Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

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

Time 1 hour 30 minutes

Paper reference **1MA1/1H**

Mathematics

PAPER 1 (Non-Calculator)

Higher Tier

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser. 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 not be used.**

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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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.

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Work out 3.67×4.2

```
   3.67
 ×  4.2
 ------
    734
  14680
 ------
 15.414
```

There are 2 decimal places in 3.67 and 1 decimal place in 4.2. There are 3 decimal places in total therefore there should be 3 decimal places in the answer

15.414

(3)

(b) Work out $59.84 \div 1.6$

```
     0 3 7 .4
16 | 5 ⁵9 ¹¹8 .⁶4
```

16, 32, 48, 64, 80, 96, 112, 128

59.84/1.6 = 598.4/16 as they are equivalent fractions. Eliminating the decimal from the denominator makes the division much easier

37.4

(3)

(Total for Question 1 is 6 marks)

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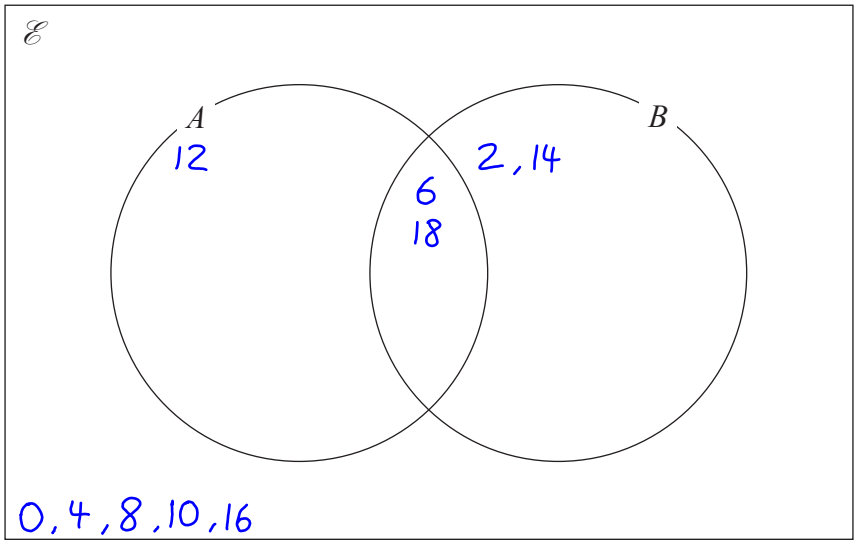
2 $\mathscr{E}$ = {even numbers less than 19}
A = {6, 12, 18}
B = {2, 6, 14, 18}

Complete the Venn diagram for this information.



(Total for Question 2 is 3 marks)

3 Work out $4\frac{1}{5} - 2\frac{2}{3}$

Give your answer as a mixed number.

$\frac{21}{5} - \frac{8}{3}$ ← Converting both into improper fractions by multiplying the whole number by the denominator then adding the result to the numerator

$\frac{63}{15} - \frac{40}{15}$ ← Making the denominators the same. A common multiple of 5 and 3 is 15 so multiplying the denominators to get this. Multiplying each numerator by the same amount as their denominator was multiplied by to keep the fractions equivalent

$\frac{23}{15}$ ← Subtracting the numerators and the denominator stays the same

Converted into a mixed number by dividing the numerator by the denominator to find the whole number and leaving the remainder in the fraction →

$1\frac{8}{15}$

(Total for Question 3 is 3 marks)

4 At the end of 2017

the value of Tamara's house was £220 000
the value of Rahim's house was £160 000

At the end of 2019

the value of Tamara's house had decreased by 20%
the value of Rahim's house had increased by 30%

At the end of 2019, whose house had the greater value?
You must show how you get your answer.

22000 × 2 = 44000 ← 10% of £220000 is £22000, which is found by dividing by 10. Multiplying this by 2 works out 20%

220000 − 44000 = 176000 ← Subtracting the value of the 20% from £220000 works out the value of Tamara's house at the end of 2019

16000 × 3 = 48000 ← 10% of £160000 is £16000, which is found by dividing by 10. Multiplying this by 3 works out 30%

160000 + 48000 = 208000 ← Adding the value of the 30% to the £160000 works out the value of Rahim's house at the end of 2019

Rahim ← Tamara's house was worth £176000 at the end of 2019. Rahim's house was worth £208000 at the end of 2019. Rahim's was worth more

(Total for Question 4 is 4 marks)

5 Rosie, Matilda and Ibrahim collect stickers.

$$\frac{\text{number of stickers Rosie has}} : \frac{\text{number of stickers Matilda has}} : \frac{\text{number of stickers Ibrahim has}} = 4:7:15$$

Ibrahim has 24 more stickers than Matilda.

Ibrahim has more stickers than Rosie.
How many more?

15−7 ← This works out that Ibrahim has 8 more parts in the ratio than Matilda

24÷8 ← 8 parts represent 24 stickers so this works out that each part is worth 3 stickers

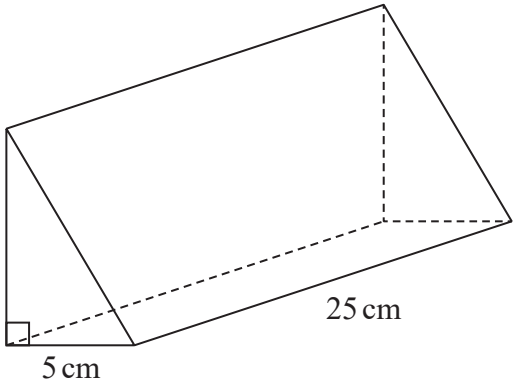
15−4 ← This works out that Ibrahim has 11 more parts in the ratio than Rosie

11×3 ← This works out how many stickers the 11 parts are worth and therefore how many more stickers Ibrahim has than Rosie

33

(Total for Question 5 is 3 marks)

6 The diagram shows a prism.



The cross section of the prism is a right-angled triangle.
The base of the triangle has length 5 cm

The prism has length 25 cm
The prism has volume 750 cm^3

Work out the height of the prism.

$\frac{1}{2} \times 5 \times h \times 25 = 750$ ← Expressing the volume of the prism in terms of the height, h, then setting it equal to the actual volume. Volume of prism = area of cross section x length. The length is 25cm. The cross section is a triangle. Area of triangle = 1/2 x base x height. The base is 5cm. The height is h

$h = \frac{750}{\frac{1}{2} \times 5 \times 25}$ ← Rearranged to make h the subject by dividing both sides by 1/2, 5 and 25

$5\overline{)750}$ = 150 ← Dividing the 750 by the 5

$5\overline{)150}$ = 030 ← Next dividing by the 25 but splitting it into dividing by 5 twice, which works as 5 x 5 = 25

$30 \div 5$

$6 \div \frac{1}{2} = 6 \times 2$ ← Next dividing by the 1/2. To divide by a fraction, keep the first number, change the division sign to a multiply and flip the fraction. 2/1 = 2

12 cm

(Total for Question 6 is 3 marks)

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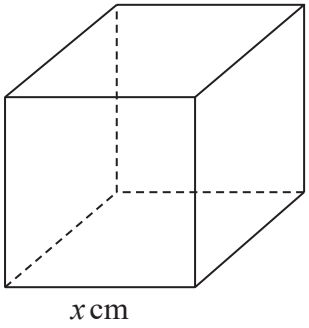
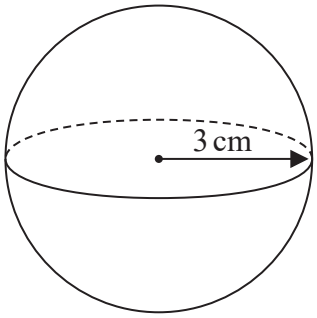
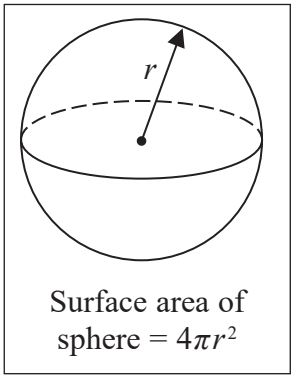
7 The diagram shows a cube with edges of length x cm and a sphere of radius 3 cm.







The surface area of the cube is equal to the surface area of the sphere.

Show that $x = \sqrt{k\pi}$ where k is an integer.

$6x^2 = 4\pi \times 3^2$ ← The cube has 6 square faces. Area of square = length^2. The length is x. So x^2 is the area of one of the faces. Multiplying this by the 6 faces gives the surface area of the cube, which is $6x^2$. This is equal to the surface area of the sphere, which is expressed by using the formula given and substituting in 3cm as the radius

$x = \sqrt{\frac{36\pi}{6}}$ ← Multiplication can be done in any order. 3^2 = 3 x 3 = 9. 4 x 9 = 36. So the surface area of the sphere is 36π. Dividing both sides by 6 then square rooting makes x the subject

$= \sqrt{6\pi}$ ← 36/6 = 6

(Total for Question 7 is 4 marks)

8 Solve $x^2 = 5x + 24$

$x^2-5x-24=0$ ← Rearranged into the quadratic form

$(x-8)(x+3)=0$ ← Factorised by putting two brackets with x and finding two numbers which multiply to -24 and add to -5. -8 and 3 do this so putting these in the brackets with x

One of the two brackets has to equal to 0. If x - 8 = 0, x = 8. If x + 3 = 0, x = -3

$x=8$ or $x=-3$

(Total for Question 8 is 3 marks)

9 (a) Write down the value of 7^0

Anything to the power of 0 is 1

1

(1)

(b) Find the value of $3 \times 3^6 \times 3^{-6}$

$a^x \times a^y = a^{x+y}$ so $3^6 \times 3^{-6} = 3^{6+-6} = 3^0 = 1$. It all becomes 3 x 1

3

(1)

(c) Find the value of 2^{-4}

$2^4 = 2 \times 2 \times 2 \times 2 = 16$. The negative power means to do the reciprocal

$\frac{1}{16}$

(1)

(d) Find the value of $27^{\frac{1}{3}}$

The power of 1/3 means to do the cube root

3

(1)

(Total for Question 9 is 4 marks)

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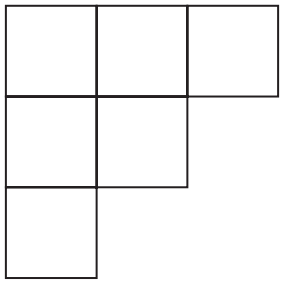
10 The diagram shows a shape made from 6 identical squares.



The total area of the shape is 5406 cm^2

(a) Find an estimate for the length of one side of each square.
Give your answer correct to the nearest whole number.

$6\overline{)5406}$ = 901

There are 6 identical squares so dividing the total area by 6 works out the area of one of the squares. The area has not been rounded at this stage as it needs to be divided by 6 and rounding it to 5000 or 5400 may not make the calculation easier

$\sqrt{900} = \sqrt{9} \times \sqrt{100}$

The 901 is now rounded to 900 as this can be split into two square numbers to make it easier to square root. $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$ so $\sqrt{9} \times \sqrt{100} = \sqrt{900}$

3 x 10 = 30

30 ..... cm

(3)

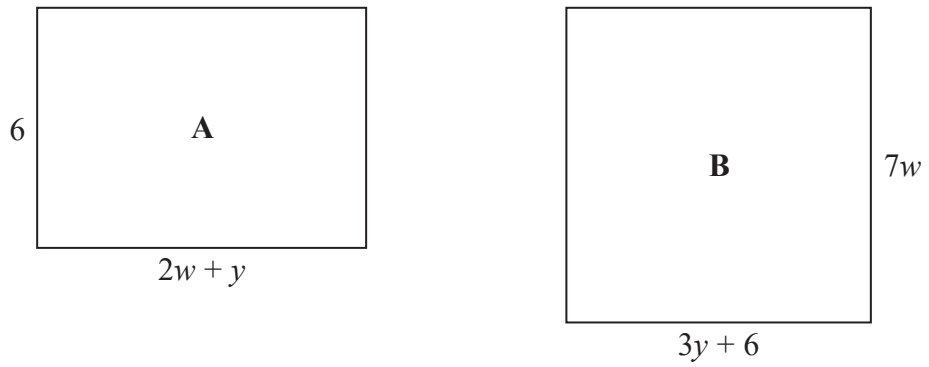
(b) Is your answer to part (a) an underestimate or an overestimate?
You must give a reason for your answer.

Underestimate as the area of one of the squares was rounded down

(1)

(Total for Question 10 is 4 marks)

11 The diagram shows two rectangles, **A** and **B**.



All measurements are in centimetres.

The area of rectangle **A** is equal to the area of rectangle **B**.

Find an expression for y in terms of w.

$6(2w+y)=7w(3y+6)$ ← The two areas are equal to each other

Area of rectangle A. Area of rectangle = length x width

Area of rectangle B. Area of rectangle = length x width

$12w+6y=21wy+42w$ ← Expanding the brackets

$6y-21wy=30w$ ← Collecting all of the terms involving y on the left and all the other terms on the right

$y(6-21w)=30w$ ← Bringing y out as a factor

Dividing both sides by (6 - 21w) → $\frac{30w}{6-21w}$

(Total for Question 11 is 4 marks)

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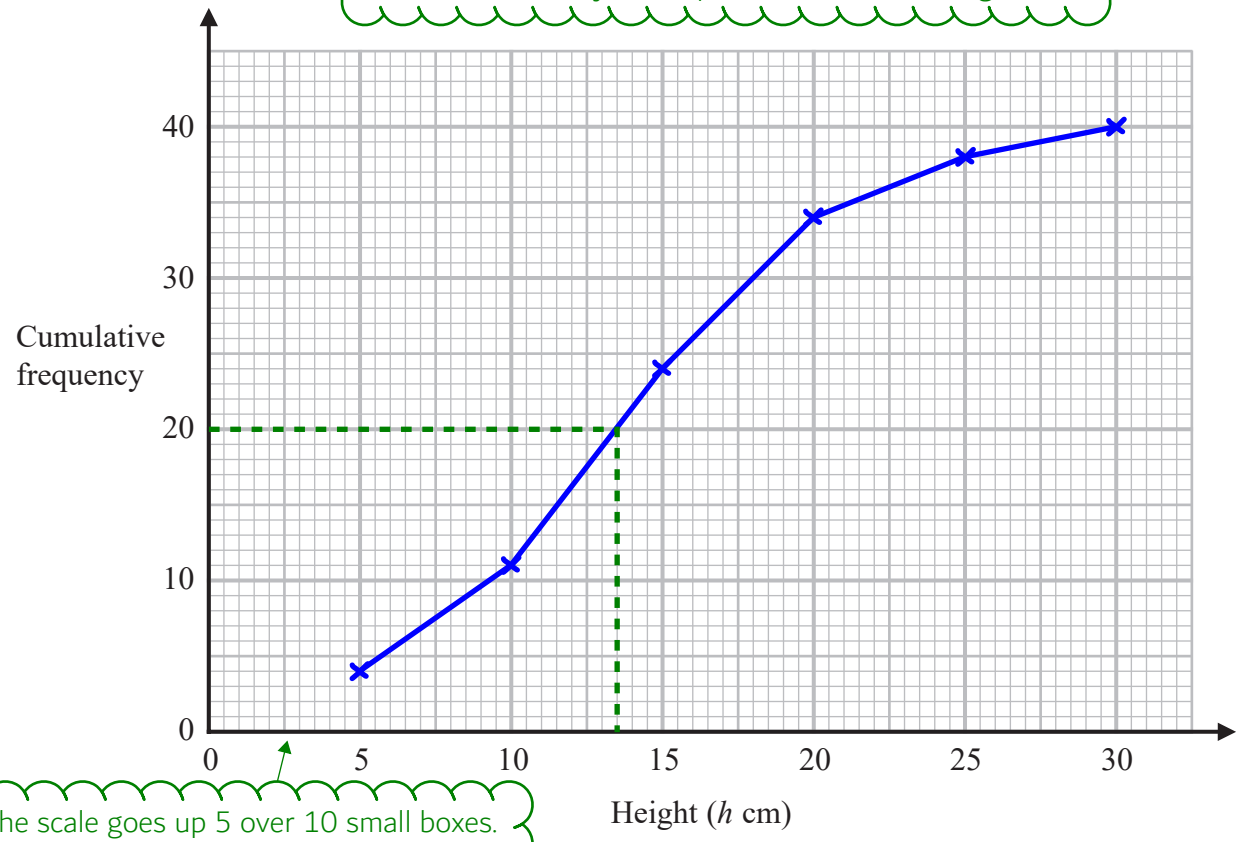
12 The cumulative frequency table gives information about the heights, in cm, of 40 plants.

Height (h cm)	Cumulative Frequency
$0 < h \leqslant 5$	4
$0 < h \leqslant 10$	11
$0 < h \leqslant 15$	24
$0 < h \leqslant 20$	34
$0 < h \leqslant 25$	38
$0 < h \leqslant 30$	40

(a) On the grid, draw a cumulative frequency graph for this information.

The cumulative frequencies are plotted at the end of each interval then joined up with a series of straight lines



The scale goes up 5 over 10 small boxes. 5/10 = 0.5 so each small box is worth 0.5

(2)

(b) Use the graph to find an estimate for the median height of the plants.

The median is halfway through the data. 40/2 = 20 so the median is about the 20th frequency. Reading across from 20 to the line then down works out the estimate

13.5 cm

(1)

(Total for Question 12 is 3 marks)

13 Ted is trying to change $0.\dot{4}\dot{3}$ to a fraction.

Here is the start of his method.

$$x = 0.\dot{4}\dot{3}$$

$$10x = 4.\dot{3}\dot{4}$$

$$10x - x = 4.\dot{3}\dot{4} - 0.\dot{4}\dot{3}$$

Evaluate Ted's method so far.

The recurring digits will not be eliminated

x should be multiplied by 100 to give $100x = 43.\dot{4}\dot{3}$, so that when x is subtracted the recurring digits are eliminated

(Total for Question 13 is 1 mark)

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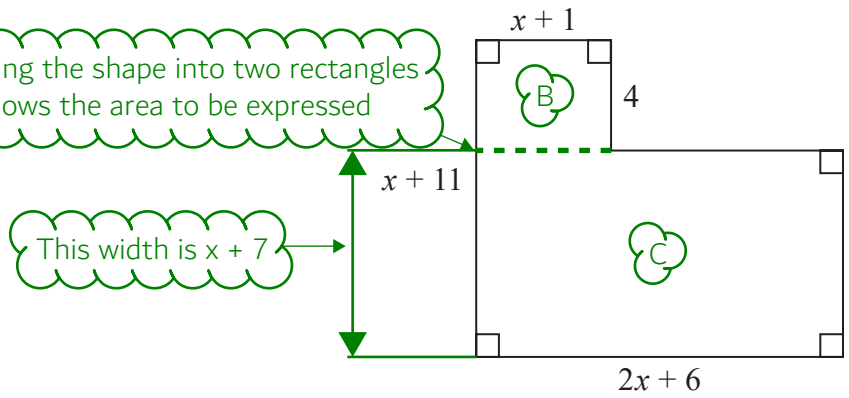
14 Here is a shape with all its measurements in centimetres.



Splitting the shape into two rectangles allows the area to be expressed

This width is x + 7

The area of the shape is A cm^2

Show that $A = 2x^2 + 24x + 46$

$A = 4(x+1) + (2x+6)(x+7)$ ← The area A is equal to the area of rectangle B + the area of rectangle C. Area of rectangle = length x width

$= 4x + 4 + 2x^2 + 14x + 6x + 42$ ← Expanding the brackets

$= 2x^2 + 24x + 46$ ← Collecting like terms

(Total for Question 14 is 3 marks)

15 Show that $\frac{4x+3}{2x} + \frac{3}{5}$ can be written in the form $\frac{ax+b}{cx}$ where a, b and c are integers.

$\frac{5(4x+3)}{2x5} + \frac{3x2x}{5x2x}$ ← Multiplying the denominator of the first fraction by 5 and the denominator of the second fraction by 2x makes them the same. The numerators need to be multiplied by the same as the denominators to keep them equivalent

$\frac{20x+15}{10x} + \frac{6x}{10x}$ ← Expanding the brackets and simplifying

$\frac{26x+15}{10x}$ ← Now the denominators are the same the fractions can be added to form a single fraction. Adding the numerators and keeping the denominator the same

(Total for Question 15 is 3 marks)

16 There are only 3 red counters and 5 yellow counters in a bag.

Jude takes at random 3 counters from the bag.

Work out the probability that he takes exactly one red counter.

$\frac{3}{8} \times \frac{5}{7} \times \frac{4}{6} \times 3$ ← Red AND yellow AND yellow OR yellow AND red AND yellow OR yellow AND yellow AND red. AND means to multiply and OR means to add. There are 8 counters in total as 3 + 5 = 8. 3 out of the 8 counters are red. Then as 1 counter is removed the total number of counters goes down to 7. Out of these, 5 are yellow. Then as 1 yellow counter is removed there is 1 less counter in total and 1 less yellow counter so for the final pick there are 4 yellow counters out of a total of 6 counters. The probability of red AND yellow AND yellow can be multiplied by 3 as the other possibilities will have the same probability

$\frac{1}{2} \times \frac{5}{7} \times \frac{1}{2} \times 3$ ← Simplifying the calculation by cancelling out common factors from the numerators and denominators

$\frac{15}{28}$

(Total for Question 16 is 4 marks)

17 On the grid show, by shading, the region that satisfies all of these inequalities.

$2y + 4 < x$ $\quad x < 3$ $\quad y < 6 - 3x$

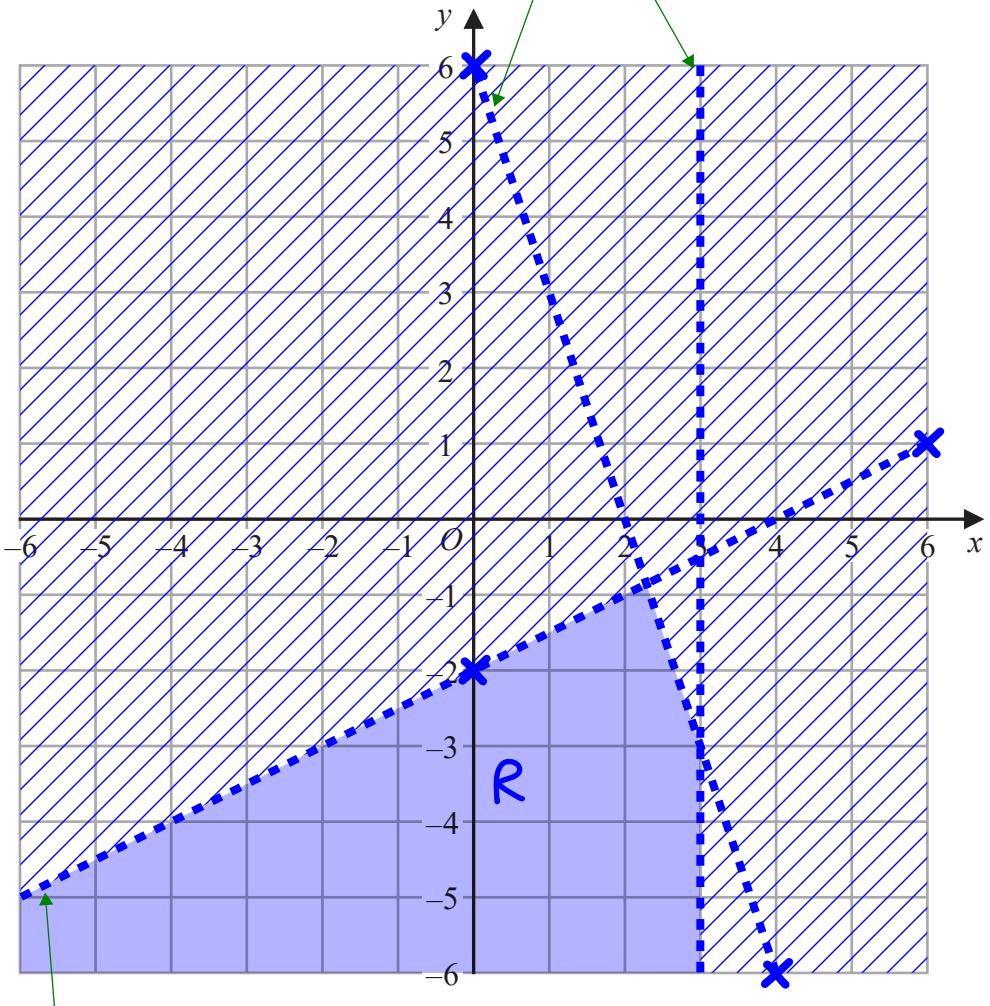
$y < \frac{x}{2} - 2$

Label the region **R**.

Rearranged to make y the subject to make the line easier to draw by subtracting 4 from both sides then dividing both sides by 2

The line of y = 6 - 3x. When x = 0, y = 6 - 3(0) = 6 so plotting the point (0 , 6). When x = 4, y = 6 - 3(4) = -6 so plotting the point (4 , -6). It is a straight line so drawing straight through both of these points. The line is dashed as y is not equal to. As y is less, the region is below the line. Crossing out everything above the line

The line of x = 3. The line is dashed as x is not equal to. As x is less, the region is on the left of this line. Crossing out everything on the right of the line



(Total for Question 17 is 3 marks)

The line of y = x/2 - 2. When x = 0, y = 0/2 - 2 = -2 so plotting the point (0 , -2). When x = 6, y = 6/2 - 2 = 1 so plotting the point (6 , 1). It is a straight line so drawing straight through both of these points. The line is dashed as y is not equal to. As y is less, the region is below the line. Crossing out everything above the line

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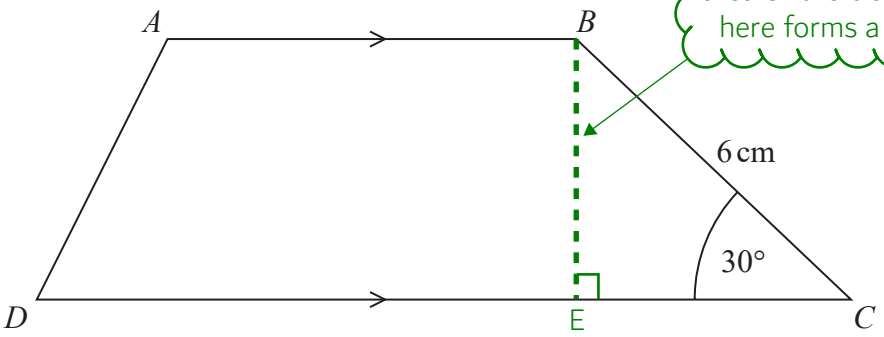
18 Here is trapezium $ABCD$.

The height is needed to express the area of the trapezium. Drawing it on here forms a right angled triangle



The area of the trapezium is $66\,\text{cm}^2$

the length of AB : the length of CD = 2 : 3

Find the length of AB.

SOH CAH TOA

Right angled trigonometry can be used to work out the height of the trapezium, side BE of the right angled triangle. Ticking H as we have the hypotenuse and O as we are looking for the opposite. There are two ticks on SOH so this formula can be used

0 30 45 60 90
0 1 2 3 4

Listing out the angles needed to be memorised and then 0, 1, 2, 3, 4 under these for the sin values. Square rooting them and putting them over 2 finds that sin30 = $\sqrt{1}/2 = 1/2$

$\frac{1}{2} \times 6$

From the SOH formula triangle, opposite = sin of the angle x hypotenuse. This works out side BE, which is the height of the trapezium

$\frac{1}{2}(x + 1.5x) \times 3 = 66$

Area of trapezium = 1/2 x (a + b) x h, where a and b are the parallel sides and h is the distance between them. The height, h, is 3. AB and CD are the parallel sides, a and b. Setting AB to x as this is what we are trying to find. From the ratio, side CD is 1.5 times greater than AB so is 1.5x. Setting the expression of the area equal to the actual area of 66cm^2

$2.5x = 44$

Dividing both sides by 3 to eliminate the multiplication by 3 on the left. 66/3 = 22. Then multiplying both sides by 2 to eliminate the 1/2 on the left. 22 x 2 = 44. x + 1.5x = 2.5x

Dividing both sides by 2.5 gives x = 44/2.5. Multiplying both the numerator and denominator by 10 gets rid of the decimals within the fraction and gives an acceptable answer which does not need to be simplified any further

$\frac{440}{25}$ ..... cm

(Total for Question 18 is 5 marks)

19 Show that $\frac{8+\sqrt{12}}{5+\sqrt{3}}$ can be written in the form $\frac{a+\sqrt{3}}{b}$, where a and b are integers.

$\sqrt{4}\times\sqrt{3}$ ← Simplifying $\sqrt{12}$ by using $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$ in reverse to split it into two smaller surds which multiply to give $\sqrt{12}$. One of them is a square number, 4, so it can be square rooted

$\frac{(8+2\sqrt{3})(5-\sqrt{3})}{(5+\sqrt{3})(5-\sqrt{3})}$ ← $\sqrt{4} = 2$ so $\sqrt{12}$ becomes $2\sqrt{3}$ when simplified. Changing the + to a - on the denominator then multiplying both the numerator and denominator by this to rationalise the denominator

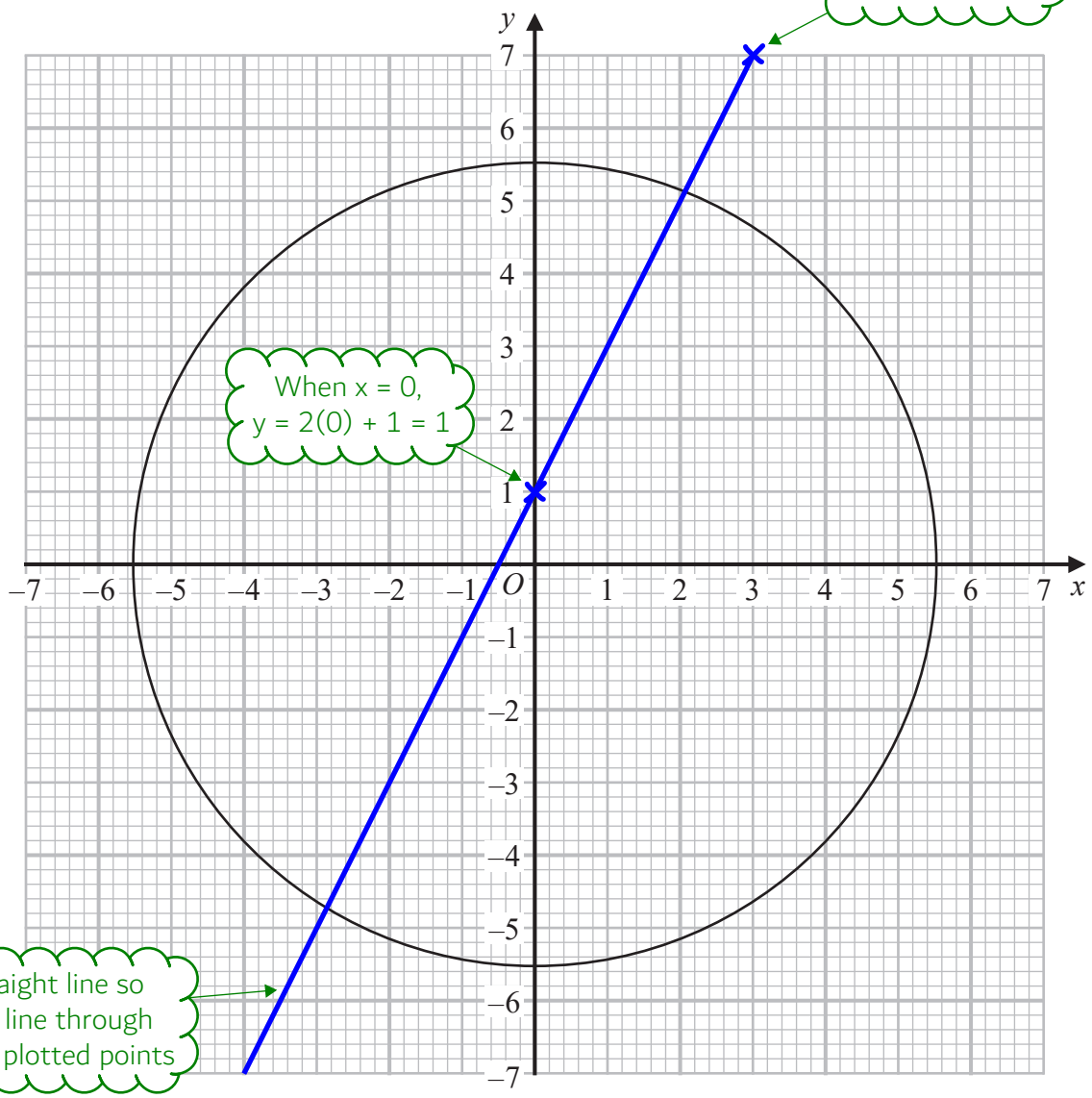
$\frac{40-8\sqrt{3}+10\sqrt{3}-6}{25-5\sqrt{3}+5\sqrt{3}-3}$ ← Expanding the brackets. $\sqrt{3} \times \sqrt{3} = 3$

$\frac{34+2\sqrt{3}}{22}$ ← Collecting like terms

$\frac{17+\sqrt{3}}{11}$ ← Simplifying the fraction into the desired form by dividing both the numerator and denominator by 2

(Total for Question 19 is 4 marks)

20 The diagram shows the graph of $x^2 + y^2 = 30.25$



Use the graph to find estimates for the solutions of the simultaneous equations

$$x^2 + y^2 = 30.25$$
$$y - 2x = 1$$

$y=2x+1$ ← Rearranged the second equation into the form y = mx + c to make it easier to draw

The estimates for the solutions are where the two graphs cross

$x=2.1$ $y=5.1$ or $x=-2.9$ $y=-4.7$

(Total for Question 20 is 3 marks)

21 The functions f and g are such that

$$f(x) = 3x^2 + 1 \quad \text{for } x > 0 \qquad \text{and} \qquad g(x) = \frac{4}{x^2} \quad \text{for } x > 0$$

(a) Work out gf(1)

$3(1)^2+1$ ← Working out f(1) by substituting x for 1 in f(x). f(1) = 4

$\frac{4}{4^2}$ ← Working out g(4) by substituting x for 4 in g(x)

$\frac{4}{16}$

(2)

The function h is such that $h = (fg)^{-1}$

(b) Find h(x)

$x = 3\left(\frac{4}{y^2}\right)^2 + 1$ ← fg(x) can be found by substituting x for g(x) in f(x). So fg(x) = $3(4/x^2)^2 + 1$. The inverse function can be found by switching x and y then rearranging to make y the subject. fg(x) is basically y

$\sqrt{\frac{(x-1)}{3}} = \frac{4}{y^2}$ ← Following BIDMAS backward and doing the opposite operations to get rid of everything apart from y on the right. First subtracting 1 from both sides, then dividing both sides by 3 then square rooting both sides

Doing the reciprocal (flipping the fractions) of both sides, then multiplying both sides by 4 then square rooting both sides makes y the subject and finds the inverse function →

$\sqrt{\frac{4}{\sqrt{\frac{(x-1)}{3}}}}$

(4)

(Total for Question 21 is 6 marks)

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22 Find the coordinates of the turning point on the curve with equation $y = 9 + 18x - 3x^2$
You must show all your working.

$y = -3(x^2 - 6x) + 9$ ← Bringing -3 out as a factor on the x and x^2 terms

$= -3(x-3)^2 + 9 - (-3)^2 \times -3$ ← Completing the square

$= -3(x-3)^2 + 36$

The turning point occurs when the square bracket is equal to 0. x = 3 for this to happen. When the square bracket is equal to 0, y = 36

(3 , 36)

(Total for Question 22 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS