

Solving linear equations

Year 9 Mathematics
Mainstream

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Learning Objectives

By the end of the lesson I hope that you understand and can apply the following to a range of questions from the Year 9 Mathematics course.

- To know the definition of an equation
- To understand that linear equations are solved by creating a series of equivalent equations
- To understand that equivalent equations are created by applying the same operation to both sides of the equation
- To be able to solve a linear equation by using inverse operations
- To know that an answer can be checked by substituting into the original equation



Recap of past learning

We have been looking at a lot of work which forms the basis of the algebra work we will be using for the rest of Year 9 and into Years 10, 11 and 12.

We have now found ways to expand brackets and algebraic expressions, collect like terms, multiply and divide terms and simplify expressions.

We now move onto the idea of equations (which are different from expressions) and how we can solve **linear equations**.



What is a linear equation

As the word seems to suggest a **linear equation** is one which, if we were to draw it on a graph, would be us a **straight line**.

We can tell is an equation is linear or not as the highest power of the pronumeral used will be 1 (one).

Examples are shown below.

Notice how the ‘x’ has no floaty number by it.

Desmos.com

a $2x + 3 = 4$

b $\frac{x}{4} - 3 = 7$

c $5 - 2x = 12$

d $\frac{2x}{3} + 5 = 7$

e $\frac{2x + 4}{9} = 2$



Solving linear equations

When we solve linear equations we are really **trying to find the value of the pronumeral** which, for the one case shown, would give the answer.

Hence, we would normally be trying to find the value of ‘x’.

When we are solving, we are trying to **get the pronumeral on it’s own**. We are trying to make it the “loner” of the equation.

We do this by back tracking.



Example

Solve each of the following equations.

a $2x + 3 = 4$

b $\frac{x}{4} - 3 = 7$

c $5 - 2x = 12$

d $\frac{2x}{3} + 5 = 7$

e $\frac{2x + 4}{9} = 2$

$2x = 2 \times x$

$-3 \quad 2x + 3 = 4 \quad -3$

$\div 2 \quad 2x = 1 \quad \div 2$

$\frac{2x}{2} = \frac{1}{2}$

$x = \frac{1}{2}$



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$\frac{x}{4} - 3 = 7$ ×4 ×4

$x - 12 = 28$ +12 +12

$x = 40$

$\frac{x}{4} = 7 + 3$ +3 ×4

$x = 10 \times 4$

$x = 40$



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$5 - 2x = 12$

$-5 \quad -2x = 12 \quad -5$

$\div -2 \quad \frac{-2x}{-2} = \frac{7}{-2} \quad \div -2$

$x = \frac{7}{-2} = -\frac{7}{2}$

$-\frac{7}{2}$

$\frac{7}{-2}$

$-\frac{7}{2}$



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e $\frac{2x + 4}{9} = 2$

$\times 3$ $\frac{2x}{3} + 5 = 7$ $\times 3$

-15 $2x = 21$ -15

$\div 2$ $2x = 6$ $\div 2$

$x = 3$



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$\times 9 \quad \frac{2x+4}{9} = 2 \quad \times 9$

$2x + 4 = 18 \quad -4$

$-4 \quad 2x = 14 \quad \div 2$

$\div 2 \quad x = 7$



Dealing with fractions

Let's face it … no one likes fractions.

The best way to get rid of a fraction is to multiply every term by the denominator of each fraction.

$$\times 2 \quad \frac{x}{\cancel{2}} - 5 = 6 \quad \times 2$$

$$\frac{5x}{2} + 1 = 4$$

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

$$+10 \quad x \cancel{+10} = 12 \quad +10$$

$$x = \underline{\underline{22}}$$



Dealing with fractions

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$$\frac{x}{2} - 5 = 6$$

$$\frac{5x}{2} + 1 = 4$$

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

$\times 2$ $\times 2$

-2 $5x = 8$ -2

$\div 5$ $5x = 6$ $\div 5$

$x = \frac{6}{5}$



Dealing with fractions

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The best way to get rid of a fraction is to multiply every term by the denominator of each fraction.

$$\frac{x}{2} - 5 = 6$$

$$\frac{5x}{2} + 1 = 4$$

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

×5 ×5

−2 $4x + 2 = 15$ −2

÷4 $4x = 13$ ÷4

$x = \frac{13}{4}$



Dealing with negative coefficients

There are two ways to do this …

1. Swap the signs of every term.
2. Add to both sides the value of the term which is negative

$$12 - 2x = 18$$

-12 $\quad -2x \cancel{+12} = 18 \quad -12$

$\div -2 \quad \cancel{-12}x = 6 \quad \div -2$

$$x = \frac{6}{-2} = -3$$

$$12 - 2x = 18$$

$x - 1$

$-12 + 2x = -18$

$2x \cancel{+12} = -18 \quad +12$

$2x = -6$

$$x = \frac{-6}{2} = -3$$



Questions to complete

The following work is the **minimum** you are expected to complete in class and at home.

You are welcome to answer more questions if you feel you have the time.

Exercise 2D
Questions: 2adgj, 3aceg, 4aceg, 5adgj, 6adgj, 7, 10

Extension: 11

