

1. Below is a question with an incorrect solution.

Describe the error made and write out a correct solution.

Question:

Solve. $4x + 5 = x + 2$

Solution:

$$4x + 5 = x + 2$$

$$3x + 5 = 2$$

$$3x = 5 - 2$$

$$3x = 3$$

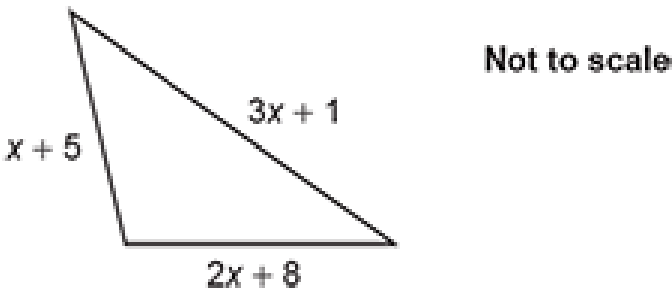
$$x = 1$$

The error is

A correct solution is

[2]

2(a). The sides of this triangle are given in centimetres.
The perimeter of the triangle is 80 cm.



Find the length of each side of the triangle.
You must show your working.

..... cm, cm and cm **[5]**

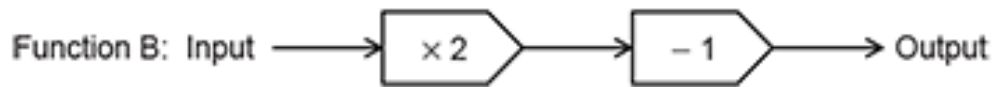
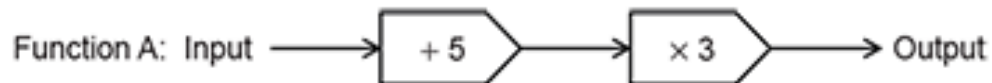
(b). Is the triangle above a right-angled triangle?
Use calculations to show how you decide.

..... because

.....

..... **[3]**

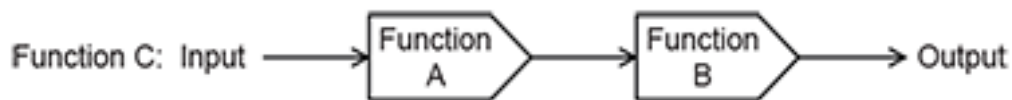
3(a). Here are two functions.



Write an algebraic expression for the output of function A when the input is x .

..... **[1]**

(b). Here is a composite function C.



The input to function C is x .

The output from function C is $2x + 1$.

Find the value of x .

You must show your working.

$x =$ **[5]**

4(a). Here are two pieces of work.

Each shows a question and the **first line** of an incorrect solution.

For each part, describe the error made in the first line of the solution.
You do **not** need to complete the solution.

Question:

Simplify. $\frac{2}{x-1} + \frac{3}{x+4}$

Solution:

$$\frac{2}{x-1} + \frac{3}{x+4} = \frac{2(x-1) + 3(x+4)}{(x-1)(x+4)}$$

[1]

(b).

Question:

Solve. $x^2 + 7x + 5 = 0$

Solution:

$$x = -\frac{7 \pm \sqrt{7^2 - 4 \times 1 \times 5}}{2 \times 1}$$

[1]

5(a).

Show that the equation $x^3 + x^2 - 5 = 0$ has a solution between $x = 1$ and $x = 2$.

[3]

(b). Find this solution correct to **1** decimal place.
You must show calculations to support your answer.

$x = \dots\dots\dots$ **[4]**

6. The k th term of a sequence is r^k , where $r \neq 0$.
The sixth term is equal to three times the second term.

Find the value of r , giving your answer correct to **3** decimal places.

$r = \dots\dots\dots$ **[4]**

7. The graph of $y = 3x + 10$ intersects the graph of $x^2 + y^2 = 20$ at two points.

Use an algebraic method to work out the coordinates of the two points.

You must show your working.

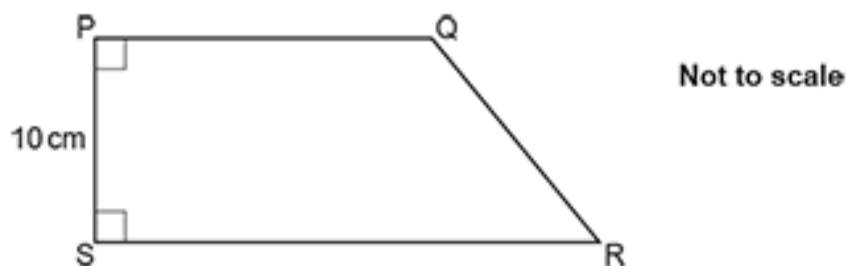
(..... ,) and (..... ,) **[6]**

8. Write $(2x - 5)(x + 4)$ in the form $2(x + a)^2 - b$.

You must show your working.

..... **[5]**

9. The diagram shows a quadrilateral, PQRS.



PS = 10 cm.

Angle QPS = Angle PSR = 90° .

SR is 6 cm longer than PQ.

The area of quadrilateral PQRS is $A \text{ cm}^2$.

Write a simplified expression for the length PQ in terms of A .

You must show your working.

..... [5]

10. Solve.

$$\frac{2(x-5)}{1-3x} = 2$$

$x = \dots\dots\dots$ **[4]**

11(a). Here are the first four terms of a sequence.

$$\frac{2}{5}$$

$$\frac{5}{10}$$

$$\frac{8}{17}$$

$$\frac{11}{26}$$

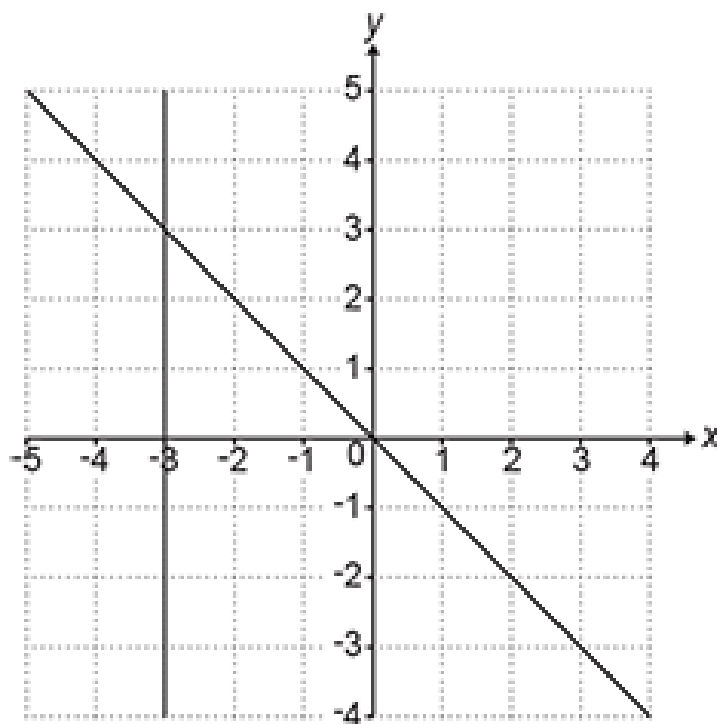
Find the next term.

$\dots\dots\dots$ **[1]**

(b). Find the n th term.

$\dots\dots\dots$ **[3]**

12. The graphs of $x = -3$ and $y = -x$ are drawn on the grid.



The region **R** satisfies the following inequalities.

$$x \leq -3 \quad y \leq -x \quad y - 1 > \frac{1}{2}x$$

By drawing one more line, find and label the region **R**.

[5]

13(a). Factorise.

$$9x^2 - 4$$

..... [2]

(b). Solve by factorisation.

$$3x^2 - 2x - 8 = 0$$

$$x = \dots\dots\dots \text{ or } x = \dots\dots\dots \quad \mathbf{[3]}$$

14. Write as a single fraction in its simplest form.

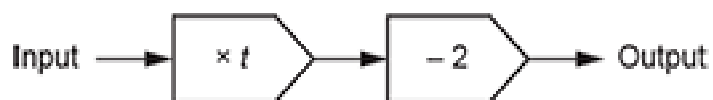
$$10 - \frac{6x + 45}{3x + 5}$$

$$\dots\dots\dots \quad \mathbf{[4]}$$

15. Factorise fully $30x^2 + 2x - 4$.

$$\dots\dots\dots \quad \mathbf{[3]}$$

16(a). Here is a function.



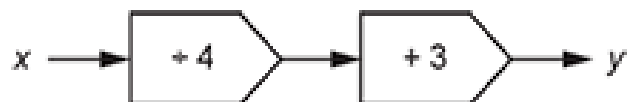
When the input is 6, the output is 18.

Find the value of t .

$t = \dots\dots\dots$ [3]

(b). Here is a function.

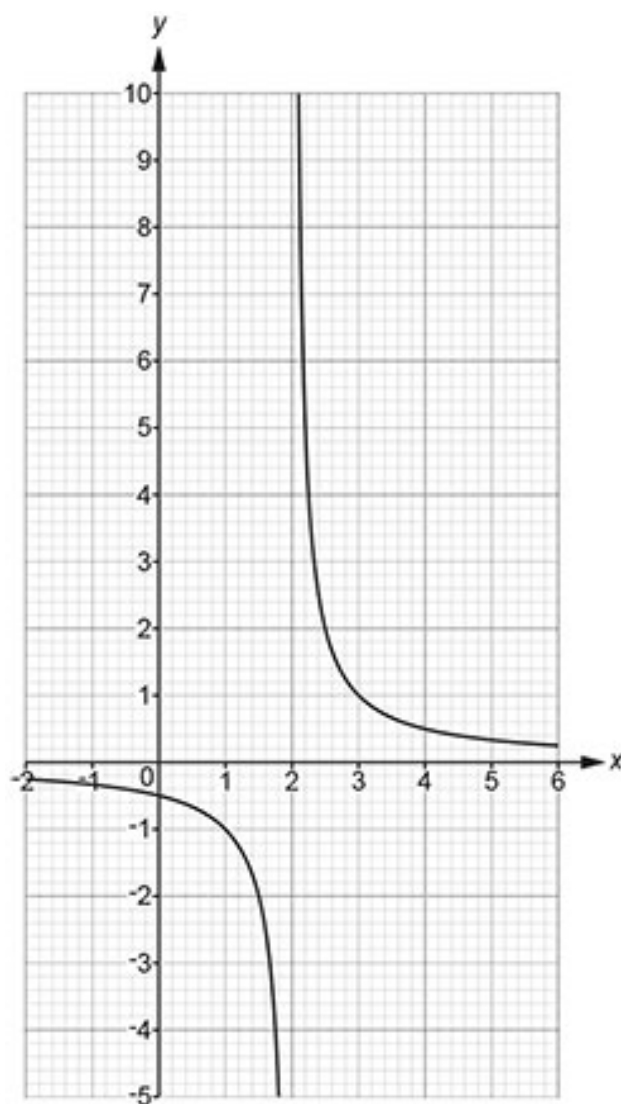
When the input is x , the output is y .



Write an algebraic expression for x in terms of y .

$\dots\dots\dots$ [2]

17(a). The graph of $y = \frac{1}{x-2}$ is drawn on the grid for $-2 \leq x \leq 6$.



There are no values of x for which $\frac{1}{x-2} = k$.

Find the value of k .

$k = \dots\dots\dots$ **[1]**

(b).

- i. **Use the graph** to find approximate solutions to the equation $\frac{1}{x-2} = 3x - 1$.
 Give your answers to **1** decimal place.
 Show your working on the graph.

$x = \dots\dots\dots$ or $x = \dots\dots\dots$ **[4]**

- ii. Show algebraically that $\frac{1}{x-2} = 3x - 1$ has the same solutions as $3x^2 - 7x + 1 = 0$.

[4]**18(a).**

By factorising, find the roots of $y = x^2 + 18x + 77$.

$x = \dots\dots\dots$ and $x = \dots\dots\dots$ **[3]**

(b).

- i. Write $y = x^2 + 18x + 77$ in the form $y = (x + a)^2 - b$.

$y = \dots\dots\dots$ [3]

- ii. Write down the coordinates of the turning point of the graph of $y = x^2 + 18x + 77$.

($\dots\dots\dots$, $\dots\dots\dots$) [2]

19. Find all the possible integer values that satisfy the inequality $-4 \leq x - 3 < 1$.

$\dots\dots\dots$ [3]

20(a). The next term in a Fibonacci sequence is found by adding together the two previous terms.

- i. The first and second terms of a particular Fibonacci sequence are x and y .

Show that the fourth term of the sequence can be written as $x + 2y$.

[2]

- ii. The fourth term of the same Fibonacci sequence is 7.
The seventh term of the sequence is 31.

Work out the value of x and the value of y .
You must show your working.

$x = \dots\dots\dots$

$y = \dots\dots\dots$ **[6]**

(b). Here are the first four terms of a sequence.

$$1 \qquad \sqrt{3} \qquad 3 \qquad 3\sqrt{3}$$

Write an expression for the n th term.

..... **[2]**

(c). Here are the first four terms of a quadratic sequence.

$$-1 \qquad 5 \qquad 13 \qquad 23$$

The n th term is $n^2 + bn + c$

Find the value of b and the value of c .

$b =$
 $c =$ **[3]**

21. Solve algebraically.

$$\begin{aligned}x^2 + y^2 &= 18 \\ y &= x - 6\end{aligned}$$

$$\begin{aligned}x &= \\ y &= \quad \mathbf{[5]}\end{aligned}$$

22(a). Describe the error in the method below and give the correct answer.

Question:

Rearrange $y = 3x + 17$ to make x the subject.

Solution:

$$y = 3x + 17$$

$$y + 17 = 3x$$

$$x = \frac{y + 17}{3}$$

Error is _____

Correct answer **[2]**

(b).

Question:

Rearrange $A = 4x^2$ to make x the subject, where $x > 0$.

Solution:

$$A = 4x^2$$

$$\sqrt{A} = \sqrt{4x^2}$$

$$\sqrt{A} = 4x$$

$$x = \frac{\sqrt{A}}{4}$$

Error is

Correct answer [2]

23. You may use these kinematics formulae to answer this question.

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

A particle has an initial velocity of 3 m/s.

After 20 seconds the particle has a velocity of 11 m/s.

Work out the distance the particle has travelled after 20 seconds.

..... m [4]

24(a). Write as a single fraction in its simplest form.

$$\frac{4}{2n+3} - \frac{2n}{n^2+1}$$

..... **[4]**

(b). simplify

$$\frac{x^2 - x - 12}{2x^2 - 3x - 20}$$

..... **[5]**

25. Solve this inequality.

$x^2 + 4x - 12 \leq 0$

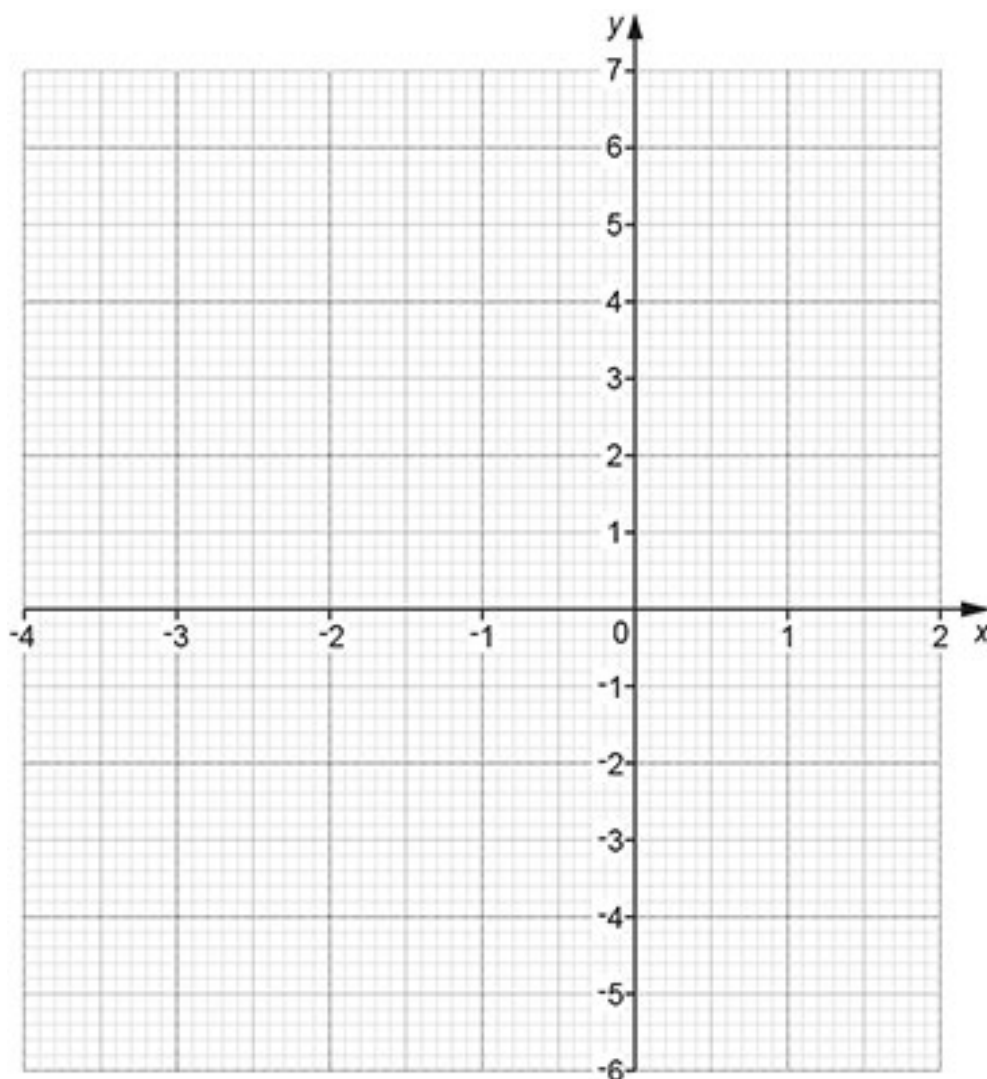
Give your answer using set notation.
You must show your working.

..... [5]

26(a). Here is a table of values for $y = x^2 + 2x - 2$.

x	-4	-3	-2	-1	0	1	2
y	6	1	-2	-3	-2	1	6

Draw the graph of $y = x^2 + 2x - 2$ for $-4 \leq x \leq 2$.

**[3]**

(b). Write down the equation of the line of symmetry of the graph.

..... **[1]**

(c). Use the graph to solve the equation $x^2 + 2x - 2 = 0$.
Give your answers to **1** decimal place.

(c) $x =$ or $x =$ **[2]**

27. $(x + 2)(3x + a)(bx + 3) = 6x^3 + 11x^2 - 17x - 30$

Find the value of a and the value of b .

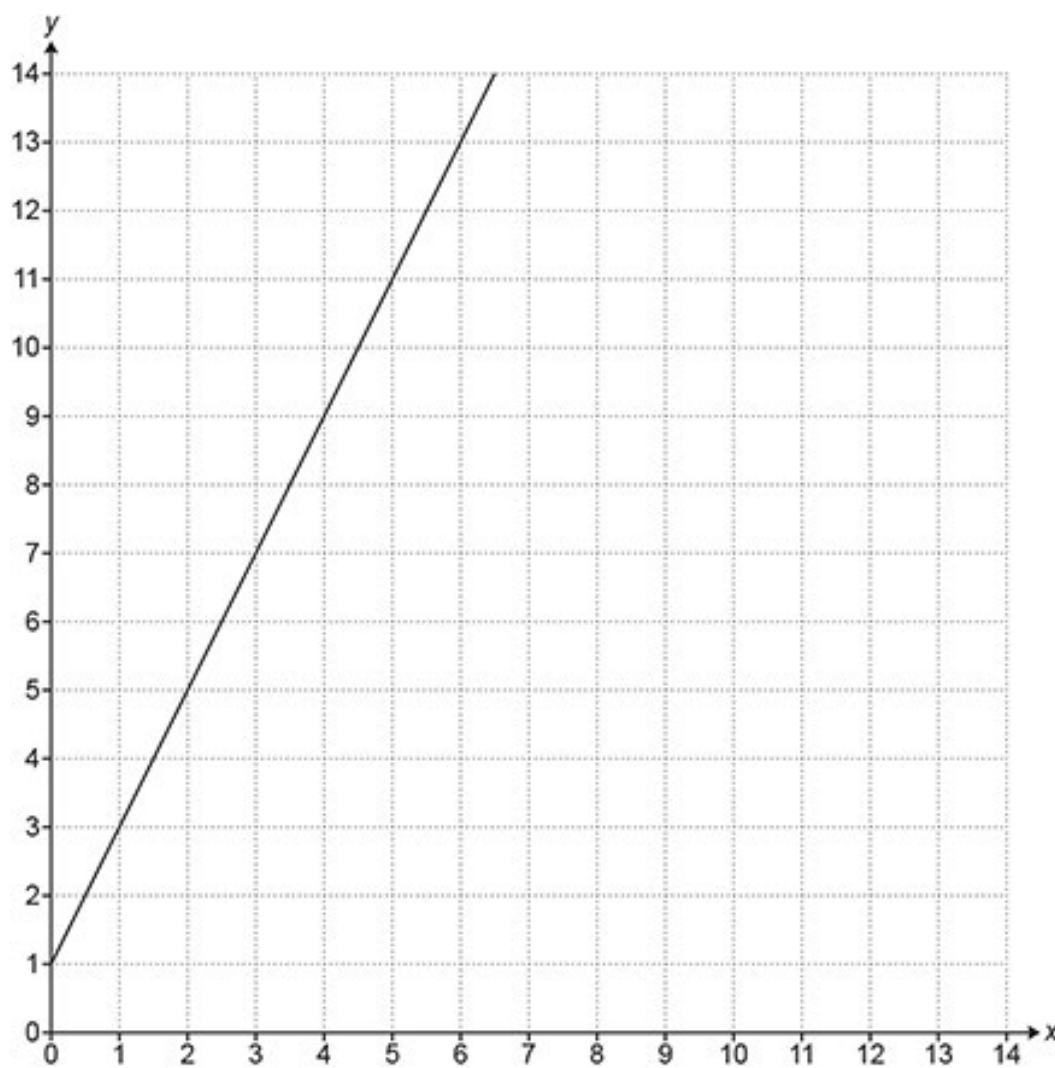
$a =$

$b =$ **[2]**

28. Use algebra to prove that an odd number multiplied by a different odd number always gives an answer that is an odd number.

[4]

29. The graph of $y = 2x + 1$ is drawn on this one centimetre grid.



The region **R** satisfies these inequalities.

$$\begin{aligned}y &\leq 2x + 1 \\y &\geq 5 \\x + y &\leq 13\end{aligned}$$

Show that the area of region **R** is 12 cm^2 .

[6]

30(a).Write $x^2 - 8x + 9$ in the form $(x - a)^2 - b$ **[3]****(b).** Use your answer from part **(a)** to solve.

$$x^2 - 8x + 9 = 0$$

Give your answers in exact form.
You must show your working.

 $x = \dots\dots\dots$ or $x = \dots\dots\dots$ **[2]**
31. You are given that

$$\frac{10a^k \times a^8}{ma^5} = \frac{2a^7}{5}$$

where k and m are integers.Find the value of k and the value of m .
 $k = \dots\dots\dots$ and $m = \dots\dots\dots$ **[4]**

32. Amir, Beth and Charlie work in a cafe.

Customers give spare change as tips.

At the end of each week, Amir, Beth and Charlie share the total amount of tips between them in the ratio matching the number of hours they worked that week.

This week:

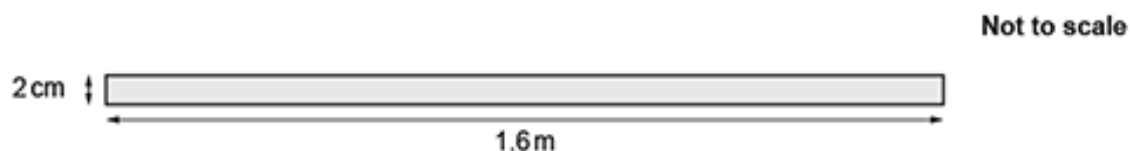
- Amir's share of the tips was £25.40.
- Beth worked twice as many hours as Amir.
- Charlie worked 5 more hours than Amir.
- The total hours worked by Amir, Beth and Charlie was 85 hours.

Calculate the total amount of tips received this week.

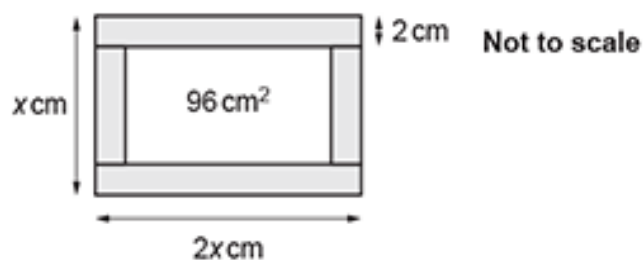
You must show your working.

£..... [6]

33. Charlie is making some wooden frames.
Charlie has a strip of wood 1.6 m long and 2 cm wide.



Each frame will be made from four pieces of wood cut from the strip to form a rectangle, as shown below.

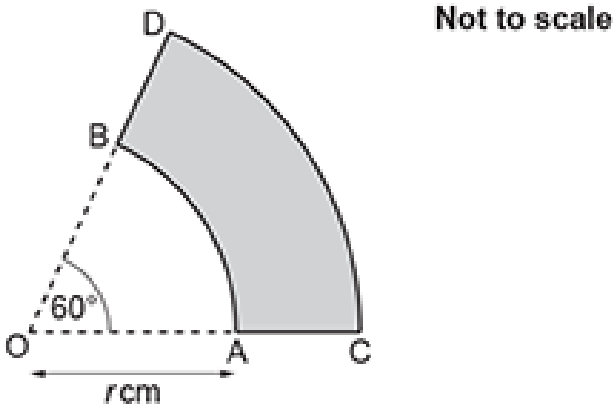


The width of each frame is x cm.
The length of each frame is $2x$ cm.
The area enclosed by each frame must be 96 cm^2 .

Work out the maximum number of frames Charlie can make from the 1.6 m length of wood.
You must show your working.

..... **[6]**

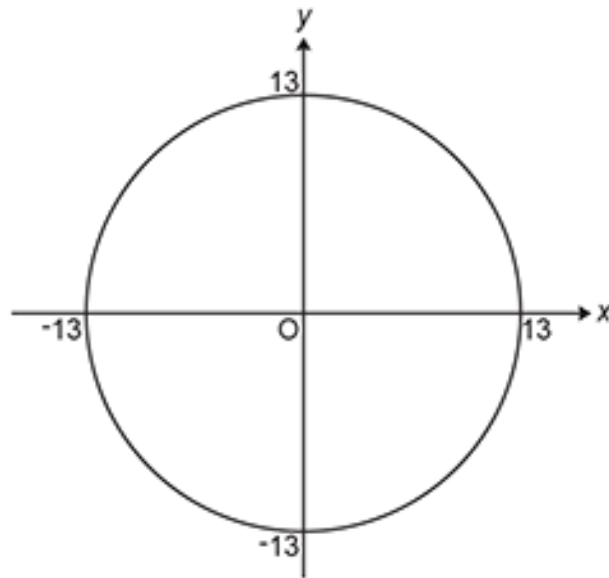
34. The diagram shows a shaded shape made by removing sector OAB from sector OCD.
Both sectors have an angle of 60° .
The radius, OA, of the smaller sector is r cm.
The ratio of radius OA to radius OC is 2 : 3.



Work out, in terms of π and r , the **total** length of arc AB and arc CD.
Give your answer in its simplest form.
You must show your working.

..... cm **[5]**

35. The graph below shows a circle with centre $(0, 0)$ and equation $x^2 + y^2 = 169$.



Show that the point $(-12, 5)$ lies on the circumference of the circle.

[2]

36(a). A car accelerates at 4.06 m/s^2 for 10.1 seconds from an initial velocity of 2.93 m/s .

Harper rounds each value to 1 significant figure.

Harper uses the rounded values and the formula

$$s = ut + \frac{1}{2}at^2$$

to estimate the distance travelled in the 10.1 seconds.

Harper's answer is 430 metres.

Using Harper's method, show that their answer is wrong.

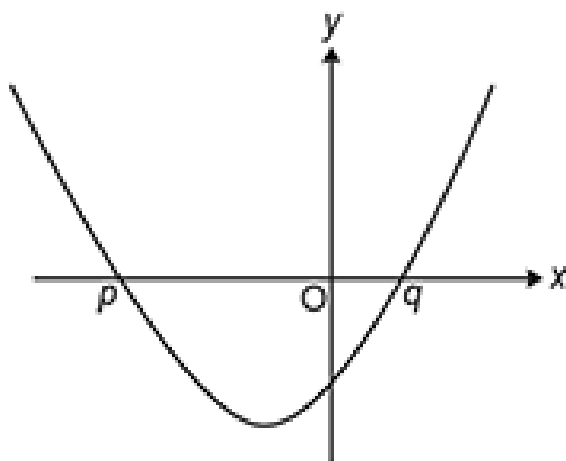
[4]

(b). Rearrange this formula to make t the subject.

$$s = \frac{1}{2}at^2$$

..... **[3]**

The roots of the equation $x^2 + 6x - 2 = 0$ are at p and q .

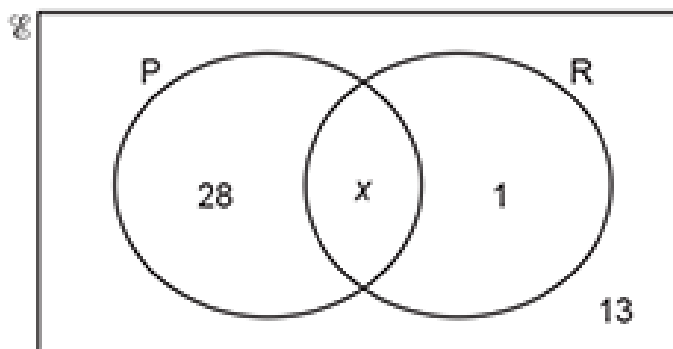


- (i) $y = \dots\dots\dots$ [1]

- [2]**

- [1]

The Venn diagram shows some of the results.
 x students liked both types of music.



The ratio of the number of students who liked pop to the number who liked rap was 5 : 2.

Work out the **total** number of students in the survey.

(a) [4]

(b). One of the students is selected at random.

Find the probability that this student does **not** like rap given that they like pop.

..... [2]

39(a). y is inversely proportional to the square root of x . $y = 5$ when $x = 36$.

Find a formula linking x and y .

..... [3]

(b). Find the value of x when $y = 20$.

$x =$ [3]

40(a).

Show that the equation $x^3 - 5x - 1 = 0$ has a solution between $x = 2$ and $x = 3$.

[3]

(b). Find this solution correct to **1** decimal place.
You must show your working.

$x = \dots\dots\dots$ **[4]**

41(a). The following kinematics formulas may be used in this question.

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

The initial velocity of a particle is 20 m/s. The acceleration of the particle is -8 m/s^2 . After t seconds, the particle has travelled 25 m.

Show that $4t^2 - 20t + 25 = 0$.

[3]

(b). Solve $4t^2 - 20t + 25 = 0$.

$t = \dots\dots\dots$ **[3]**

(c). Show that the particle is stationary when it has travelled 25 m.

[3]

42. Rearrange this formula to make y the subject.

$$\frac{5y + 2}{y} = \frac{3t - 7}{2}$$

$\dots\dots\dots$ **[5]**

43. Multiply out and simplify.

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

$\dots\dots\dots$ **[2]**

44. A bag of sweets contains jellies, mints and toffees.

The ratio of jellies to mints is $n : 2$.

The ratio of mints to toffees is $5 : 3n$.

Work out the ratio of jellies to toffees.

Give your answer in its simplest form.

..... : **[4]**

45. Simplify fully.

$$\frac{2x^2 - 50}{x^2 + 7x + 10}$$

..... **[5]**

46. $x^2 - 2y = 5$ and $4y + z = 7$.

Write z in terms of x .

Give your answer in its simplest form.

..... **[4]**

47. n is a positive integer.

Prove that $(2n + 1)(n - 3)(n + 2) + 3n(n + 7)$ is always even.

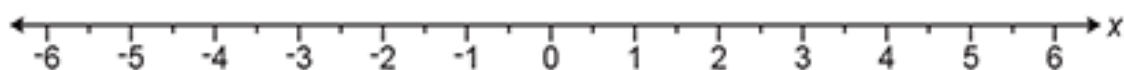
..... [6]

48(a). Solve the inequality.

$$4(x - 3) < x$$

..... s[3]

(b). Show your answer to **part above** on the number line.



[2]

49. Force is measured in newtons (N).

A force of 198.5 N is applied to a rectangular surface of length 4.9 cm and width 4.1 cm.

Work out an **estimate** of the pressure, in N / cm², applied to this rectangular surface.

[The formula for pressure is: $\text{Pressure} = \frac{\text{Force}}{\text{Area}}$]

..... N / cm² **[4]**

50. Here are the first four terms of a quadratic sequence.

-1 3 13 29

The n th term is $an^2 + bn + c$.

Find the values of a , b and c .

$a =$

$b =$

$c =$ **[4]**

51. Solve algebraically.

$$\begin{aligned}y &= x + 3 \\(x - 3)^2 + y^2 &= 50\end{aligned}$$

You must show your working.

$$\begin{aligned}x &= \dots\dots\dots y = \dots\dots\dots \\x &= \dots\dots\dots y = \dots\dots\dots \mathbf{[5]}\end{aligned}$$

52. Alex, Blake and Charlie play a computer game.

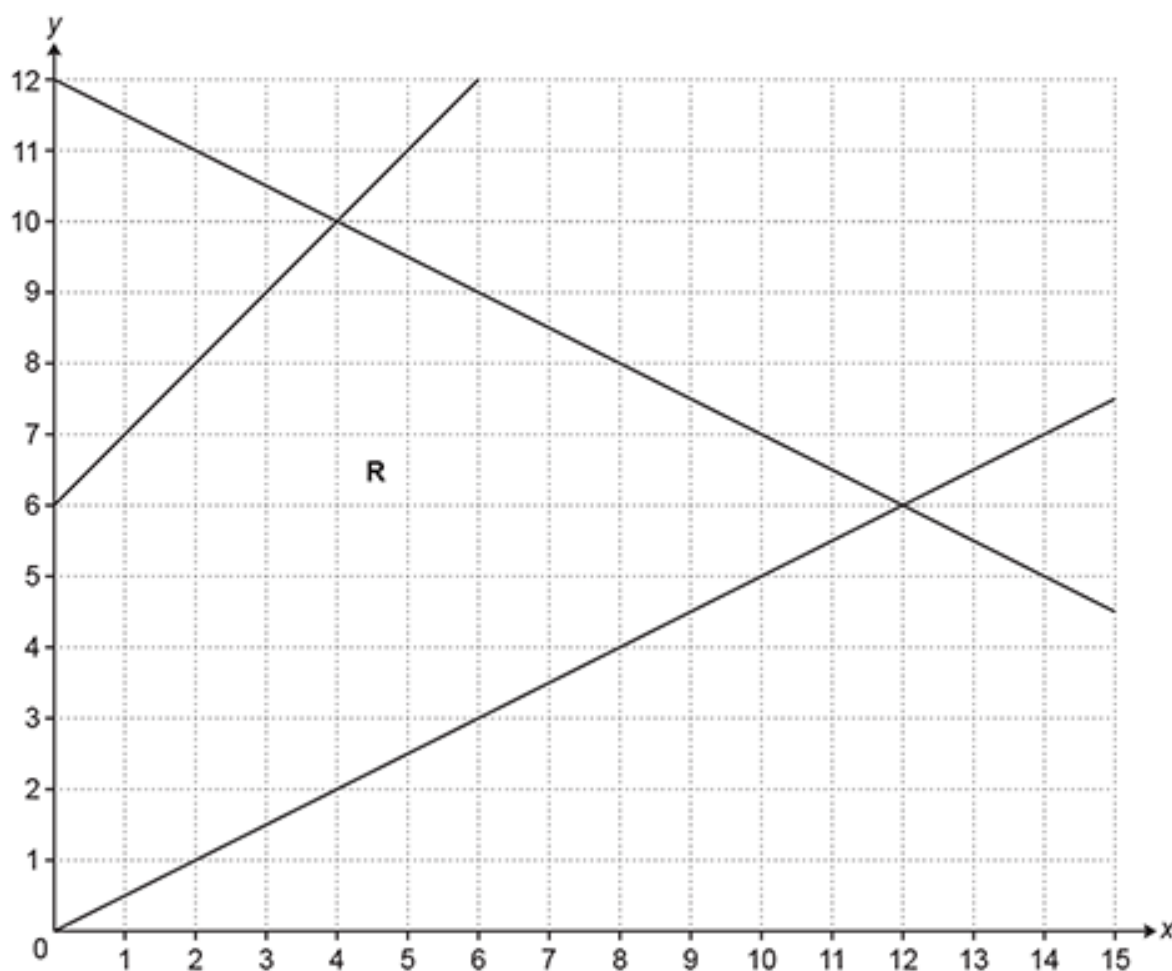
Alex goes first and scores n points.

- Blake scores 8 points less than 3 times the number of points scored by Alex.
- Charlie scores 25 more points than Blake.
- The three people score a total of 618 points.

Work out how many points they each score.
You must show your working.

Alex =
Blake =
Charlie = **[7]**

53(a). The region **R** is shown on this grid.



Region **R** is defined by four inequalities.
One of the inequalities is $x \geq 0$.

Use the symbols $\leq$ and $\geq$ to complete the other three inequalities.

$$x \geq 0$$

$$y \leq \frac{1}{2}x$$

$$x + 2y \leq 24$$

$$y \leq -\frac{1}{2}x + 6$$

[2]

(b). The inequality $x \geq 0$ is replaced by a new inequality.
Region **R** is then a kite.

Write down the new inequality.

..... [3]

54. Find the coordinates of the turning point of the graph of $y = x^2 + 6x + 17$.

(..... ,)**[4]**

55. Simplify.

$$x^{12} \div x^4$$

..... **[1]**

END OF QUESTION PAPER