

Worksheet 20: algebra questions

This worksheet has algebra skills questions plus a few challenge questions.

Make sure you have some notes about each of the section headings.

Basic conventions of algebra

- 1) Simplify $b^2 + b^2 + b^2$
- 2) Simplify $f + f + f + f - f$
- 3) Simplify $4x + 2x + 5x - 3x - x$
- 4) Work out the value of $3b$ when $b = 6$
- 5) Simplify $3a \times 5b$
- 6) Simplify $-7p \times 5q$
- 7) Simplify $-5x \times -6y$
- 8) Simplify $4xy + yx$
- 9) Simplify $5x^2 + 3x^2$
- 10) Simplify $4x \times 5x$
- 11) Write $x^5 \times x^4$ as a single power of x
- 12) Simplify $a \times b \times c$
- 13) Simplify $4xy \times 3x$
- 14) Simplify $-3xy \times 5yx$
- 15) Algernon writes a linear expression as $y \times 20 + 1x$.
Re-write his expression using the conventions of algebra
- 16) Evadne writes a linear expression as $-p15 + q20$.
Re-write her expression using the conventions of algebra
- 17) Write down the median of these three expressions: x^2 , $x^2 + 3$, $x^2 - 4$
Does the order of the expressions depend on the value of x ?

BIDMAS and negative numbers

Algebra depends on these rules. Check your answers before moving on.

- 1) Work out $-3 - 5$
- 2) What is -6×7 ?
- 3) Work out $15 \div -3$
- 4) Work out $-8 + 17$
- 5) Work out -4×-6
- 6) Work out $5 \times 7 + 3 \times 4$
- 7) Work out $6 \times 3 - 5 \times 3$
- 8) Work out $3 \times 4 - 5 \times -2$
- 9) Work out $\frac{(-2)^2 - (3 \times 6)}{\sqrt{49}}$ Hint: answer is an integer

Collect like terms

- 1) Simplify $3y + 4y + 2y + y$
- 2) Simplify $4x + 3 + 2x + 8$
- 3) Simplify $5x + 2y - 2x + 3y$
- 4) Simplify $-3q + 2p - q + 5p$
- 5) Simplify $3x^2 - 4x + x^2 - x$
- 6) Simplify $4xy + 3yx - xy$
- 7) Simplify $x^2 - 3x + 4x - 12$ as far as you can
- 8) Simplify $x + y - x - y + 6$
- 9) Simplify $4x - 2y + 3x - 6y - x + 5y$
- 10) Simplify $\frac{12x - 18y}{6}$ so it is in the form $ax + b$ where a and b are integers.

Multiply out brackets

- 1) Expand $3(4x + 5)$
- 2) Multiply out $2(x - 3)$
- 3) Expand $-3(2x + 1)$
- 4) Expand $-5(3x - 2)$
- 5) Expand $x(x + 1)$
- 6) Multiply out and simplify $2(2x + 1) + 3(5x + 2)$
- 7) Multiply out $3x(2x - 5)$
- 8) Multiply out and simplify $3(x + 1) - 2(4x - 5)$
- 9) Multiply out $3xy(5x + 2y)$
- 10) **Challenge:** Write the expression $\frac{12x - 9}{3} - \frac{8x - 20}{4}$ as an expression in the form $ax + b$ where a and b are integers

Factorise linear expressions

- 1) Factorise $12x + 6$
- 2) Factorise $4p - 12$
- 3) Factorise $5x + 10$
- 4) Factorise $18 - 6a$
- 5) Factorise $x^2 - x$
- 6) Factorise $3x^2 - 12x$ completely
- 7) Factorise $4xy + 12x^2$ fully
- 8) Factorise $xy^2 - x^2y$
- 9) Factorise $25 - 10x$
- 10) **Challenge:** Factorise $\frac{3}{4}x + 2\frac{1}{4}$ so that the bracket contains an expression with integer coefficients

Multiply out pairs of brackets

- 1) Multiply out $(x + 1)(x + 2)$
- 2) Multiply out $(x + 1)(x - 2)$
- 3) Multiply out $(2x + 1)(x + 5)$
- 4) Multiply out $(x + 3)(x - 3)$
- 5) Multiply out $(2x + 5)(2x - 5)$
- 6) Multiply out $(12 - x)(x + 3)$
- 7) Multiply out $(3x - 6)(4x + 5)$
- 8) Multiply out $(4x - 3)(4x + 3)$
- 9) Write the expression $(x + 3)(x + 2)$ in the form $ax^2 + bx + c$ where a , b and c are integers
- 10) $(x + 3)(x + 1) \equiv ax^2 + bx + c$
Find the values of a , b and c
- 11) **Challenge:** $(x + p)(x + q) \equiv x^2 + 3x + c$
Find possible values of the integers p , q and c
- 12) **Challenge:** Show that $(px + q)(px - q) \equiv (px)^2 - q^2$

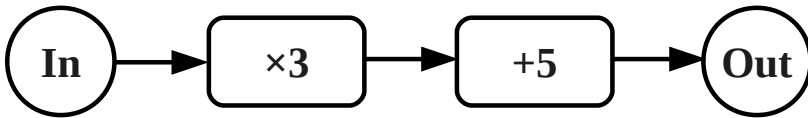
Factorise quadratic expressions

- 1) Factorise $x^2 + 2x + 1$
- 2) Factorise $x^2 + 4x + 4$
- 3) Factorise $x^2 + 2x - 3$
- 4) Factorise $x^2 - 2x + 3$
- 5) Factorise $x^2 - 9$
Hint: 'difference of two squares'
- 6) **Challenge:** Factorise $6x^2 + 19x + 15$

Use function machines

Question 1

Look at the function machine below...

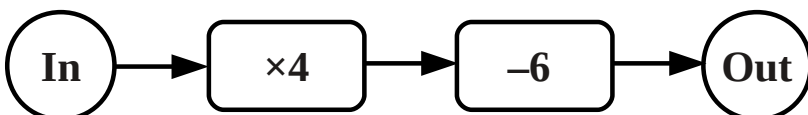


Use the function machine to complete the table of values...

In	Out
0	
1	
2	
3	
$4\frac{1}{2}$	
	32
-1	
-7	
	$9\frac{1}{2}$
x	

Extension: get some squared paper and plot the output against the input for the first four rows of the table. Can you write a formula for the graph?

Question 2



- Work out the value of the output when the input is 5
- Work out the value of the input that gives the output -10
- Challenge:** find an input so that the output is twice the input

Substituting into expressions

- 1) Work out the value of $3a$ when $a = 7$
- 2) $A = 3x + 2y$
Work out the value of A when $x = 2$ and $y = 5$
- 3) $y = 4x + 3$
Work out the value of y when $x = 3$
- 4) $B = 3x - 2y$
Work out the value of B when $x = 3$ and $y = 8$
- 5) $C = 3p - 4q$
Work out the value of C when $p = 5$ and $q = -2$
- 6) $2y + 3x$
Work out the value of the expression when $y = 0$ and $x = 4$
- 7) **Challenge:** $D = 4x + 3y$
 - a) Work out the value of x when $y = 0$ and $D = 12$
 - b) Work out the value of y when $x = 0$ and $D = 12$

Making expressions from words

- 1) Write down an expression for the cost of n pencils at 15p each
- 2) Write down an expression for the cost of x lemons at 20p each
- 3) Oranges cost 25p and apples cost 20p
Write an expression for the total cost of x oranges and y apples
- 4) Archie thinks of a number n , doubles it then subtracts five
Write an expression in terms of n for Archie's answer
- 5) James is x years old
Inderjit is twice as old as James
Aaron is three years older than James
Write an expression for the total of their ages

Solve (mostly) linear equations

- 1) Solve $3x = 15$
- 2) Solve $\frac{x}{10} = 2$
- 3) Solve $x + 9 = 12$
- 4) Solve $x - 6 = 20$
- 5) Solve $3x + 4 = 19$
- 6) Solve $5x - 6 = 4$
- 7) Solve $4x + 6 = 2$
- 8) Solve $5x + 3 = 10$
- 9) Solve $1.2x - 0.4 = 2$
- 10) Solve $3x + 5 = 4x - 3$
- 11) Solve $2x + 6 = 4x - 14$
- 12) **Challenge:** Write down both solutions of $x^2 = 16$

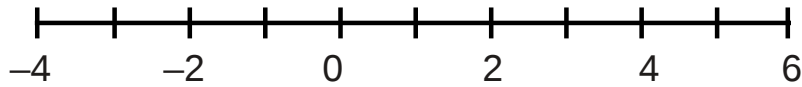
Change the subject of a formula

- 1) Rearrange the formula $y = 3x$ to make x the subject
- 2) Rearrange the formula $A = C + 5$ to make C the subject
- 3) $A = 4m + 5$
Rearrange the formula to make m the subject
- 4) $A = L \times W$
Rearrange the formula to make W the subject
- 5) $y + 3x = 12$
Rearrange the formula to make y the subject
- 6) $y = 2x + 1$
Rearrange the formula to make x the subject

Work with inequalities

Question 1

Represent the inequality $-1 < x \leq 5$ on the number line below

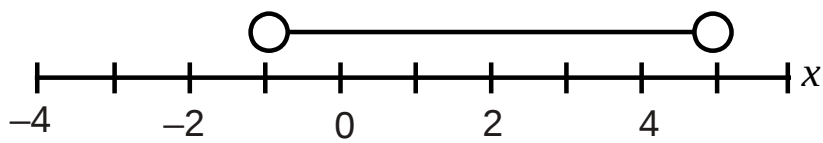


Question 2

Write down all the integers that satisfy the inequality $-2 \leq y < 3$

Question 3

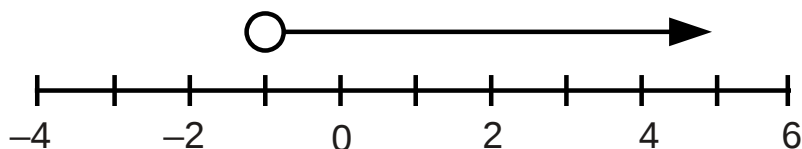
Look at the inequality represented on the number line below...



- Write this inequality in symbols
- Write down all the integers that satisfy the inequality

Question 4

- Solve the inequality $3x + 1 < 16$
- Write down the inequality represented on the number line below



- Write down all the integers that satisfy both inequalities

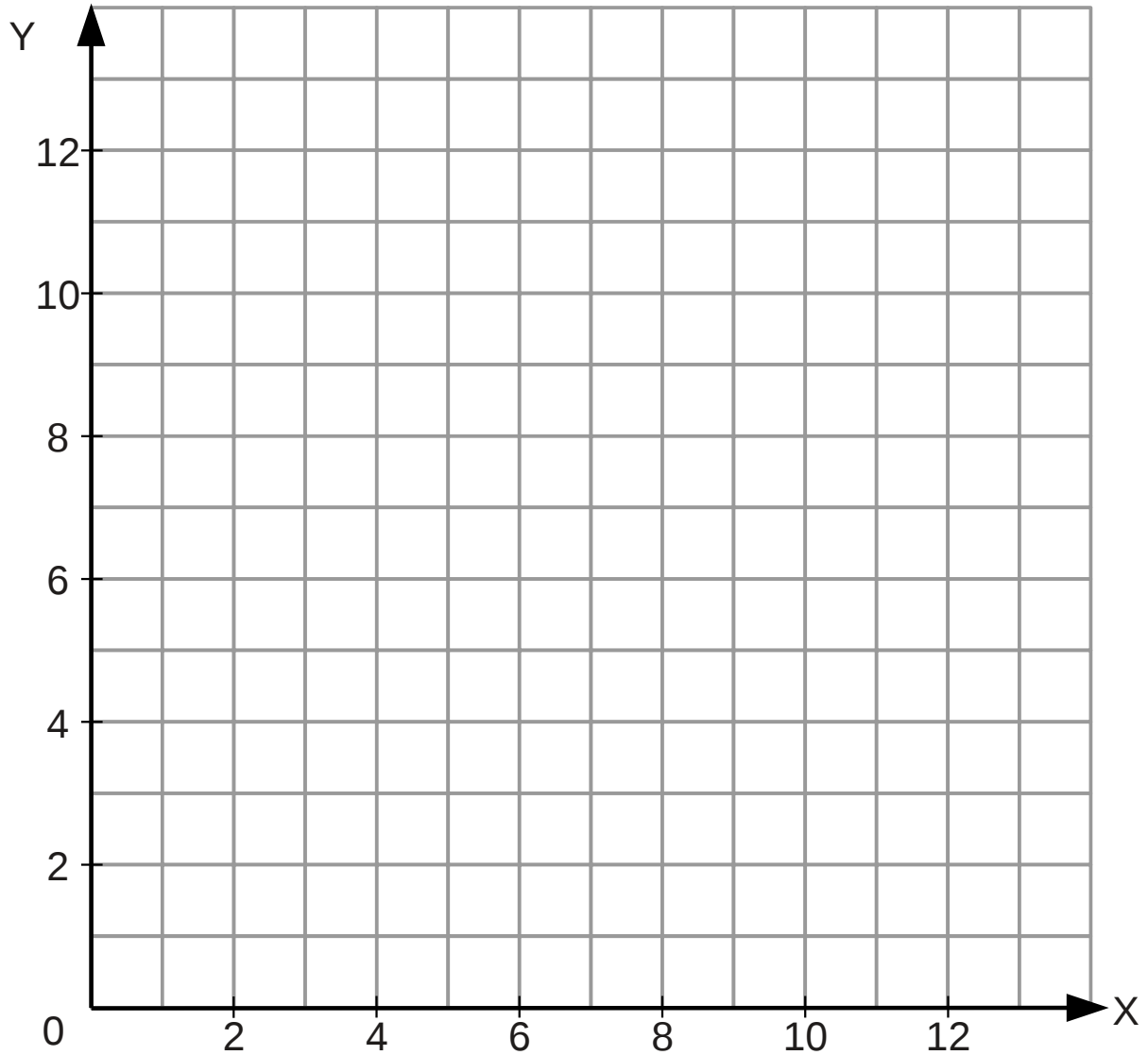
Solve simultaneous equations

- 1) Ethel buys two turnips and three potatoes for £2.10
Thomaz buys a turnip and three potatoes for £1.50
Work out the cost of a single turnip and the cost of a single potato
- 2) Solve the simultaneous equations...
$$3x + y = 18$$
$$x + y = 8$$
- 3) Solve the simultaneous equations
$$4x + 2y = 14$$
$$3x - 2y = 7$$
- 4) Solve the simultaneous equations
$$5x + 3y = 26$$
$$2x + 4y = 16$$
- 5) **Challenge:** Solve the simultaneous equations
$$2x + 3y = 15$$
$$5x - 2y = -\frac{1}{2}$$

Find n^{th} term for linear sequences

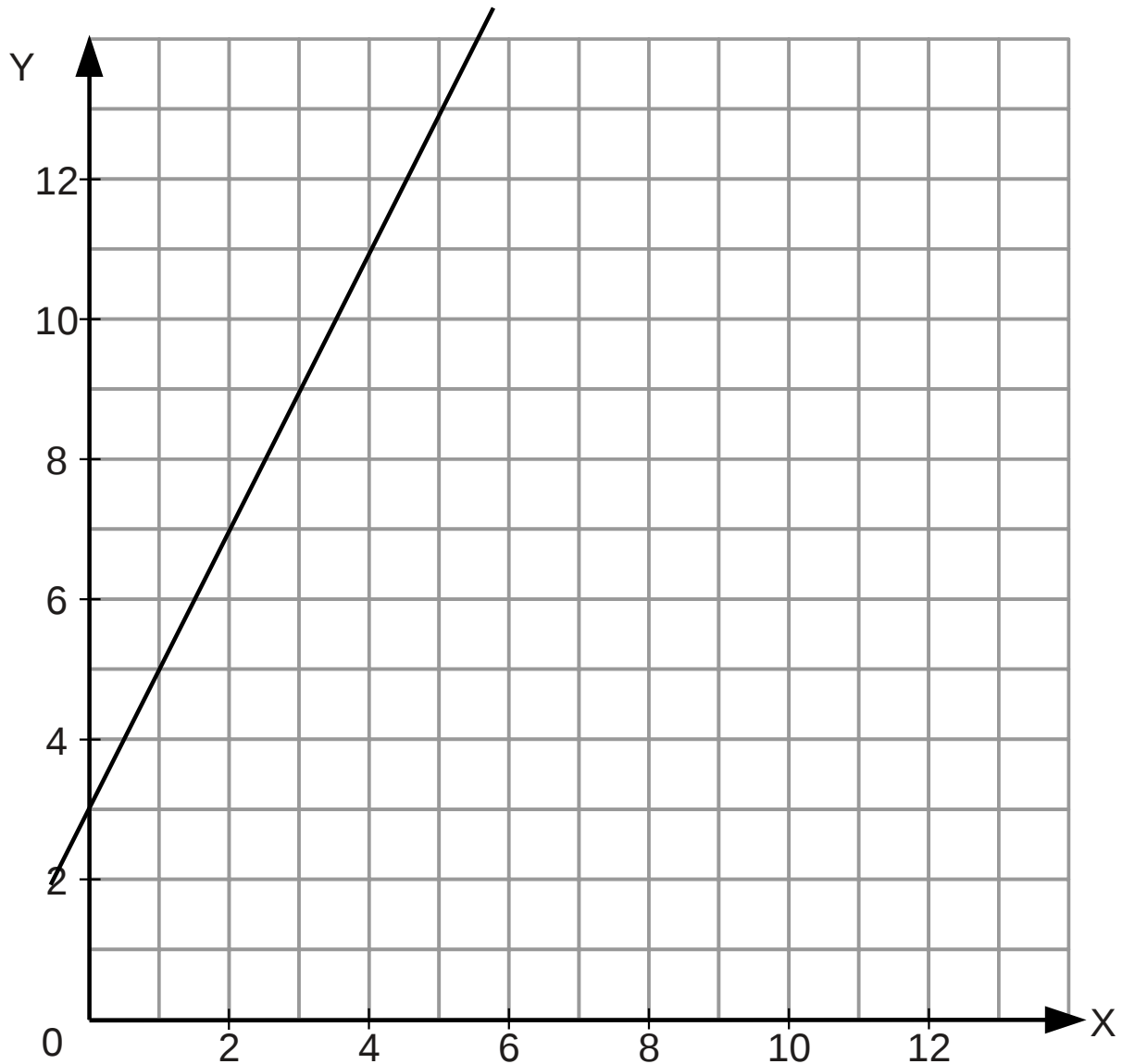
- 1) Find a formula for the n th term of the sequence 7, 10, 13, 16...
- 2) Can 307 be a term in the sequence 3, 7, 11, 15...?
Show a calculation and explain the reason for your answer
- 3) Algernon says that 1, 1, 2, 3, 5, 8, 13 is a linear sequence
Explain why he is wrong
- 4) Find a formula for the n th term of the sequence 2, 8, 14...
- 5) **Challenge:** 40, 37, 34, 31... Find n th term. Which term is the last positive term?

Plot coordinates



- 1) Plot the point (5, 9) and label the point A
- 2) Plot the point (2, 7) and label the point B
- 3) Write down the coordinates of a point C that makes a right angled triangle with A, B and C as vertices
- 4) Draw the line $x = 6$ on the grid
- 5) Reflect the triangle ABC in the line $x = 6$
- 6) Challenge: work out the area of the triangle ABC

Plot and find the formula of a straight line graph



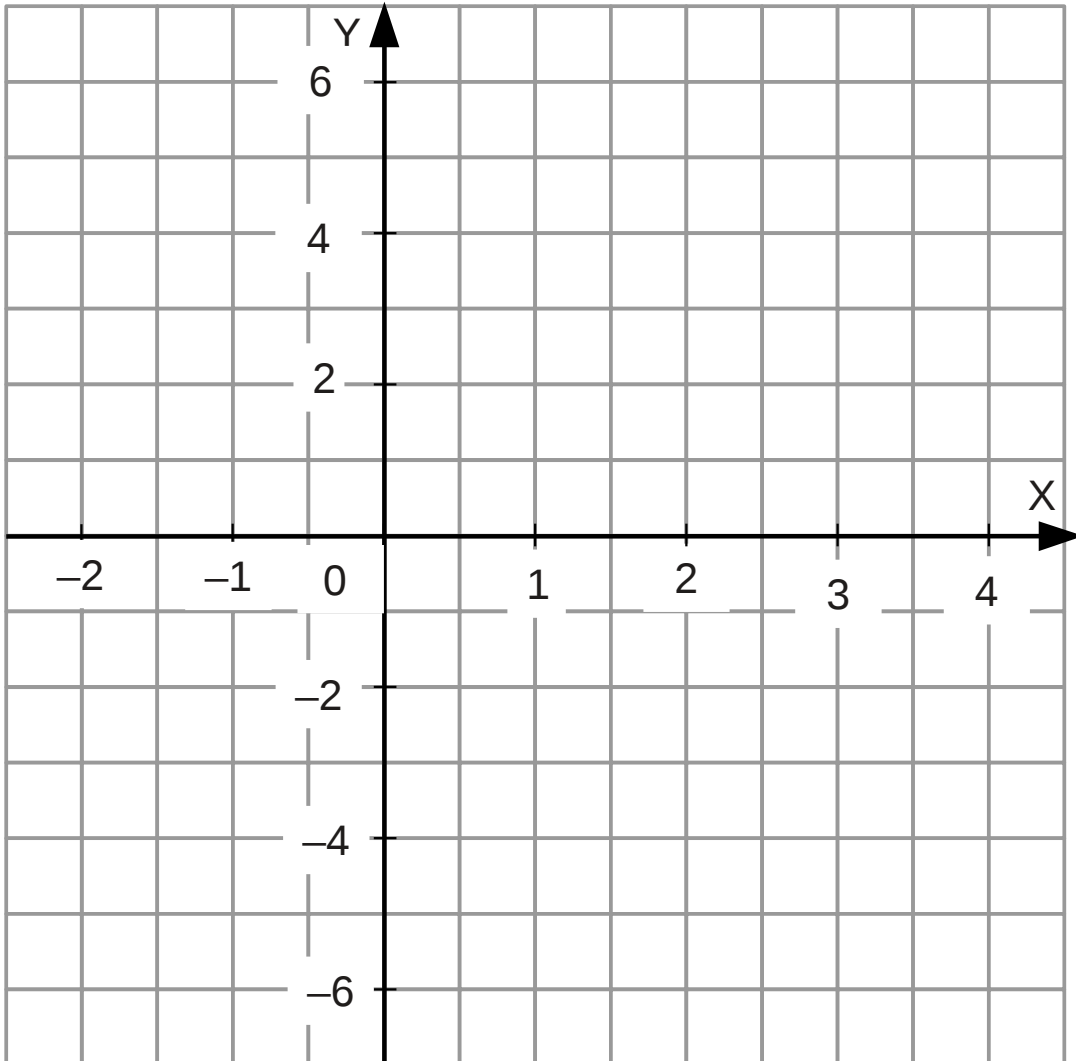
- 1) Find the gradient of the straight line graph drawn on the grid above
- 2) Write down the y-intercept of the line
- 3) Write down the formula of the line
- 4) Plot the graph of $y = 3x + 1$ on the grid above
- 5) Write down the coordinates of the point where the two straight line graphs cross
- 6) **Challenge:** can you set up and solve an equation to find the coordinates of where the two graphs cross?
- 7) **Challenge:** plot the graph of $2y + 3x = 12$ on the grid above

Plot a quadratic graph from the formula

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

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

b) Plot the graph of $y = x^2 - 2x - 3$ on the grid below



c) Draw the axis of symmetry of the curve on the grid

d) **Challenge:** Circle the points on the graph where $x^2 - 2x - 3 = 0$