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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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

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1   The table shows some information about the weights of 50 potatoes.

Weight (w grams)	Frequency
$10 < w \leqslant 20$	6
$20 < w \leqslant 30$	21
$30 < w \leqslant 40$	13
$40 < w \leqslant 50$	7
$50 < w \leqslant 60$	3

Iveta drew this frequency polygon for the information in the table.
The frequency polygon is **not** fully correct.

Weight (w grams)
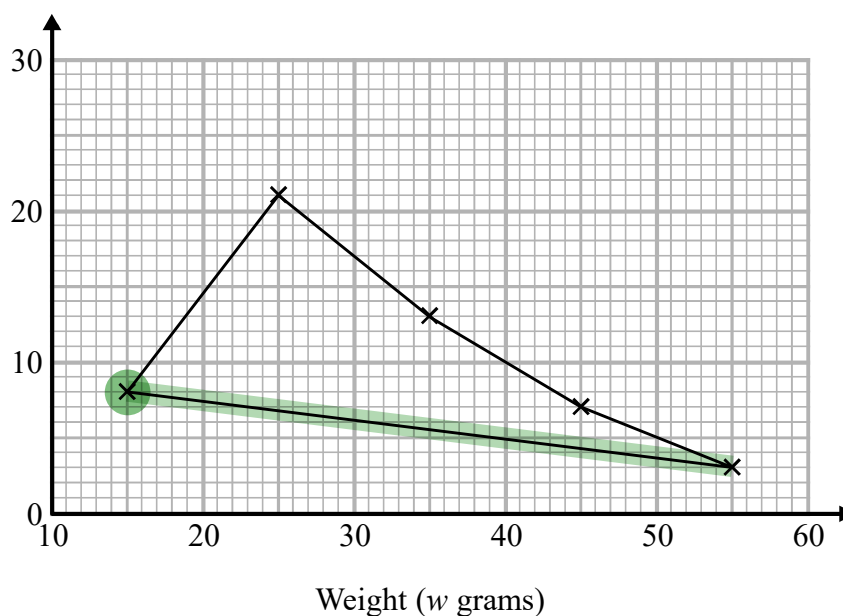
Write down **two** things that are wrong with the frequency polygon.

1 The first point isn't plotted at 6

....

2 There shouldn't be a line connecting the first and last point

....

(Total for Question 1 is 2 marks)

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2 The length of a pencil is 128 mm correct to the nearest millimetre.

Complete the error interval for the length of the pencil.

$128 \pm \frac{1}{2}$ ← *Adding and subtracting half of the resolution (what it is to the nearest) works out the upper and lower bound of the measurement*

...127.5... mm ⩽ length < ...128.5... mm

(Total for Question 2 is 2 marks)

3 Tom and Adam have a total of 240 stamps.
The ratio of the number of Tom's stamps to the number of Adam's stamps is $3:7$

Tom buys some stamps from Adam.
The ratio of the number of Tom's stamps to the number of Adam's stamps is now $3:5$

How many stamps does Tom buy from Adam?
You must show all your working.

$\frac{3}{8} \times 240 - \frac{3}{10} \times 240$

There are 10 parts in total in the first ratio as 3 + 7 = 10. Tom had 3 parts of these so had 3/10 of the stamps. 3/10 x 240 works out 3/10 of the 240 stamps and therefore works out how many stamps he had. There are 8 parts in total in the second ratio as 3 + 5 = 8. Tow has 3 parts of these so now has 3/8 of the stamps. 3/8 x 240 works out 3/8 of the 240 stamps and therefore works out how many stamps he now has. Subtracting the number of stamps he had from the number he now has works out the difference and therefore how many he must have bought from Adam

...18...

(Total for Question 3 is 4 marks)

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4 Each person in a fitness club is going to get a free gift.
Stan is going to order the gifts.

Stan takes a sample of 50 people in the fitness club.
He asks each person to tell him the gift they would like.

The table shows information about his results.

Gift	Number of people
sports bag	17
gym towel	7
headphones	11
voucher	15

There are 700 people in the fitness club.

(i) Work out how many sports bags Stan should order.

$\frac{17}{50} \times 700$ ← 17/50 is the fraction of the sample which chose sports bag so he should order this fraction of the 700 people

.......................238.......................

(2)

(ii) Write down any assumption you made **and** explain how this could affect your answer.

The sample is representative. The answer could be different

The proportion of the people wanting the sports bag out of the 700 people many not be the same as the proportion of the people wanting it out of the sample of 50 people. We assumed the proportion is the same meaning that the sample is representative
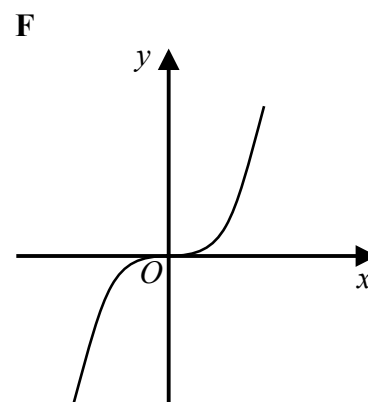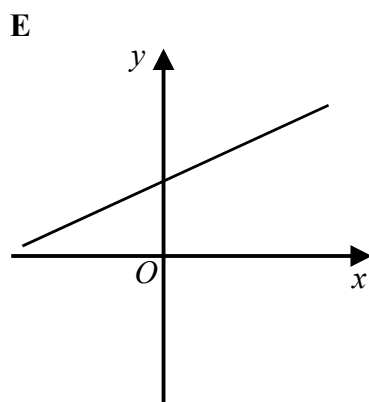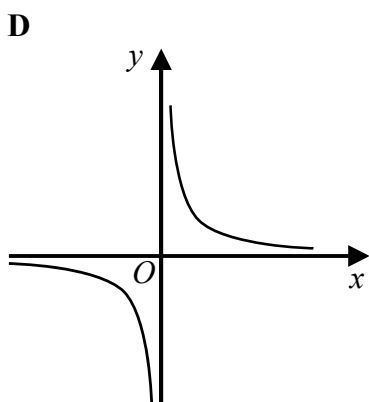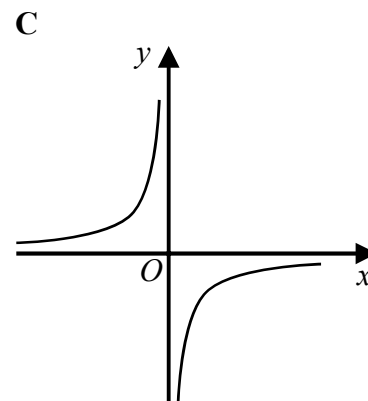
(1)

(Total for Question 4 is 3 marks)

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5 Here are six graphs.

A

B

C

D

E

F
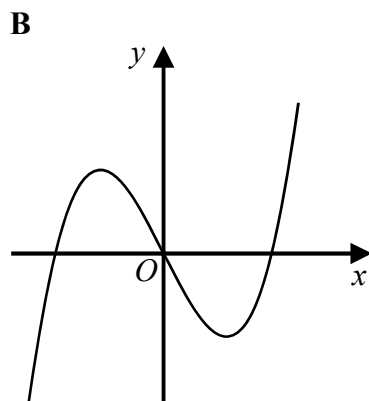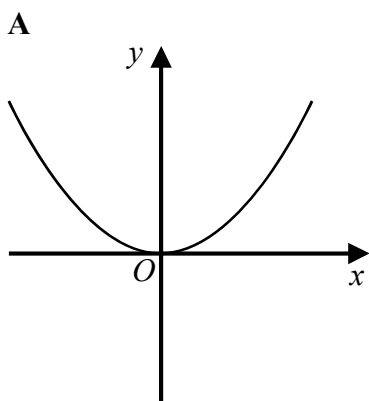
Write down the letter of the graph that could have the equation

(a) $y = x^3$

Using table mode, enter f(x) = x³. Start: -5. End: 5. Step 1

F

(1)

(b) $y = \dfrac{1}{x}$

Using table mode, enter f(x) = 1/x. Start: -5. End: 5. Step 1

D

(1)

(Total for Question 5 is 2 marks)

These give a table of values for each equation and can be compared to the six graphs

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6 The nth term of a sequence is $2n^2 - 1$

The nth term of a different sequence is $40 - n^2$

Show that there is only one number that is in both of these sequences.

1, 7, 17, 31, 49

39, 36, 31, 24, 15, 4, -9

Using table mode, enter f(x) = 2x^2 - 1 and g(x) = 40 - x^2. Start: 1. End: 30. Step: 1

This lists out both sequences. Only 31 is in both sequences and this is shown as one of the sequences increases and the other decreases. The second sequence will continue below -9 but the increasing first sequence starts at 1 so there cannot be any other numbers in both sequences

(Total for Question 6 is 3 marks)

7 Work out $(3.42 \times 10^{-7}) \div (7.5 \times 10^{-6})$
Give your answer in standard form.

0.0456 ← Typing into the calculator give this

The answer must be multiplied by 10 twice to give a number between 1 and 10 and therefore it needs to be multiplied by 10^{-2} to keep it equal

4.56×10^{-2}

(Total for Question 7 is 2 marks)

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8 The number of days, *d*, that it will take to build a house is given by

$$d = \frac{720}{n}$$

where *n* is the number of workers used each day.

Ali's company will take 40 days to build the house.
Hayley's company will take 30 days to build the house.

Hayley's company will have to use more workers each day than Ali's company.

How many more?

$dn = 720$

$n = \frac{720}{d}$

Rearranging the equation to make n the subject so that the number of workers can be worked out. First multiplying both sides by n to eliminate it as the denominator. Then dividing both sides by d
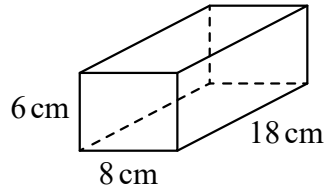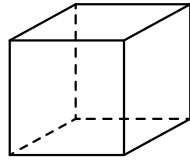
$\frac{720}{30} - \frac{720}{40}$

720/30 works out how many workers Hayley's company will have to use and 720/40 works out how many workers Ali's company will have to use. Subtracting these works out the difference and therefore how many more Hayley's company will have to use

6

(Total for Question 8 is 3 marks)

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9 The diagram shows a cube and a cuboid.

6 cm   8 cm   18 cm

The total surface area of the cube is equal to the total surface area of the cuboid.

Janet says,

"The volume of the cube is equal to the volume of the cuboid."

Is Janet correct?
You must show how you get your answer.

$18 \times 8 \times 6 = 864$ ← This is the volume of the cuboid. Volume of cuboid = length x width x height

$$\left(\sqrt{\frac{6 \times 8 \times 2 + 18 \times 6 \times 2 + 18 \times 8 \times 2}{6}}\right)^3 = 1000$$

This is the volume of the cube. Volume of cube = length^3. The length of the sides on the cube is found by square rooting the area of one of the square faces. The area of one of the square faces is found by dividing the total surface area of the cube by 6 as there are 6 identical square faces. The surface area of the cube is the same as the surface are of the cuboid and this is found by adding together the areas of all the faces on the cuboid. Area of rectangle = length x width. 6 x 8 works out the area of the front face. Opposite faces on a cuboid are the same so this is multiplied by 2 to also account for the back face. 18 x 6 works out the area of the right face. This is multiplied by 2 to also account for the left face. 18 x 8 works out the area of the bottom face. This is multiplied by 2 to also account for the top face

No ← The volume of the cube is not equal to the volume of the cuboid

(Total for Question 9 is 5 marks)

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10 Make k the subject of the formula $y = \sqrt{2m - k}$

$y^2 = 2m - k$ ← Squaring both sides of the equation eliminates the square root on the right

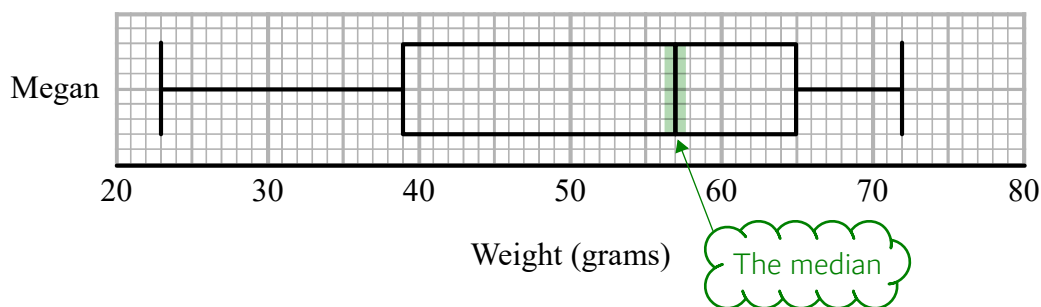$y^2 - 2m = -k$ ← Subtracting 2m from both sides to get the k term on its own

Dividing both sides by -1 flips the signs and gets rid of the negative in front of k

$-y^2 + 2m = K$

(Total for Question 10 is 2 marks)

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11 Megan grows potatoes.

The box plot below shows information about the weights of Megan's potatoes.

Megan says that half of her potatoes weigh less than 50 grams each.

(a) Is Megan correct?
Give a reason for your answer.

No, the median is more than 50

The median is 57 so half of the potatoes weigh less than 57 grams

(1)

Amy also grows potatoes.

The box plot below shows information about the weights of Amy's potatoes.
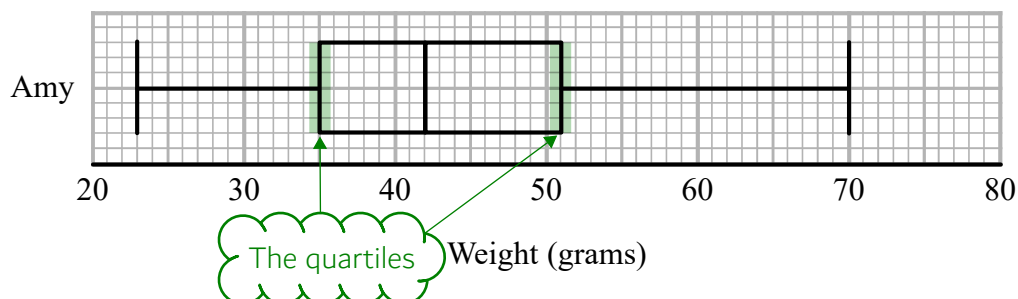
(b) Compare the distribution of the weights of Megan's potatoes with the distribution of the weights of Amy's potatoes.

The median weight of Megan's potatoes is greater

The median of Megan's is 57 and the median of Amy's is 42

The interquartile range of the weights of Megan's potatoes is greater

The box is wider for Megan's than it is for Amy's

(2)

(Total for Question 11 is 3 marks)

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12 The diagram shows triangle *ABC*.

ADC and *DEB* are straight lines.

AD = 4.4 cm
BC = 8.6 cm
E is the midpoint of *DB*.

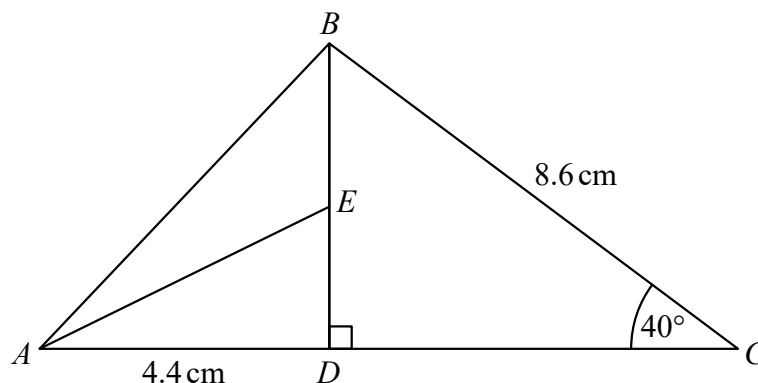Angle *CDB* = 90°
Angle *DCB* = 40°

Work out the size of angle *EAD*.
Give your answer correct to 1 decimal place.
You must show all your working.

$S^{\stackrel{O}{\frown}}H$ $C^{\stackrel{A}{\frown}}H$ $T^{\stackrel{O}{\frown}}A$

Writing SOH CAH TOA as formula triangles. First working with right angled triangle DBC and ticking H as we have the hypotenuse and O as need to find the opposite. There are two ticks on the SOH formula triangle so this one can be used to work out the opposite DB. Then working with the right angled triangle AED and underlining A as we have the adjacent and O as we can work out the opposite ED. The TOA formula triangle can be used to work out the angle EAD

$\tan^{-1}\left(\dfrac{\left(\dfrac{\sin40\times8.6}{2}\right)}{4.4}\right)$

Working with the right angled triangle AED, (tan of the angle) = opposite/adjacent, so (the angle) = tan⁻¹(opposite/adjacent). The adjacent is 4.4 and the opposite is side ED, which can be found by dividing side DB by 2 as E is the midpoint of DB. Side DB is the opposite in right angled triangle DBC and opposite = (sin of the angle) x hypotenuse. The hypotenuse of this triangle is 8.6 and the angle is 40°

........................32.1........................ °

(Total for Question 12 is 4 marks)

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13 Sakira invested £3550 in a savings account for 3 years.

She was paid 2.6% per annum compound interest for each of the first 2 years.
She was paid *R*% interest for the third year.

Sakira had £3819.21 in her savings account at the end of the 3 years.

Work out the value of *R*.
Give your answer correct to 1 decimal place.

$$3550 \times \left(\frac{100+2.6}{100}\right)^2 \times \frac{100+R}{100} = 3819.21$$

100 + 2.6 expresses the percentage the amount of money in the savings account rises to each year for the first 2 years. Putting this over 100 converts the percentage into a fraction. Multiplying the £3550 by this fraction twice (so raising it to the power of 2) increases it by 2.6% twice. Then expressing this amount increased by R% must equal to the £3819.21. 100 + R expresses the percentage of the amount of money in the savings account rises to in the third year. Putting this over 100 converts the percentage into a fraction, which when multiplied by increases by R%

$$R = \frac{3819.21}{3550 \times \left(\frac{100+2.6}{100}\right)^2} \times 100 - 100$$

Rearranging the equation to find R

.... 2.2 ....

(Total for Question 13 is 3 marks)

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14 Sadia is going to buy a new car.
For the car, she can choose one body colour, one roof colour and one wheel type.

She can choose from
19 different body colours
25 different wheel types

The total number of ways Sadia can choose the body colour and the roof colour and the wheel type is 3325

Work out the number of different roof colours that Sadia can choose from.

$19 \times R \times 25 = 3325$ ← Let R be the number of different roof colours. Using the product rule for counting expresses the total number of ways Sadia can choose the body colour and the roof colour and the wheel type. This must be equal to 3325

$R = \dfrac{3325}{19 \times 25}$ ← Rearranged to find R

.... 7 ....

(Total for Question 14 is 2 marks)

15 Expand and simplify $(3x + 2)(2x + 1)(x - 5)$

$6x^2 + 3x + 4x + 2$ ← Expanded out the first two brackets

$(6x^2 + 7x + 2)(x - 5)$ ← Simplified the expansion by collecting like terms and writing multiplied by the third bracket

$6x^3 - 30x^2 + 7x^2 - 35x + 2x - 10$ ← Expanded out these two brackets

Simplified the expansion by collecting like terms

.... $6x^3 - 23x^2 - 33x - 10$ ....

(Total for Question 15 is 3 marks)

.CG Maths.

16 Marek has 9 cards.
There is a number on each card.

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**

Marek takes at random two of the cards.
He works out the product of the numbers on the two cards.

Work out the probability that the product is an even number.

EE,EO,OE,OO

Systematically listing out the possible outcomes. E stands for even and O stands for odd. Underlining the outcomes which will result in an even product (which means multiplied together)

$\frac{4}{9} \times \frac{3}{8} + \frac{4}{9} \times \frac{5}{8} + \frac{5}{9} \times \frac{4}{8}$

Even AND even OR even AND odd OR odd AND even. AND means to multiply and OR means to add the probabilities. 4 out of the 9 cards are even so the probability of getting the first even is 4/9. Given that one even card is chosen there is now one fewer card in total so there are only 8 in total and also one fewer even card so there are only 3 even cards for the second pick so the probability of getting even for the second card is 3/8. Similar logic is used for the other outcomes

$\frac{13}{18}$

(Total for Question 16 is 3 marks)

.CG Maths.

17
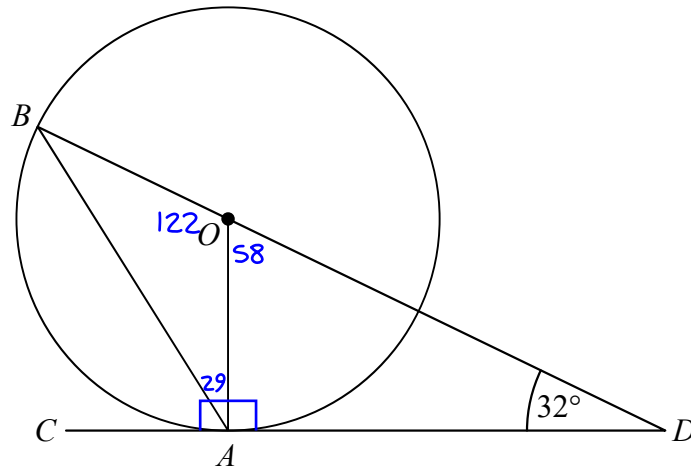
A and *B* are points on a circle with centre *O*.
CAD is the tangent to the circle at *A*.
BOD is a straight line.

Angle *ODA* = 32°

Work out the size of angle *CAB*.
You must show all your working.

1) Angle OAD is 90° as a tangent and radius are perpendicular. OA is a radius.

2) Angle AOD is 58° as there are 180 degrees in total in a triangle and 180 - 90 - 32 = 58.

3) Angle BOA is 122° as angles around a point on a straight line add up to 180 and 180 - 58 = 122.

4) Angle BAO is 29° as triangle BOA is isosceles as BO and AO are both radii so are equal in length, the base angles of an isosceles triangle are equal and there are 180 degrees in total in a triangle. (180 - 122)/2 = 29.

5) Angle OAC is 90° as a tangent and radius are perpendicular. OA is a radius.

6) Angle CAB Is 61° as 90 - 29 = 61

.... 61 .... °

(Total for Question 17 is 3 marks)

.CG Maths.

18 The histogram gives information about the heights, in metres, of the trees in a park.
The histogram is incomplete.

Frequency density
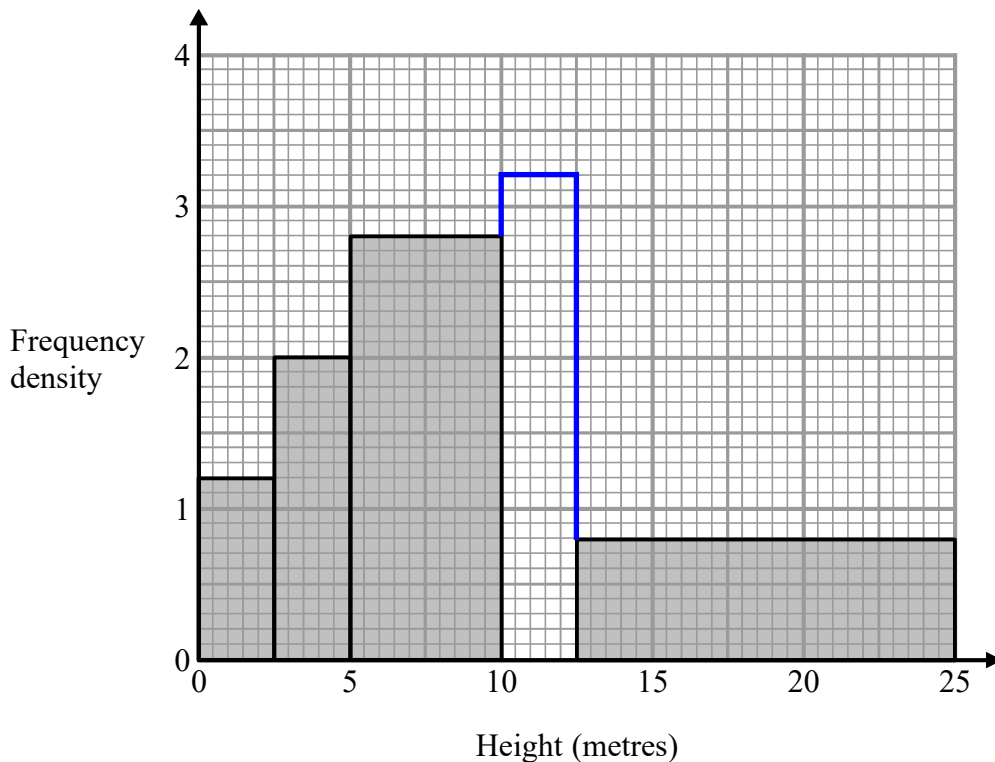
Height (metres)

20% of the trees in the park have a height between 10 metres and 12.5 metres.
None of the trees in the park have a height greater than 25 metres.

Complete the histogram.

$c \,^F\, d$

The area of each box gives the frequency on a histogram. Frequency = class width x frequency density. Writing this as a formula triangle where F stands for frequency, C stands for class width and d stands for frequency density

$$\left(\frac{(2.5-0)\times1.2+(5-2.5)\times2+(10-5)\times2.8+(25-12.5)\times0.8}{4}\right) = 3.2$$
$$\frac{}{12.5-10}$$

The bar for 10 to 12.5 metres needs to be completed. Its frequency density needs to be worked out. From the formula triangle, frequency density = frequency/(class width). The class width is 12.5 - 10. The frequency of the trees between 10 and 12.5 metres is 20% of the total meaning that the rest of the trees are 80% of the total so dividing the frequency of the rest of the trees by 4 will give the frequency of the trees between 10 and 12.5 metres as 80/4 = 20. The frequency of the rest of the trees is worked out by adding together all of the frequencies of the individual bars. Frequency = class width x frequency density. The class widths are worked out by subtracting the lower bound of each bar from the upper bound of each bar

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19 The diagram shows a hemisphere with diameter 8.4 cm.

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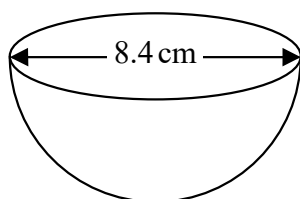
Volume of sphere = $\frac{4}{3}\pi r^3$

Work out the volume of the hemisphere.
Give your answer correct to 3 significant figures.

$$\frac{\frac{4}{3}\pi \times \left(\frac{8.4}{2}\right)^3}{2}$$

The radius is half of the diameter so the diameter is divided by 2 to express the radius. The radius is substituted into the formula for the volume of a sphere to find the volume of the whole sphere. The volume of the whole sphere is divided by 2 as a hemisphere is half of the whole sphere

The answer of 155.1695443 is rounded to 3 significant figures

.... 155 .... cm³

(Total for Question 19 is 2 marks)

---

20 $d = \frac{1}{8}c^3$

$c = 10.9$ correct to 3 significant figures.

By considering bounds, work out the value of d to a suitable degree of accuracy.
Give a reason for your answer.

$$\frac{1}{8}\left(10.9 - \frac{0.1}{2}\right)^3 = 159.6611406$$

$$\frac{1}{8}\left(10.9 + \frac{0.1}{2}\right)^3 = 164.1165469$$

Working out the upper and lower bound of d by substituting in the upper and lower bound of c into the formula. The lower bound of c is found by subtracting half of the resolution of the measurement and the upper bound of c is found by adding half of the resolution of the measurement. The resolution of the measurement is 0.1 as this is the value of the place the third significant figure is in

160 as both round to this to 2 significant figures

We cannot be more precise (using more significant figures) without both the upper bound and lower bound rounding to different values

(Total for Question 20 is 4 marks)

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21 Here is a speed-time graph for a train journey between two stations.
The journey took 100 seconds.
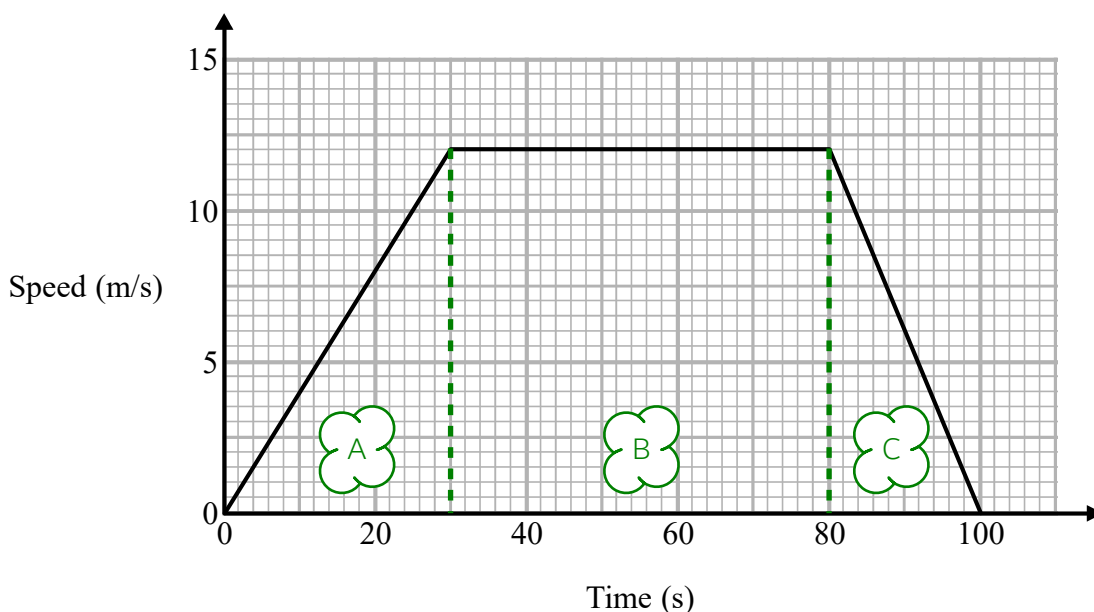
(a) Calculate the time taken by the train to travel half the distance between the two stations.
You must show all your working.

$\frac{1}{2} \times 30 \times 12 = 180$ ← The area under the line is the distance travelled. Area of triangle A = 1/2 x base x height. The base is 30 and the height is 12. Area of rectangle B = length x width. The length is 50 and the width is 12. Area of triangle C = 1/2 x base x height. The base is 20 and the height is 12

$50 \times 12 = 600$

$\frac{1}{2} \times 20 \times 12 = 120$

$\frac{180 + 600 + 120}{2}$ ← Adding all of the areas together then dividing by 2 works out that half the distance between the two stations is 450m

$450 - 180$ ← Subtracting the area of triangle A leaves the remaining distance, which must end somewhere in the rectangle

$s \frac{d}{t}$

$30 + \frac{270}{12}$ ← Time = distance/speed. The distance into the rectangle is 270m and the speed is 12m/s. Adding this time to the 30 seconds already accounted for works out the total time to do half the distance

....................52.5.................... seconds

(4)

(b) Compare the acceleration of the train during the first part of its journey with the
acceleration of the train during the last part of its journey.

It is greater during the last part

As the gradient is steeper. The gradient is the acceleration, the rate in which the speed changes

(1)

(Total for Question 21 is 5 marks)

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22 The number of rabbits on a farm at the end of month n is P_n
The number of rabbits at the end of the next month is given by $P_{n+1} = 1.2P_n - 50$

At the end of March there are 200 rabbits on the farm.

(a) Work out how many rabbits there will be on the farm at the end of June.

Enter 200 then press =. Enter 1.2ANS − 50 and press = three times

ANS takes the previous value and substitutes it into the formula. Each time pressing equals works out the number of rabbits in the next month. As June is three months after March, the iteration formula is used three times

The answer of 163.6 is rounded to the nearest whole number

164

(3)

(b) Considering your results in part (a), suggest what will happen to the number of rabbits on the farm after a long time.
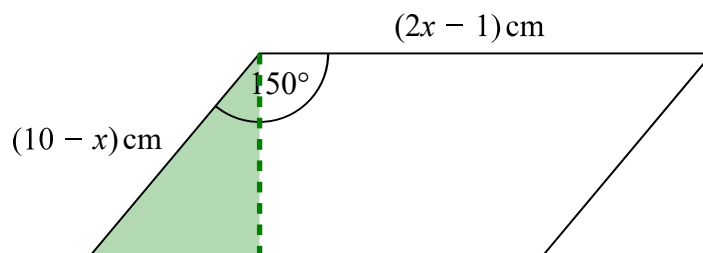
It will decrease

In April there were 190. In May there were 178. In June there were 164. This is a decreasing pattern

(1)

(Total for Question 22 is 4 marks)

.CG Maths.

23 The diagram shows a parallelogram.

$(2x - 1)\,\text{cm}$

$150°$

$(10 - x)\,\text{cm}$

The area of the parallelogram is greater than $15\,\text{cm}^2$

(a) Show that $2x^2 - 21x + 40 < 0$

$S^O_H \ C^A_H \ T^O_A$

Using right angled trigonometry to work out the height of the parallelogram, which is the dashed line in the green triangle. Ticking H as we have the hypotenuse and A as we are looking for the adjacent

$(2x-1) \times \cos 60 \times (10-x) > 15$

Area of parallelogram = base x height. The base is (2x - 1) and the height is the adjacent in the green triangle. Adjacent = (cos of the angle) x hypotenuse. The angle is 60° as the height is perpendicular to the base and 150 - 90 = 60. The hypotenuse is (10 - x). The expression of the area must be greater than 15

$(20x - 2x^2 - 10 + x) \times \frac{1}{2} - 15 > 0$

Expanding the brackets, evaluating cos60 and subtracting 15 from both sides

$-2x^2 + 21x - 40 > 0$

$2x^2 - 21x + 40 < 0$

Multiplying both sides by 2 to eliminate the fraction then collecting like terms. Then dividing both sides by -1 to show the desired inequality. When dividing by a negative the inequality symbol needs to flip
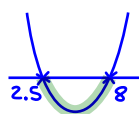
(3)

(b) Find the range of possible values of x.

$x = \dfrac{--21 \pm \sqrt{(-21)^2 - 4 \times 2 \times 40}}{2 \times 2}$

Using the quadratic formula to work out what x is when the function of x is equal to 0
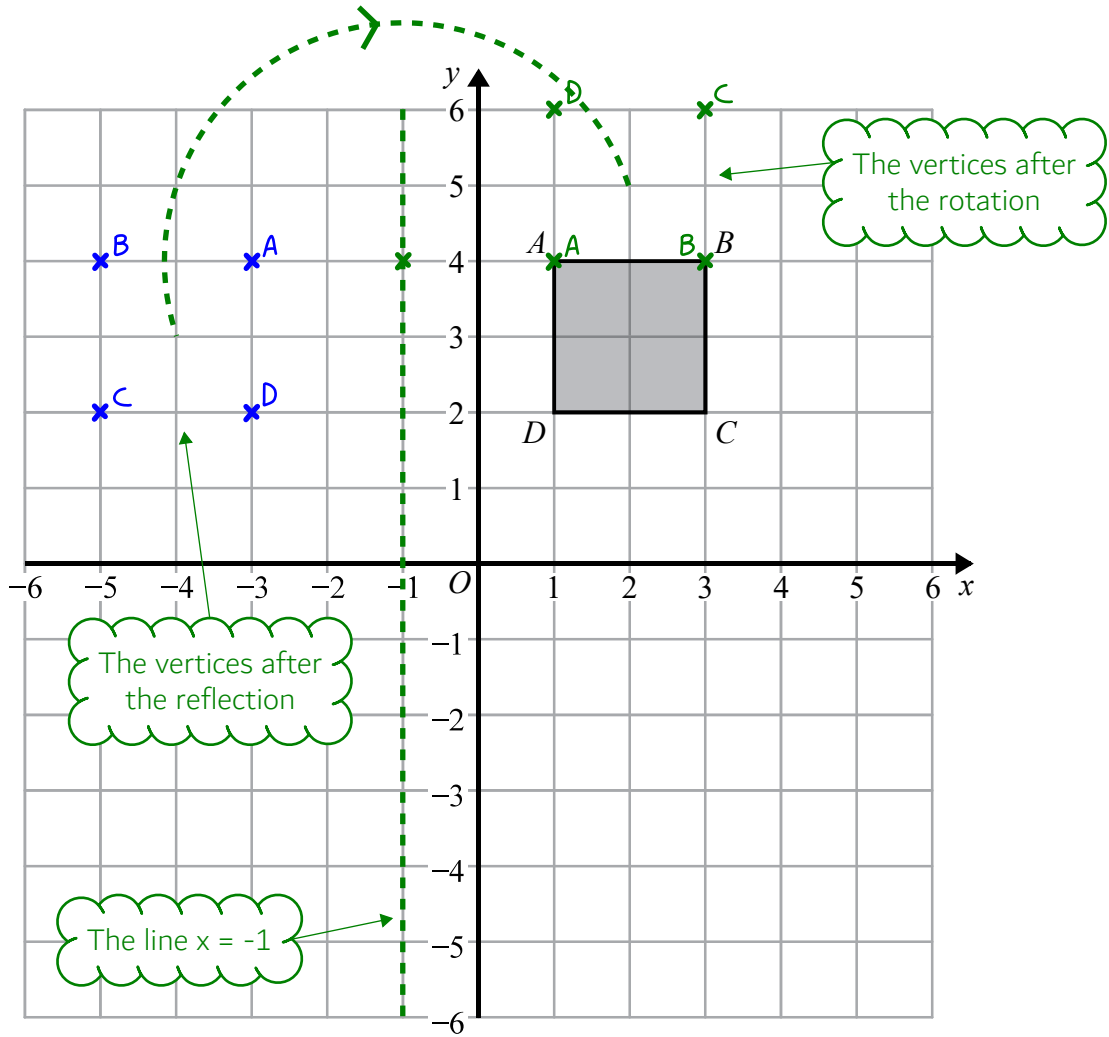
$x = 8, \ x = 2.5$

Sketching the quadratic to visualise where the solutions to the inequality are. x must be between 2.5 and 8 for the function to be less than 0

2.5   8

$2.5 < x < 8$

(3)

(Total for Question 23 is 6 marks)

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24

Square *ABCD* is transformed by a combined transformation of a reflection in the line $x = -1$ followed by a rotation.

Under the combined transformation, two vertices of the square *ABCD* are invariant.

Describe fully one possible rotation.

Rotation 180° about (-1 , 4)

A and B are invariant as they are in the same place

(Total for Question 24 is 2 marks)

25 The straight line **L** has equation $3x + 2y = 17$

The point A has coordinates $(0, 2)$
The straight line **M** is perpendicular to **L** and passes through A.

Line **L** crosses the y-axis at the point B.
Lines **L** and **M** intersect at the point C.

Work out the area of triangle ABC.
You must show all your working.

$y = -\frac{3}{2}x + \frac{17}{2}$ ← Rearranging the equation of line L into the form y = mx + c to work out its gradient and where it crosses the y-axis by subtracting 3x from both sides then dividing all terms on both sides by 2

$y = \frac{2}{3}x + 2$ ← Writing the equation of line M in the form y = mx + c. The gradient of M is 2/3 as it is the negative reciprocal of -3/2 as the lines are perpendicular. The line M goes through (0 , 2), which means that c is 2 as this is the y-intercept

$0 = \frac{13}{6}x - \frac{13}{2}$ ← Solving the two equations simultaneously to work out the coordinates of point C. Subtracting the equation for line L from the equation for line M cancels out the y terms and leaves an equation just in terms of x which can be solved

$\frac{13}{2} \div \frac{13}{6} = x = 3$ ← Adding 13/2 to both sides then dividing by 13/6 finds x, which is 3

$y = \frac{2}{3}(3) + 2 = 4$ ← Substituting 3 for x in the equation of line M to work out that the y coordinate of C is 4

$\times B(0, \frac{17}{2})$

$\times C(3,4)$

$\times A(0,2)$
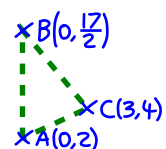
← Doing a sketch of points A, B and C to visualise the triangle. Point B has coordinates (0 , 17/2) as 17/2 is the y-intercept in the equation of line L

$\frac{1}{2}(\frac{17}{2} - 2) \times 3$ ← Area of triangle = 1/2 x base x height. AB is the base

9.75

(Total for Question 25 is 5 marks)

TOTAL FOR PAPER IS 80 MARKS

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