

# Linear equations 1

To solve a linear equation you need to get the letter on its own on one side.

It is really important to write your working **neatly** when you are solving equations.

Every line of working should have an equals sign in it.

Start a new line for each step.  
Do one operation at a time.

$$\begin{aligned} 5x + 3 &= 18 \\ 5x &= 15 \\ x &= 3 \end{aligned}$$

Write down the operation you are carrying out. Remember to do the same thing to both sides of the equation.

Line up the equals signs.

## Letter on both sides?

To solve an equation you have to get the letter on its own on one side of the equation.

Start by collecting like terms so that all the letters are together.

$$\begin{aligned} 2 - 2x &= 26 + 4x & (+2x) \\ 2 &= 26 + 6x & (-26) \\ -24 &= 6x & (\div 6) \\ -4 &= x \end{aligned}$$

You can write your answer as  
 $-4 = x$  or as  $x = -4$

## Equations with brackets

Always start by multiplying out the brackets then collecting like terms.

For a reminder about multiplying out brackets have a look at page 17.

$$19 = 8 - 2(5 - 3y)$$

$$19 = 8 - 10 + 6y$$

$$19 = -2 + 6y & (+2)$$

$$21 = 6y & (\div 6)$$

$$\frac{21}{6} = y$$

$$y = \frac{7}{2} \text{ or } 3\frac{1}{2} \text{ or } 3.5$$

Your answer can be written as a fraction or decimal.

## Worked example

Solve  $7r + 2 = 5(r - 4)$

$$\begin{aligned} 7r + 2 &= 5r - 20 & (-5r) \\ 2r + 2 &= -20 & (-2) \\ 2r &= -22 & (\div 2) \\ r &= -11 \end{aligned}$$

Target grade 4

(3 marks)

Multiply out the brackets then collect all the terms in  $r$  on one side. You need to write down each step of your working clearly.

## Examiners' report

Don't use a trial and improvement method to solve an equation. You probably won't find the correct answer, and you can't get any method marks.

Real students have struggled with questions like this in recent exams – **be prepared!**



## Now try this

1 Solve

(a)  $5w - 17 = 2w + 4$   
(b)  $2(x + 11) = 20$

(3 marks)  
(3 marks)

2 Solve

(a)  $6y - 9 = 2(y - 8)$   
(b)  $4m - 2(m - 3) = 7m - 14$

Target grade 4

Expand the brackets first.

Expand the brackets then collect all the  $m$  terms on one side of the equation.



# Linear equations 2

## Equations with fractions

When you have an equation with fractions, you need to get rid of any fractions before solving. You can do this by multiplying every term by the lowest common multiple (LCM) of the denominators.

$$\frac{x}{3} + \frac{x-1}{5} = 11 \quad (\times 15)$$

The LCM of 3 and 5 is 15.

$$\frac{5}{3}x + \frac{3}{5}(x-1) = 165$$

Cancel the fractions. There is more about simplifying algebraic fractions on page 47.

$$5x + 3x - 3 = 165$$

$$8x - 3 = 165 \quad (+ 3)$$

$$8x = 168 \quad (\div 8)$$

$$x = 21$$

### Multiplying by an expression

You might have to multiply by an expression to get rid of the fractions.

$$\frac{20}{n-3} = -5 \quad (\times (n-3))$$

$$20 = -5(n-3)$$

### Worked example

Target grade **4**

(3 marks)

Solve  $\frac{29-x}{4} = x+5$

$$\frac{4(29-x)}{4} = 4(x+5)$$

$$29-x = 4(x+5)$$

$$29-x = 4x+20 \quad (+x)$$

$$29 = 5x+20 \quad (-20)$$

$$9 = 5x \quad (\div 5)$$

$$\frac{9}{5} = x$$

Eliminate fractions **before** you start solving the equation. You can do this by multiplying both sides of the equation by 4.

Use brackets to show that you are multiplying everything by 4.

$$4(x+5) \checkmark \quad 4x+5 \times$$

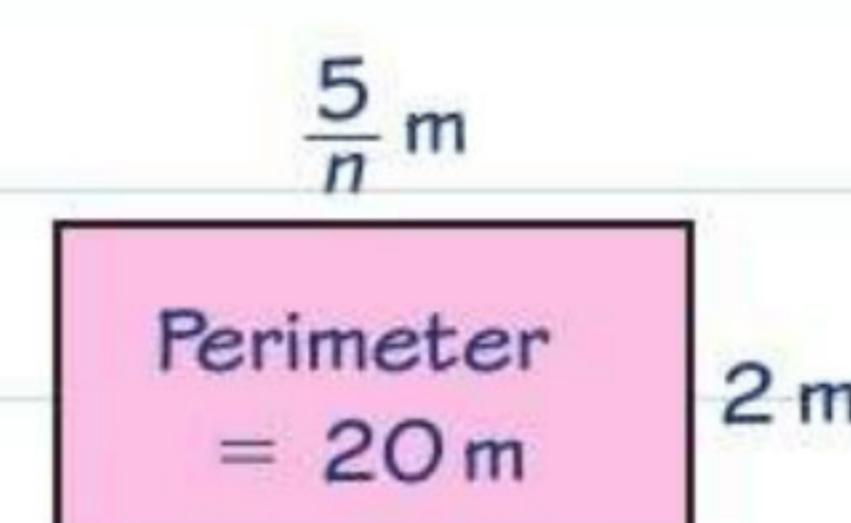
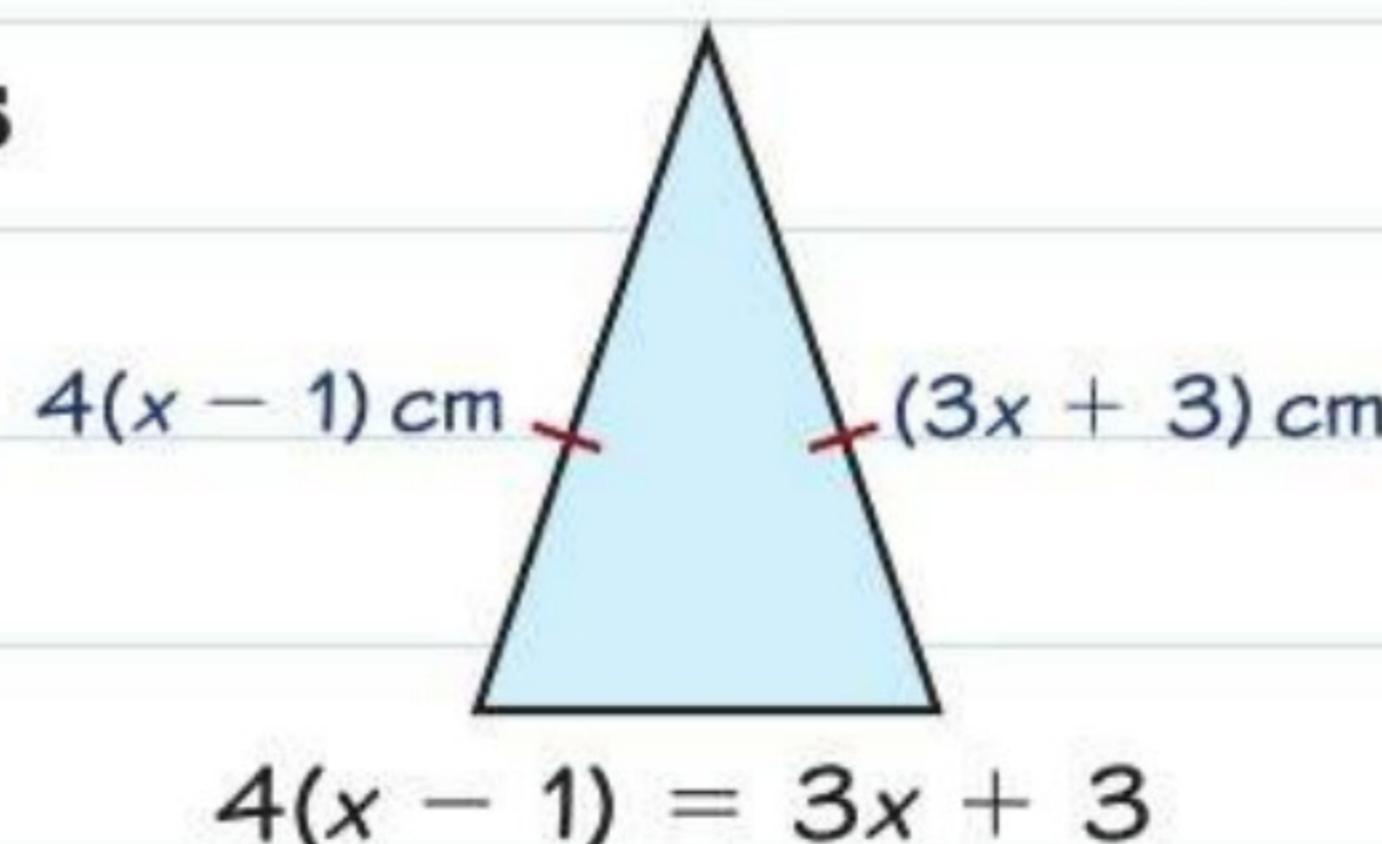
Multiply out the brackets, then solve the equation normally. Remember that your answer could be a fraction.

### Top tip!

It's OK to leave the answer to an equation as an improper fraction. Don't waste time converting to mixed numbers or decimals.

### Writing your own equations

You can find unknown values by writing and solving equations.



### Now try this

Target grade **4**

1 Solve

$$(a) \frac{25-3w}{4} = 10$$

(3 marks)

$$(b) 5x-10 = \frac{18-x}{3}$$

(3 marks)

Target grade **6**

2 Solve

$$(a) \frac{2y}{3} + \frac{y-4}{2} = 5$$

(3 marks)

$$(b) \frac{3m-1}{4} - \frac{2m+4}{3} = 1.5$$

(3 marks)