YEAR 9 — REASONING WITH ALGEBRA...
Forming and Solving Equations

What do I need to be able to do?

By the end of this unit you should be able to:
- Solve inequalities with negative numbers
- Solve equations with unknowns on both sides
- Solve inequalities with unknowns on both sides
- Substitute into formulae and equations
- Rearrange formulae

Keywords

Inequality: an inequality compares who values showing if one is greater than, less than or equal to another

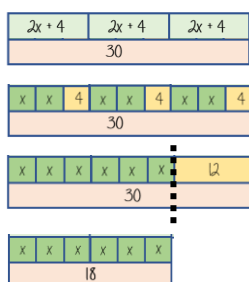**Variable**: a quantity that may change within the context of the problem

Rearrange: Change the order

Inverse operation: the operation that reverses the action

Substitute: replace a variable with a numerical value

Solve: find a numerical value that satisfies an equation

Solve equations with brackets (R)

$3(2x + 4) = 30$

Expand the brackets

$6x + 12 = 30$
$\quad -12 \qquad -12$

$6x = 18$
$\div 6 \quad \div 6 \qquad x = 3$

Form and solve inequalities (R)

Two more than treble my number is greater than 11

Find the possible range of values

$3x + 2 > 11$

Solve

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

$x > 3$

Inequalities with negatives

Method 1   Make x positive first
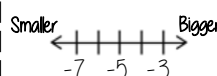
$2 - 3x > 17$
$+3x \quad +3x$
$\quad 2 > 17 + 3x$
$-17 \quad -17$
$-15 > 3x$
$\div 3 \quad \div 3$
$-5 > x$

x is true for any value smaller than -5

✓ **CHECK IT!**
$2 - 3(-6) = 20$
TRUE/ CORRECT

Smaller ←—|—|—|—|—|—|—→ Bigger
$\qquad -7 \quad -5 \quad -3$

Method 2   Keep the negative x

$2 - 3x > 17$
$-2 \quad -2$
$-3x > 15$
$\div -3 \quad \div -3$
$x > -5$

x is true for any value bigger than -5

This cannot be true…

$x < -5$

When you multiply or divide x by a negative you need to reverse the inequality

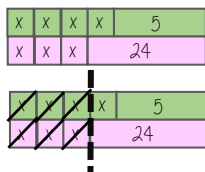## Equations with unknown on both sides

$4x + 5 = 3x + 24$
$-3x \qquad -3x$

$x + 5 = 24$
$-5 \qquad -5$

$x = 19$

Inequalities with unknown on both sides

Solving inequalities has the same method as equations

$5(x + 4) < 3(x + 2)$
$5x + 20 < 3x + 6$
$2x + 20 < 6$
$2x < -14$
$x < -7$

Check it!

$5(-8 + 4) < 3(-8 + 2)$
$5(-4) < 3(-6)$
$-20 < -18$
✓ -20 IS smaller than -18

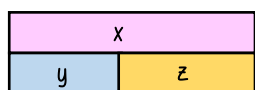## Formulae and Equations

Formulae – all expressed in symbols

Substitute in values →

Equations – include numbers and can be solved

Rearranging Formulae (one step)

$x = y + z$

Rearrange to make y the subject.
$y = x - z$

$y \xrightarrow{+z} x$

$y \xleftarrow{-z} x$

Using inverse operations or fact families will guide you through rearranging formulae

Rearranging can also be checked by substitution.

Language of rearranging…

Make XXX the subject

Change the subject

Rearrange

Rearranging Formulae (two step)

In an equation (find x)

$4x - 3 = 9$
$+3 \quad +3$
$4x = 12$
$\div 4 \quad \div 4$
$x = 3$

In a formula (make x the subject)

$xy - s = a$
$+s \quad +s$
$xy = a + s$
$\div y \quad \div y$
$x = \dfrac{a + s}{y}$

The steps are the same for solving and rearranging

Rearranging is often needed when using $y = mx + c$

eg Find the gradient of the line $2y - 4x = 9$

Make y the subject first $y = \dfrac{4x + 9}{2}$

Gradient $= \dfrac{4}{2} = 2$