



eClassroom

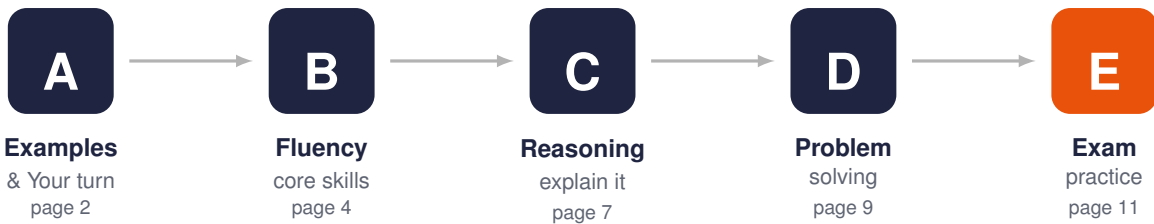
GCSE MATHEMATICS • ALGEBRA

Linear Graphs

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • No calculator

Free Linear Graphs worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: plot straight-line graphs from a table of values • find gradients and y-intercepts, and use $y = mx + c$ • find the equation of a line from a graph or from two points • use parallel lines and read real-life graphs • *Higher:* perpendicular lines, perpendicular bisectors, tangents and coordinate proof.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER Higher only: perpendicular lines, perpendicular bisectors and tangents to circles, plus coordinate proof. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	10	13	17
Higher marks	16	14	17	15
My score				

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Name

Class

Date



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A

Worked examples & Your turn

Read each example carefully. Cover it up, then answer the question beside it using the same method.

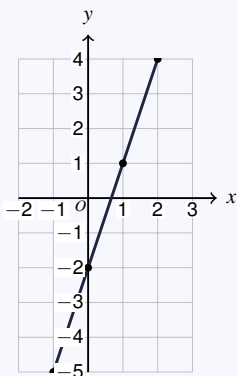
FOUNDATION

Everyone starts here

Worked example A1

Draw the graph of
 $y = 3x - 2$ for x from -1
 to 2

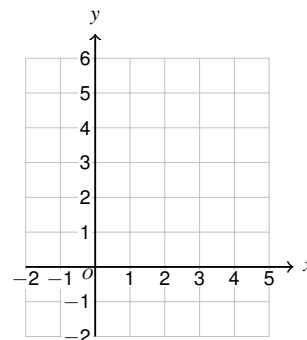
Table: $x = -1, 0, 1, 2$ gives
 $y = -5, -2, 1, 4$. Plot the
 points and join them with a
 ruler.



a straight line through $(0, -2)$

Your turn A1

Draw the graph of
 $y = 4 - x$ for x from -1 to
 4



Worked example A2

Find the gradient of the line through $(1, 3)$ and
 $(4, 12)$

$$\text{Gradient} = \frac{\text{change in } y}{\text{change in } x}$$

$$\frac{12 - 3}{4 - 1} = \frac{9}{3}$$

3

Your turn A2

Find the gradient of the line through $(-2, 5)$ and
 $(2, -3)$

Worked example A3

Find the equation of the line through $(1, 5)$ and
 $(3, 11)$

$$\text{Gradient} = \frac{6}{2} = 3, \text{ so } y = 3x + c. \text{ Substitute } (1, 5): 5 = 3 + c$$

$$y = 3x + 2$$

Your turn A3

Find the equation of the line through $(-1, 7)$ and
 $(3, -1)$



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HIGHER*Higher only: perpendicular lines and coordinate proof***Worked example A4: rearranging first**Find the gradient and y-intercept of $4x + 2y = 10$ *Make y the subject to get the form $y = mx + c$*

$$2y = -4x + 10 \quad y = -2x + 5$$

gradient -2 , intercept 5 **Your turn A4**Find the gradient and y-intercept of $3y - 6x = 9$ **Worked example A5: perpendicular lines**Find the equation of the line perpendicular to $y = 3x + 1$ that passes through $(6, 2)$ *Perpendicular gradients multiply to -1 : the new gradient is $-\frac{1}{3}$*

$$2 = -\frac{1}{3}(6) + c, \text{ so } c = 4$$

$$y = -\frac{1}{3}x + 4$$

Your turn A5Find the equation of the line perpendicular to $y = -\frac{1}{2}x + 2$ that passes through $(1, 5)$ **Worked example A6: the perpendicular bisector** $A(0, 2)$ and $B(4, 6)$. Find the equation of the perpendicular bisector of AB .*Midpoint $(2, 4)$. Gradient of AB is 1 , so the bisector has gradient -1*

$$4 = -2 + c$$

$$y = -x + 6$$

Your turn A6 $A(-2, 1)$ and $B(4, -3)$. Find the equation of the perpendicular bisector of AB .**Worked example A7: points on one line**Show that $(0, 1)$, $(2, 5)$ and $(5, 11)$ lie on a straight line.*Compare the gradients between the first point and each of the others.*

$$\frac{5-1}{2-0} = 2 \quad \frac{11-1}{5-0} = 2$$

same gradient, so a straight line

Your turn A7Do $(1, 2)$, $(3, 7)$ and $(5, 11)$ lie on a straight line? Show your working.

B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION

Everyone starts here

B1 A line has equation $y = 3x - 4$

- (a) Find y when $x = 2$ (b) Find y when $x = -1$ (c) Find x when $y = 11$ (d) Is $(4, 7)$ on the line?
[4 marks]

B2 Write down the gradient and the y -intercept of each line.

- (a) $y = 4x + 1$ (b) $y = 1 - 4x$ (c) $y = 4x$ (d) $y = 4$
[4 marks]

B3 Find the gradient of the line through each pair of points.

- (a) $(1, 2)$ and $(3, 8)$ (b) $(1, 8)$ and $(3, 2)$
(c) $(-2, 1)$ and $(2, 3)$ (d) $(0, 5)$ and $(4, 5)$
[4 marks]

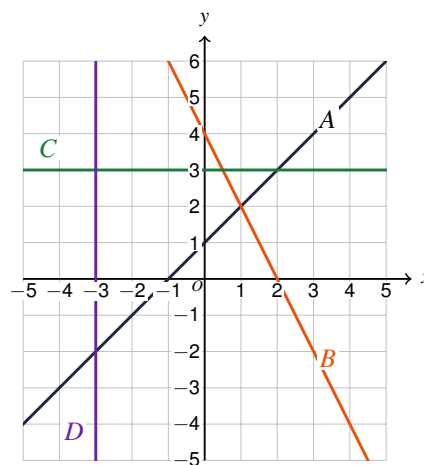
B4 Find the equation of each line.

- (a) gradient 2, through $(0, 3)$ (b) gradient 2, through $(1, 3)$
(c) gradient -3 , through $(2, 1)$ (d) gradient $\frac{1}{2}$, through $(4, 0)$
[4 marks]



FOUNDATION*continued: parallel lines and reading graphs***B5** Find the equation of the line that is

- (a) parallel to $y = 5x - 2$ and passes through $(0, 7)$
- (b) parallel to $y = -x + 1$ and passes through $(3, 1)$
- (c) parallel to $2y = x + 6$ and passes through $(2, 5)$

[3 marks]**B6** Write down the equation of each line A , B , C and D .**[4 marks]****HIGHER***Higher tier only***B7** Find the gradient and the y-intercept of each line.

(a) $2y = 6x + 8$

(b) $y - 3x = 5$

(c) $2x + 5y = 10$

(d) $3x - 4y = 12$

[4 marks]**B8** Find the gradient of a line perpendicular to a line with

(a) gradient 3

(b) gradient $-\frac{1}{2}$

(c) gradient $\frac{2}{3}$

(d) equation $2x + 3y = 6$

[4 marks]

HIGHER*continued: perpendicular lines*

B9 Find the equation of the line through the given point, perpendicular to the given line.

(a) $y = 2x + 1$, through $(0, 4)$

(b) $y = 2x + 1$, through $(2, 5)$

(c) $y = -3x$, through $(3, 0)$

(d) $x + 2y = 8$, through $(1, 1)$

[4 marks]

B10 Are the lines in each pair parallel, perpendicular or neither? Give a reason.

(a) $y = 2x + 1$ and $y = 2x - 5$

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

(c) $y = 3x$ and $3y = x$

(d) $2x + 3y = 6$ and $3x - 2y = 4$

[4 marks]



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C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** Sam says, "The gradient of $y = 7 - 2x$ is 7"
Explain why Sam is wrong, and write down the correct gradient. [2 marks]
- C2** Jo finds the gradient of the line through (1, 4) and (3, 10). She writes $\frac{3-1}{10-4} = \frac{1}{3}$
Explain Jo's mistake, and find the correct gradient. [2 marks]
- C3** (a) Is the point (4, 9) on the line $y = 3x - 2$? Explain.
(b) The point (k , 13) is on the line $y = 3x - 2$. Find k . [3 marks]
- C4** Explain why the lines $y = 2x + 3$ and $y = 2x - 1$ never meet. [3 marks]



HIGHER*Higher tier only*

- C5** Kai says, “A line perpendicular to a line with gradient 4 has gradient -4 ”
Explain why Kai is wrong, and give the correct gradient. [3 marks]
- C6** $A(1, 1)$, $B(4, 3)$ and $C(2, 6)$ are the vertices of a triangle.
Show that the triangle has a right angle at B . [3 marks]
- C7** $A(0, 0)$, $B(4, 2)$, $C(5, 6)$ and $D(1, 4)$
Show that $ABCD$ is a parallelogram. [3 marks]
- C8** The lines $y = 2x + 1$ and $y = kx - 3$ meet at a point P . The two lines and the y -axis form a triangle with area 8 units^2
- (a) Show that P has x -coordinate $\frac{4}{k-2}$
- (b) Find the two possible values of k . [5 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

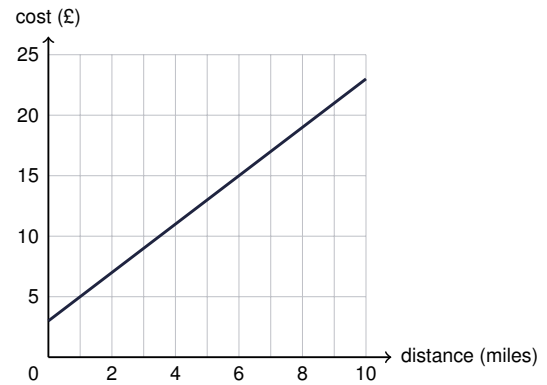
FOUNDATION

Everyone starts here

D1 The graph shows the cost of a taxi journey.

(a) Find the gradient of the line.

(b) Explain what the gradient and the y-intercept mean for the taxi fare.



[3 marks]

D2 A tank holds 400 litres of water. It is emptied at a steady rate. After t minutes the volume is $V = 400 - 25t$ litres.

(a) Write down the gradient of the graph of V against t , and say what it means.

(b) How long does the tank take to empty? (c) Where does the graph cross the V axis? [4 marks]

D3 A line passes through $(-1, 1)$ and $(3, 9)$. Find the coordinates of the point where it crosses the x -axis.

[3 marks]

D4 $ABCD$ is a square with $A(1, 1)$, $B(5, 1)$, $C(5, 5)$ and $D(1, 5)$.

Find the equations of the diagonals AC and BD .

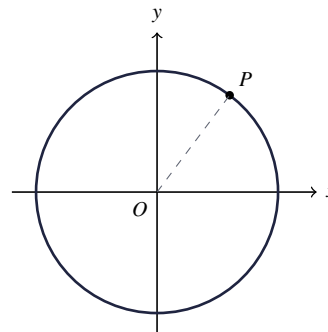
[3 marks]



HIGHER*Higher tier only*

- D5** Find the equation of the line through $(4, -1)$ that is parallel to $3x + 2y = 7$. Find where it crosses both axes. [4 marks]

- D6** The circle $x^2 + y^2 = 25$ passes through the point $P(3, 4)$.
Find the equation of the tangent to the circle at P .



[4 marks]

- D7** The lines $2x + ky = 5$ and $3x - 4y = 1$ are drawn on the same axes.
(a) Find k if the lines are perpendicular. (b) Find k if the lines are parallel. [4 marks]

- D8** The line L has equation $y = 3x - 2$. The point A is $(7, 0)$.
(a) Find the equation of the line through A perpendicular to L .
(b) Find the point where this line meets L .
(c) Hence find the reflection of A in the line L . [5 marks]



E**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION

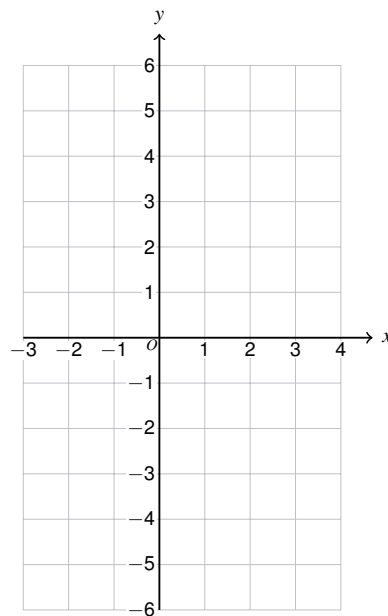
Foundation and Higher crossover

E1 (a) Complete the table of values for $y = 2x - 1$

x	-2	-1	0	1	2	3
y		-3			3	

(2)

(b) On the grid, draw the graph of $y = 2x - 1$ for values of x from -2 to 3



(2)

(Total for Question E1 is 4 marks)

E2 Write down the gradient and the y-intercept of the line $y = 5 - 3x$

gradient y-intercept

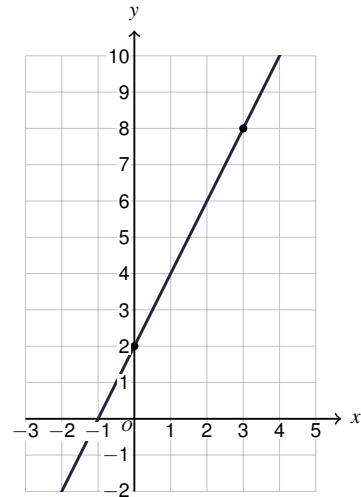
(Total for Question E2 is 2 marks)



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- E3** Find the equation of the straight line shown on the grid.



.....
(Total for Question E3 is 3 marks)

- E4** Here are the equations of four lines. $y = 3x + 1$ $y = 1 + 2x$ $2y = 6x - 5$ $y = 3 - x$
Which two lines are parallel? Give a reason.

.....
(Total for Question E4 is 2 marks)

- E5** A straight line passes through the points (2, 5) and (6, 13).
Find the equation of the line.

.....
(Total for Question E5 is 3 marks)



E6 The line L has equation $3x + 2y = 12$

(a) Find the coordinates of the points where L crosses the x -axis and the y -axis.

.....
(2)

(b) Find the gradient of L .

.....
(1)

(Total for Question E6 is 3 marks)

HIGHER

Higher tier only

E7 Find the equation of the line that is perpendicular to $y = 2x - 3$ and passes through the point $(4, 1)$.

.....
(Total for Question E7 is 3 marks)

E8 A is the point $(-1, 3)$ and B is the point $(5, 7)$.

Find the equation of the perpendicular bisector of AB .

.....
(Total for Question E8 is 4 marks)

E9 Show that the points $(1, 4)$, $(3, 10)$ and $(6, 19)$ lie on a straight line.

(Total for Question E9 is 3 marks)



E10 The line L_1 passes through $(0, 6)$ and $(4, -2)$. The line L_2 is perpendicular to L_1 and passes through the point $(2, 2)$, which is on L_1 .

Find the area of the triangle formed by L_1 , L_2 and the y -axis.

.....
(Total for Question E10 is 5 marks)

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