^3 =$	125	27	
$\text{cm} =$	5	3	6
$\text{cm}^2 =$	25	9	36

Writing the ratio of the volume of A to the volume of B

Cube rooting both sides of the ratio of volume gives the ratio of length. From the 1 : 2 ratio, the radius of C is double the radius of B so if there are 3 parts for B there must be 6 parts for C

Squaring all sides of the ratio of lengths give the ratio of areas

The 9 parts of B can be ignored

25 : 36

(Total for Question 19 is 3 marks)

20 In a village,

if it rains on one day, the probability that it will rain on the next day is 0.8

if it does **not** rain on one day, the probability that it will rain on the next day is 0.6

A weather forecaster says,

“There is a 70% chance that it will rain in the village on Monday.”

Work out an estimate for the probability that it will rain in the village on Wednesday.

You must show all your working.

RRR, RNR, NRR, NNR

Systematically listing the possibilities for it to rain on Wednesday. Rain Monday AND rain Tuesday AND rain Wednesday OR rain Monday AND not rain Tuesday AND rain Wednesday OR not rain Monday AND rain Tuesday AND rain Wednesday OR not rain Monday AND not rain Tuesday AND rain Wednesday

$$\frac{70}{100} \times 0.8 \times 0.8 + \frac{70}{100} \times 0.2 \times 0.6 + \frac{30}{100} \times 0.6 \times 0.8 + \frac{30}{100} \times 0.4 \times 0.6$$

AND means to multiply the probabilities. OR means to add the probabilities. 70% is converted into a fraction by putting it over 100. The probability for not raining on Monday must be 30% as $100\% - 70\% = 30\%$. The probability of not raining after raining is 0.2 as $1 - 0.8 = 0.2$. The probability of not raining after not raining is 0.4 as $1 - 0.6 = 0.4$

0.748

(Total for Question 20 is 4 marks)

21 The time period, T seconds, of a simple pendulum of length l cm is given by the formula

$$T = 2\pi \sqrt{\frac{l}{g}}$$

Katie uses a simple pendulum in an experiment to find an estimate for the value of g .

Here are her results.

$l = 52.0$ correct to 3 significant figures.

$T = 1.45$ correct to 3 significant figures.

Work out the upper bound and the lower bound for the value of g .

Use $\pi = 3.142$

You must show all your working.

$$\frac{T}{2\pi} = \sqrt{\frac{L}{g}} \quad \leftarrow \text{Dividing both sides by } 2\pi$$

$$\frac{T^2}{4\pi^2} = \frac{L}{g} \quad \leftarrow \text{Squaring both sides eliminates the square root on the right}$$

$$\frac{g}{L} = \frac{4\pi^2}{T^2} \quad \leftarrow \text{Doing the reciprocal of both sides makes } g \text{ the numerator}$$

$$g = \frac{4\pi^2 L}{T^2} \quad \leftarrow \text{Multiplying both sides by } L \text{ gets } g \text{ on its own}$$

$$52.0 \pm \frac{0.1}{2} \quad \leftarrow \text{Adding and subtracting half of the resolution finds the upper and lower bound for } L. \text{ The resolution is } 0.1 \text{ as this is the place value of the 3rd significant figure}$$

$$1.45 \pm \frac{0.01}{2} \quad \leftarrow \text{Adding and subtracting half of the resolution finds the upper and lower bound for } T. \text{ The resolution is } 0.01 \text{ as this is the place value of the 3rd significant figure}$$

$$\frac{4 \times 3.142^2 \times 52.05}{1.445^2} \quad \leftarrow \text{Substituting the upper bound of } L \text{ and the lower bound of } T \text{ into the right side finds the the upper bound for } g$$

$$\frac{4 \times 3.142^2 \times 51.95}{1.455^2} \quad \leftarrow \text{Substituting the lower bound of } L \text{ and the upper bound of } T \text{ into the right side finds the the lower bound for } g$$

$$\text{upper bound} = \dots\dots\dots 984.4$$

$$\text{lower bound} = \dots\dots\dots 969.0$$

(Total for Question 21 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS