



eClassroom

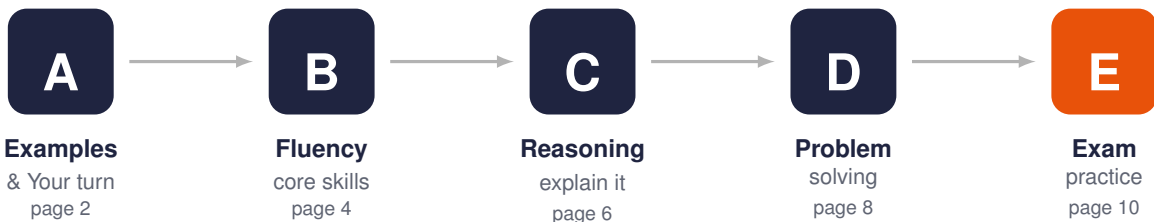
GCSE MATHEMATICS • ALGEBRA

Linear Equations

Worksheet

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

Free Linear Equations 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: solve equations with the unknown on both sides and with brackets • solve equations with fractions • form equations from angles, perimeters and prices, then solve them • *Higher:* two fractions, the unknown in a denominator, equations that become linear, and equations with no solution.

Which questions are for me?

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

HIGHER The same skills where Higher papers use them: two fractions, the unknown in a denominator, equations that become linear, and equations with no solution. 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	18
Higher marks	16	14	17	14
My score				

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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**

Solve $4x + 9 = 1$

Undo the +9, then undo the $\times 4$

$$4x = -8$$

$$x = -2$$

Your turn A1

Solve $\frac{x}{5} - 3 = 4$

Worked example A2

Solve $5x - 3 = 2x + 12$

Subtract $2x$ from both sides so the x terms are on one side.

$$3x - 3 = 12 \quad 3x = 15$$

$$x = 5$$

Your turn A2

Solve $3y + 7 = 8y - 13$

Worked example A3

Solve $3(2x - 5) = 2(x + 3) + 1$

Expand both sides first.

$$6x - 15 = 2x + 7 \quad 4x = 22$$

$$x = 5.5$$

Your turn A3

Solve $5(y + 2) - 3 = 2(y + 11)$



HIGHER*Higher strategies: these are new ways of thinking, not longer sums***Worked example A4: a fraction with several terms**

Solve $\frac{3x-1}{4} = x-3$

Multiply both sides by 4, keeping the right side in a bracket.

$$3x-1 = 4(x-3) = 4x-12$$

$$x = 11$$

Your turn A4

Solve $\frac{5x+2}{3} = 2x-1$

Worked example A5: two fractions

Solve $\frac{x+1}{2} + \frac{x+4}{3} = 6$

Multiply every term by 6, the common denominator.

$$3(x+1) + 2(x+4) = 36 \quad 5x+11 = 36$$

$$x = 5$$

Your turn A5

Solve $\frac{x+2}{4} - \frac{x-3}{6} = 2$

Worked example A6: x in the denominator

Solve $\frac{2x+1}{x-3} = 5$

Multiply both sides by $(x-3)$

$$2x+1 = 5x-15 \quad 3x = 16$$

$$x = \frac{16}{3}$$

Your turn A6

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

Worked example A7: equations that become linear

Solve $(x+4)(x-1) = (x+2)(x+3) - 12$

Expand both sides. The x^2 terms cancel.

$$x^2+3x-4 = x^2+5x-6 \quad 2 = 2x$$

$$x = 1$$

Your turn A7

Solve $(x-3)^2 = (x+1)^2 - 32$



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** Solve

(a) $x + 7 = 12$

(b) $7x = 12$

(c) $\frac{x}{7} = 12$

(d) $7 - x = 12$

[4 marks]**B2** Solve

(a) $3x + 5 = 20$

(b) $3x - 5 = 20$

(c) $5 - 3x = 20$

(d) $\frac{x+5}{3} = 20$

[4 marks]**B3** Solve

(a) $5x + 2 = 3x + 10$

(b) $5x + 2 = 3x - 10$

(c) $2x + 9 = 5x - 3$

(d) $7 - 2x = 3x - 8$

[4 marks]**B4** Solve

(a) $4(x - 3) = 20$

(b) $4(x - 3) = 2x + 8$

(c) $4(x - 3) = 2(x + 8)$

(d) $4(x - 3) - 2(x - 5) = 10$

[4 marks]**B5** Solve

(a) $\frac{x}{4} + 3 = 8$

(b) $\frac{x+3}{4} = 8$

(c) $\frac{3x}{4} = 9$

[3 marks]**B6** Form an equation and solve it to find x .

(a) Angles on a straight line are $(x + 40)^\circ$ and $(2x - 10)^\circ$

(b) The angles of a triangle are x° , x° and $(2x + 20)^\circ$

(c) A triangle has sides x cm, x cm and $(2x - 3)$ cm. Its perimeter is 29 cm.

(d) A square has side $(3x - 2)$ cm. Its perimeter is 40 cm.

[4 marks]

HIGHER*Higher tier only***B7** Solve

(a) $\frac{2x+5}{3} = x$

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

(c) $\frac{2x+5}{3} = \frac{x+4}{2}$

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

[4 marks]**B8** Solve

(a) $\frac{x}{2} + \frac{x}{3} = 10$

(b) $\frac{x}{2} - \frac{x}{3} = 10$

(c) $\frac{x+1}{2} + \frac{x+1}{3} = 10$

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

[4 marks]**B9** Solve

(a) $\frac{20}{x} = 4$

(b) $\frac{20}{x+1} = 4$

(c) $\frac{20}{x+1} = \frac{5}{x-2}$

(d) $\frac{x+6}{x-1} = 3$

[4 marks]**B10** Solve

(a) $x(x+3) = x^2 + 12$

(b) $(x+2)^2 = x^2 + 20$

(c) $(x+1)(x+5) = (x+2)^2 + 7$

(d) $(2x-1)^2 - (2x+3)^2 = 8$

[4 marks]

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 Ella solves $3x + 5 = 20$ and writes $3x = 25$, so $x = \frac{25}{3}$

Explain Ella's mistake, and solve the equation correctly.

[2 marks]

C2 Ben solves $\frac{x+4}{3} = x - 2$ and writes $x + 4 = 3x - 2$

Explain Ben's mistake, and solve the equation correctly.

[2 marks]

C3 (a) Sam says, " $2x + 7 = 7$ has no solution, because $2x = 0$ " Explain why Sam is wrong.

(b) Solve $5 - 2x = 5 - 4x$

[3 marks]

C4 Show that $x = 2.5$ is the solution of $6(x - 1) = 2x + 4$

[3 marks]



HIGHER*Higher tier only*

- C5** Mia solves $\frac{x}{3} + 2 = \frac{x}{2}$ by multiplying by 6. She writes $2x + 2 = 3x$, so $x = 2$

Explain Mia's mistake, and solve the equation correctly.

[3 marks]

- C6** Leo solves $\frac{x+5}{2} - \frac{x-1}{3} = 4$ and writes $3x + 15 - 2x - 2 = 24$

Explain Leo's mistake, and solve the equation correctly.

[3 marks]

- C7** $kx + 3 = 2x + 11$

(a) Find k if the solution is $x = 4$ (b) Find the value of k for which the equation has no solution.

[3 marks]

- C8** (a) Show that $2(3x - 1) - 4x = 2(x + 3)$ has no solution.

(b) Show that $3(x + 4) - x = 2(x + 6)$ is true for every value of x

(c) Explain, in terms of what happens to the x terms and the numbers, how you can tell which of these two cases you have.

[5 marks]



D**Problem solving**

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

FOUNDATION *Everyone starts here*

- D1** Ali, Ben and Cara share £84. Ben gets £6 more than Ali. Cara gets twice as much as Ben.

How much does Cara get?

[3 marks]

- D2** Kim is paid £9.50 for each hour she works, plus a bonus of £20. One week she is paid £153

Form and solve an equation to find how many hours she worked.

[3 marks]

- D3** The diagram shows a quadrilateral.

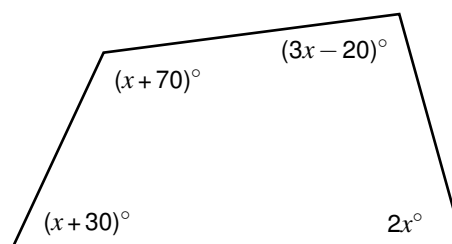


Diagram NOT accurately drawn

Find the size of the largest angle.

[4 marks]

- D4** A square has side $(x + 3)$ cm. An equilateral triangle has side $(2x - 1)$ cm. They have the same perimeter.

Find the perimeter.

[3 marks]



HIGHER*Higher tier only*

- D5** The mean of the five numbers $2x$, $x+5$, $3x-1$, 12 , $x+9$ is 12
Find x , and hence find the median of the five numbers. [4 marks]
- D6** (a) The sum of three consecutive even numbers is 22 more than the smallest of them. Find the three numbers.
(b) Explain why the sum of any three consecutive even numbers is a multiple of 6 [4 marks]
- D7** Taxi A charges £3 plus £1.60 for each kilometre. Taxi B charges £1.50 plus £1.90 for each kilometre.
(a) For what distance do the two taxis cost the same?
(b) Which taxi is cheaper for a journey of 8 km, and by how much? [4 marks]
- D8** A rectangle is 4 cm longer than it is wide. When its length is decreased by 3 cm and its width is increased by 2 cm, its area does not change.
Find the length and width of the original rectangle. [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) Solve $5x - 7 = 18$

$x = \dots\dots\dots$
(1)

(b) Solve $\frac{x}{3} + 4 = 10$

$x = \dots\dots\dots$
(1)

(Total for Question E1 is 2 marks)

E2 Solve $7x + 4 = 3x - 12$

$x = \dots\dots\dots$

(Total for Question E2 is 2 marks)

E3 Solve $4(2y - 3) = 3y + 8$

$y = \dots\dots\dots$

(Total for Question E3 is 3 marks)



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- E4** The angles of a triangle are x° , $(2x + 10)^\circ$ and $(3x - 40)^\circ$

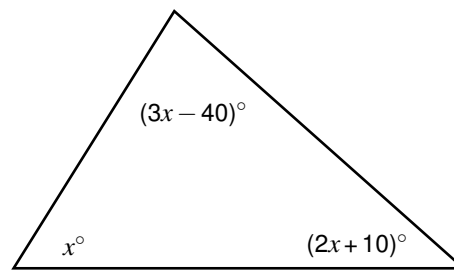


Diagram NOT accurately drawn

Find the size of the largest angle.

..... $^\circ$

(Total for Question E4 is 4 marks)

- E5** A rectangle has length $(3x + 2)$ cm and width $(x - 1)$ cm. Its perimeter is 42 cm.
Work out the area of the rectangle.

..... cm²

(Total for Question E5 is 4 marks)

- E6** Solve $\frac{2x + 1}{5} = x - 4$

$x =$

(Total for Question E6 is 3 marks)



HIGHER*Higher tier only*

E7 Solve $\frac{x+7}{3} = \frac{2x-1}{5} + 2$

 $x = \dots\dots\dots$ **(Total for Question E7 is 3 marks)**

E8 Solve $\frac{5}{x+1} = \frac{3}{x-1}$

 $x = \dots\dots\dots$ **(Total for Question E8 is 3 marks)**

E9 Solve $(x+3)^2 - (x-2)^2 = 45$

 $x = \dots\dots\dots$ **(Total for Question E9 is 3 marks)**

E10 Jo cycles from home to town at an average speed of 15 km/h. She walks back along the same route at 5 km/h.

The whole journey takes 2 hours 40 minutes. The distance from home to town is d km.

(a) Show that $\frac{d}{15} + \frac{d}{5} = \frac{8}{3}$

(2)

(b) Find the distance from home to town.

..... km

(2)

(c) Work out Jo's average speed for the whole journey.

..... km/h

(1)

(Total for Question E10 is 5 marks)

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