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

Time 1 hour 30 minutes

| Paper reference | **1MA1/2H** |

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Mathematics
PAPER 2 (Calculator)
Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator, Formulae Sheet (enclosed). 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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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.
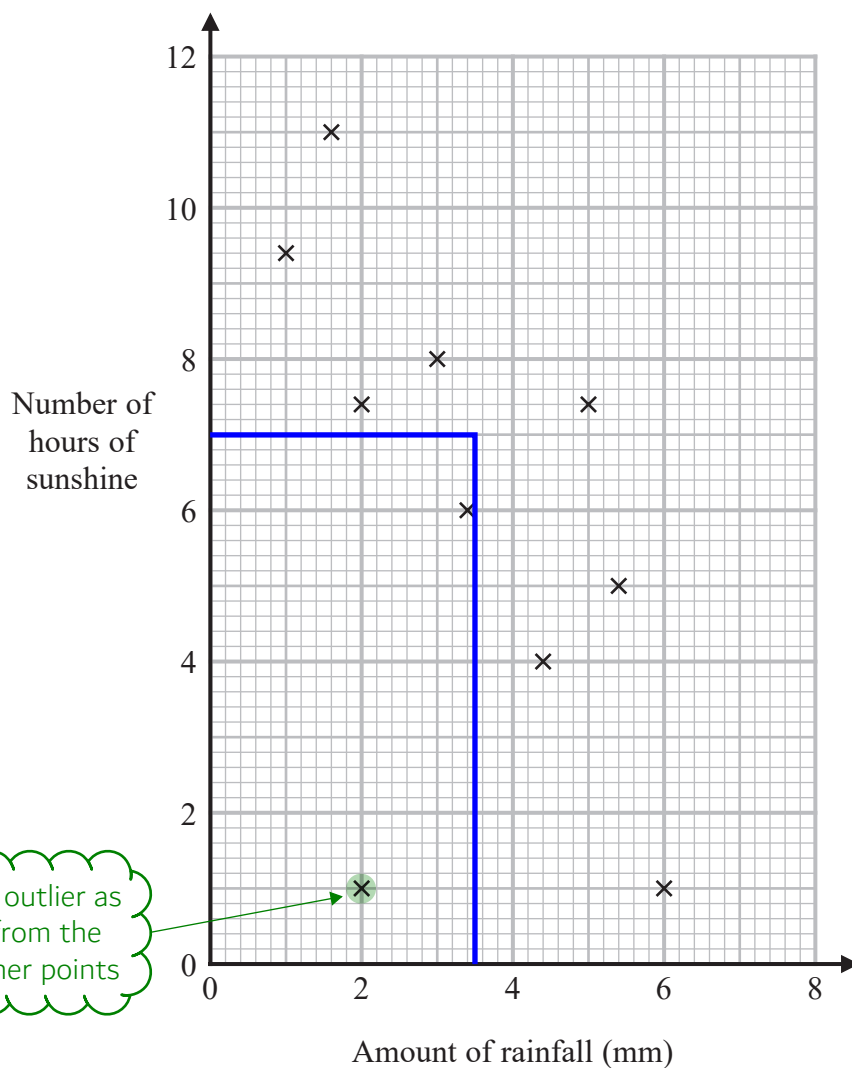
If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

.CG Maths.

1 The scatter graph shows information about the amount of rainfall, in mm, and the number of hours of sunshine for each of ten English towns on the same day.

This point is an outlier as it is far away from the trend of the other points

One of the points is an outlier.

(a) Write down the coordinates of this point.

(............2............ , ...1............)

(1)

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(b) Ignoring the outlier, describe the relationship between the amount of rainfall and the number of hours of sunshine.

Negative correlation

As the rainfall increases, the sunshine generally decreases. This is negative correlation

(1)

On the same day in another English town there were 7 hours of sunshine.

(c) Using the scatter graph, estimate the amount of rainfall in this town on this day.

Drawing across from 7 hours of sunshine to a point which is roughly in the middle of the surrounding data points then down to the number of hours of rainfall. It is halfway between 3 and 4 so is 3.5
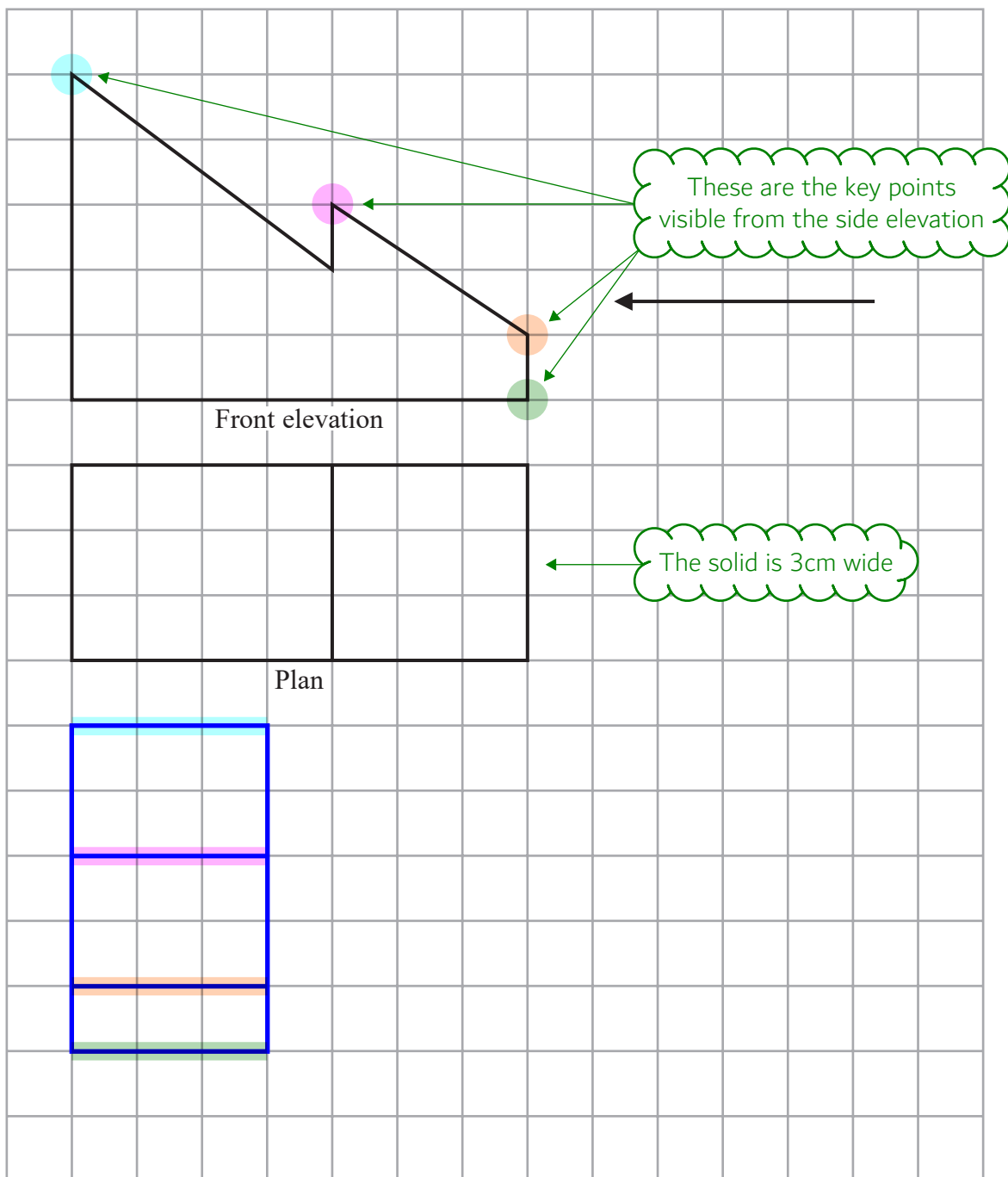
3.5 .... mm

(2)

(Total for Question 1 is 4 marks)

2 The front elevation and the plan of a solid are shown on the grid.

On the grid, draw the side elevation of the solid from the direction of the arrow.

Front elevation

These are the key points visible from the side elevation

Plan

The solid is 3cm wide

(Total for Question 2 is 2 marks)

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3 Here are the first five terms of an arithmetic sequence.

$$7 \qquad 13 \qquad 19 \qquad 25 \qquad 31$$

(a) Find an expression, in terms of n, for the nth term of this sequence.

> The sequence increases by 6 between each term so must involve 6n.
> Going backward in the sequence finds that the 0th term (the one before the first term) would be 1 so the nth term must be 6n + 1

$6n+1$

(2)

The nth term of a different sequence is $8 - 6n$

(b) Is -58 a term of this sequence?
   You must show how you get your answer.

$8 - 6n = -58$

> Setting the expression of the nth term equal to the -58 then rearranging to find n to find out what term it would be

$-6n = -66$

> Subtracting 8 from both sides gets the n term on its own

$n = 11$

> Dividing both sides by -6 gets n on its own

Yes

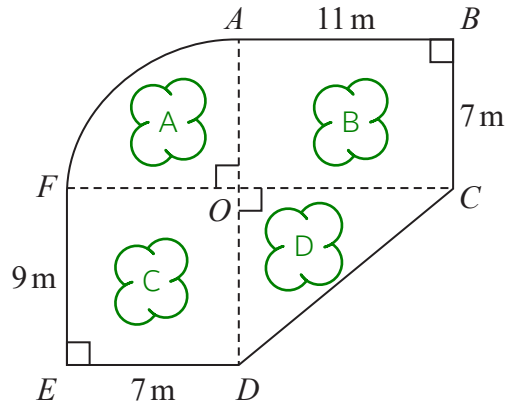> n is a whole number so -58 must be in the sequence. -58 is the 11th term

(Total for Question 3 is 4 marks)

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4 The diagram shows a plan of Jason's garden.

ABCO and *DEFO* are rectangles.
CDO is a right-angled triangle.
AFO is a sector of a circle with centre *O* and angle *AOF* = 90°

Jason is going to cover his garden with grass seed.
Each bag of grass seed covers 14 m² of garden.
Each bag of grass seed costs £10.95

Work out how much it will cost Jason to buy all the bags of grass seed he needs.

$11 \times 7 = 77$ ← Area of rectangle B. Area of rectangle = length x width

$9 \times 7 = 63$ ← Area of rectangle C. Area of rectangle = length x width

$\frac{1}{2} \times 11 \times 9 = 49.5$ ← Area of triangle D. Area of triangle = 1/2 x base x height

$\frac{1}{4} \times \pi \times 7^2 = \frac{49}{4}\pi$ ← Area of the sector of a circle A. Area of circle = π x radius². The radius is 7m. The sector is 1/4 of a circle

$77 + 63 + 49.5 + \frac{49}{4}\pi$ ← Adding all the areas of the shapes works out that the area of the garden is 227.98451m²

$227.9... \div 14$ ← Dividing the area of the garden by the 14m² covered by each bag of grass seed works out that 16.2... bags of grass seed are needed
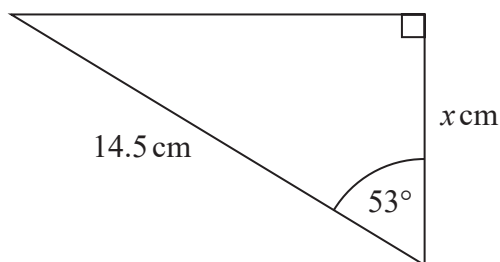
17×10.95 ← Rounding the number of bags of grass seed up to the next whole number as there needs to be a whole number of bags and 16 would not be enough. Multiplying 17 bags by the cost of each bag works out the cost of all the bags

£............186.15............

(Total for Question 4 is 5 marks)

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5

Work out the value of *x*.
Give your answer correct to 3 significant figures.

$S^O_H \ C^{\acute{A}}_H \ T^O_{\acute{A}}$ ← Writing out SOH CAH TOA as formula triangles. 14.5cm is the hypotenuse so ticking H and we are looking for the adjacent so ticking A

$COS(53) \times 14.5$ ← There are two ticks on the CAH formula triangle so this one can be used. Covering over A tells us that adjacent = cos of the angle x hypotenuse

The answer of 8.726... is rounded to 3 significant figures → *x* = ... 8.73 ....

(Total for Question 5 is 2 marks)

6 Ella invests £7000 for 2 years in an account paying compound interest.

In the first year, the rate of interest is 3%
In the second year, the rate of interest is 1.5%

Work out the value of Ella's investment at the end of 2 years.

$7000 \times \dfrac{100+3}{100} \times \dfrac{100+1.5}{100}$
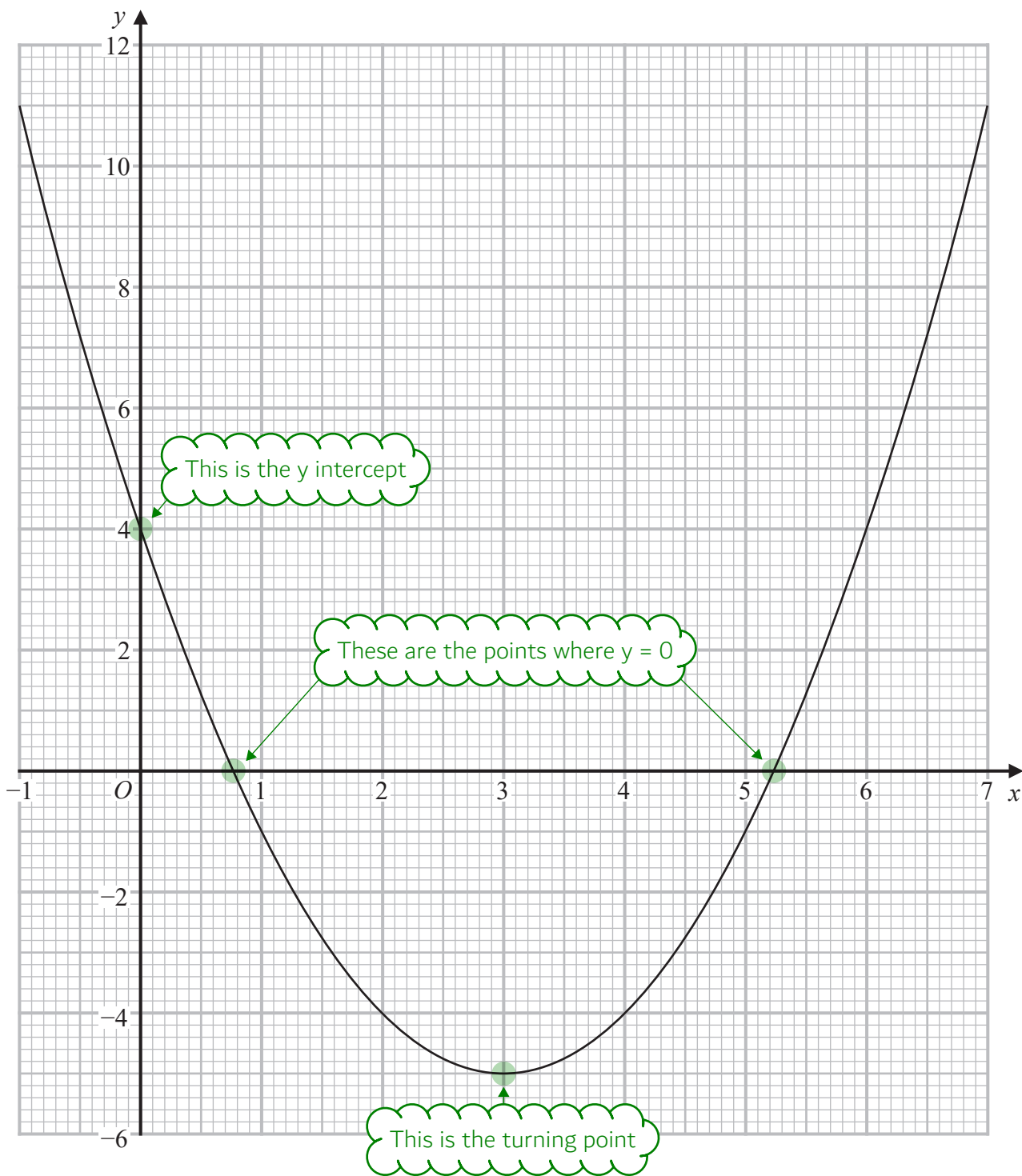
Adding the 3% to 100% expresses the percentage it rises to when increased by 3%. Putting this over 100 converts it into a fraction. When multiplying by this fraction, it increases the amount by 3%. Doing the same for the 1.5%

£.................... 7318 15 ....

(Total for Question 6 is 3 marks)

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7 Here is the graph of $y = x^2 - 6x + 4$

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(a) Write down the *y* intercept of the graph of $y = x^2 - 6x + 4$

4

(1)

(b) Write down the coordinates of the turning point of the graph of $y = x^2 - 6x + 4$

(3 , -5)

(1)

(c) Use the graph to find estimates for the roots of $x^2 - 6x + 4 = 0$

It is basically asking what x is when y = 0

0.75 , 5.25

(2)

(Total for Question 7 is 4 marks)

.CG Maths.

8 Chanda buys a necklace for £120
She sells the necklace for £135

Work out her percentage profit.

$\dfrac{135-120}{120} \times 100$

> Subtracting the £120 from the £135 expresses the profit. Putting this over the original £120 expresses the profit as a fraction. Multiplying this by 100 converts it into a percentage

12.5 ....%

(Total for Question 8 is 3 marks)

9 Here are the equations of two straight lines.

$$y = \frac{1}{2}x - 6 \qquad\qquad 6y = 3x + 7$$

Oscar says that these lines are parallel.

Is Oscar correct?
You must give a reason for your answer.

$y = \frac{1}{2}x + \frac{7}{6}$

> The general equation of a straight line is y = mx + c, where m is the gradient and c is the y intercept. Rearranging the second equation into this form by dividing all terms on both sides by 6. 3/6 simplifies to 1/2

Yes, as both have a gradient of 1/2

> Parallel lines have the same gradient. The value of m in both equations is 1/2 and this is the gradient when in the form y = mx + c

(Total for Question 9 is 2 marks)

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10 Aaliyah bought a car.

In the first year after she bought the car, its value depreciated at a rate of 23% per annum.
In the second year after she bought the car, its value depreciated at a rate of 19% per annum.

At the end of the second year the car was worth £10 914.75

What was the value of the car when Aaliyah bought it?

$$x \times \frac{100-23}{100} \times \frac{100-19}{100} = 10914.75$$

Let x be the value of the car when Aaliyah bought it. Subtracting the 23% from 100% expresses the percentage it decreases to after it had depreciated by 23%. Putting this over 100 converts it into a fraction. Multiplying by this fraction decreases by 23%. Doing the same for the 19%. x decreased by 23% then decreased by 19% must be equal to the value at the end of the second year

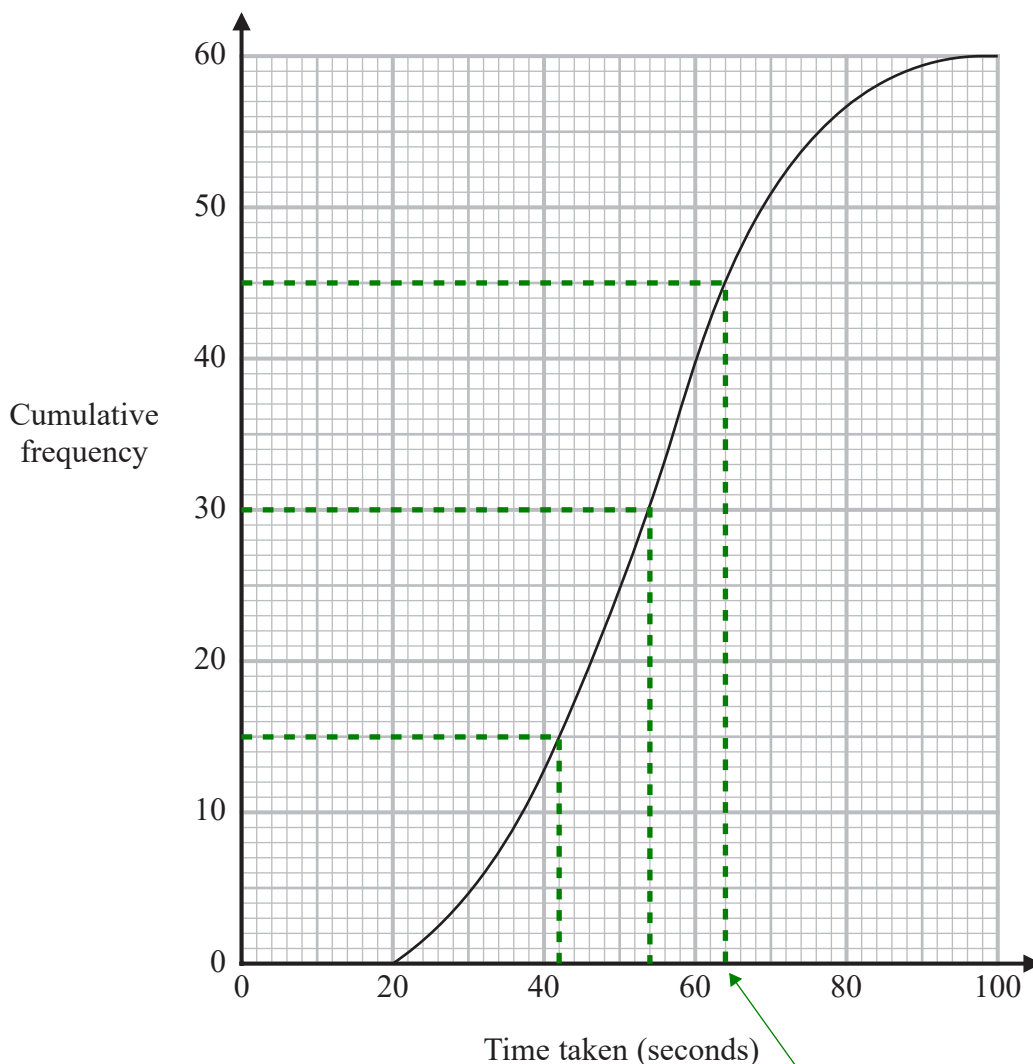$$x = \frac{10914.75}{\frac{100-23}{100} \times \frac{100-19}{100}}$$

Rearranged to make x the subject by dividing both sides by the fractions

£............... 17500 ....

(Total for Question 10 is 3 marks)

.CG Maths.

11 In an experiment, 60 students each completed a puzzle.

The cumulative frequency graph shows information about the times taken for the 60 students to complete the puzzle.


For these 60 students,

the least time taken was 24 seconds
the greatest time taken was 96 seconds.

Reading across from the cumulative frequencies of 15, 30 and 45 (as these are 1/4, 1/2 and 3/4 of the way through the 60 students) to the line then down to the time taken works out the lower quartile, median and upper quartile

On the grid below, draw a box plot for the distribution of the times taken by the students.
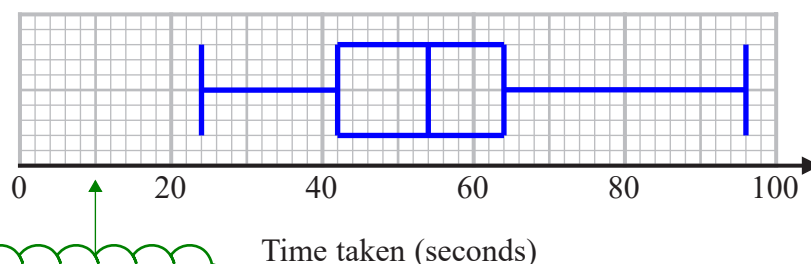
The scale goes up 20 over 10 small boxes. 20 ÷ 10 = 2, so each small box is worth 2

(Total for Question 11 is 3 marks)

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12 The number of insects in a population at the start of the year n is P_n

The number of insects in the population at the start of year $(n + 1)$ is P_{n+1} where

The population in the next year → $P_{n+1} = kP_n$ ← The population in the current year
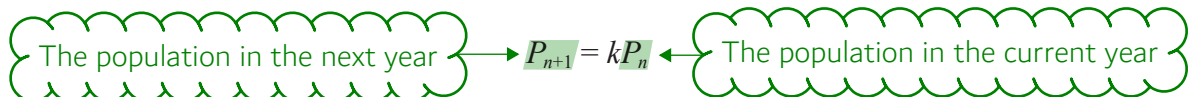
Given that k has a constant value of 1.13

(a) find out how many years it takes for the number of insects in the population to double.
   You must show how you get your answer.

Using table mode. f(x) = 1.13^x. Start: 1. End: 30. Step: 1

This lists out 1.13^1, 1.13^2, 1.13^3... all the way to 1.13^{30}. The value of k is multiplied by the population each year so the power of k increases by 1 each year

After the 5th year, the population is 1.84... times greater than the original population. After the 6th year, the population is 2.08... times greater than the original population. This is the first time it is over double

1.13^5=1.8...
1.13^6=2.0...

6

(2)

The value of k actually increases year on year from its value of 1.13 in year 1

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

It could decrease

As the multiplier is increasing it could get to double the population quicker. However as the increase is not given, it is not certain if it will be less than 6 years as the value of 2.08... was more than double
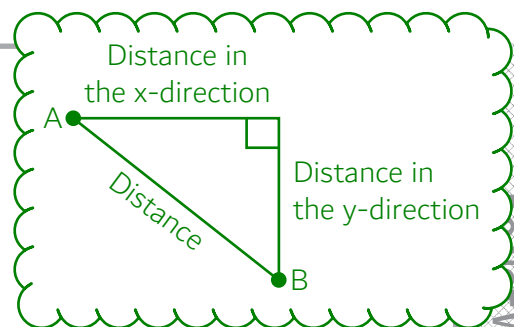
(1)

(Total for Question 12 is 3 marks)

13 *A* and *B* are points on a centimetre grid.
A is the point with coordinates (−7, 6)
B is the point with coordinates (8, −5)

Work out the length of *AB*.
Give your answer correct to 1 decimal place.

Distance in the x-direction
Distance in the y-direction
Distance

$8 - -7 = 15$ — This works out the distance in the x-direction

$6 - -5 = 11$ — This works out the distance in the y-direction

$11^2 + 15^2 = AB^2$ — Pythagoras' Theorem can be used to work out the distance as the distances form a right-angled triangle. $a^2 + b^2 = c^2$, where a and b are the shorter sides and c is the longest side

$\sqrt{11^2 + 15^2}$ — Square rooting both sides finds AB

.... 18.6 .... cm

(Total for Question 13 is 2 marks)

14 Using algebra, prove that $1.06\dot{2}$ can be written as $1\frac{14}{225}$

$x = 1.06\dot{2}$ — Let x be the recurring decimal

$10x = 10.62\dot{2}$ — There is 1 recurring digit so multiplying by 10 once gives 10x, which as a decimal can have the recurring digit in the same decimal place

$9x = 9.56$ — Subtracting x from 10x cancels out the recurring digit and leaves a terminating decimal

$x = \frac{9.56}{9}$ — Dividing both sides by 9 expresses x as a fraction

$= 1\frac{14}{225}$ — The fraction simplifies to the mixed number we are trying to prove it can be written as

(Total for Question 14 is 3 marks)

.CG Maths.

15 Faiza is studying the population of rabbits in a park.
She wants to estimate the number of rabbits in the park.

On Monday she catches a random sample of 20 rabbits in the park, marks each rabbit with a tag and releases them back into the park.

On Tuesday she catches a random sample of 42 rabbits in the park.
12 of the rabbits are marked with a tag.

(a) Find an estimate for the number of rabbits in the park.

$$\frac{12}{20}x = 42$$

Let x be the total number of rabbits in the park. 12 out of the 20 rabbits with a tag had been caught on Tuesday therefore we can estimate that 12/20 of the total rabbits have been caught. This fraction of x must be 42

$$x = 42 \div \frac{12}{20}$$

Dividing both sides by 12/20 gets x on its own

.... 70 ....

(3)

Albie is studying the population of rabbits in a wood.

One day, he catches 55 rabbits and finds that 40 of these rabbits are marked with a tag.

Albie estimates there are 50 rabbits in the wood.

(b) Explain why Albie's estimate cannot be correct.
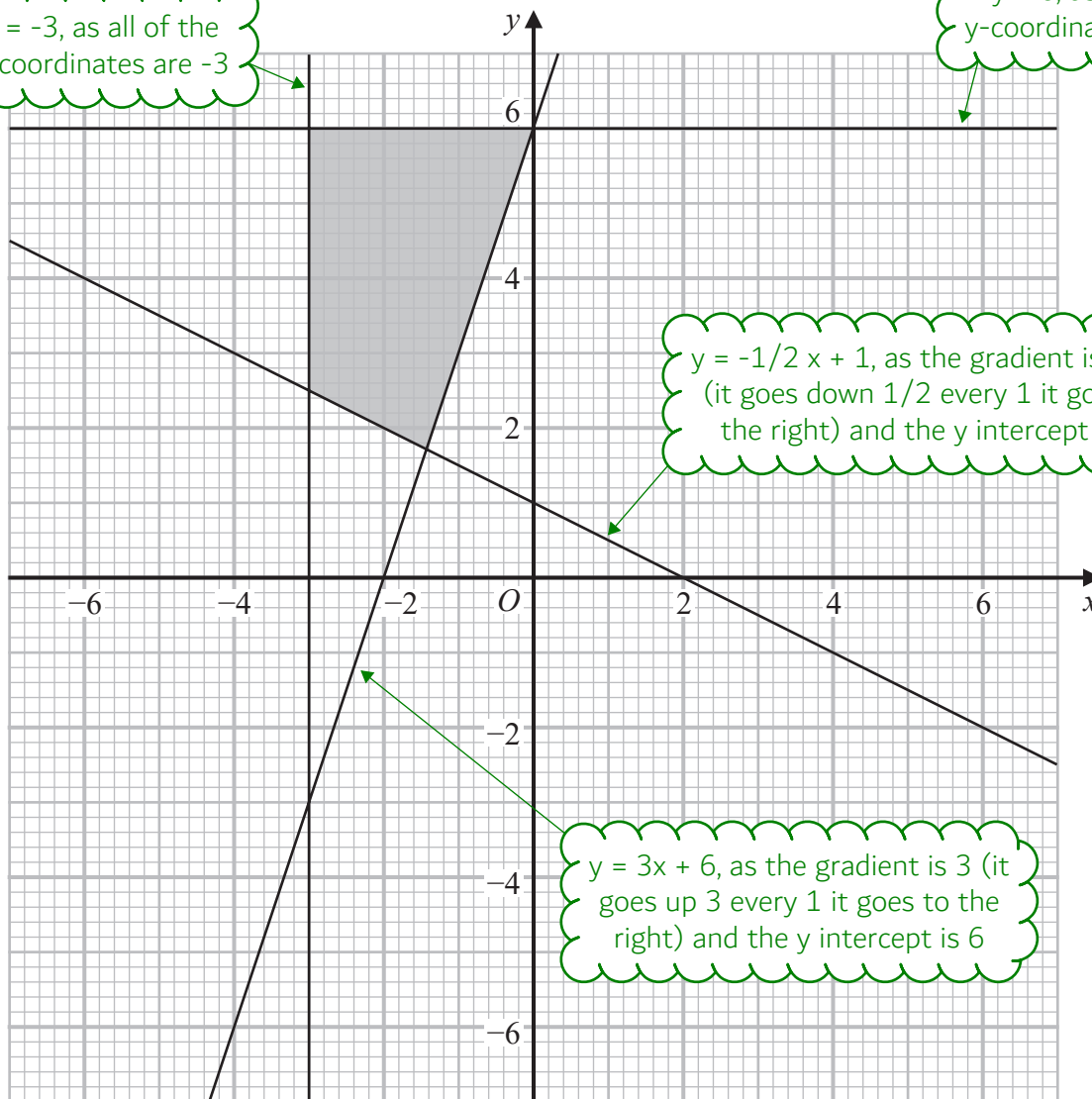
50 is less than the 55 he caught

....

....

(1)

(Total for Question 15 is 4 marks)

.CG Maths.

16 The shaded region shown on the grid is bounded by four straight lines.

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

x = -3, as all of the x-coordinates are -3

y = 6, as all the y-coordinates are 6

y = -1/2 x + 1, as the gradient is -1/2 (it goes down 1/2 every 1 it goes to the right) and the y intercept is 1

y = 3x + 6, as the gradient is 3 (it goes up 3 every 1 it goes to the right) and the y intercept is 6

Find the four inequalities that define the shaded region.

As the region is below the line y = 6

$y \leq 6$

As the region is to the right of the line x = -3

$x \geq -3$

As the region is above the line y = -1/2 x + 1

$y \geq -\frac{1}{2}x + 1$

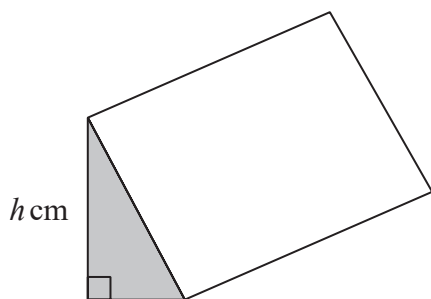As the region is above the line y = 3x + 6

$y \geq 3x + 6$

(Total for Question 16 is 4 marks)

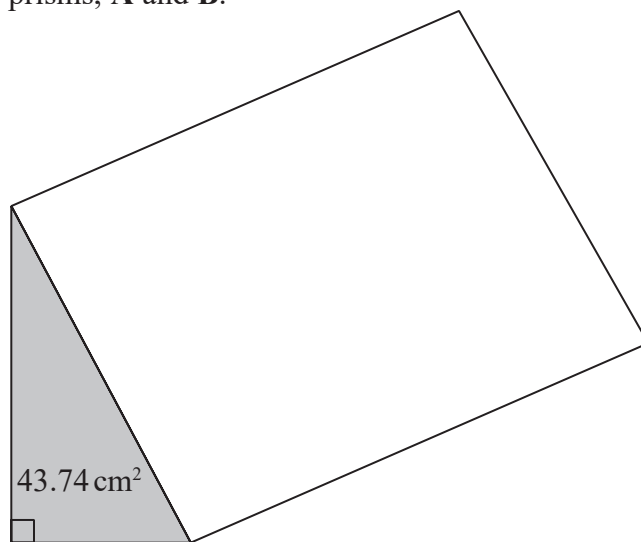All of the inequalities involve equal to as well because the lines are solid (dashed means they cannot be equal to)

.CG Maths.

17 The diagram shows two similar solid triangular prisms, **A** and **B**.

h cm

43.74 cm²

8.1 cm

Prism **A**   Prism **B**

The volume of prism **A** is 58.806 cm³
The volume of prism **B** is 1587.762 cm³

The cross section of each prism is a right-angled triangle.

For prism **B**
    the length of the base of the triangle is 8.1 cm
    the area of the triangle is 43.74 cm²

The height of the triangle for prism **A** is h cm.

Work out the value of h.

$1587.762 \div 58.806$ ← Dividing the volume of B by the volume of A works out that the volume scale factor from A to B is 27

$\sqrt[3]{27} = 3$ ← The unit of volume is cm³ and the unit of length is cm. So cube rooting the volume scale factor works out that the length scale factor is 3

$\frac{1}{2} \times 8.1 \times H = 43.74$ ← Creating an equation for the area of the triangle for prism B. Area of triangle = 1/2 x base x height. The base is 8.1cm and the height can be H

$H = \dfrac{43.74}{\frac{1}{2} \times 8.1}$ ← Rearranging to make H the subject by dividing both sides by 1/2 and 8.1. So the height of the triangle for prism B is 10.8cm
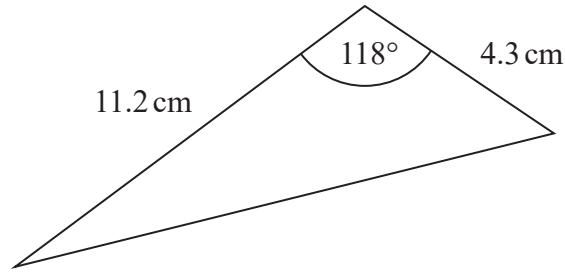
$10.8 \div 3$ ← Dividing the height of the triangle for prism B by the length scale factor works out the height of the triangle for prism A

$h =$ .... 3.6 ....

(Total for Question 17 is 4 marks)

18 Here is a triangle.

Work out the area of the triangle.
Give your answer correct to 3 significant figures.

$\frac{1}{2} \times 11.2 \times 4.3 \times \sin(118)$

Area of triangle = 1/2 absinC, where a and b are two sides and C is the angle between them

The answer of 21.261... is rounded to 3 significant figures

.................21.3................. cm²

(Total for Question 18 is 2 marks)

19 Solve $6x^2 + 5x - 6 = 0$
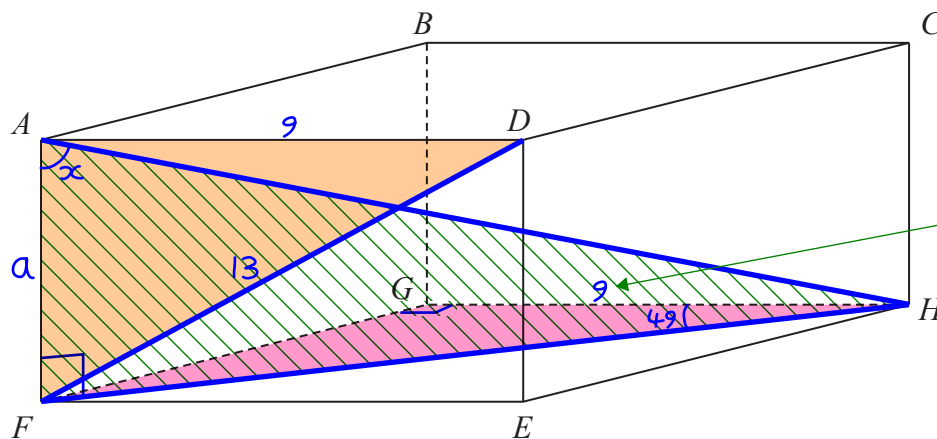
$\frac{-5 \pm \sqrt{5^2 - 4 \times 6 \times -6}}{2 \times 6}$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

The equation is in the form ax² + bx + c = 0 so it can be solved using the quadratic formula. a = 6, b = 5 and c = -6

$\frac{2}{3} , -\frac{3}{2}$

(Total for Question 19 is 3 marks)

.CG Maths.

20 *ABCDEFGH* is a cuboid.

GH is the same length as AD

$AD = 9$ cm
$FD = 13$ cm
Angle $GHF = 49°$

Work out the size of angle *FAH*.
Give your answer correct to the nearest degree.

$a^2 + 9^2 = 13^2$

First working with the orange right-angled triangle. Pythagoras' Theorem can be used to work out the missing side in the triangle (labelled a on the diagram). $a^2 + b^2 = c^2$, where c is the longest side and a and b are the two shorter sides

$a = \sqrt{13^2 - 9^2}$
$= 2\sqrt{22}$

Rearranged to find a by subtracting 9^2 from both sides then square rooting

$S^O\overset{\checkmark}{H} C\overset{\checkmark}{A}\overset{\checkmark}{H} T^O\overset{\checkmark}{A}$

Now working with the pink right-angled triangle. Writing SOH CAH TOA as formula triangles and ticking A as we have the adjacent and H as we should find the hypotenuse

$\dfrac{9}{\cos 49} = 13.7...$

There are two ticks on the CAH formula triangle so this one can be used. Covering H tells us that hypotenuse = adjacent/(cos of the angle)

Storing the exact value as one of the letters on the calculator

$S^{\checkmark}_O H C^{\checkmark}_A H T^{\checkmark}_O A$

Now working with the green lined triangle. Writing SOH CAH TOA as formula triangles and ticking O as we have the opposite and A as we have the adjacent

$\tan x = \dfrac{13.7...}{2\sqrt{22}}$

There are two ticks on the TOA formula triangle so this one can be used. Covering T tells us that tan of the angle = opposite/adjacent

Using the exact value stored on the calculator
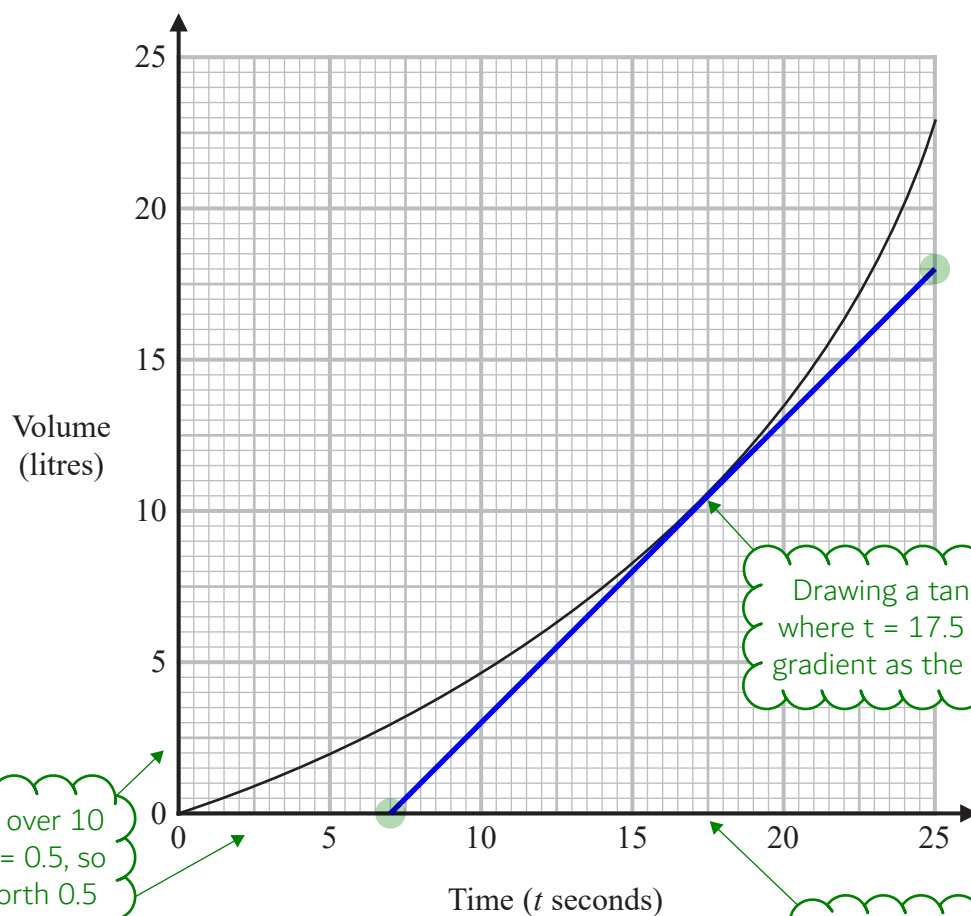
$x = \tan^{-1}\left(\dfrac{13.7...}{2\sqrt{22}}\right)$

Doing the inverse tan of both sides finds x

The value of 55.6... is rounded to the nearest degree

56 °

(Total for Question 20 is 4 marks)

.CG Maths.

21 The graph below gives the volume, in litres, of water in a container t seconds after the water starts to fill the container.

Volume (litres)

Time (t seconds)

Drawing a tangent to the curve where t = 17.5 as it has the same gradient as the curve at that point

Both scales go up 5 over 10 small boxes. 5 ÷ 10 = 0.5, so each small box is worth 0.5

17.5 is halfway between 15 and 20

(a) Calculate an estimate for the gradient of the graph when $t = 17.5$
You must show how you get your answer.

$\frac{18-0}{25-7}$

Gradient = (change in y)/(change in x). Picking the two points highlighted at the ends of the tangent. 18 - 0 expresses the change in y and 25 - 7 expresses the change in x

1

(3)

(b) Describe fully what the gradient in part (a) represents.

The rate the volume increases

(1)

(Total for Question 21 is 4 marks)

.CG Maths.

22 $f(x) = \sqrt[3]{x}$

$g(x) = 2x + 3$

$h(x) = fg(x)$

Find $h^{-1}(x)$

$\sqrt[3]{2x+3}$ ← Expressing the composite function fg(x) by substituting g(x) for x in f(x). This is h(x)

$x = \sqrt[3]{2y+3}$ ← Finding the inverse function h⁻¹(x) by switching h(x) with x and x with y then rearranging to find y. This does the exact opposite

$x^3 = 2y+3$ ← Cubing both sides eliminates the cube root on the right

$x^3 - 3 = 2y$ ← Subtracting 3 from both sides gets the y term on its own

Dividing both sides by 2 makes y the subject. What y is equal to is the inverse function h⁻¹(x)

$h^{-1}(x) = $ ....$\dfrac{x^3-3}{2}$........

(Total for Question 22 is 3 marks)

23 A race is measured to have a distance of 10.6 km, correct to the nearest 0.1 km.
Sam runs the race in a time of 31 minutes 48 seconds, correct to the nearest second.

Sam's average speed in this race is V km/hour.

By considering bounds, calculate the value of V to a suitable degree of accuracy.
You must show all your working and give a reason for your answer.

$$48 + \frac{1}{2} = 48.5$$

$$48 - \frac{1}{2} = 47.5$$

> Working out the upper and lower bound of the number of seconds by adding and subtracting half of the resolution. The resolution is 1 as they are to the nearest second

$$\frac{10.6 - \frac{0.1}{2}}{0°31'48.5"} = 19.90044538$$

$$\frac{10.6 + \frac{0.1}{2}}{0°31'47.5"} = 20.09960682$$

> Working out the upper and lower bound of the speed in km/hour. The unit tells us to divide the distance in kilometres by the time in hours. To get the lower bound, the lower bound of the distance must be divided by the upper bound of the time. To get the upper bound, the upper bound of the distance must be divided by the lower bound of the time. The upper and lower bound of the distance is expressed by adding and subtracting half of the resolution. The resolution is 0.1 as it is to the nearest 0.1km. The time is inputted as a sexagesimal and is written as it is put into the calculator. Writing down all the digits of the calculator display as the answers

20

As both the upper and lower bound round to this to 2 significant figures

> The value of V cannot be any more precise without the upper and lower bound giving different values

(Total for Question 23 is 5 marks)

.CG Maths.

24 A circle has equation $x^2 + y^2 = 12.25$

The point P lies on the circle.
The coordinates of P are (2.1, 2.8)

The line **L** is the tangent to the circle at point P.

Find an equation of **L**.
Give your answer in the form $ax + by = c$, where a, b and c are integers.

> The tangent is a straight line. The general equation of a straight line is y = mx + c, where m is the gradient and c is the y intercept

$$\frac{2.8-0}{2.1-0} = \frac{4}{3}$$

> Gradient = (change in y)/(change in x). The only two coordinates known are P and the centre of the circle, (0 , 0). The straight line connecting these is the radius. The change in y is 2.8 - 0 and the change in x is 2.1 - 0. So the gradient of the radius is 4/3

$$y = -\frac{3}{4}x + c$$

> The gradient of the tangent is the negative reciprocal of 4/3 as the tangent and radius are perpendicular. Reciprocal means to flip the fraction. So the gradient of the tangent is -3/4. Substituting this for m in the general equation of a straight line

$$c = y + \frac{3}{4}x$$

> Rearranging to find c by adding 3/4 x to both sides

$$= 2.8 + \frac{3}{4}(2.1)$$

> Substituting in the coordinates of P as these are on the tangent so satisfy the equation

$$= \frac{35}{8}$$

> Leaving as a fraction as it is easier to convert back into an integer

$$8y = -6x + 35$$

> Substituting c back into the equation and multiplying all terms by 8 to get rid of the denominators

> Adding 6x to both sides to get the equation in the desired form

$$6x + 8y = 35$$

(Total for Question 24 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS

.CG Maths.