# YEAR 10 – DEVELOPING ALGEBRA...

@whisto_maths

# Simultaneous Equations

## What do I need to be able to do?

**By the end of this unit you should be able to:**

- Determine whether (x,y) is a solution
- Solve by substituting a known variable
- Solve by substituting an expression
- Solve graphically
- Solve by subtracting/ adding equations
- Solve by adjusting equations
- Form and solve linear simultaneous equations

## Keywords

**Solution:** a value we can put in place of a variable that makes the equation true
**Variable:** a symbol for a number we don't know yet
**Equation:** an equation says that two things are equal – it will have an equals sign =
**Substitute:** replace a variable with a numerical value
**LCM:** lowest common multiple (the first time the times table of two or more numbers match)
**Eliminate:** to remove
**Expression:** a maths sentence with a minimum of two numbers and at least one math operation (no equals sign)
**Coordinate:** a set of values that show an exact position
**Intersection:** the point two lines cross or meet

## Is (x, y) a solution?

x and y represent values that can be substituted into an equation

Does the coordinate (1,8) lie on the line y=3x+5?

This coordinate represents x=1 and y=8

$y = 3x + 5$

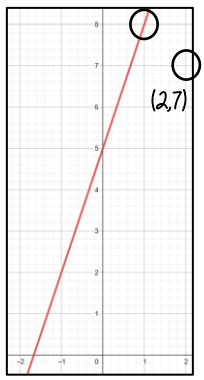
$8 = 3(1) + 5$

As the substitution makes the equation correct the coordinate (1,8) IS on the line y=3x+5

Is (2,7) on the same line?

$7 \neq 3(2) + 5$

No 7 does NOT equal 6+5




## Substituting known variables

A line has the equation 3x + y = 14

Stephanie knows the point x = 4 lies on that line. Find the value for y

$x = 4$

$3x + y = 14$

| x | x | x | y |
|---|---|---|---|
| 14 | | | |

$3(4) + y = 14$

| 4 | 4 | 4 | y |
|---|---|---|---|
| 14 | | | |

$12 + y = 14$

$-12 \quad -12$

$y = 2$

Two different variables, two solutions

| y |
|---|
| 2 |

## Substituting in an expression

$x = 2y$

$x + y = 30$

Pair of simultaneous equations (two representations)

Substitute 2y in place of the x variable as they represent the same value

$x = 2y$

| y | y |
|---|---|
| x | |

$x + y = 30$

| x | y |
|---|---|
| 30 | |

| y | y | y |
|---|---|---|
| 30 | | |

$3y = 30$

| y |
|---|
| 10 |

$3y = 30$

$\div 3 \quad \div 3$

$y = 10$

$x = 2y$

| 10 | 10 |
|---|---|
| x | |

$x = 20$

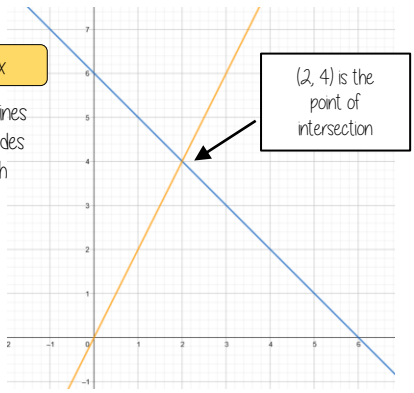
## Solve graphically

$x + y = 6$ $y = 2x$

Linear equations are straight lines
The point of intersection provides the x and y solution for both equations

The solution that satisfies both equations is

$x = 2$ and $y = 4$




## Solve by subtraction

| 18 | | | | |
|---|---|---|---|---|
| x | x | x | y | y |

| 10 | | |
|---|---|---|
| x | y | y |

| 8 | |
|---|---|
| x | x |

$x = 4$

$y = 3$

$3x + 2y = 18$

$-\ x + 2y = 10$

$2x = 8$

$\div 2 \quad \div 2$

$x = 4$

$x + 2y = 10$

$(4) + 2y = 10$

$-4 \quad -4$

$2y = 6$

$\div 2 \quad \div 2$

$y = 3$

| x | x | x | y | y | = 18 |
|---|---|---|---|---|---|
| x | y | y | | | = 10 |

| x | x | x | y | y | = 18 |
|---|---|---|---|---|---|
| x | y | y | | | = 10 |

| x | x | = 8 |
|---|---|---|
| x | | = 4 |
| y | | = 3 |

## Solve by addition

$3x + 2y = 16$

$+\ 6x - 2y = 2$

$9x = 18$

$\div 9 \quad \div 9$

$x = 2$

$3x + 2y = 16$

$3(2) + 2(y) = 16$

$6 + 2y = 16$

$-6 \quad -6$

$2y = 10$

$y = 5$

Addition makes zero pairs

| x | x | x | y | y | = 16 |
|---|---|---|---|---|---|
| x | x | x | -y | -y | = 2 |

| x | x | x | = 18 |
|---|---|---|---|
| x | x | x | |
| x | x | x | |

| x | = 2 |
|---|---|
| y | = 5 |

## Solve by adjusting one

$h + j = 12$

$2h + 2j = 29$

No equivalent values

| 12 | | | | |
|---|---|---|---|---|
| h | j | | | |
| h | h | j | j | j |
| 29 | | | | |

$2h + 2j = 24$

$2h + 2j = 29$

| 24 | | | | |
|---|---|---|---|---|
| h | h | j | j | |
| h | h | j | j | j |
| 29 | | | | |

By proportionally adjusting one of the equations – now solve the simultaneous equations choosing an addition or subtraction method

## Solve by adjusting both

$2x + 3y = 39$

$5x - 2y = -7$

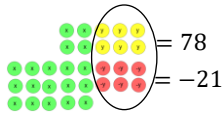
| x | x | y | y | y | = 39 |
|---|---|---|---|---|---|
| x | x | x | -y | -y | = -7 |
| x | x | | | | |

Use LCM to make equivalent x OR y values. Because of the negative values using zero pairs and y values is chosen choice

$4x + 6y = 78$

$15x - 6y = -21$

Now solve by addition




Addition makes zero pairs

# YEAR 10 – DEVELOPING ALGEBRA...

# Representing solutions of equations and inequalities

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## What do I need to be able to do?

**By the end of this unit you should be able to:**

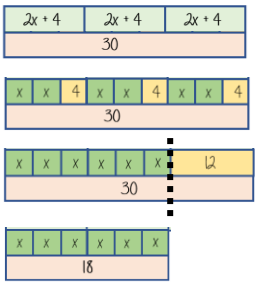
- Form and solve equations and inequalities
- Represent and interpret solutions on a number line as inequalities
- Draw straight line graphs and find solutions to equations
- Form and solve equations and inequalities with unknowns on both sides

## Keywords

**Solution:** a value we can put in place of a variable that makes the equation true
**Variable:** a symbol for a number we don't know yet
**Equation:** an equation says that two things are equal – it will have an equals sign =
**Expression:** numbers, symbols and operators grouped together to show the value of something
**Identity:** On equation where both sides have variables that cause the same answer includes ≡
**Linear:** an equation or function that is the equation of a straight line
**Intersection:** the point that two lines meet
**Inequality:** an inequality compares two values showing if one is greater than, less than or equal to another.

## Solve equations (R)

$3(2x + 4) = 30$




$3(2x + 4) = 30$

Expand the brackets

$6x + 12 = 30$

$-12 \quad -12$

Substitute to check your answer. This could be negative or a fraction or decimal

$6x = 18$

$\div 6 \quad \div 6$

$x = 3$

## Form and solve inequalities (R)

Two more than treble my number is greater than 11

**Form**

$x \rightarrow \times 3 \rightarrow +2 \rightarrow 11$

$3x + 2 > 11$

**Solve**

$x \leftarrow \div 3 \leftarrow -2 \leftarrow 11$

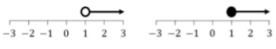
$x > 3$

## Solutions on a number line


$x < 1$ $\quad x \leq 1$

Both represent values less than 1

Includes the value 1



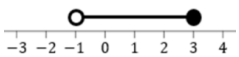

$x > 1$ $\quad x \geq 1$

Both represent values more than 1

Includes the value 1

- Includes the value it sits above
- Does NOT include the value it sits above

Values less than or equal to 3 but also more than -1




$-1 < x \leq 3$

This includes the integer values 0, 1, 2, 3

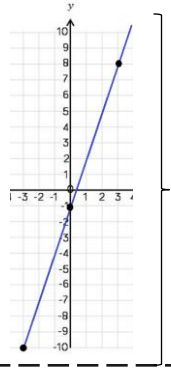
## Plotting straight line graphs (R)

$y = 3x - 1$ → 3 x the x coordinate then – 1

| x | -3 | 0 | 3 |
|---|---|---|---|
| y | -10 | -1 | 8 |

Draw a table to display this information

This represents a coordinate pair (-3, -10)



You only need two points to form a straight line

Plotting more points helps you decide if your calculations are correct (if they do make a straight line)

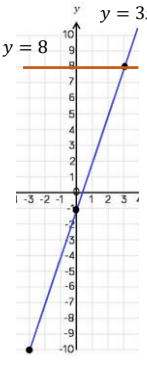
Remember to join the points to make a line

## Find solutions graphically

For linear equations there is only one point the graph meets the x value

$x = 2$
$y = 4$

These two lines will cross at (2,4) because they are just x= and y= they are parallel to axes and meet in one place



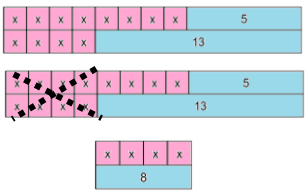

$3x - 1 = 8$

Remember equation of a line format is $y = mx + c$

The solution is the point the two lines meet (3,8)

## Equations: unknown on both sides (R)

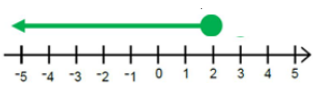
$8x + 5 = 4x + 13$




$8x + 5 = 4x + 13$
$-4x \quad -4x$
$4x + 5 = 13$
$-5 \quad -5$
$4x = 8$
$\div 4 \quad \div 4$
$x = 2$

## Inequalities: unknown on both sides

$8x + 5 \leq 4x + 13$ → $x \leq 2$




Only value 2 or less will satisfy this inequality