

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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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 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.

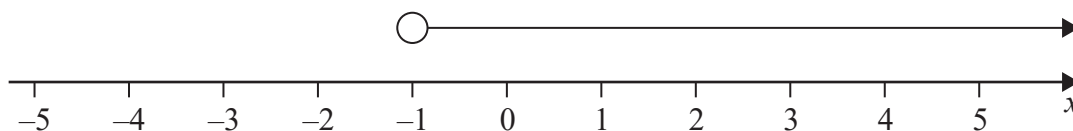
If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

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

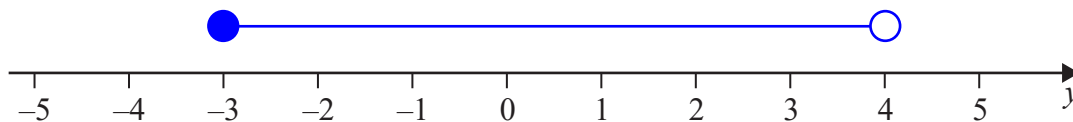


x is greater than -1 as the arrow goes to the right of -1.
It cannot be equal to -1 as the circle is not shaded in

$$x > -1$$

(1)

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



(2)

(Total for Question 1 is 3 marks)

DO NOT WRITE IN THIS AREA

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DO NOT WRITE IN THIS AREA



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

$2^2 \times 3 \times 7$ ← 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

If using a Casio fx-85GT CW, go to CATALOG, Numeric Calc then GCD. $GCD(60, 84) = 12$

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

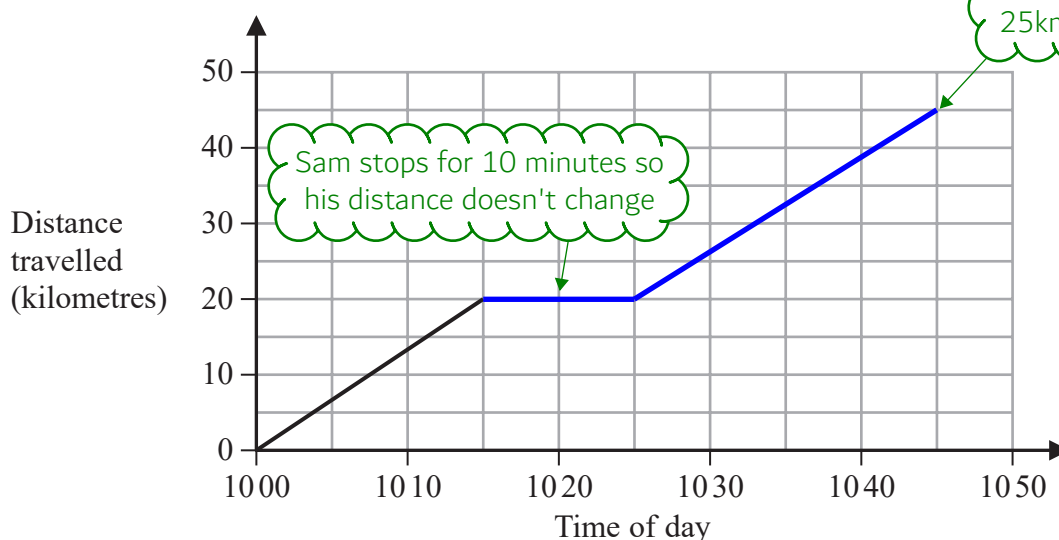
$2^3 \times 3 \times 5$ ← The highest power of each prime in both lists multiplied together gives the LCM

If using a Casio fx-85GT CW, go to CATALOG, Numeric Calc then LCM. $LCM(24, 40) = 120$

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.

$s^d t$

Quoting the formula triangle for distance, speed and time

$\frac{20}{0:15}$

From the formula triangle, speed = distance/time. The distance is 20km and the time is 15 minutes. Time can be entered into the calculator using the $\frac{\square}{\square}$ button

..... 80 km/h
(2)

At 1015 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.

$75 \times 0:20 = 25$

From the formula triangle, distance = speed x time. The speed is 75km/h and the time is 20 minutes. Time can be entered into the calculator using the $\square \times \square$ button

(3)

(Total for Question 3 is 5 marks)

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

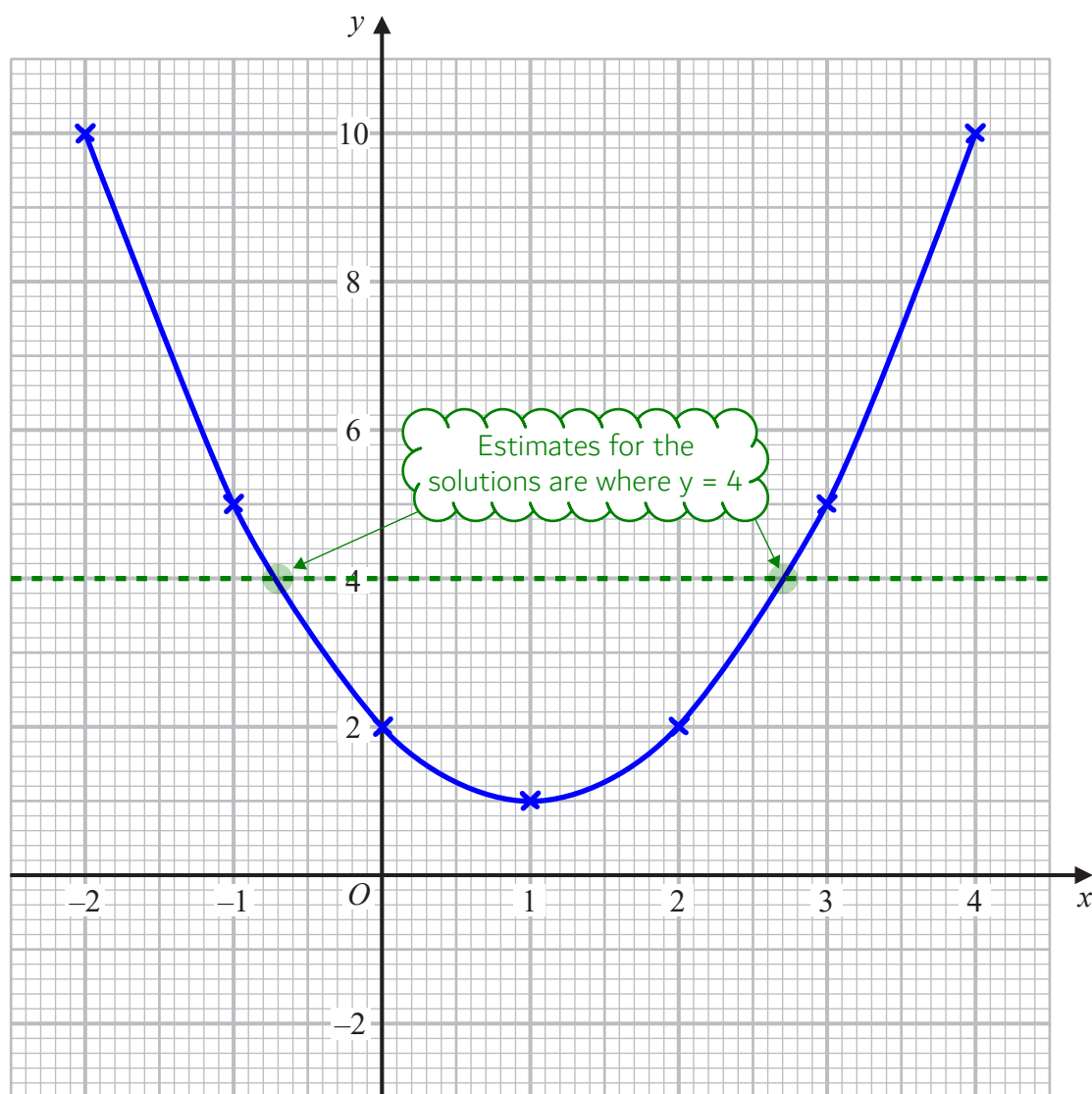
x	-2	-1	0	1	2	3	4
y	10	5	2	1	2	5	10

(2)

Use table mode. 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)



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

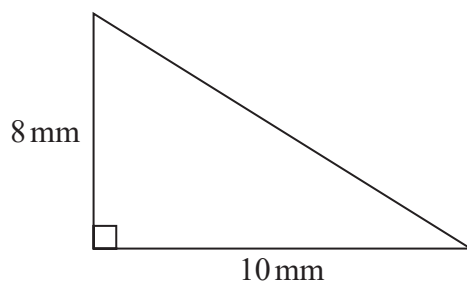
$$x = -0.7$$

$$x = 2.7$$

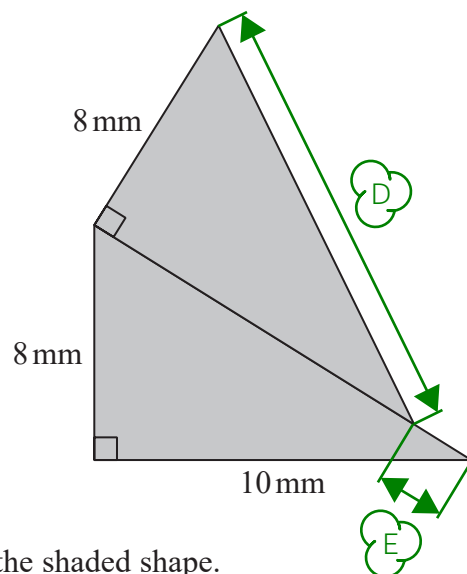
(2)

(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.

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

Pythagoras' Theorem can be used to work out the longest side of the right angled triangle

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

c is the longest side so rearranged to make this the subject

$$= \sqrt{10^2 + 8^2}$$

Substituted a for 10 and b for 8

$$10 + 8 + 8 + \underbrace{2\sqrt{41}}_{\text{Side D}} + \underbrace{(2\sqrt{41} - 10)}_{\text{Side E}}$$

Perimeter is all of the outside edges added together

Side D

Side E

The answer is quoted as a decimal to 3 significant figures

41.6 mm

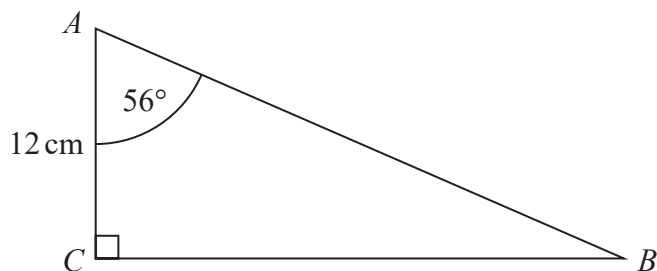
(Total for Question 5 is 4 marks)

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6 ABC is a right-angled triangle.



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

S^ÓH C^ÁH T^ÓÁ

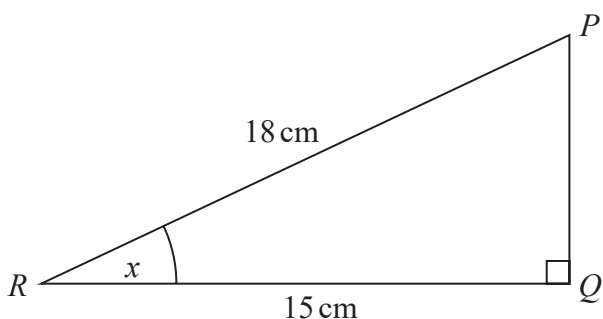
Right angled trigonometry can be used to work out side BC .
Ticking A as we have the adjacent and O as we are looking for the opposite. The tan formula can be used as it has two ticks

$\tan 56 \times 12$

From the tan formula triangle, opposite = tan of the angle \times adjacent

..... 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.

S^ÓH C^ÁH T^ÓÁ

Right angled trigonometry can be used to work out angle x .
Ticking H and A as we have the hypotenuse and the adjacent. The cos formula can be used as it has two ticks

$\cos^{-1}\left(\frac{15}{18}\right)$

From the formula triangle, cos of the angle = adjacent/hypotenuse.
So angle = $\cos^{-1}(\text{adjacent/hypotenuse})$

..... 33.6 °
(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.

$d = \frac{m}{v}$

Quoting the formula triangle for density, mass and volume

$$\frac{1.8 \times 80 + 1.2 \times 40}{120}$$

From the formula triangle, density = mass/volume. The volume of C is 120 cm^3 . The mass of C can be found by adding the masses of A and B. From the formula triangle, mass = density x volume. Multiplying the density of A by the volume of A works out the mass of A and multiplying the density of B by the volume of B works out the mass of B

.....1.6..... g/cm^3

(Total for Question 7 is 3 marks)

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- 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 $0 < t \leq 20$.
This is because the intervals and frequencies are combined as it goes

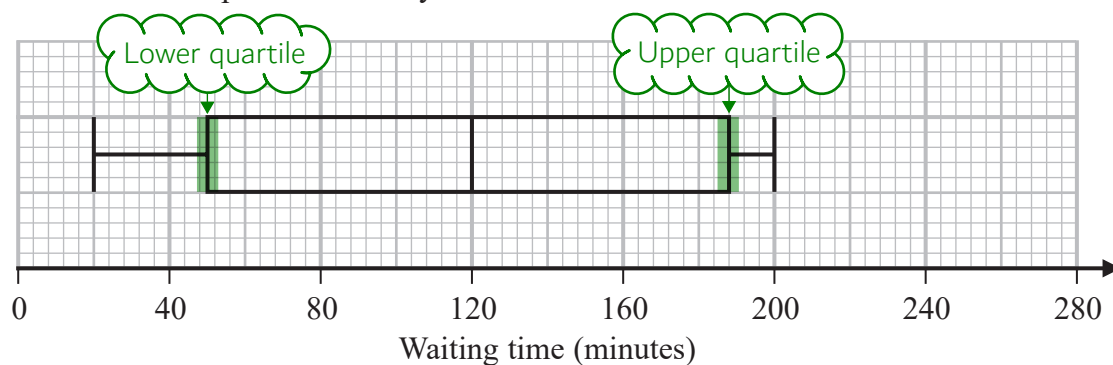
(Total for Question 8 is 1 mark)

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- 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.

$$(160 + 4 \times 7) - (40 + 4 \times 2.5)$$

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, the median is 2 hours

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

(1)

The scale goes up 40 over 10 small boxes. $40/10 = 4$ so each small box is worth 4. The upper quartile is 7 boxes after 160 so adding 7 lots of 4 works out the upper quartile. The lower quartile is 2.5 boxes after 40 so adding 2.5 lots of 4 works out the lower quartile

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.

<p>Better Investments</p> <p>Compound Interest</p> <p>2.5% per annum</p>

<p>County Bank</p> <p>Compound Interest</p> <p>2% per annum for the first two years 3.5% per annum for each extra year</p>

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.

$$x \times \left(\frac{100+2.5}{100}\right)^3 = 344605$$

100 + 2.5 works out the percentage Louise's investment rises to each year. Dividing this by 100 converts it into a multiplier which when multiplied by increases by 2.5%. Multiplying x by this to the power of 3 increases x by 2.5% 3 times, which must be equal to the value of the investment at the end of 3 years

$$\frac{344605}{\left(\frac{100+2.5}{100}\right)^3} \times \left(\frac{100+2}{100}\right)^2 \times \frac{100+3.5}{100}$$

The value of x , which is expressed by rearranging the first equation

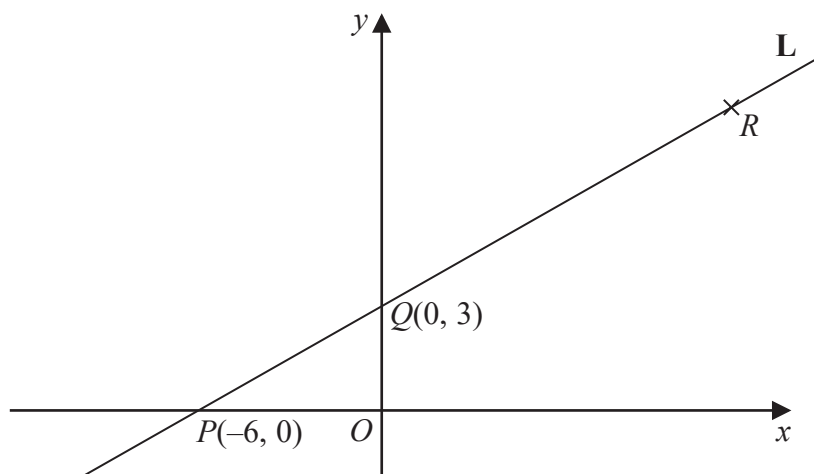
Applying the first 2 years of interest to Sadiq's investment

Applying the next 1 year of interest to Sadiq's investment

£ 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.

$$0 + \frac{0 - (-6)}{2} \times 3$$

Working out the x coordinate of R. $0 - (-6)$ works out the distance in the x direction from P to Q. Dividing this by 2 works out what 1 part of the ratio is worth in the x direction. Multiplying this by 3 works out what the distance is in the x direction from Q to R. Adding this to the x coordinate of Q

$$3 + \frac{3 - 0}{2} \times 3$$

Doing a similar method to work out the y coordinate of R

$$(\dots\dots\dots 9 \dots\dots\dots, \dots\dots\dots 7.5 \dots\dots\dots)$$

(2)

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

$$\frac{-1}{\left(\frac{3-0}{0-(-6)}\right)}$$

Working out the gradient of the line that is perpendicular to L by doing the negative reciprocal of the gradient of L. Gradient = (change in y)/(change in x). Change in y is found by subtracting the y coordinates of P and Q. Change in x is found by subtracting the x coordinate of P and Q in the same order

The general equation of a straight line is $y = mx + c$, where m is the gradient and c is the y-intercept. The gradient is -2 and the y-intercept is 3

$$y = -2x + 3$$

(3)

(Total for Question 11 is 5 marks)

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

$$3x^2 + 2x - 6x - 4$$

Expanding out the first two brackets

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

Simplifying and writing the third bracket

$$6x^3 + 9x^2 - 8x^2 - 12x - 8x - 12$$

Expanding out these two brackets

Simplifying the final answer

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

(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.

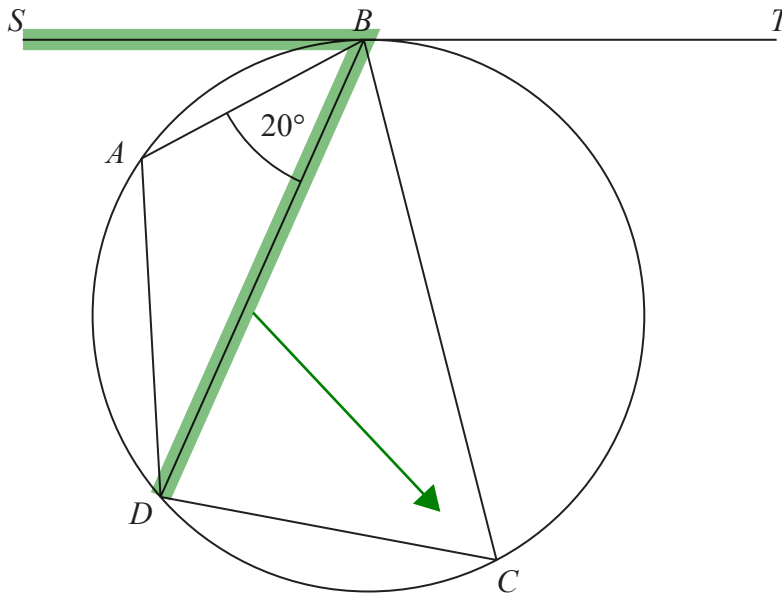
Work out the number of different ways there are to choose one teacher, one girl and one boy.

$$16 \times 120 \times 100$$

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.

$$180 / (3 + 1)$$

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

$3 + 1$ works out how many parts there are in total in the ratio. This many parts represent 180 as angles BAD and BCD are opposite angles in a cyclic quadrilateral so must be 180 in total. Dividing the 180 by this many parts works out what 1 part represents and therefore what angle BCD is

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

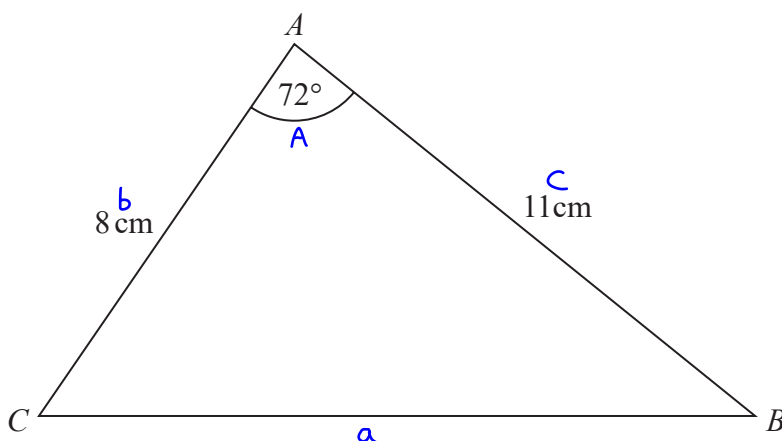
$$45 - 20$$

Angle SBA can be found by subtracting angle ABD from angle SBD

..... 25 °

(Total for Question 14 is 4 marks)

15 Here is triangle ABC .



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

$$a^2 = b^2 + c^2 - 2bc \cos A$$

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 must be used

$$BC = \sqrt{8^2 + 11^2 - 2 \times 8 \times 11 \times \cos 72}$$

Rearranged to make a the subject by square rooting both sides then substituting in the values

The answer of 11.42860486 is rounded to 3 significant figures

11.4

..... 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

The answer of 41.84648672 is rounded to 3 significant figures

41.8

..... 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 $x_0 = 2$

Enter 2 into the calculator then press = (or EXE) then enter $\sqrt[3]{10 - 2 \text{ ANS}}$. Pressing =/EXE once gives x_1 , pressing it again gives x_2 , then pressing it again gives x_3

This works as it substitutes in the previous iteration of x into the formula to find the next iteration of x . x_{n+1} means the next iteration of x and x_n means the current iteration of x

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

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

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

(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 .

$$x = \sqrt[3]{10 - 2x}$$

This must be what the iterative formula is derived from

$$x^3 = 10 - 2x$$

Cubing both sides

$$x^3 + 2x - 10 = 0$$

Rearranged into the desired form

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

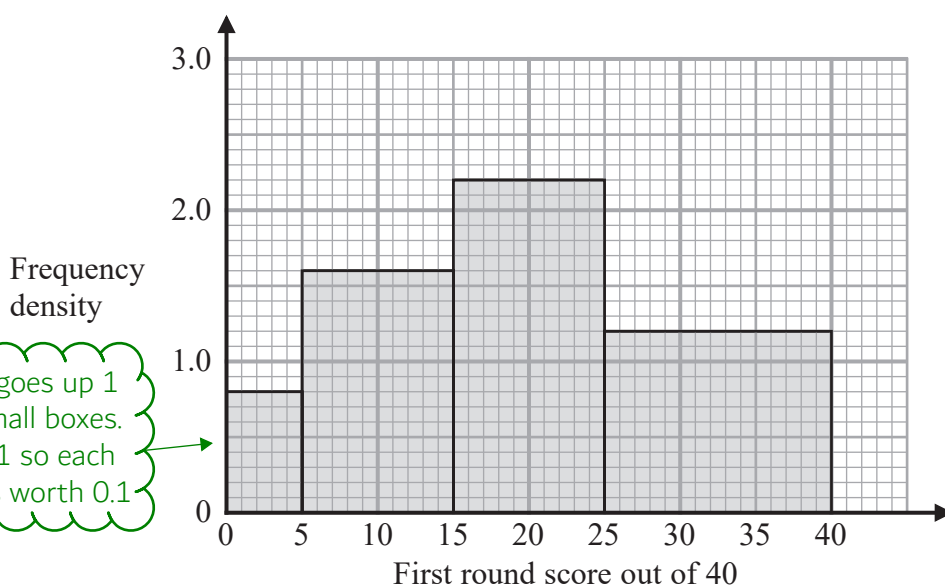
$$b = \dots\dots\dots -10$$

(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.



The scale goes up 1 over 10 small boxes.
 $1/10 = 0.1$ so each small box is worth 0.1

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.

$$(5-0) \times 0.8 = 4$$

$$(15-5) \times 1.6 = 16$$

$$(25-15) \times 2.2 = 22$$

$$(40-25) \times 1.2 = 18$$

Frequency on a histogram is the area of each box.
 Frequency = class width \times frequency density. The class width is how wide each box is and is found by finding the difference between the highest and lowest value of each box

$$\frac{20}{100} \times (4 + 16 + 22 + 18)$$

Adding all of the frequencies works out the total number of people. Doing 20% of this to work out how many people qualified by converting 20% into a fraction multiplier and multiplying the total by this

$$40 - \frac{12}{18} \times (40 - 25)$$

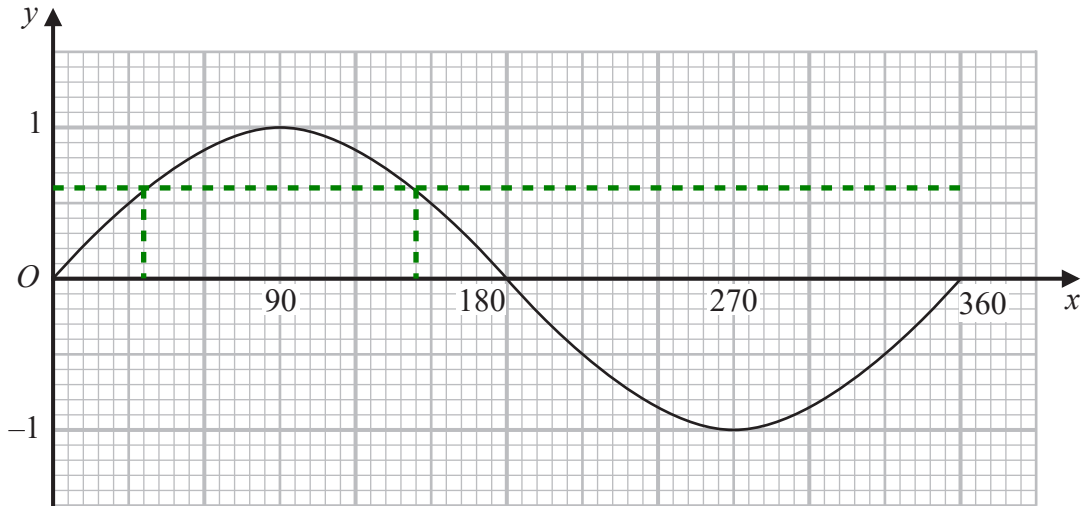
There are 12 who qualified. All of these must be in the last class as there were 18 in this one and this is more than 12. Assuming that the scores are equally spread out within the last class, the minimum score needed to qualify is $12/18$ of the way from the end. Doing this fraction of class width then subtracting this from the highest value in the class works out an estimate for the score needed to qualify

30

(Total for Question 17 is 4 marks)

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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

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

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. $90/15 = 6$ 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

$x = 36$
 $x = 144$
 $x = 396$
 $x = 504$

(2)

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

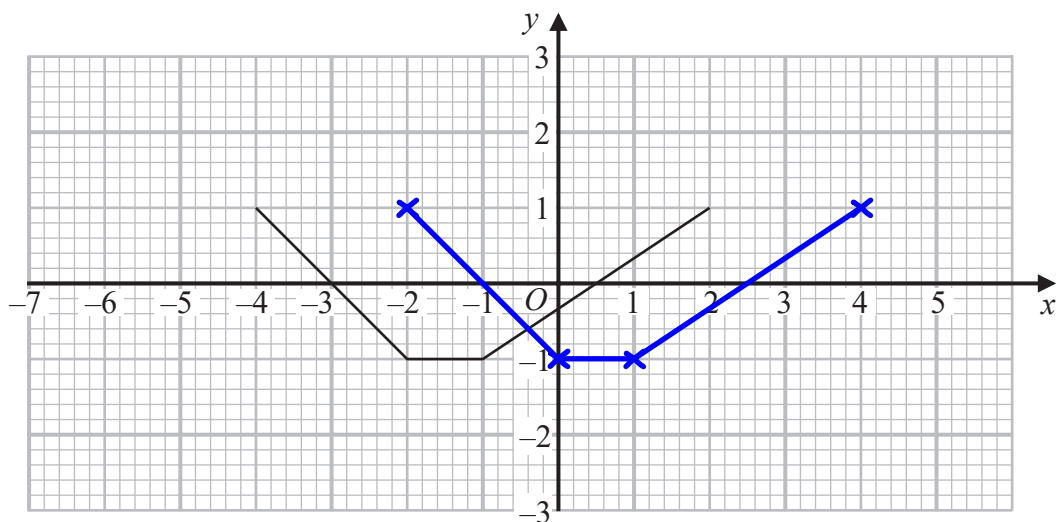
(b) Write down an equation of the reflected graph.

$y = -f(x)$ 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)

DO NOT WRITE IN THIS AREA

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
25	9	1
25	9	4
		36

The ratio of the volumes of A and B is 125 : 27. The unit of volume is cm^3 . The unit of length is cm. So to go from the ratio of volume to the ratio of length, both sides need to be cube rooted. The unit of area is cm^2 . So to go from the ratio of length to the ratio of area, both sides need to be squared. $(\sqrt[3]{125})^2 = 25$. $(\sqrt[3]{27})^2 = 9$. Also squaring the ratio of the lengths of B and C (radius is a length) gives the ratio of their areas. $1^2 = 1$. $2^2 = 4$. Writing the ratio of the areas of A : B and B : C over each other then combining them by making the same number of parts for B. 9 is a common multiple of 9 and 1 so multiplying both sides of the 1 : 4 gives 9 : 36 then the ratios can be combined

B can be ignored then the ratio of A : C can be written

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 and 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.

$$\frac{T^2}{(2\pi)^2} = \frac{l}{g}$$

Rearranging to make g the subject. Dividing both sides by 2π then squaring both sides

$$\frac{(2\pi)^2 l}{T^2} = g$$

Doing the reciprocal of both sides then multiplying both sides by l

$$\frac{(2 \times 3.142)^2 \times (52.0 + \frac{0.1}{2})}{(1.45 - \frac{0.01}{2})^2}$$

Using 3.142 as π , the upper bound of l and the lower bound of T to work out the upper bound of g . Using the upper bound of l as it is a numerator and positive and the lower bound of T as it is a denominator and positive (dividing by less makes a greater answer). To express the upper bound, adding half of the resolution of the measurement. To express the lower bound, subtracting half of the resolution of the measurement. The resolution of l is 0.1 as the third significant figure is in the first decimal place. The resolution of T is 0.01 as the third significant figure is in the second decimal place

$$\frac{(2 \times 3.142)^2 \times (52.0 - \frac{0.1}{2})}{(1.45 + \frac{0.01}{2})^2}$$

Using 3.142 as π , the lower bound of l and the upper bound of T to work out the lower bound of g . Using the lower bound of l as it is a numerator and positive and the upper bound of T as it is a denominator and positive (dividing by more makes a smaller answer)

upper bound = 984

lower bound = 969

(Total for Question 21 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS