

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)

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Monday 12 November 2018

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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.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 7357 correct to 3 significant figures.

Only the first three figures are quoted.
All other figures become 0. The 5 rounds
to a 6 as there is a 7 in the next place

7360

(1)

- (b) Work out $\frac{\sqrt{17 + 4^2}}{7.3^2}$

Write down all the figures on your calculator display.

Type into the calculator

0.1077981356

(2)

(Total for Question 1 is 3 marks)

- 2 Last year Jo paid £245 for her car insurance.
This year she has to pay £883 for her car insurance.

Work out the percentage increase in the cost of her car insurance.

$$\frac{883 - 245}{245} \times 100$$

Using the percentage change formula:
(new - old)/old x 100

260.4 %

(Total for Question 2 is 3 marks)

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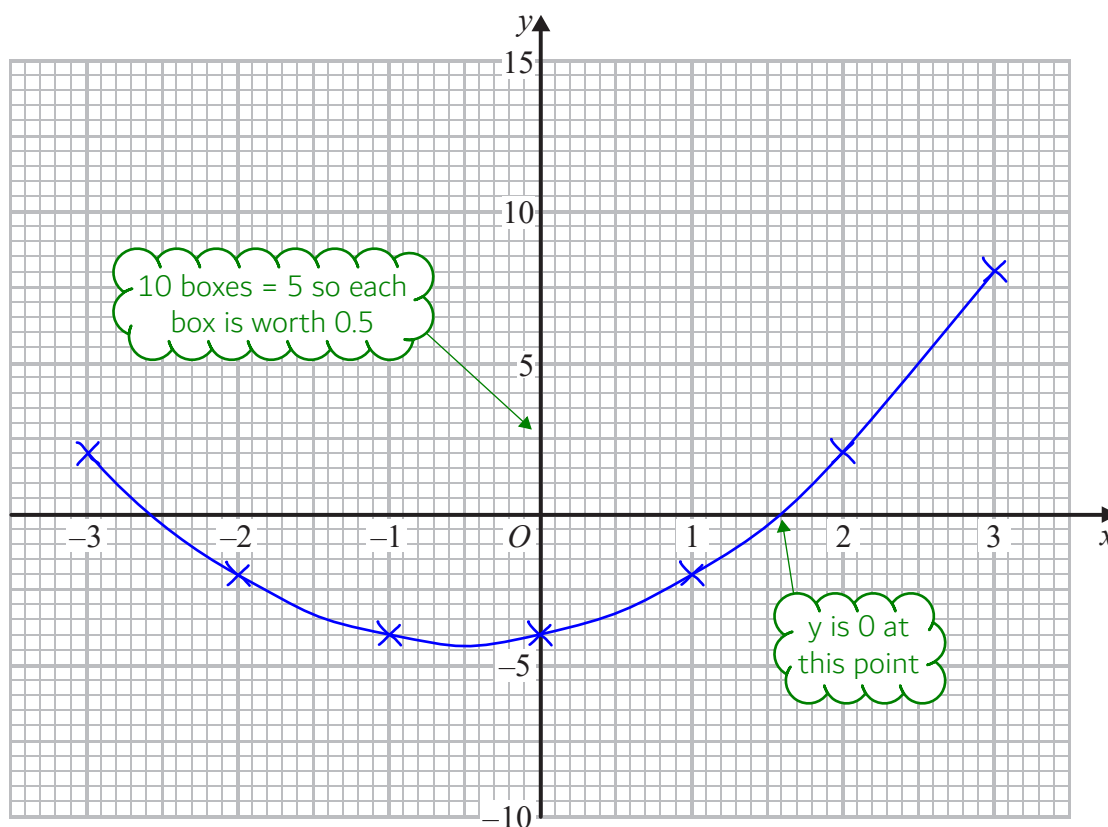
3 (a) Complete this table of values for $y = x^2 + x - 4$

x	-3	-2	-1	0	1	2	3
y	2	-2	-4	-4	-2	2	8

Use table mode by pressing Menu then 3. Type in $f(x) = x^2 + x - 4$. Start: -3. End: 3. Step: 1

(2)

(b) On the grid, draw the graph of $y = x^2 + x - 4$ for values of x from -3 to 3



(2)

(c) Use the graph to estimate a solution to $x^2 + x - 4 = 0$

This value will depend on how you have drawn the curve

Estimate what x is when y is 0

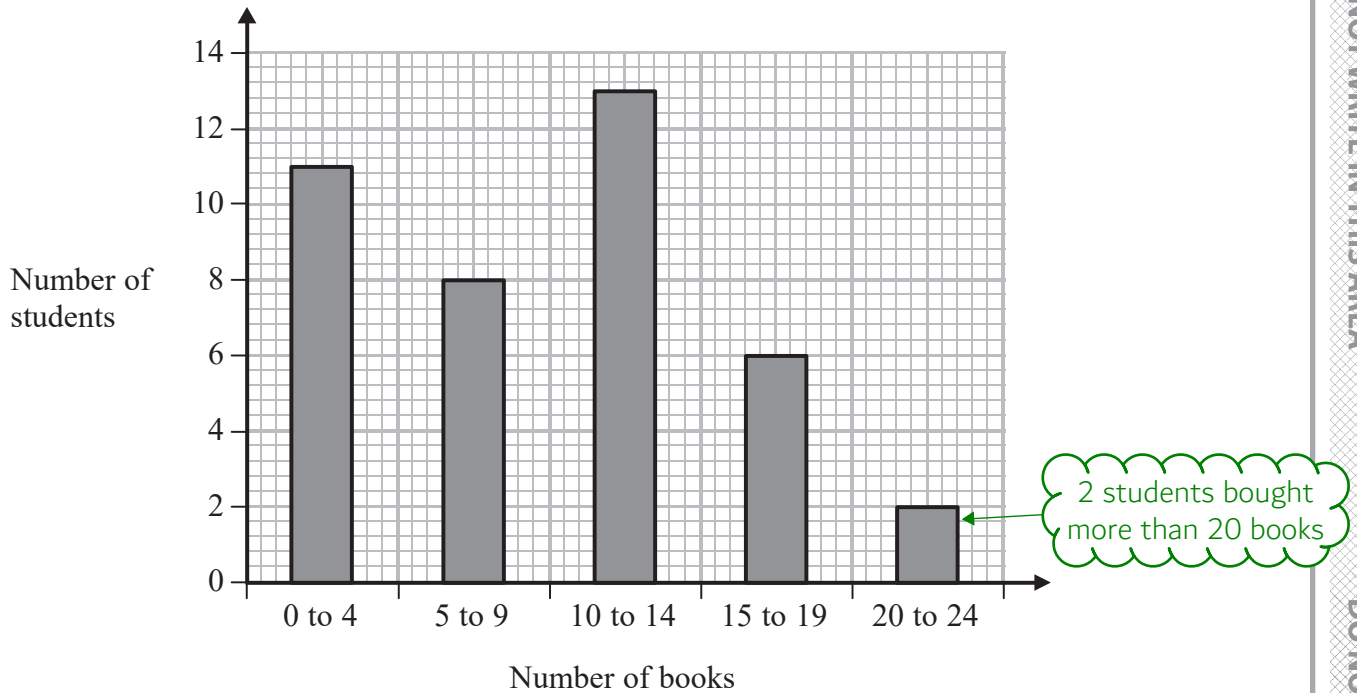
.....
1.6

(1)

(Total for Question 3 is 5 marks)

4 Fran asks each of 40 students how many books they bought last year.

The chart below shows information about the number of books bought by each of the 40 students.



(a) Work out the percentage of these students who bought 20 or more books.

$$\frac{2}{40} \times 100$$

2 out of the 40 students bought more than 20 books. To convert the fraction $2/40$ into a percentage, multiply it by 100

.....
S %
(2)

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- (b) Show that an estimate for the mean number of books bought is 9.5
You must show all your working.

$$\frac{11 \times 2 + 8 \times 7 + 13 \times 12 + 6 \times 17 + 2 \times 22}{40} = 9.5$$

Mean = total/number. To estimate the total, multiply the number of students for each category by the mid point of the number of books for that category then add together all the results.
The number is 40 as there are 40 students

(4)

(Total for Question 4 is 6 marks)

5 Lara is a skier.

She completed a ski race in 1 minute 54 seconds.
The race was 475 m in length.

Lara assumes that her average speed is the same for each race.

- (a) Using this assumption, work out how long Lara should take to complete a 700 m race.
Give your answer in minutes and seconds.

$$\frac{d}{s} = t$$

From the formula triangle:
time = distance/speed
speed = distance/time

$$\frac{475}{60 + 54} = \frac{25}{6}$$

This works out the average speed in metres per second. The minute has been converted into seconds

$$\frac{700}{\left(\frac{25}{6}\right)} = 168$$

This works out the time taken for the 700m race in seconds

$168/60 = 2.8$ so 2 whole minutes.
 $2 \times 60 = 120$, $168 - 120 = 48$ so 48 seconds in addition to the minutes

2 minutes 48 seconds
(3)

Lara's average speed actually increases the further she goes.

- (b) How does this affect your answer to part (a)?

It would take less time

700m is further than 475m so the average speed would be higher

(1)

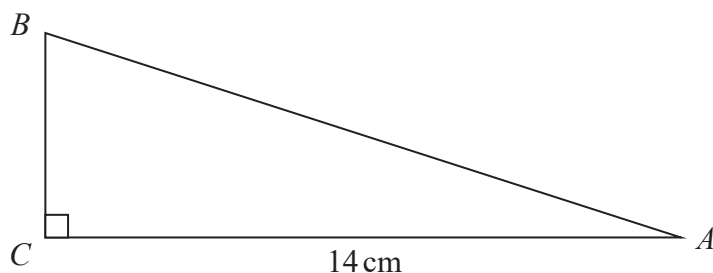
(Total for Question 5 is 4 marks)

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6 ABC is a right-angled triangle.



$AC = 14$ cm.
 Angle $C = 90^\circ$

size of angle B : size of angle $A = 3 : 2$

Work out the length of AB .
 Give your answer correct to 3 significant figures.

$$180 - 90 = 90$$

There are 180 degrees in a triangle. Subtracting angle C works out the total of angle A and B

$$5p = 90, p = 18$$

There are 5 parts in total in the ratio and this represents 90 degrees. Dividing by 5 works out that 1 part is worth 18 degrees. Multiplying by 2 works out that 2 parts (angle A) are worth 36 degrees

$$2p = 36$$

SOH CAH TOA

We have the adjacent and we are finding the hypotenuse. So the CAH formula triangle can be used

$$\frac{A}{C/H}$$

From the formula triangle:
 hypotenuse = adjacent / cos of the angle

$$\frac{14}{\cos 36} = 17.30495168$$

Rounded to 3 significant figures

.....17.3.....cm

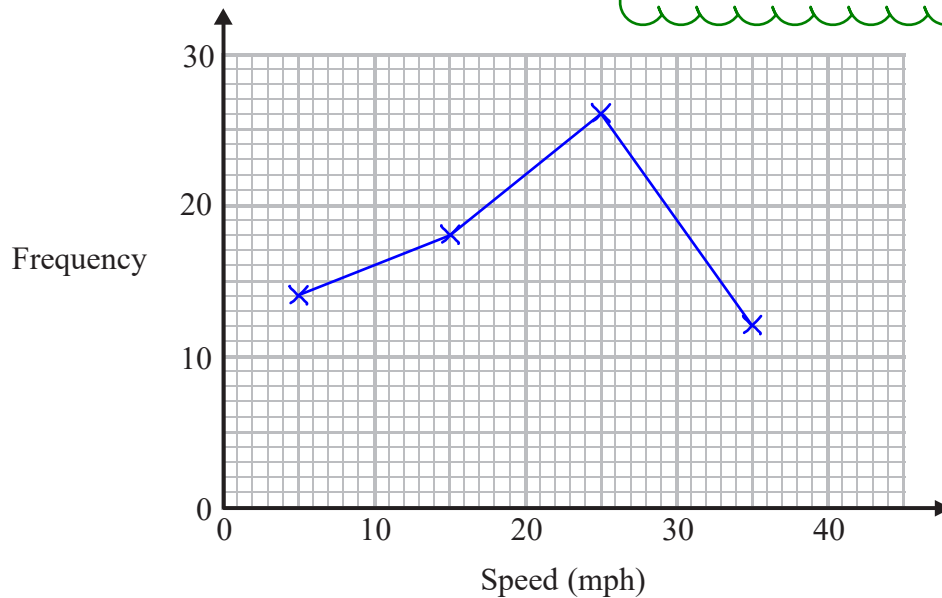
(Total for Question 6 is 4 marks)

7 The table gives information about the speeds of 70 cars.

Speed (s mph)	Frequency
$0 < s \leq 10$	14
$10 < s \leq 20$	18
$20 < s \leq 30$	26
$30 < s \leq 40$	12

Draw a frequency polygon for this information.

Points plotted at the midpoints of each category then joined up with straight lines



(Total for Question 7 is 2 marks)

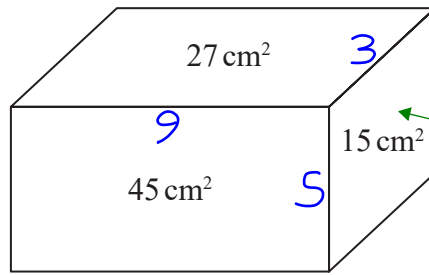
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8 The diagram shows a solid metal cuboid.

The areas of three of the faces are marked on the diagram.
The lengths, in cm, of the edges of the cuboid are whole numbers.



Area of rectangle = length x width
 The factor pairs of 15 are 1 and 15, 3 and 5. So the length and width of this face could be 15cm and 1cm or 3cm and 5cm. The sides of 15cm and 1cm don't work with the other faces so they must be 5cm and 3cm.

$5 \times 3 = 15$
 $9 \times 5 = 45$
 $9 \times 3 = 27$

The metal cuboid is melted and made into cubes.
Each of the cubes has sides of length 2.5 cm.

Work out the greatest number of these cubes that can be made.

Volume of a cuboid = length x width x height

$$\frac{9 \times 3 \times 5}{2.5^3} = 8.64$$

Dividing the volumes works out how many cubes can be made

Volume of a cube = length³

We are looking for a whole number of cubes so we need to round down

..... 8

(Total for Question 8 is 5 marks)

9 (a) Expand and simplify $(x-2)(2x+3)(x+1)$

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

Expand the first pair of brackets

$$(2x^2 - x - 6)(x+1)$$

Simplify and write the third bracket

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

Expand with the third bracket

Collect like terms and simplify

$$\underline{2x^3 + x^2 - 7x - 6}$$

(3)

$$\frac{y^4 \times y^n}{y^2} = y^{-3}$$

(b) Find the value of n .

$$y^{4+n-2} = y^{-3}$$

Combining the powers to get a single power of y .

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

$$a^x \div a^y = a^{x-y}$$

$$4 + n - 2 = -3$$

The power on the left side must be equal to the power on the right side

Rearranged to find n

$$\underline{-5}$$

(2)

(c) Solve $5x^2 - 4x - 3 = 0$

Give your solutions correct to 3 significant figures.

$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(5)(-3)}}{2(5)}$$

Using the quadratic formula

Put in the positive first then the negative.

$$1.272779789$$

$$-0.4717797887$$

Rounded to 3 significant figures

$$\underline{1.27 \text{ and } -0.472}$$

(3)

(Total for Question 9 is 8 marks)

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10 $f(x) = 4\sin x^\circ$

(a) Find $f(23)$

Give your answer correct to 3 significant figures.

$4\sin 23 = 1.562924514$

1.56
.....
(1)

$g(x) = 2x - 3$

(b) Find $fg(34)$

Give your answer correct to 3 significant figures.

$fg(34) = 4\sin(2(34)-3) = 3.625231148$

Substitute $g(x)$ for x in $f(x)$ to get $fg(x)$. $fg(x) = 4\sin(2x - 3)$. Then substitute 34 for x in $fg(x)$

3.63
.....
(2)

$h(x) = (x + 4)^2$

Ivan needs to solve the following equation $h(x) = 25$

He writes

$(x + 4)^2 = 25$
 $x + 4 = 5$
 $x = 1$

This is not fully correct.

(c) Explain why.

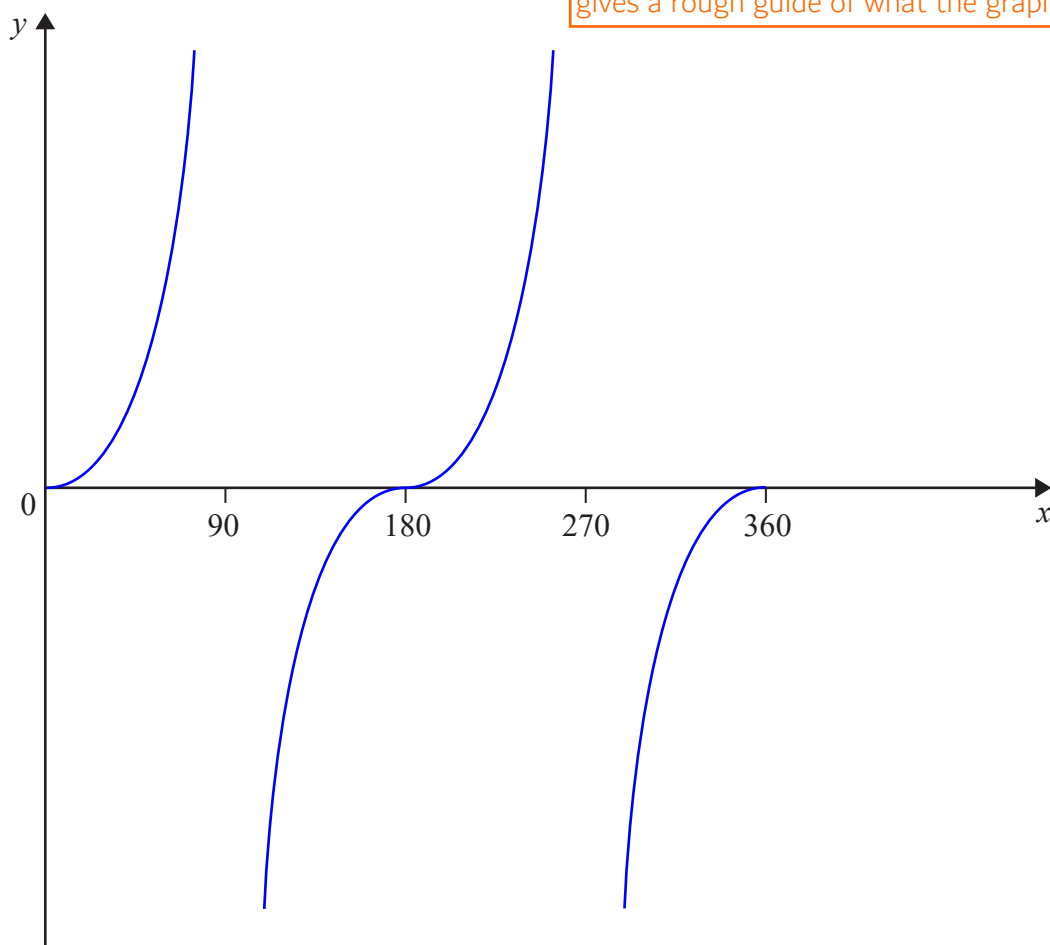
The square root of 25 is also -5

.....
.....
(1)

(Total for Question 10 is 4 marks)

11 Sketch the graph of $y = \tan x^\circ$ for $0 \leq x \leq 360$

Use table mode (press Menu then 3) with the $f(x) = \tan x$. Start: 0. End: 360. Step: 15. This gives a rough guide of what the graph looks like



(Total for Question 11 is 2 marks)

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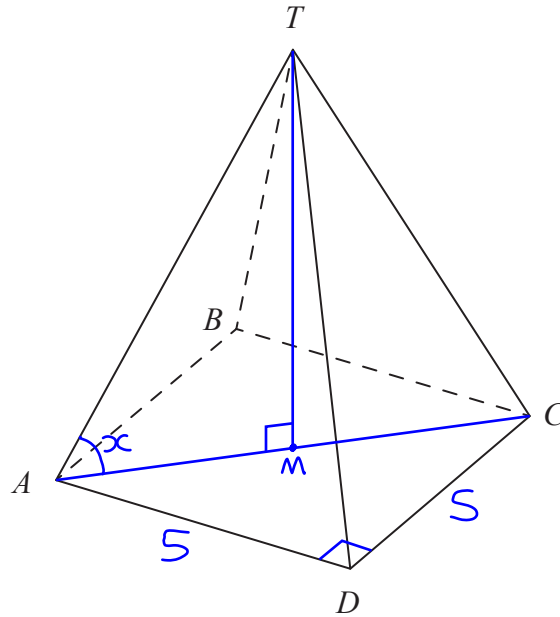
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12 Here is a pyramid with a square base $ABCD$.



$$AB = 5 \text{ m}$$

The vertex T is 12 m vertically above the midpoint of AC .

Calculate the size of angle TAC .

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

Triangle ADC has a right angle so Pythagoras' Theorem can be used to find the missing side

$$AC = \sqrt{5^2 + 5^2} = 5\sqrt{2}$$

We need to find AC, which is the longest side. Rearranging to make c the subject by square rooting both sides. c is AC

$$AM = \frac{5\sqrt{2}}{2}$$

AM is half AC as M is the midpoint of AC

SÓH CÁH TÓÁ TIA

Using SOH CAH TOA on the right angled triangle AMT to find angle TAC. We have the opposite and adjacent so we can use TOA. The formula triangle tells us that $\tan x = \text{opposite/adjacent}$. Rearranging this gives $x = \tan^{-1}(\text{opposite/adjacent})$

$$x = \tan^{-1}\left(\frac{12}{\left(\frac{5\sqrt{2}}{2}\right)}\right) = 73.58355963$$

73.6 °

(Total for Question 12 is 4 marks)

- 13 The number of animals in a population at the start of year t is P_t .
The number of animals at the start of year 1 is 400

Given that

$$P_{t+1} = 1.01P_t$$

work out the number of animals at the start of year 3

$$P_1 = 400$$

← Start of year 1

$$P_2 = 1.01 \times 400 = 404$$

← Start of year 2

$$P_3 = 1.01 \times 404 = 408.04$$

← Start of year 3

There can't be a decimal amount of animals so we round down

408

(Total for Question 13 is 2 marks)

- 14 y is inversely proportional to x^3

$$y = 44 \text{ when } x = a$$

Show that $y = 5.5$ when $x = 2a$

$$y \propto \frac{1}{x^3} \quad y = \frac{k}{x^3}$$

← Converting the proportion into an equation in terms of k

$$k = yx^3 = 44a^3$$

← Rearranging to find k and substituting in the values of x and y

$$y = \frac{44a^3}{(2a)^3} = \frac{44a^3}{8a^3} = \frac{44}{8} = 5.5$$

← Substituting the value of k back into the equation and substituting in $2a$ for x

(Total for Question 14 is 3 marks)

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15 Prove algebraically that the difference between the squares of any two consecutive odd numbers is always a multiple of 8

$$(2n+3)^2 - (2n+1)^2$$

2n is an even number. Adding 1 gives 2n + 1, which is an odd number. Adding 2 to this gives 2n + 3, the next odd number. Square 2n + 3 and 2n + 1. Difference is largest subtract smallest.

$$4n^2 + 12n + 9 - 4n^2 - 4n - 1$$

Expand out the square brackets using the rule: square the first term, double the product of the two terms and square the last term. Remember that the second bracket is negative so we need to flip the signs of each of the terms when expanding

$$8n + 8$$

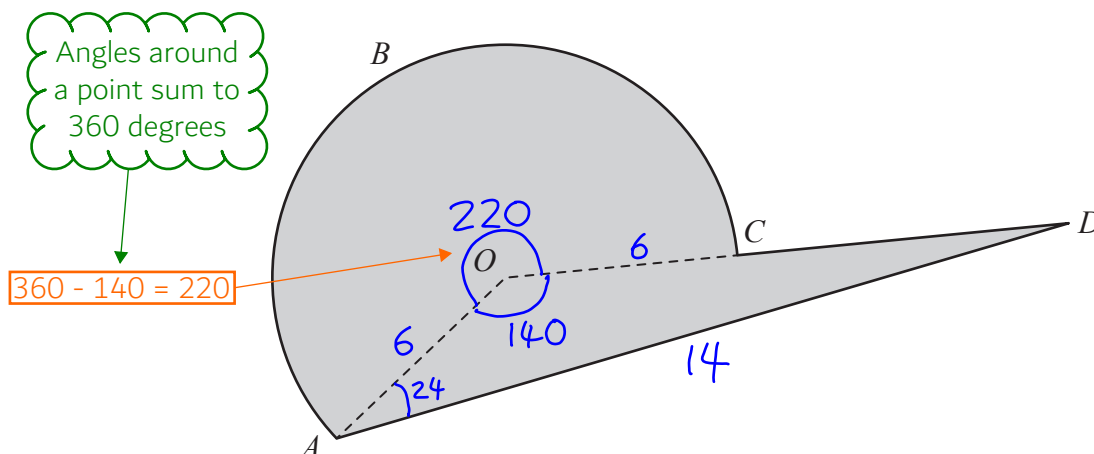
Collect the like terms and simplify

$$8(n+1)$$

Multiples of 8 are divisible by 8 so bringing out 8 as a factor shows that it is always a multiple of 8

(Total for Question 15 is 3 marks)

16 Here is a shaded shape $ABCD$.



The shape is made from a triangle and a sector of a circle, centre O and radius 6 cm.
 OCD is a straight line.

$$AD = 14 \text{ cm}$$

$$\text{Angle } AOD = 140^\circ$$

$$\text{Angle } OAD = 24^\circ$$

Calculate the perimeter of the shape.

Give your answer correct to 3 significant figures.

$$\frac{220}{360} \times \pi \times 6 \times 2 = \frac{22}{3}\pi$$

This works out the length of the arc AC .
 $\pi \times \text{diameter} = \text{circumference}$. Diameter = 2 x radius.
 We have 220 out of the 360 degrees of the circle

$$\frac{a}{\sin A} = \frac{b}{\sin B}$$

The sine rule can be used to work out side OD as we have opposite pairs: 14cm is opposite 140° and OD is opposite 24°

$$OD = \frac{14 \sin 24}{\sin 140} = 8.85\dots$$

Rearrange to make a the subject and substitute in the values from the triangle. $a = OD$, $b = 14$, $A = 24$, $B = 140$

Store the full answer on the calculator: 8.858778416

$$CD = OD - 6 = 2.85\dots$$

$$CD = OD - OC$$

Store the full answer on the calculator: 2.858778416

$$\frac{22}{3}\pi + 14 + CD$$

Perimeter is all of the sides on the outside added together

$$= 39.89712454$$

$$\dots\dots\dots 39.9 \text{ cm}$$

(Total for Question 16 is 5 marks)

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17 The table shows information about the distances 570 students travelled to a university open day.

Distance (d miles)	Frequency
$0 < d \leq 20$	120
$20 < d \leq 50$	90
$50 < d \leq 80$	120
$80 < d \leq 150$	140
$150 < d \leq 200$	100

F.d. Frequency density

6 ← $120 \div 20$

3 ← $90 \div 30$

4 ← $120 \div 30$

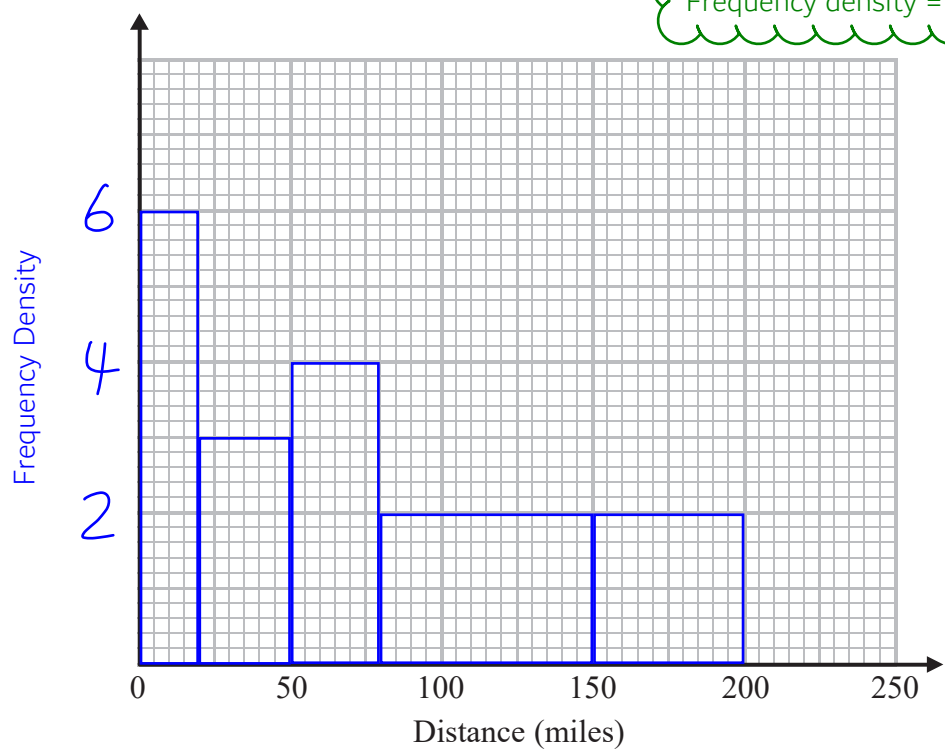
2 ← $140 \div 70$

2 ← $100 \div 50$

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(a) Draw a histogram for the information in the table.

Frequency = class width \times frequency density
 Frequency density = frequency / class width



(3)

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(b) Estimate the median distance.

$570 \div 2 = 285$

$285 - 120 - 90 = 75$

$50 + \frac{75}{120} \times 30$

The median is halfway through the data. The 285th value is roughly halfway

The 285th value is 75 into the third category

..... 68.75 miles

(2)

(Total for Question 17 is 5 marks)

Assuming that the data within the third category is evenly spaced, the 285th value would be 75 along out of the 120. The class width is 30. So it will be $75/120$ of 30 after 50

18 A high speed train travels a distance of 487km in 3 hours.

The distance is measured correct to the nearest kilometre.
The time is measured correct to the nearest minute.

Distance needs to be in km and
time needs to be in minutes

By considering bounds, work out the average speed, in **km/minute**, of the train to a suitable degree of accuracy.

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

$$\begin{array}{c} d \\ \hline s \mid t \end{array}$$

From the formula triangle, speed = distance/time

$$S_U = \frac{d_U}{t_L} = \frac{487.5}{179.5} = 2.715877437$$

U stands for upper bound and L stands for lower bound. 487km is to the nearest 1km so it could be 1/2 km more than this. 3 hours is 180 minutes and is to the nearest 1 minute so could be up to 1/2 minute less than this

$$S_L = \frac{d_L}{t_U} = \frac{486.5}{180.5} = 2.695290859$$

487km is to the nearest 1km so it could be 1/2 km lower than this. 3 hours is 180 minutes and is to the nearest 1 minute so could be up to 1/2 minute more than this

Both the upper and lower bound round to 2.7 to 1 decimal place

.....2.7..... km/minute

(Total for Question 18 is 5 marks)

19 Solve algebraically the simultaneous equations

$$\begin{aligned} 2x^2 - y^2 &= 17 \\ x + 2y &= 1 \end{aligned}$$

$$x = 1 - 2y$$

Rearrange the second equation to make x the subject

$$2(1 - 2y)^2 - y^2 = 17$$

Substitute x for 1 - 2y in the first equation to eliminate the x terms

$$2 - 8y + 8y^2 - y^2 = 17$$

Expand out the brackets using square the first term, double the product of the two terms, square the last term and multiply each of the new terms by 2

$$7y^2 - 8y - 15 = 0$$

Collect the like terms, simplify and arrange into the quadratic form $ax^2 + bx + c = 0$

$$7y^2 + 7y - 15y - 15 = 0$$

$7x - 15 = -105$. What multiplies to give -105 and add to give -8? 7 and -15 do (we can use table mode on the calculator to help find the factor pairs of 105 by using the function $f(x) = 105/x$ with start: 1, end: 30 and step: 1). Split the middle term into 7y and -15y

$$7y(y + 1) - 15(y + 1) = 0$$

Factorise the left two terms and the right two terms separately

$$(7y - 15)(y + 1) = 0$$

Bring into a fully factorised form

$$y = \frac{15}{7} \text{ or } y = -1$$

Either $7y - 15 = 0$ or $y + 1 = 0$. Rearrange both of these equations to find y

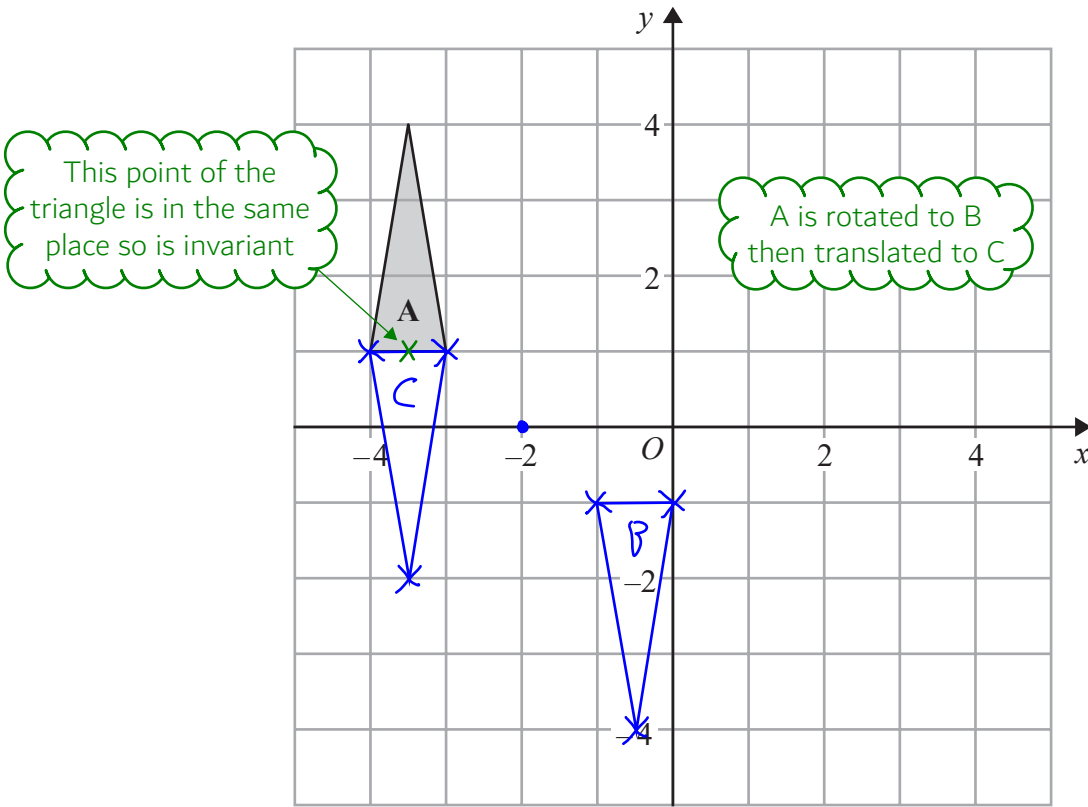
$$x = 1 - 2\left(\frac{15}{7}\right) = -\frac{23}{7}$$

Substitute the y values into $x = 1 - 2y$ to find the x values

$$x = 1 - 2(-1) = 3$$

$$x = -\frac{23}{7} \quad y = \frac{15}{7} \quad \text{or} \quad x = 3 \quad y = -1$$

(Total for Question 19 is 5 marks)



Triangle A is transformed by the combined transformation of a rotation of 180° about the point $(-2, 0)$ followed by a translation with vector $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$

One point on triangle A is invariant under the combined transformation.

Find the coordinates of this point.

(.....-3.5.....,.....1.....)

(Total for Question 20 is 2 marks)

TOTAL FOR PAPER IS 80 MARKS

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