



Student name: _____

NIVEL SECUNDARIO

Unit 0: Algebra and Graphs**The aims are to enable students to:**

- Use letters to express generalized numbers and express basic arithmetic processes algebraically.
- Substitute numbers for words and letters in complicated formulae.
- Construct and rearrange complicated formulae and equations.
- Manipulate directed numbers.
- Use brackets and extract common factors.
- Expand products of algebraic expressions. Factorize where possible expressions of the form:
$$ax + bx + kay + kby$$
$$a^2x^2 - b^2y^2$$
$$a^2 + 2ab + b^2$$
$$ax^2 + bx + c$$
- Manipulate algebraic fractions.
- Factorize and simplify rational expressions.
- Use and interpret positive, negative and zero indices.
- Use and interpret fractional indices. Use the rules of indices.
- Derive and solve linear equations in one unknown.
- Derive and solve simultaneous linear equations in two unknowns.
- Derive and solve simultaneous equations, involving one linear and one quadratic.
- Derive and solve quadratic equations by factorization, completing the square and by use of the formula.
- Derive and solve linear inequalities.
- Demonstrate familiarity with Cartesian coordinates in two dimensions.
- Find the gradient of a straight line.
- Calculate the gradient of a straight line from the coordinates of two points on it.
- Calculate the length and the coordinates of the midpoint of a straight line from the coordinates of its end points.
- Interpret and obtain the equation of a straight-line graph.
- Determine the equation of a straight line parallel to a given line.
- Find the gradient of parallel and perpendicular lines.
- Represent inequalities graphically and use this representation to solve simple linear programming problems.
- Use function notation, e.g., $f(x) = 3x - 5$, $f: x \rightarrow 3x - 5$, to describe simple functions. Find inverse functions $f^{-1}(x)$. Form composite functions as defined by $gf(x) = g[f(x)]$.
- Construct tables of values and draw graphs for functions of the form ax^n (and simple sums of these) and functions of the form $ab^x + c$.
- Solve associated equations approximately, including finding and interpreting roots by graphical methods.
- Draw and interpret graphs representing exponential growth and decay problems.
- Recognize, sketch, and interpret graphs of functions.
- Estimate gradients of curves by drawing tangents.



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Exercise 1

Solve the simultaneous equations

$$\frac{1}{2}x + 2y = 16,$$

$$2x + \frac{1}{2}y = 19.$$

Answer $x =$

.....

y =

Exercise 2

The points A(6,2) and B(8,5) lie on a straight line.

- (a) Work out the gradient of this line.

Answer (a)

- (b) Work out the equation of the line, giving your answer in the form $y = mx + c$.

Answer (b)



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Exercise 3

Solve

(a) $0.2x + 3.6 = 1.2,$

Answer (a) $x = \dots$

(b) $\frac{2 - 3x}{5} < x + 2.$

Answer (b) \dots **Exercise 4**

Simplify

$$\frac{x+2}{x} - \frac{x}{x+2}.$$

Write your answer as a fraction in its simplest form.



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Exercise 5

Write the number 2381.597 correct to

- (a) 3 significant figures,

Answer(a)

- (b) 2 decimal places,

Answer(b)

- (c) the nearest hundred.

Answer(c)

Exercise 6

Make d the subject of the formula

$$c = \frac{d^3}{2} + 5 .$$

Exercise 7

Factorise completely

- (a) $7ac + 14a$,

Answer(a)

- (b) $12ax^3 + 18xa^3$.

Answer(b)

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Exercise 8

Solve the inequality

$$4 - 5x < 2(x + 4).$$

Exercise 9

Simplify

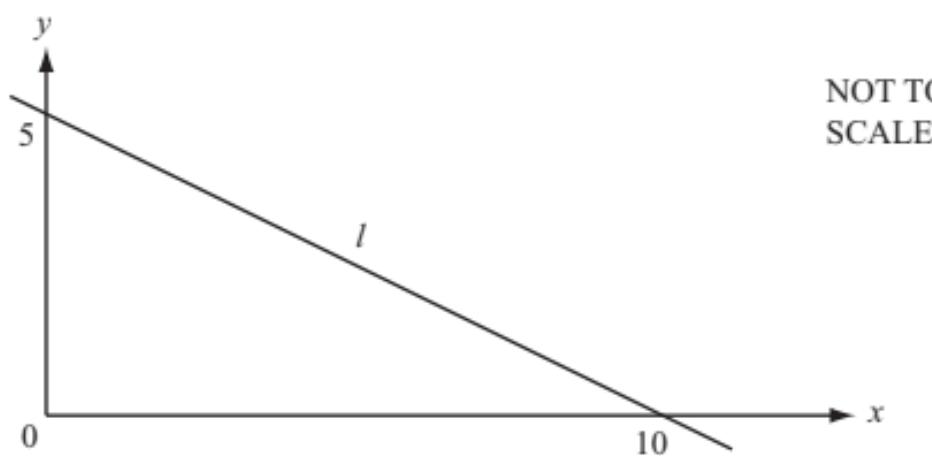
(a) $\left(\frac{x^{27}}{27} \right)^{\frac{2}{3}},$

Answer(a)

(b) $\left(\frac{x^{-2}}{4} \right)^{-\frac{1}{2}}.$

Answer(b)

Exercise 10





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- (a) Calculate the gradient of the line l .

Answer(a)
.....

- (b) Write down the equation of the line l .

Answer(b)
.....

Exercise 11

Write as a single fraction in its simplest form

$$\frac{5}{x} - \frac{4}{x+1}.$$

Answer
.....

Exercise 12

$$f(x) = \frac{x+3}{x}, \quad x \neq 0.$$

- (a) Calculate $f\left(\frac{1}{4}\right)$.

Answer(a)
.....



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(b) Solve $f(x) = \frac{1}{4}$.Answer(b) $x = \dots$ **Exercise 13**

Solve the simultaneous equations

$$\begin{aligned}0.4x + 2y &= 10, \\0.3x + 5y &= 18.\end{aligned}$$

Answer $x = \dots$ $y = \dots$ **Exercise 14**

Solve the equation

$$\frac{x-2}{4} = \frac{2x+5}{3}.$$

Answer $x = \dots$



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Exercise 15

Angharad had an operation costing \$500.

She was in hospital for x days.

The cost of nursing care was \$170 for each day she was in hospital.

- (a) Write down, in terms of x , an expression for the total cost of her operation and nursing care.

Answer(a) \$

- (b) The total cost of her operation and nursing care was \$2370.

Work out how many days Angharad was in hospital.

Answer(b)

Exercise 16

Factorise

(a) $4x^2 - 9$,

Answer(a)

(b) $4x^2 - 9x$,

Answer(b)

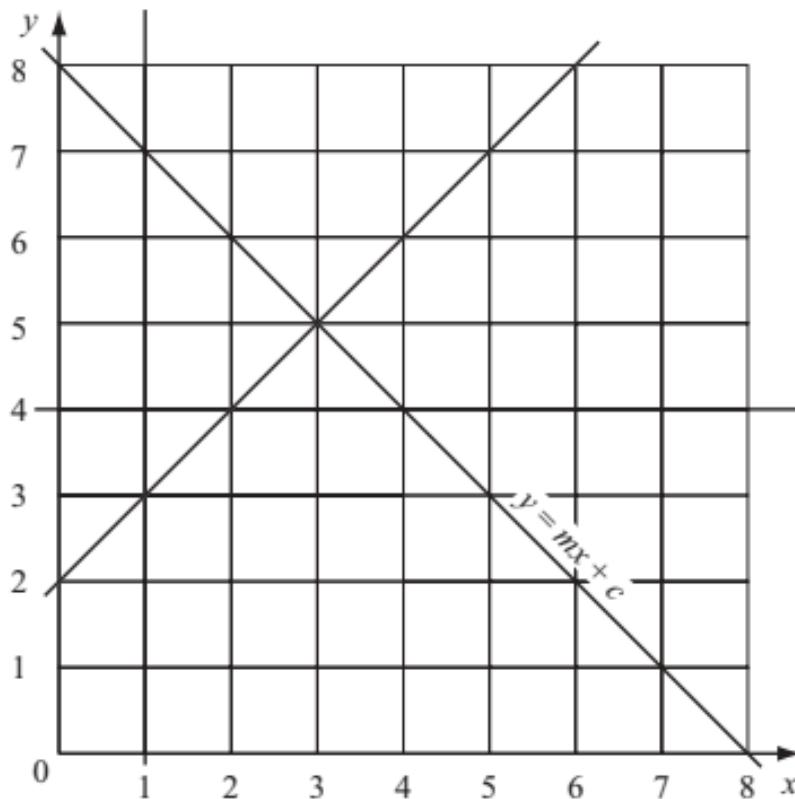
(c) $4x^2 - 9x + 2$.

Answer(c)

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Exercise 17



- (a) One of the lines in the diagram is labelled $y = mx + c$.
 Find the values of m and c .

Answer(a) $m = \dots$

$c = \dots$

- (b) Show, by shading all the **unwanted** regions on the diagram, the region defined by the inequalities

$$x \geq 1, \quad y \leq mx + c, \quad y \geq x + 2 \quad \text{and} \quad y \geq 4.$$

Write the letter **R** in the region required.



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Exercise 18

(a)

$$\frac{2}{3} + \frac{5}{6} = \frac{x}{2}.$$

Find the value of x .Answer(a) $x = \dots$

(b)

$$\frac{5}{3} \div \frac{3}{y} = \frac{40}{9}.$$

Find the value of y .Answer(b) $y = \dots$ **Exercise 19**f: $x \mapsto 5 - 3x$.(a) Find $f(-1)$.Answer(a) \dots (b) Find $f^{-1}(x)$.Answer(b) \dots (c) Find $ff^{-1}(8)$.Answer(c) \dots

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Exercise 20

Solve the equations

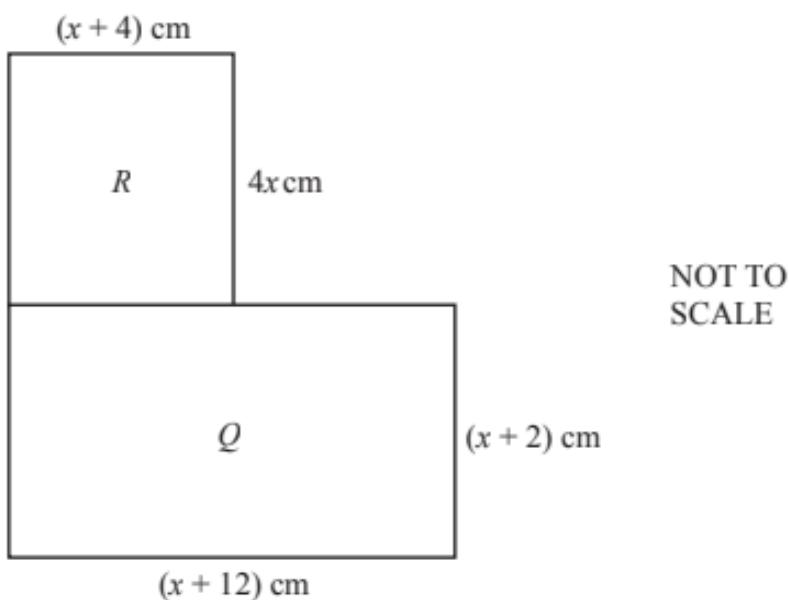
(a) $0.2x - 3 = 0.5x,$

Answer(a) $x = \dots\dots\dots$

(b) $2x^2 - 11x + 12 = 0.$

Answer(b) $x = \dots\dots\dots$ or $x = \dots\dots\dots$

Exercise 21



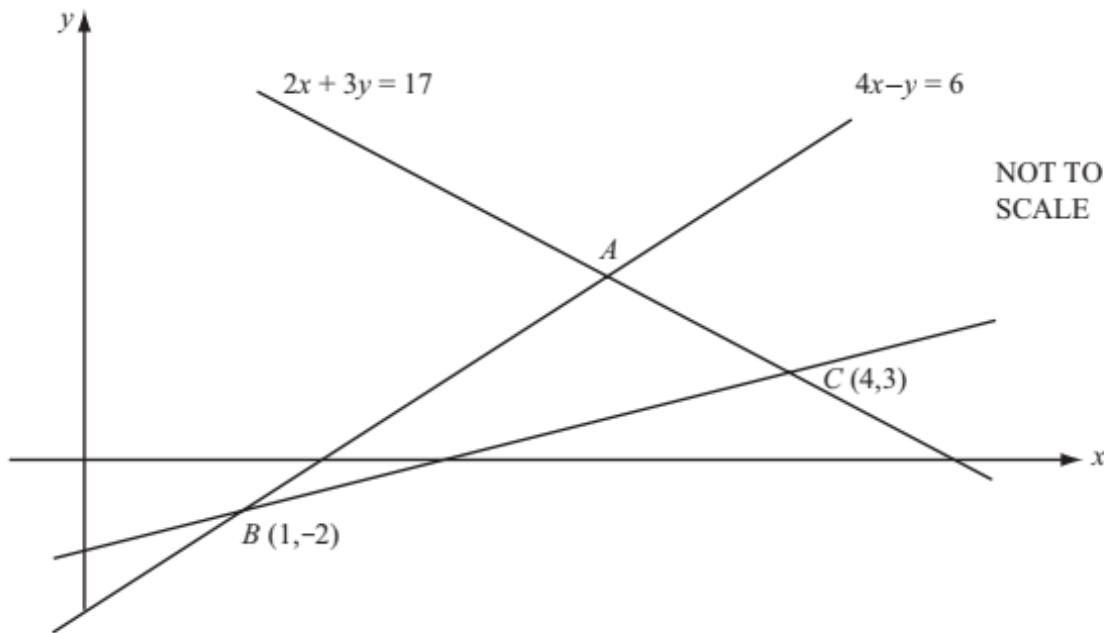
- (a) (i) Write down an expression for the area of rectangle R.

Answer(a) (i) cm^2

(ii) Show that the total area of rectangles R and Q is $5x^2 + 30x + 24$ square centimetres.

- (b) The total area of rectangles R and Q is 64 cm^2 .
Calculate the value of x correct to 1 decimal place.

Exercise 22



In the diagram, the line AC has equation $2x + 3y = 17$ and the line AB has equation $4x - y = 6$.
The lines BC and AB intersect at $B(1, -2)$.
The lines AC and BC intersect at $C(4, 3)$.

- (a) Use algebra to find the coordinates of the point A .

- (b) Find the equation of the line BC .

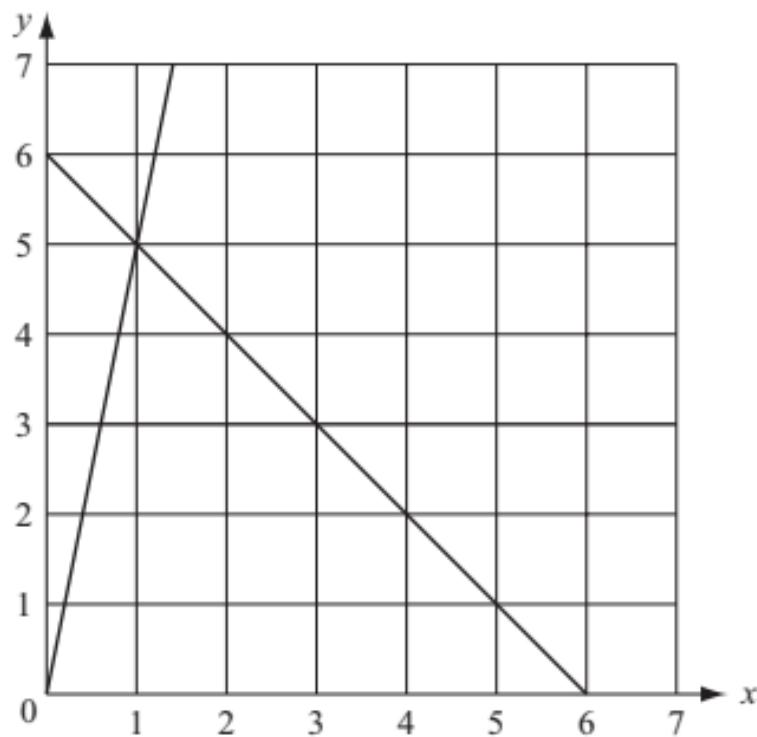
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Exercise 23

Write as a fraction in its simplest form

$$\frac{x-3}{4} + \frac{4}{x-3}.$$

Exercise 24

By shading the **unwanted** parts of the grid above, find and label the region R which satisfies the following three inequalities

$$y \geq 3, \quad y \geq 5x \quad \text{and} \quad x + y \leq 6.$$



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Exercise 25

The function $f(x)$ is given by

$$f(x) = 3x - 1.$$

Find, in its simplest form,

(a) $f^{-1}f(x)$,

Answer(a)
.....

(b) $ff(x)$.

Answer(b)
.....

Exercise 26

(a) $\sqrt{32} = 2^p$. Find the value of p .

Answer(a) $p =$

(b) $\sqrt[3]{\frac{1}{8}} = 2^q$. Find the value of q .

Answer(b) $q =$

Exercise 27

The equation of a straight line can be written in the form $3x + 2y - 8 = 0$.

(a) Rearrange this equation to make y the subject.

Answer(a) $y =$



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- (b) Write down the gradient of the line.

Answer(b)

- (c) Write down the co-ordinates of the point where the line crosses the y axis.

Answer(c) (..... ,)

Exercise 28

Solve the simultaneous equations

$$2x + \frac{1}{2}y = 1,$$

$$6x - \frac{3}{2}y = 21.$$

Answer $x =$

$y =$

Exercise 29

$x^2 + 4x - 8$ can be written in the form $(x + p)^2 + q$.

Find the values of p and q .

Answer $p =$ and $q =$

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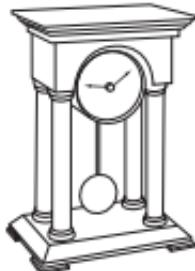
Exercise 30

Solve the equations

(a) $\frac{2x}{3} - 9 = 0,$

Answer(a) $x =$
.....

(b) $x^2 - 3x - 4 = 0.$

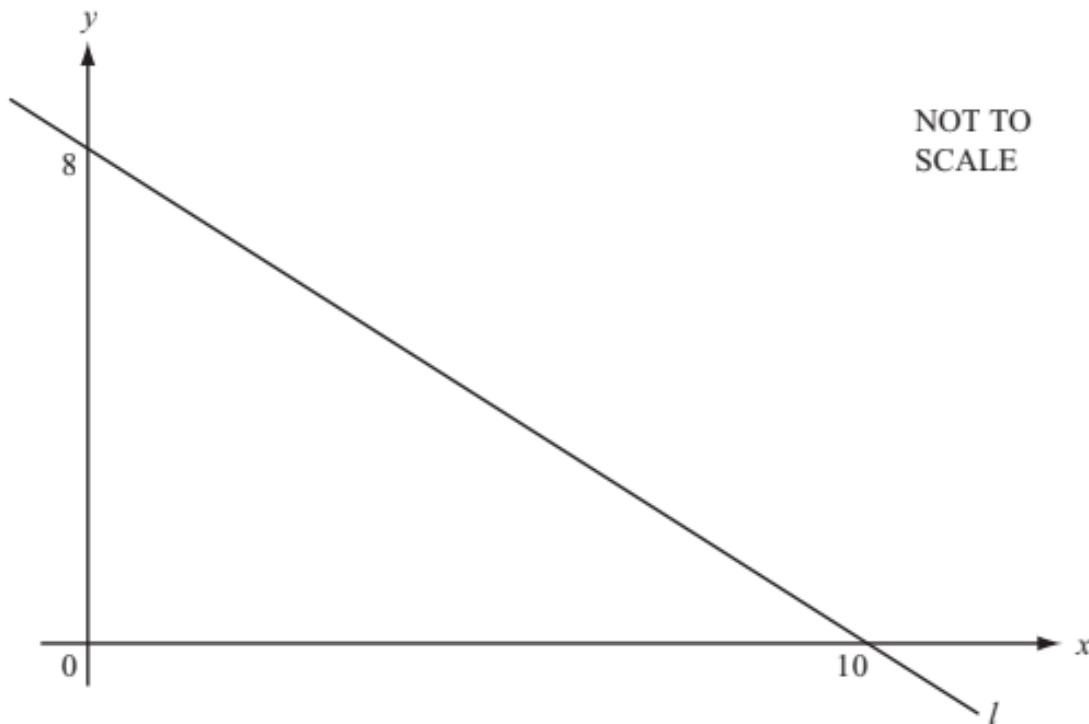
Answer(b) $x =$ or $x =$ **Exercise 31**The length of time, T seconds, that the pendulum in the clock takes to swing is given by the formula

$$T = \frac{6}{\sqrt{(1+g^2)}}.$$

Rearrange the formula to make g the subject.

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Exercise 32

The line l passes through the points $(10, 0)$ and $(0, 8)$ as shown in the diagram.

- (a) Find the gradient of the line as a fraction in its simplest form.

Answer(a)

- (b) Write down the equation of the line parallel to l which passes through the origin.

Answer(b)

- (c) Find the equation of the line parallel to l which passes through the point $(3, 1)$.

Answer(c) $y =$



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Exercise 33

- (a) Simplify $(27x^6)^{\frac{1}{3}}$.

Answer(a)
.....

- (b) $(512)^{-\frac{2}{3}} = 2^p$. Find p .

Answer(b) $p =$
.....**Exercise 34**

- (a) The table shows corresponding values of x and y for the function

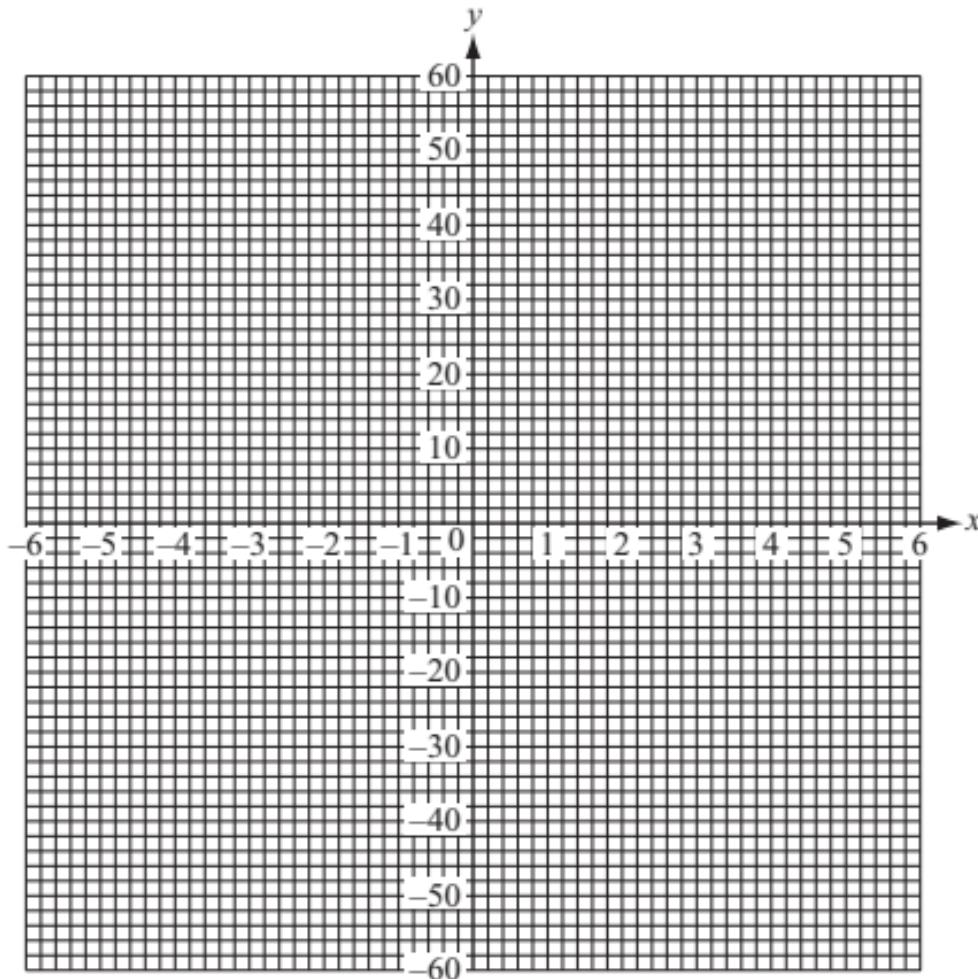
$$y = \frac{60}{x} \quad (x \neq 0).$$

x	-6	-5	-4	-3	-2	-1	1	2	3	4	5	6
y		-12	-15		-30		60				12	10

- (i) Fill in the missing values of y in the table above.
(ii) Plot the points on the grid below and draw the graph for $-6 \leq x \leq -1$ and $1 \leq x \leq 6$.

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- (b) Write down the order of rotational symmetry of the graph.

Answer(b)

- (c) Draw the lines of symmetry of the graph on the grid.

- (d) One line of symmetry intersects the graph at two points.

- (i) Write down the co-ordinates of these two points.

Answer(d)(i) (..... ,) and (..... ,)

- (ii) Write down the equation of this line of symmetry.

Answer(d)(ii)

- (e) Find the gradient of the other line of symmetry.

Answer(e)

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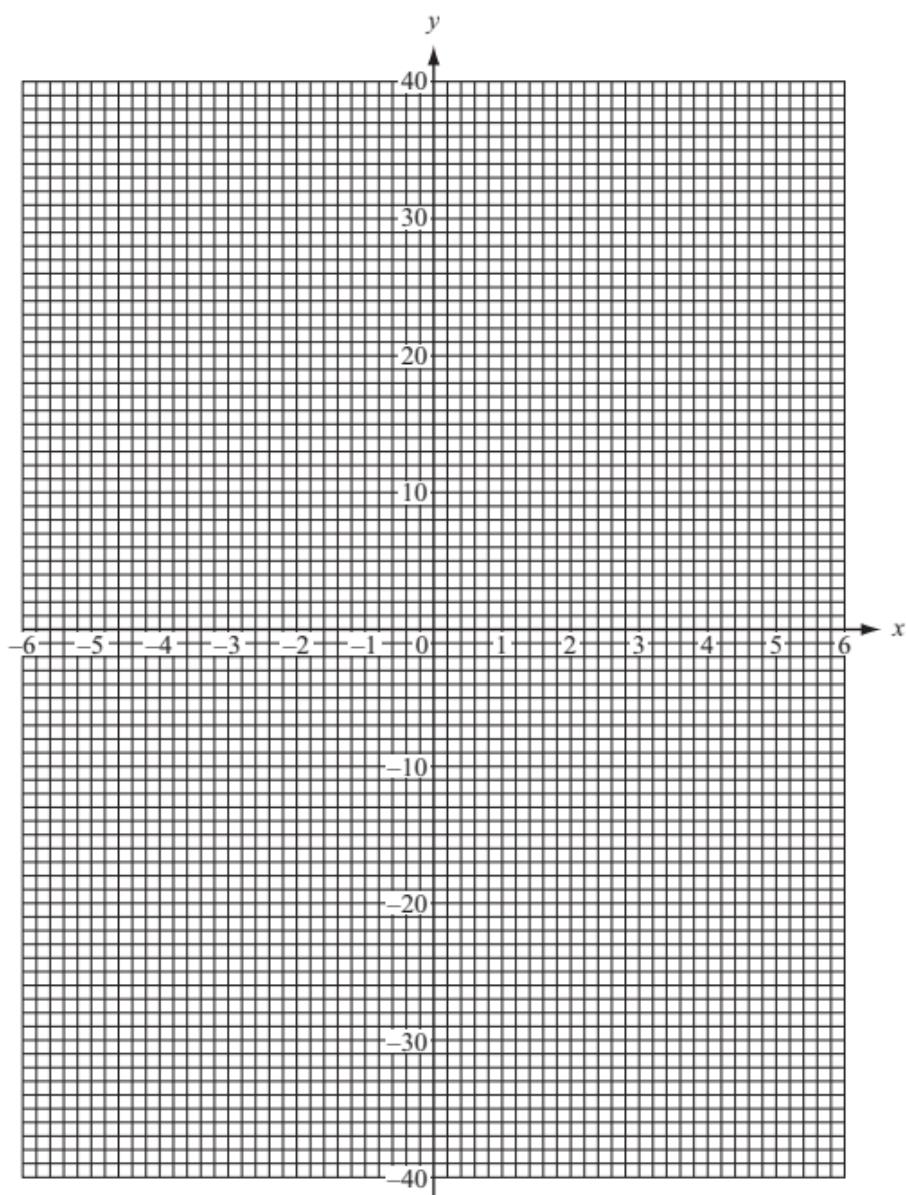
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Exercise 35

- (a) Complete the table for the function $y = \frac{36}{x}$, ($x \neq 0$).

x	-6	-5	-4	-3	-2	-1		1	2	3	4	5	6
y		-7.2	-9		-18			18		9	7.2		

- (b) On the grid below, draw the graph of $y = \frac{36}{x}$ for $-6 \leq x \leq -1$ and $1 \leq x \leq 6$.



- (c) Use your graph to find x when $y = 21$.

Answer(c) $x =$

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- (d) Complete the table for the function $y = x^2$.

x	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6
y		25	16		4	1		1	4		16	25	

- (e) On the same grid, draw the graph of $y = x^2$ for $-6 \leq x \leq 6$.

- (f) Write down the co-ordinates of the point of intersection of the graphs of $y = \frac{36}{x}$ and $y = x^2$.

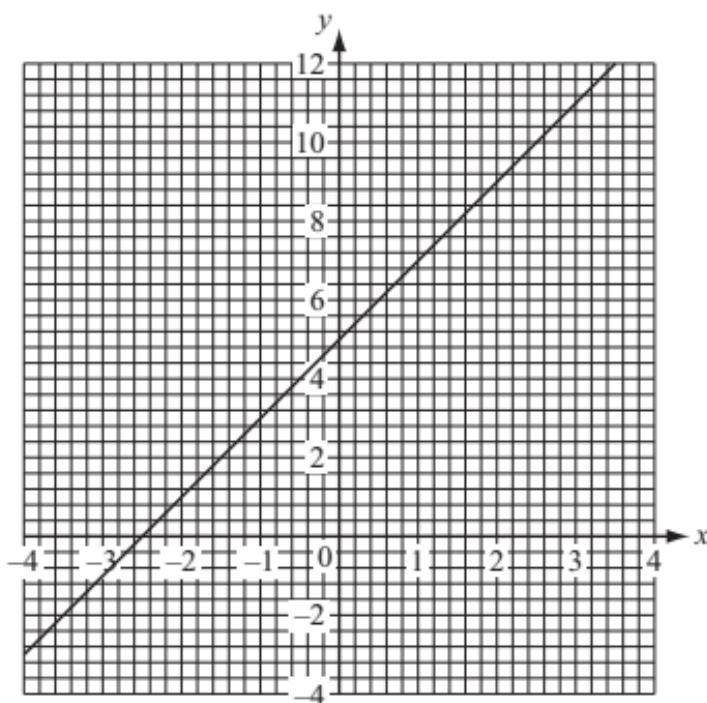
Answer(f)(..... ,)

Exercise 36

- (a) The equation of a straight line is $y = mx + c$.
 Which letter in this equation represents the gradient?

Answer(a)

(b)



Write down the equation of the line shown on the grid above.

Answer(b)

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- (c) Complete the table of values for $y = 12 - x^2$.

x	-4	-3	-2	-1	0	1	2	3	4
y	-4	3		11		11	8		-4

- (d) On the grid above, draw the graph of $y = 12 - x^2$.

- (e) Write down the coordinates of the points of intersection of the straight line with your curve.

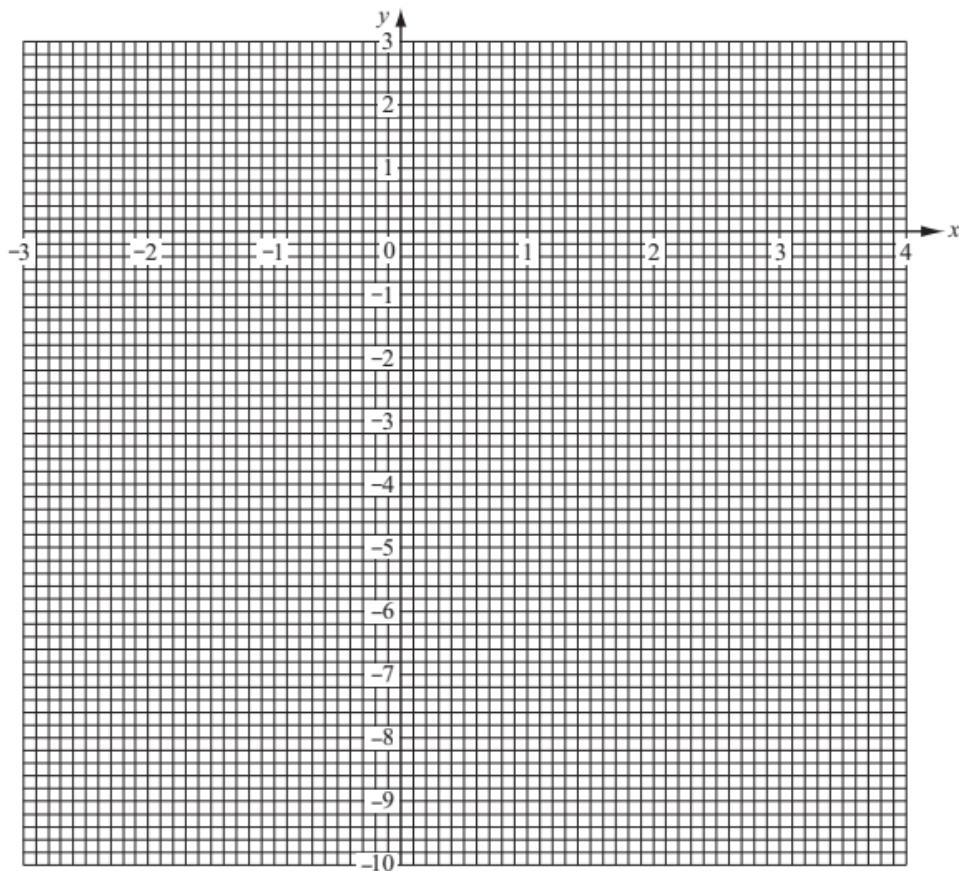
Answer(e) (.....,) and (.....,

Exercise 37

- (a) Complete the table for the equation $y = -x^2 + x + 2$.

x	-3	-2	-1	0	1	2	3	4
y	-10		0	2	2	0		

- (b) On the grid below draw the graph of $y = -x^2 + x + 2$.





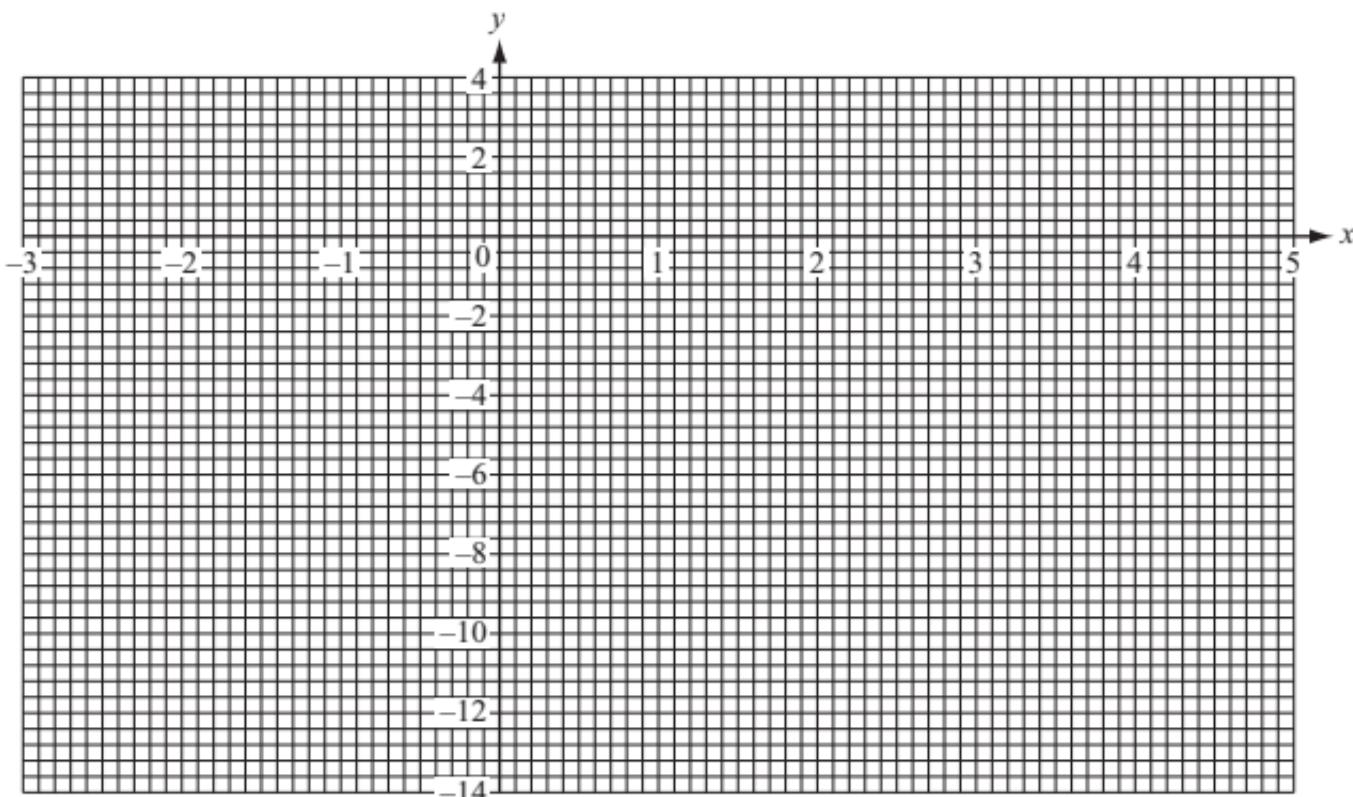
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(c) On the grid, draw the line of symmetry of your graph.

(d) Use your graph to find the maximum value of y .Answer(d) $y = \dots$ (e) Draw the line $y = 1$ on the grid.(f) Write down the two values of x for which $-x^2 + x + 2 = 1$.Answer(f) $x = \dots$ or $x = \dots$ **Exercise 38**(a) Complete the table of values for $y = 1 + 2x - x^2$.

x	-3	-2	-1	0	1	2	3	4	5
y	-14	-7				1	-2		-14

(b) Draw the graph of $y = 1 + 2x - x^2$ on the grid below.

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- (c) Use your graph to find the solutions to the equation $1 + 2x - x^2 = 0$.

Answer (c) $x = \dots$

or $x = \dots$

- (d) (i) On the grid, draw the line of symmetry of the graph.

- (ii) Write down the equation of this line of symmetry.

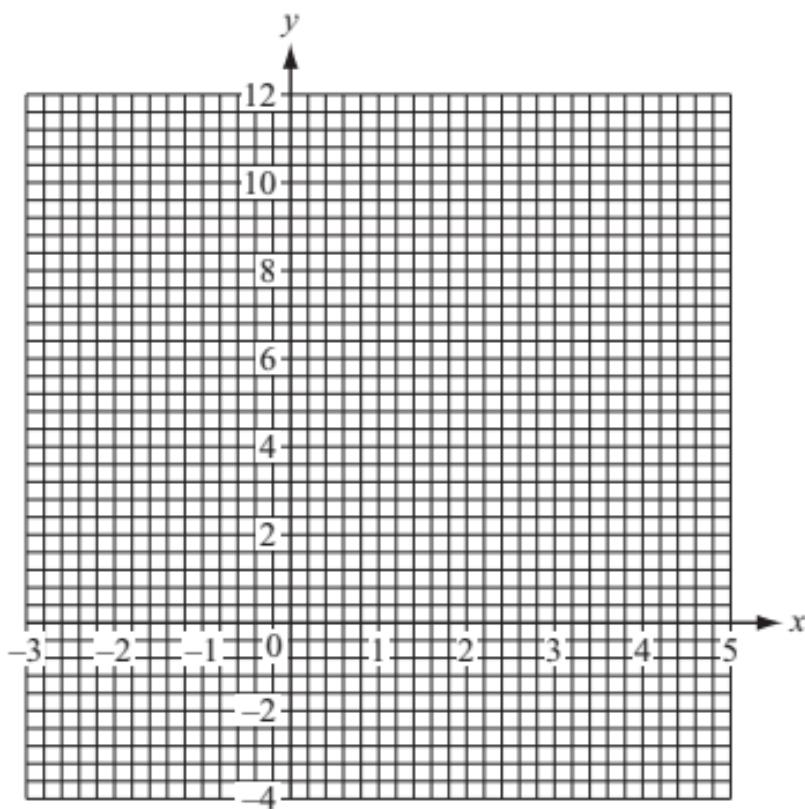
Answer(d)(ii) \dots

Exercise 39

- (a) (i) Complete the table of values for $y = x^2 - 2x - 3$.

x	-3	-2	-1	0	1	2	3	4	5
y	12		0		-4	-3	0	5	

- (ii) Draw the graph of $y = x^2 - 2x - 3$ on the grid below.



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- (iii) Use your graph to find the solutions to $x^2 - 2x - 3 = -1$.
Give your answers to 1 decimal place.

Answer(a)(iii) $x = \dots$ or $x = \dots$

- (b) (i) Complete the table of values for the equation $y = \frac{2}{x}$.

x	0.25	0.5	1	2	3	4	5
y		4		1	0.7	0.5	0.4

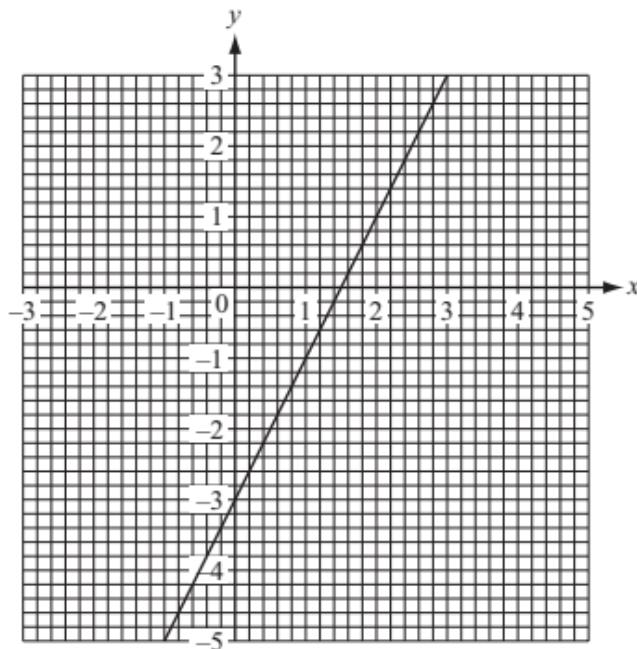
- (ii) On the same grid draw the graph of $y = \frac{2}{x}$ for $0.25 \leq x \leq 5$.

- (iii) Write down the x co-ordinate of the point of intersection of your two graphs.

Answer(b)(iii) $x = \dots$

Exercise 40

(a)



The simultaneous equations $2x - y = 3$ and $x + y = 2$ can be solved graphically.

- (i) Which of these equations is shown by the line on the grid above?

Answer(a)(i) _____



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- (ii) Find the gradient of the line on the grid.

Answer(a)(ii)

- (iii) Complete the table below for the other equation.

x	-1	0	1	2	3
y					

- (iv) Draw this line on the grid above.

- (v) Use your graphs to write down the solution to the two equations.

Give your values correct to 1 decimal place.

Answer(a)(v) x =

y =

- (b) Use algebra to solve the following simultaneous equations exactly.
Show all your working.

$$\begin{aligned}2x - y &= 3, \\x + y &= 2.\end{aligned}$$

Answer(b) x =

y =

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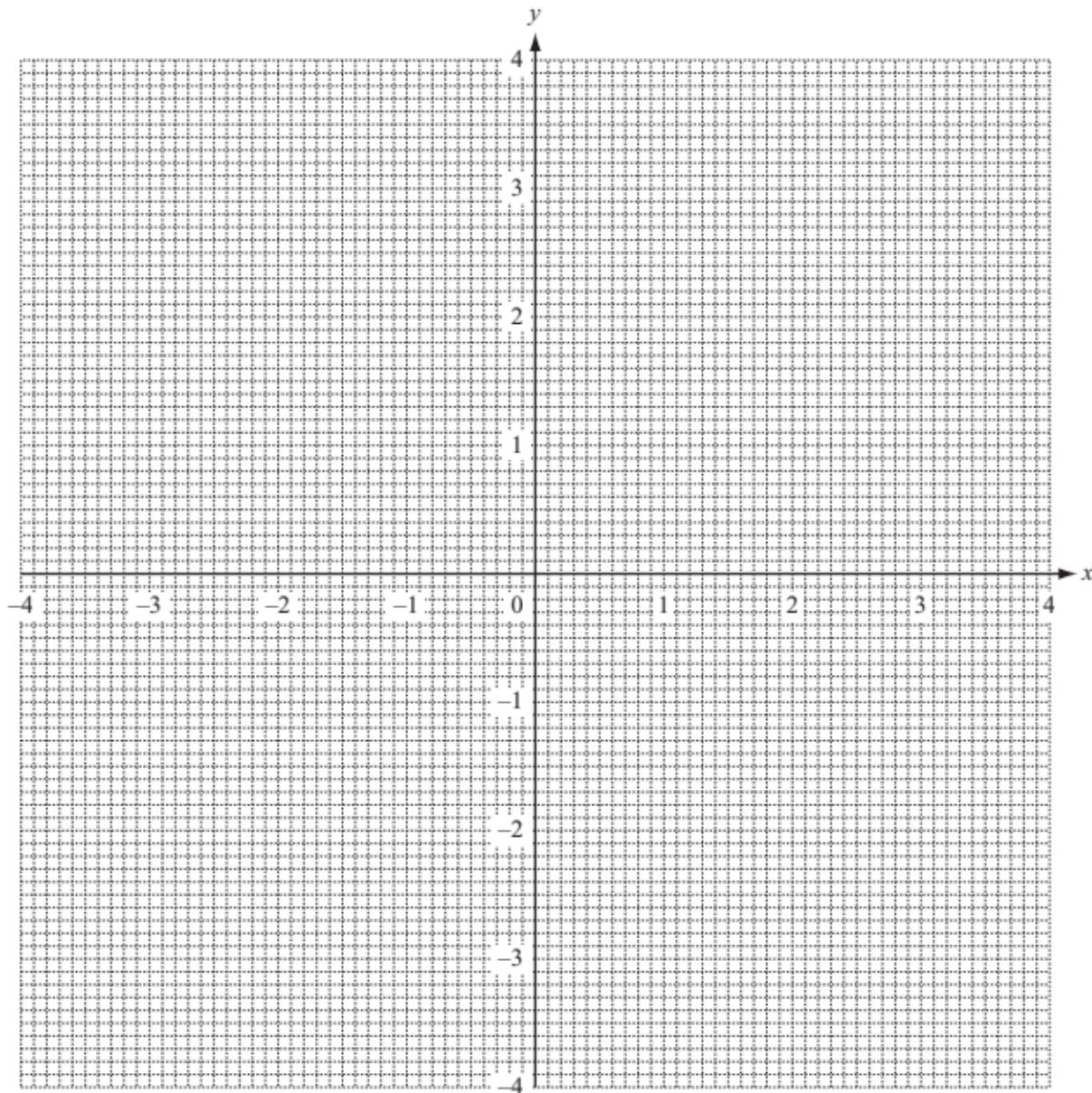
Exercise 41

- (a) The table shows some values for the equation $y = \frac{x}{2} - \frac{2}{x}$ for $-4 \leq x \leq -0.5$ and $0.5 \leq x \leq 4$.

x	-4	-3	-2	-1.5	-1	-0.5	0.5	1	1.5	2	3	4
y	-1.5	-0.83	0	0.58			-3.75		-0.58	0	0.83	1.5

- (i) Write the missing values of y in the empty spaces.

- (ii) On the grid, draw the graph of $y = \frac{x}{2} - \frac{2}{x}$ for $-4 \leq x \leq -0.5$ and $0.5 \leq x \leq 4$.





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- (b) Use your graph to solve the equation $\frac{x}{2} - \frac{2}{x} = 1$.

Answer(b) $x = \dots$ or $x = \dots$

- (c) (i) By drawing a tangent, work out the gradient of the graph where $x = 2$.

Answer(c)(i) \dots

- (ii) Write down the gradient of the graph where $x = -2$.

Answer(c)(ii) \dots

- (d) (i) On the grid, draw the line $y = -x$ for $-4 \leq x \leq 4$.

- (ii) Use your graphs to solve the equation $\frac{x}{2} - \frac{2}{x} = -x$.

Answer(d)(ii) $x = \dots$ or $x = \dots$

- (e) Write down the equation of a straight line which passes through the origin and does **not** intersect the graph of $y = \frac{x}{2} - \frac{2}{x}$.

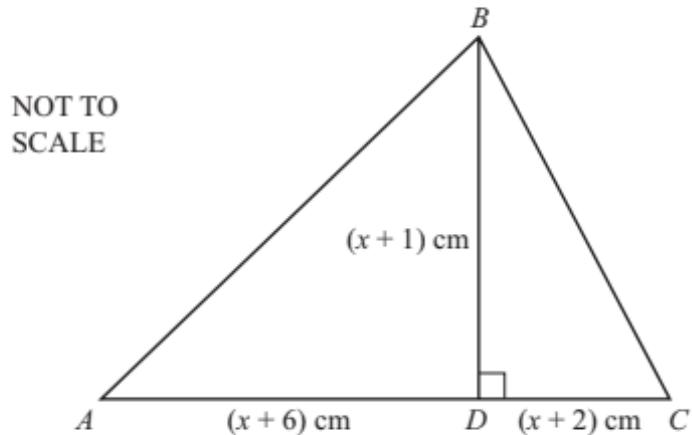
Answer(e) \dots

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Exercise 42

(a)



In triangle ABC , the line BD is perpendicular to AC .

$AD = (x + 6)$ cm, $DC = (x + 2)$ cm and the height $BD = (x + 1)$ cm.

The area of triangle ABC is 40 cm^2 .

(i) Show that $x^2 + 5x - 36 = 0$.

Answer (a)(i)

(ii) Solve the equation $x^2 + 5x - 36 = 0$.

Answer(a)(ii) $x = \dots$ or $x = \dots$

(iii) Calculate the length of BC .

Answer(a)(iii) $BC = \dots$ cm



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- (b) Amira takes 9 hours 25 minutes to complete a long walk.

- (i) Show that the time of 9 hours 25 minutes can be written as $\frac{113}{12}$ hours.

Answer (b)(i)

- (ii) She walks $(3y + 2)$ kilometres at 3 km/h and then a further $(y + 4)$ kilometres at 2 km/h.

Show that the total time taken is $\frac{9y + 16}{6}$ hours.

Answer(b)(ii)

- (iii) Solve the equation $\frac{9y + 16}{6} = \frac{113}{12}$.

Answer(b)(iii) $y =$

- (iv) Calculate Amira's average speed, in kilometres per hour, for the whole walk.

Answer(b)(iv) km/h



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Exercise 43

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

$$g(x) = x^2 + 1$$

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

(a) Find the value of

(i) $f\left(-\frac{1}{2}\right),$

Answer(a)(i)

(ii) $g(-5),$

Answer(a)(ii)

(iii) $h(-3).$

Answer(a)(iii)

(b) Find the inverse function $f^{-1}(x).$ Answer(b) $f^{-1}(x) =$

(c) $g(x) = z.$

Find x in terms of $z.$ Answer(c) $x =$ **(d)** Find $gf(x)$, in its simplest form.Answer(d) $gf(x) =$

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- (e) $h(x) = 512$.
Find the value of x .

Answer(e) $x = \dots$

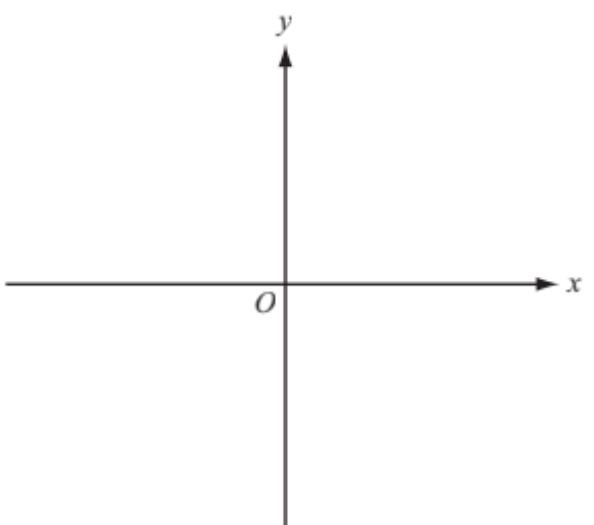
- (f) Solve the equation $2f(x) + g(x) = 0$, giving your answers correct to 2 decimal places.

Answer(f) $x = \dots$ or $x = \dots$

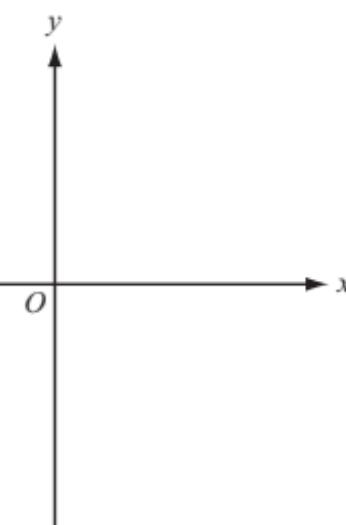
- (g) Sketch the graph of

(i) $y = f(x)$,

(ii) $y = g(x)$.

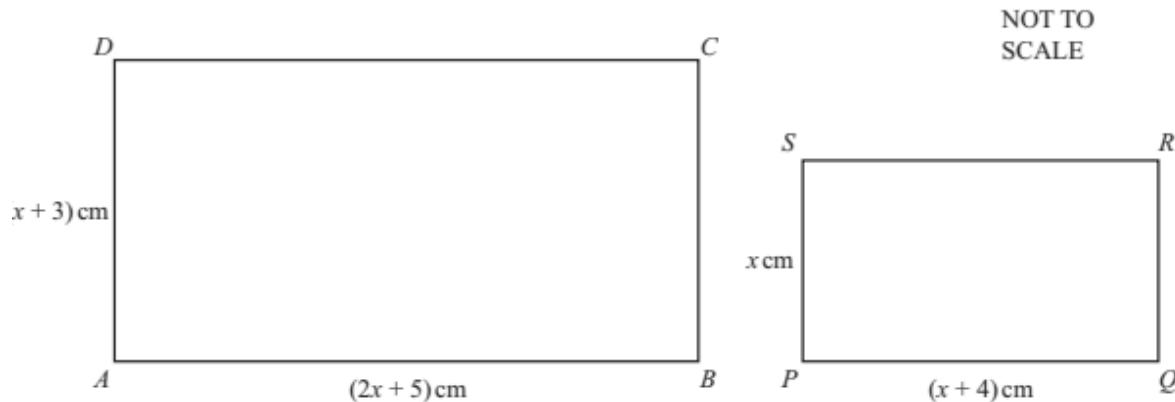


(i) $y = f(x)$



(ii) $y = g(x)$

Exercise 44



The diagram shows two rectangles $ABCD$ and $PQRS$.

$AB = (2x + 5)\text{cm}$, $AD = (x + 3)\text{cm}$, $PQ = (x + 4)\text{cm}$ and $PS = x\text{cm}$.

(a) For one value of x , the area of rectangle $ABCD$ is 59 cm^2 more than the area of rectangle $PQRS$.

(i) Show that $x^2 + 7x - 44 = 0$.

Answer(a)(i)

(ii) Factorise $x^2 + 7x - 44$.

Answer(a)(ii)

(iii) Solve the equation $x^2 + 7x - 44 = 0$.

Answer(a)(iii) $x = \dots$ or $x = \dots$

(b) For a different value of x , the rectangles $ABCD$ and $PQRS$ are similar.

(i) Show that this value of x satisfies the equation $x^2 - 2x - 12 = 0$.

Answer(b)(i)

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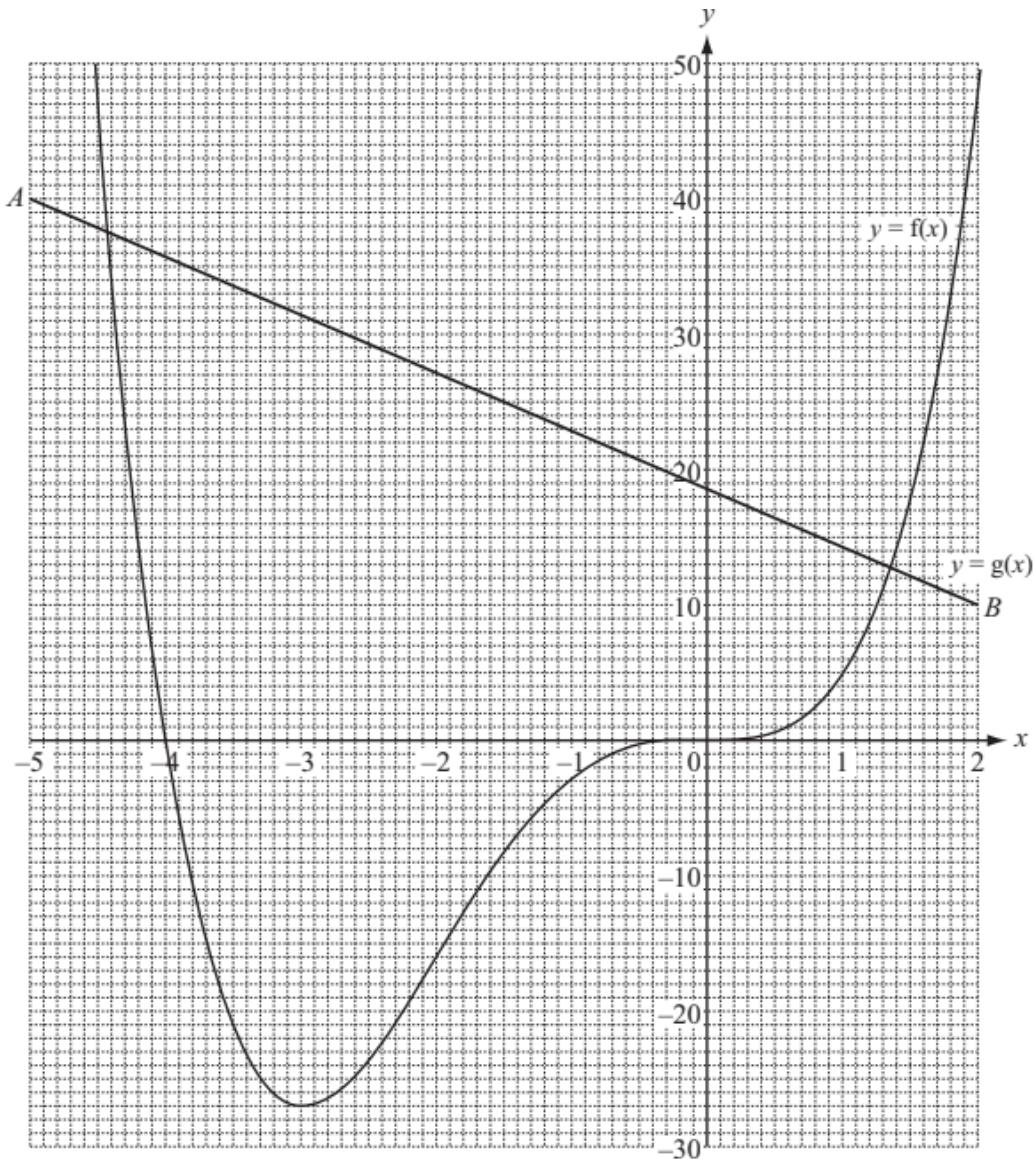
- (ii) Solve the equation $x^2 - 2x - 12 = 0$, giving your answers correct to 2 decimal places.

Answer(b)(ii) $x = \dots$ or $x = \dots$

- (iii) Calculate the perimeter of the rectangle $PQRS$.

Answer(b)(iii) cm

Exercise 45



The graphs of $y = f(x)$ and $y = g(x)$ are shown above.



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(a) Find the value of

(i) $f(-2)$,

Answer(a)(i)

(ii) $g(0)$.

Answer(a)(ii)

(b) Use the graphs to solve

(i) the equation $f(x) = 20$,Answer(b)(i) $x =$ or $x =$ (ii) the equation $f(x) = g(x)$,Answer(b)(ii) $x =$ or $x =$ (iii) the inequality $f(x) < g(x)$.

Answer(b)(iii)

(c) Use the points A and B to find the gradient of $y = g(x)$ as an exact fraction.

Answer(c)

(d) On the grid, draw the graph of $y = g(x) - 10$.(e) (i) Draw the tangent to the graph of $y = f(x)$ at $(-3, -27)$.

(ii) Write down the equation of this tangent.

Answer(e)(ii)

(f) A region, R , contains points whose co-ordinates satisfy the inequalities

$$-3 \leq x \leq -2, \quad y \leq 40 \quad \text{and} \quad y \geq g(x).$$

On the grid, draw suitable lines and label this region R .



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Exercise 46

(a) Solve the equation $\frac{m-3}{4} + \frac{m+4}{3} = -7$.

Answer(a) $m =$

(b) (i) $y = \frac{3}{x-1} - \frac{2}{x+3}$

Find the value of y when $x = 5$.

Answer(b)(i)

(ii) Write $\frac{3}{x-1} - \frac{2}{x+3}$ as a single fraction.

Answer(b)(ii)

(iii) Solve the equation $\frac{3}{x-1} - \frac{2}{x+3} = \frac{1}{x}$.

Answer(b)(iii) $x =$

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(c)
$$p = \frac{t}{q-1}$$

Find q in terms of p and t .

Exercise 47

(a) $f(x) = 2^x$

Complete the table.

x	-2	-1	0	1	2	3	4
$y = f(x)$		0.5	1	2	4		

(b) $g(x) = x(4-x)$

Complete the table.

x	-1	0	1	2	3	4
$y = g(x)$		0	3		3	0

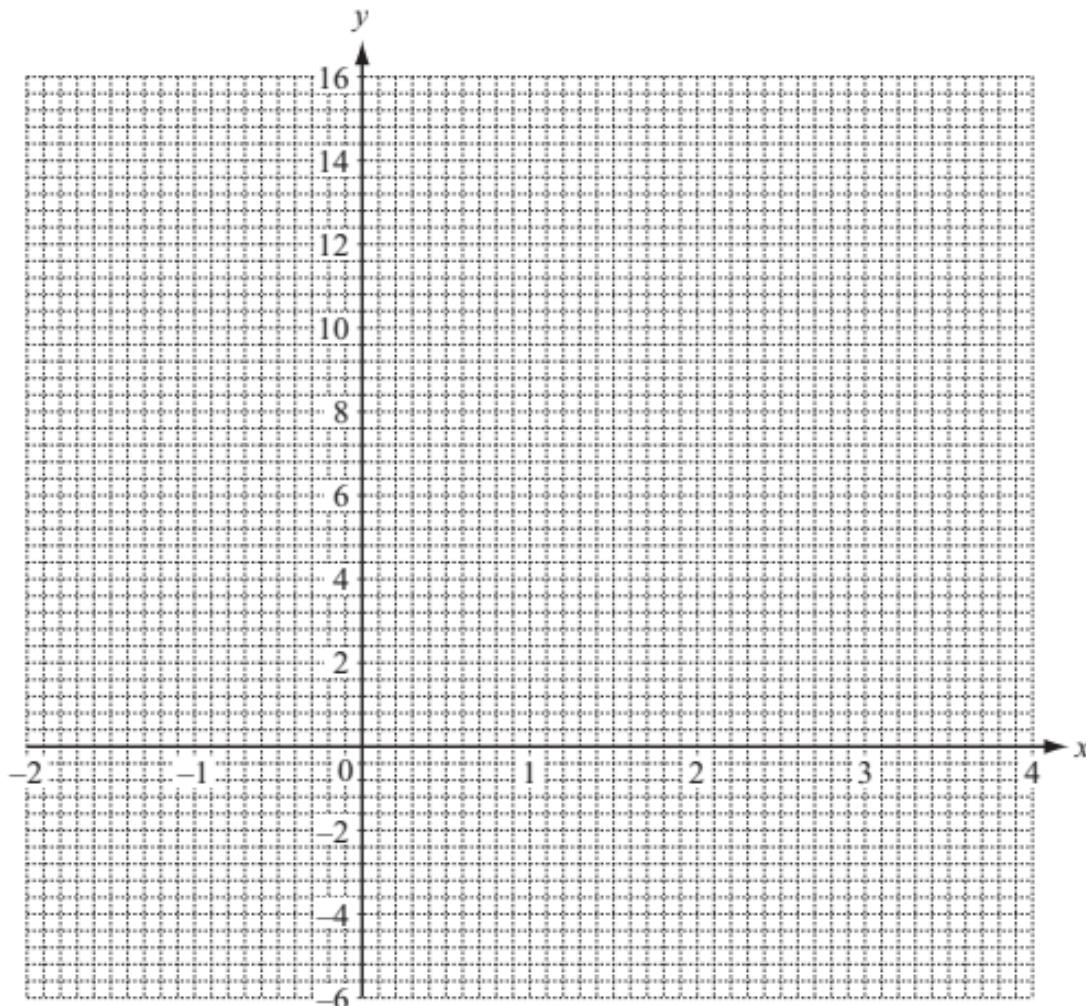
(c) On the grid, draw the graphs of

(i) $y = f(x)$ for $-2 \leq x \leq 4$,

(ii) $y = g(x)$ for $-1 \leq x \leq 4$.

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(d) Use your graphs to solve the following equations.

(i) $f(x) = 10$

Answer(d)(i) $x = \dots$

(ii) $f(x) = g(x)$

Answer(d)(ii) $x = \dots$ or $x = \dots$

(iii) $f^{-1}(x) = 1.7$

Answer(d)(iii) $x = \dots$



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Exercise 48

- (a) Solve the following equations.

(i) $\frac{5}{w} = \frac{3}{w+1}$

Answer(a)(i) $w =$

(ii) $(y+1)^2 = 4$

Answer(a)(ii) $y =$ or $y =$

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

Answer(a)(iii) $x =$

- (b) (i) Factorise
- $u^2 - 9u - 10$
- .

Answer(b)(i)

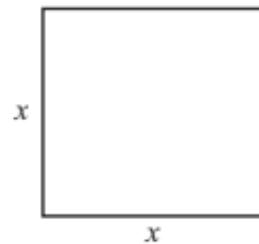
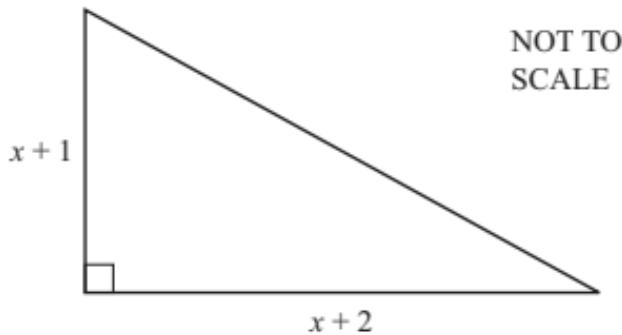
- (ii) Solve the equation
- $u^2 - 9u - 10 = 0$
- .

Answer(b)(ii) $u =$ or $u =$

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(c)



The area of the triangle is equal to the area of the square.
All lengths are in centimetres.

- (i) Show that $x^2 - 3x - 2 = 0$.

Answer(c)(i)

- (ii) Solve the equation $x^2 - 3x - 2 = 0$, giving your answers correct to 2 decimal places.
Show all your working.

Answer(c)(ii) $x = \dots$ or $x = \dots$

- (iii) Calculate the area of one of the shapes.

Answer(c)(iii) cm²

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Exercise 49

A company has a vehicle parking area of 1200 m^2 with space for x cars and y trucks.

Each car requires 20 m^2 of space and each truck requires 100 m^2 of space.

- (a) Show that $x + 5y \leq 60$.

Answer(a)

- (b) There must also be space for

- (i) at least 40 vehicles,
- (ii) at least 2 trucks.

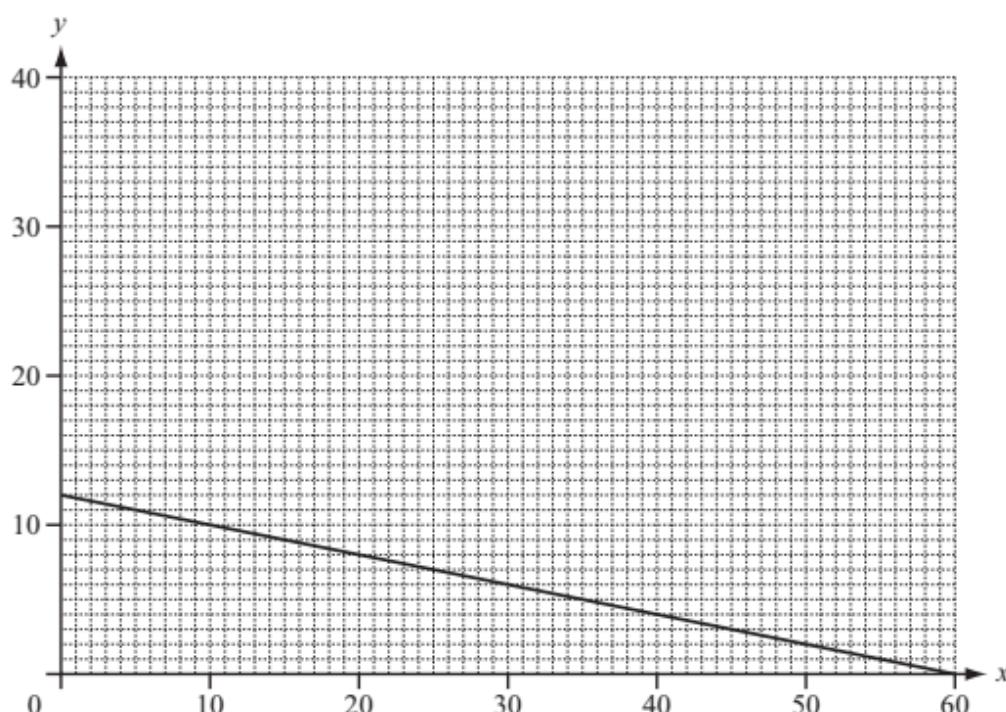
Write down two more inequalities to show this information.

Answer(b)(i)

Answer(b)(ii)

- (c) One line has been drawn for you.

On the grid, show the three inequalities by drawing the other two lines and shading the **unwanted** regions.



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- (d) Use your graph to find the largest possible number of trucks.

Answer(d)

- (e) The company charges \$5 for parking each car and \$10 for parking each truck.
Find the number of cars and the number of trucks which give the company the greatest possible income.

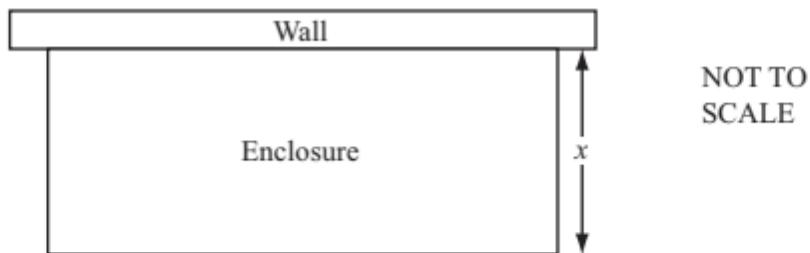
Calculate this income.

Answer(e) Number of cars =

Number of trucks =

Greatest possible income = \$

Exercise 50



A farmer makes a rectangular enclosure for his animals.
He uses a wall for one side and a total of 72 metres of fencing for the other three sides.

The enclosure has width x metres and area A square metres.

- (a) Show that $A = 72x - 2x^2$.

Answer (a)

- (b) Factorise completely $72x - 2x^2$.

Answer(b)

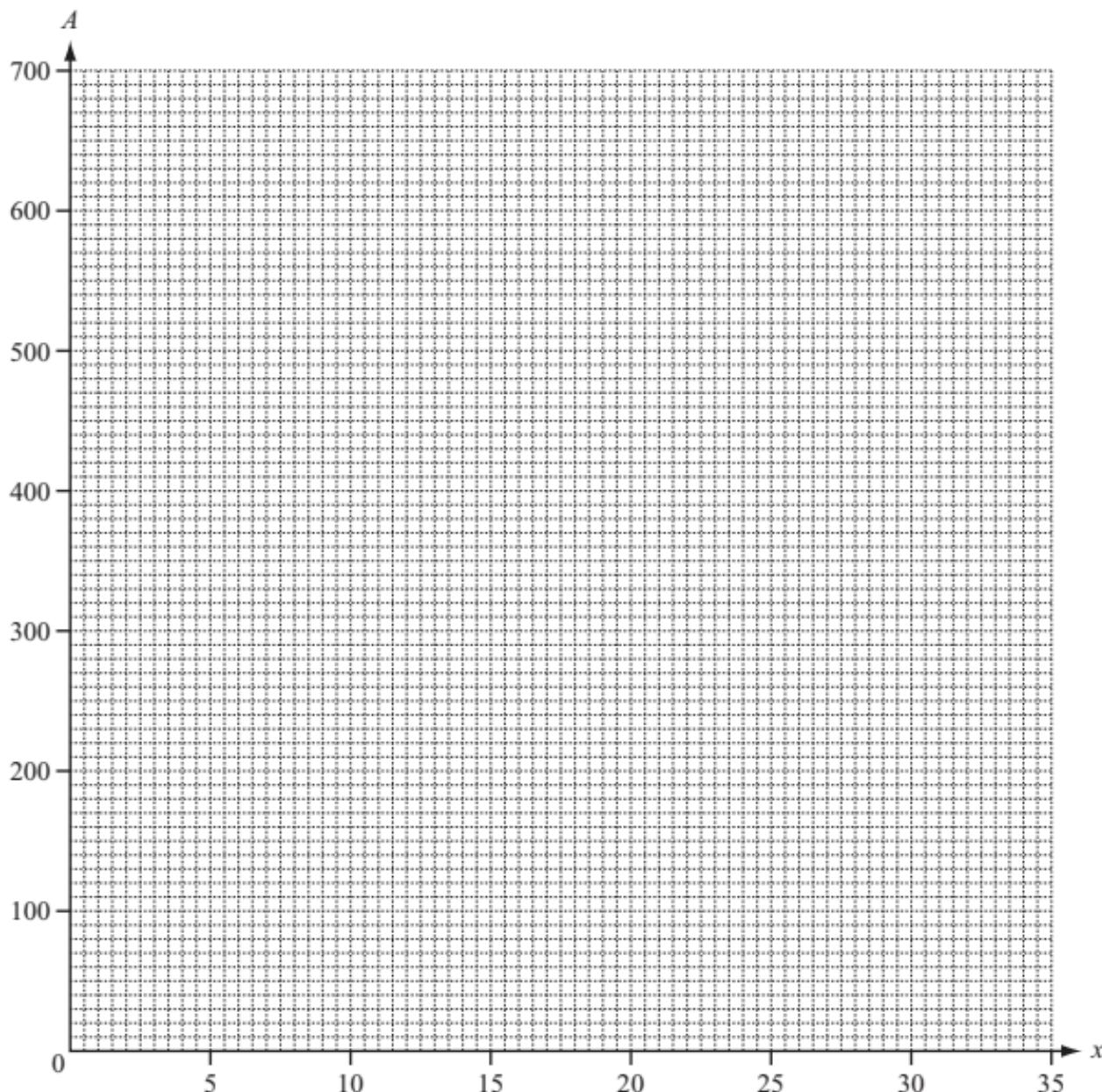
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- (c)** Complete the table for $A = 72x - 2x^2$.

x	0	5	10	15	20	25	30	35
A	0	310	520			550	360	

- (d)** Draw the graph of $A = 72x - 2x^2$ for $0 \leq x \leq 35$ on the grid opposite.





(e) Use your graph to find

(i) the values of x when $A = 450$,

$$\text{Answer}(e)(i) x = \dots \text{ or } x = \dots$$

(ii) the maximum area of the enclosure.

$$\text{Answer}(e)(ii) \dots \text{ m}^2$$

(f) Each animal must have at least 12 m^2 for grazing.

Calculate the greatest number of animals that the farmer can keep in an enclosure which has an area of 500 m^2 .

$$\text{Answer}(f) \dots$$

Exercise 51

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

$$g(x) = x^2$$

Work out

(i) $f(2)$,

$$\text{Answer}(a)(i) \dots$$

(ii) $g(-2)$,

$$\text{Answer}(a)(ii) \dots$$

(iii) $ff(x)$ in its simplest form,

$$\text{Answer}(a)(iii) ff(x) = \dots$$

(iv) $f^{-1}(x)$, the inverse of $f(x)$,

$$\text{Answer}(a)(iv) f^{-1}(x) = \dots$$

(v) x when $gf(x) = 4$.

$$\text{Answer}(a)(v) x = \dots \text{ or } x = \dots$$



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Exercise 52

- (a) Find the integer values for
- x
- which satisfy the inequality
- $-3 < 2x - 1 \leq 6$
- .

Answer(a)

(b) Simplify $\frac{x^2 + 3x - 10}{x^2 - 25}$.

Answer(b)

(c) (i) Show that $\frac{5}{x-3} + \frac{2}{x+1} = 3$ can be simplified to $3x^2 - 13x - 8 = 0$.

Answer(c)(i)

(ii) Solve the equation $3x^2 - 13x - 8 = 0$.

Show all your working and give your answers correct to two decimal places.

Answer(c)(ii) $x =$ or $x =$ **Exercise 53**

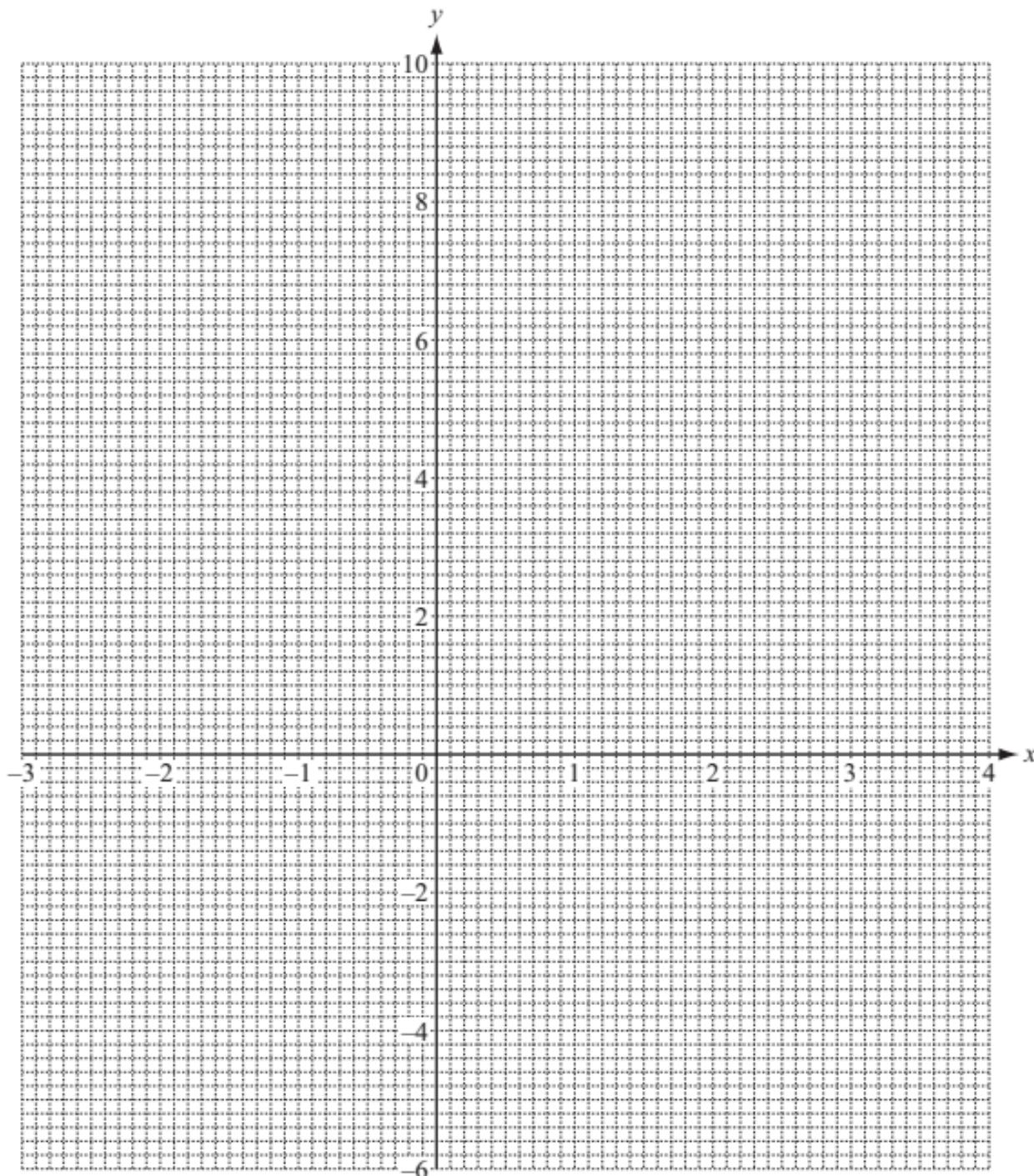
- (a) Complete the table for the function
- $f(x) = \frac{x^3}{2} - 3x - 1$
- .

x	-3	-2	-1.5	-1	0	1	1.5	2	3	3.5
$f(x)$	-5.5		1.8	1.5		-3.5	-3.8	-3		9.9

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- (b) On the grid draw the graph of $y = f(x)$ for $-3 \leq x \leq 3.5$.



- (c) Use your graph to

- (i) solve $f(x) = 0.5$,

Answer(c)(i) $x = \dots$ or $x = \dots$ or $x = \dots$



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- (ii) find the inequalities for k , so that $f(x) = k$ has only 1 answer.

Answer(c)(ii) $k < \dots$

$k > \dots$

- (d) (i) On the same grid, draw the graph of $y = 3x - 2$ for $-1 \leq x \leq 3.5$.

- (ii) The equation $\frac{x^3}{2} - 3x - 1 = 3x - 2$ can be written in the form $x^3 + ax + b = 0$.

Find the values of a and b .

Answer(d)(ii) $a = \dots$ and $b = \dots$

- (iii) Use your graph to find the **positive** answers to $\frac{x^3}{2} - 3x - 1 = 3x - 2$ for $-3 \leq x \leq 3.5$.

Answer(d)(iii) $x = \dots$ or $x = \dots$

Exercise 54

Mr Chang hires x large coaches and y small coaches to take 300 students on a school trip.
Large coaches can carry 50 students and small coaches 30 students.
There is a maximum of 5 large coaches.

- (a) Explain clearly how the following two inequalities satisfy these conditions.

- (i) $x \leq 5$

Answer(a)(i) \dots

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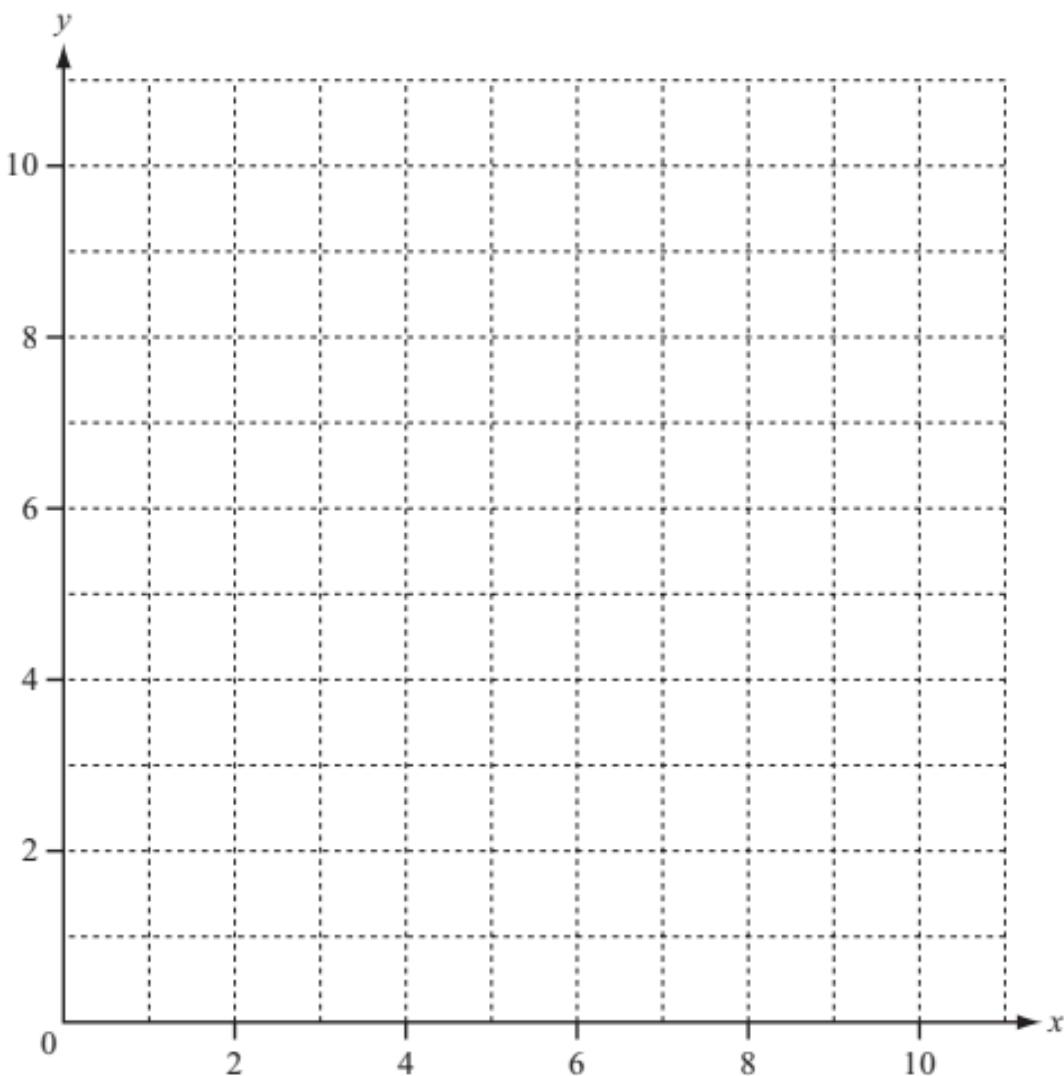
(ii) $5x + 3y \geq 30$

Answer(a)(ii)

.....

Mr Chang also knows that $x + y \leq 10$.

- (b) On the grid, show the information above by drawing three straight lines and shading the **unwanted** regions.





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- (c) A large coach costs \$450 to hire and a small coach costs \$350.

- (i) Find the number of large coaches and the number of small coaches that would give the minimum hire cost for this school trip.

Answer(c)(i) Large coaches

Small coaches

- (ii) Calculate this minimum cost.

Answer(c)(ii) \$

Exercise 55

Answer the whole of this question on a sheet of graph paper.

The table gives values of $f(x) = 2^x$, for $-2 \leq x \leq 4$.

x	-2	-1	0	1	2	3	4
$f(x)$	p	0.5	q	2	4	r	16

- (a) Find the values of p , q and r .
- (b) Using a scale of 2 cm to 1 unit on the x -axis and 1 cm to 1 unit on the y -axis, draw the graph of $y = f(x)$ for $-2 \leq x \leq 4$.
- (c) Use your graph to solve the equation $2^x = 7$.
- (d) What value does $f(x)$ approach as x decreases?
- (e) By drawing a tangent, estimate the gradient of the graph of $y = f(x)$ when $x = 1.5$.
- (f) On the same grid draw the graph of $y = 2x + 1$ for $0 \leq x \leq 4$.
- (g) Use your graph to find the non-integer solution of $2^x = 2x + 1$.

**Exercise 56**

$$f(x) = x^2 - 4x + 3 \quad \text{and} \quad g(x) = 2x - 1.$$

- (a) Solve $f(x) = 0$.
- (b) Find $g^{-1}(x)$.
- (c) Solve $f(x) = g(x)$, giving your answers correct to 2 decimal places.
- (d) Find the value of $gf(-2)$.
- (e) Find $fg(x)$. Simplify your answer.

Exercise 57

Answer the whole of this question on a sheet of graph paper.

Tiago does some work during the school holidays.

In one week he spends x hours cleaning cars and y hours repairing cycles.

The time he spends repairing cycles is at least equal to the time he spends cleaning cars.

This can be written as $y \geq x$.

He spends no more than 12 hours working.

He spends at least 4 hours cleaning cars.

- (a) Write down two more inequalities in x and/or y to show this information.
- (b) Draw x and y axes from 0 to 12, using a scale of 1 cm to represent 1 unit on each axis.
- (c) Draw three lines to show the three inequalities. Shade the **unwanted** regions.
- (d) Tiago receives \$3 each hour for cleaning cars and \$1.50 each hour for repairing cycles.
 - (i) What is the least amount he could receive?
 - (ii) What is the largest amount he could receive?

**Exercise 58**

Answer the whole of this question on one sheet of graph paper.

$$f(x) = 1 - \frac{1}{x^2}, \quad x \neq 0.$$

(a)

x	-3	-2	-1	-0.5	-0.4	-0.3		0.3	0.4	0.5	1	2	3
$f(x)$	p	0.75	0	-3	-5.25	q		q	-5.25	-3	0	0.75	p

Find the values of p and q .

- (b) (i)** Draw an x -axis for $-3 \leq x \leq 3$ using 2 cm to represent 1 unit and a y -axis for $-11 \leq y \leq 2$ using 1 cm to represent 1 unit.
- (ii)** Draw the graph of $y = f(x)$ for $-3 \leq x \leq -0.3$ and for $0.3 \leq x \leq 3$.
- (c)** Write down an integer k such that $f(x) = k$ has no solutions.
- (d) On the same grid,** draw the graph of $y = 2x - 5$ for $-3 \leq x \leq 3$.
- (e) (i)** Use your graphs to find solutions of the equation $1 - \frac{1}{x^2} = 2x - 5$.
- (ii)** Rearrange $1 - \frac{1}{x^2} = 2x - 5$ into the form $ax^3 + bx^2 + c = 0$, where a , b and c are integers.
- (f) (i)** Draw a tangent to the graph of $y = f(x)$ which is parallel to the line $y = 2x - 5$.
- (ii)** Write down the equation of this tangent.

Exercise 59

- (a) (i)** The cost of a book is $\$x$.

Write down an expression in terms of x for the number of these books which are bought for \$40.

- (ii)** The cost of each book is increased by \$2.

The number of books which are bought for \$40 is now one less than before.

Write down an equation in x and show that it simplifies to $x^2 + 2x - 80 = 0$.

- (iii)** Solve the equation $x^2 + 2x - 80 = 0$.

- (iv)** Find the original cost of one book.



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- (b) Magazines cost \$ m each and newspapers cost \$ n each.
One magazine costs \$2.55 more than one newspaper.
The cost of two magazines is the same as the cost of five newspapers.
- (i) Write down two equations in m and n to show this information.
- (ii) Find the values of m and n .

Exercise 60**Answer the whole of this question on a sheet of graph paper.**

$$f(x) = 3x - \frac{1}{x^2} + 3, \quad x \neq 0.$$

- (a) The table shows some values of $f(x)$.

x	-3	-2.5	-2	-1.5	-1	-0.5	-0.4	-0.3	0.3	0.4	0.5	1	1.5	2	2.5	3
$f(x)$	p	-4.7	-3.3	-1.9	-1	-2.5	-4.5	-9.0	-7.2	-2.1	0.5	q	7.1	8.8	10.3	r

Find the values of p , q and r .

- (b) Draw axes using a scale of 1 cm to represent 0.5 units for $-3 \leq x \leq 3$ and 1 cm to represent 2 units for $-10 \leq y \leq 12$.
- (c) On your grid, draw the graph of $y = f(x)$ for $-3 \leq x \leq -0.3$ and $0.3 \leq x \leq 3$.
- (d) Use your graph to solve the equations
- (i) $3x - \frac{1}{x^2} + 3 = 0$,
- (ii) $3x - \frac{1}{x^2} + 7 = 0$.
- (e) $g(x) = 3x + 3$.
On the same grid, draw the graph of $y = g(x)$ for $-3 \leq x \leq 3$.
- (f) (i) Describe briefly what happens to the graphs of $y = f(x)$ and $y = g(x)$ for large positive or negative values of x .
- (ii) Estimate the gradient of $y = f(x)$ when $x = 100$.