Q Big idea *Tino Rangatiratanga - the self-determination principle*

DO Now

View the video

WALT - solve equations with pronumerals (Variables) on both sides

Success Criteria:

I know when solving equations with pronumerals on both sides. I have to transfer pronumerals from both sides to one side.

I know I need to isolate the variables to get my answer.

EXAMPLE 1

Solve the following equations.

a $5x + 2 = 3x - 5$ **b** $15 - 2x = 11 + x$

	Solve	Think	Apply
a	$5x + 2 = 3x - 5$ $5x + 2 - 3x = 3x - 5 - 3x$ $2x + 2 = -5$ $2x + 2 - 2 = -5 - 2$ $2x = -7$ $\frac{2x}{2} = \frac{-7}{2}$ $x = -\frac{7}{2}$ $= -3\frac{1}{2}$	Subtract $3x$ from both sides. Subtract 2 from both sides. Divide both sides by 2.	Eliminate the pronumeral from one side of the equation by adding or subtracting one of the pronumeral terms. Solve the resulting equation in the same way as in the previous exercise.
b	$15 - 2x = 11 + x$ $15 - 2x + 2x = 11 + x + 2x$ $15 = 11 + 3x$ $15 - 11 = 11 + 3x - 11$ $4 = 3x$ $\frac{4}{3} = \frac{3x}{3}$ $\frac{4}{3} = x$ $x = 1\frac{1}{3}$	Add $2x$ to both sides. Subtract 11 from both sides. Divide both sides by 3. Swap the pronumeral to the left-hand side.	

Solve the equation with the unknown on both sides

Practice

Use the link for extra practice

1 Solve the following equations with integer solutions.

a $5x + 2 = 2x + 14$
b $3x + 7 = 11 - x$
c $5 + x = 8 - 2x$
d $3x - 4 = 5x - 2$
e $3 - x = x + 7$
f $4 - 2x = 3 - x$
g $2x - 3 = x + 6$
h $5x - 9 = 1 + 6x$
i $3x - 5 = 7 - x$

2 Solve the following equations.

a $8x + 7 = 4x - 2$
b $7x + 3 = 2x + 7$
c $5 + 2x = 11 - x$
d $x - 3 = 5x + 7$
e $3 + x = 17 + 4x$
f $15 - 3x = 2 - x$
g $2x + 5 = 9 - 2x$
h $3x - 5 = 5x = 9$
i $5 - 7x = 3x + 2$
j $5a + 3 = a - 1$
k $4 - 3s = 2s + 17$
l $9x - 4 = 3 + 4x$
m $11a - 7 = 5a + 12$
n $3y - 5 = -14 - 2y$
o $7p = 15 - 3p$

EXAMPLE 2

By substituting, check the solutions to the following equations.

a $2x - 5 = 10 - 3x$ $(x = 3)$ **b** $5x + 2 = 2x - 7$ $(x = 2)$

	Solve	Think	Apply
a	Does $2x - 5 = 10 - 3x$ when $x = 3$? LHS: $2 \times 3 - 5 = 1$ RHS: $10 - 3 \times 3 = 1$ LHS = RHS $\therefore x = 3$ is the solution.	Substitute 3 for x on both sides of the equation. Left-hand side = 1 Right-hand side = 1 $x = 3$ is a solution.	Substitute the value of x and evaluate both sides of the equation. Both sides must give the same value for that value of x to be a solution. The actual value of the sides is not relevant.
b	Does $5x + 2 = 2x - 7$ when $x = 2$? LHS: $5 \times 2 + 2 = 12$ RHS: $2 \times 2 - 7 = -3$ $12 \neq -3$ $\therefore x = 2$ is not the solution.	Substitute 2 for x on both sides of the equation. Left-hand side = 12 Right-hand side = -3 This is not a solution.	

3 By substituting, check the solutions to the following equations.

a $3x + 9 = 4 + 2x$ $(x = 1)$
b $9a + 2 = 7a - 4$ $(a = -3)$
c $7a - 5 = 3 - a$ $(a = 2)$
d $15 - 2x = 6 + x$ $(x = 3)$
e $2x - 3 = 7 - 4x$ $(x = \frac{5}{3})$
f $5x - 7 = 3 + x$ $(x = 3\frac{1}{2})$

Extension Activity

involves expanding brackets and collecting like terms

[Solving equations with brackets]

EXAMPLE 3

Solve these equations.

a $5(x + 1) - 2(x - 2) = 7$ **b** $3(x + 1) = 5x + 3(2x - 1)$

	Solve	Think	Apply
a	$5(x + 1) - 2(x - 2) = 7$ $5x + 5 - 2x + 4 = 7$ $3x + 9 = 7$ $3x + 9 - 9 = 7 - 9$ $3x = -2$ $x = -\frac{2}{3}$	Expand the brackets. Collect the like terms. Subtract 9 from both sides. Divide both sides by 3.	The number and its sign in front of the brackets is multiplied by each term within the brackets. The most common error is to multiply the second term in the brackets incorrectly. Be vigilant with the signs.
b	$3(x + 1) = 5x + 3(2x - 1)$ $3x + 3 = 5x + 6x - 3$ $3x + 3 = 11x - 3$ $3x + 3 - 3x = 11x - 3 - 3x$ $3 = 8x - 3$ $3 + 3 = 8x - 3 + 3$ $\frac{6}{8} = \frac{8x}{8}$ $\frac{3}{4} = x$ $x = \frac{3}{4}$	Expand the brackets. Collect the like terms. Subtract $3x$ from both sides. Add 3 to both sides. Divide both sides by 8.	

4 Solve for x in these equations given that all answers are integers.

a $3(x + 1) - 2(x - 4) = 13$ **b** $2(x - 5) + 3(x + 2) = -9$

c $4(x - 5) + 5(x + 1) = 12$ **d** $2(x - 1) = 3(x + 5) - 22$

e $4(x - 2) = 3x + 4(x - 2)$ **f** $2(x - 1) = 4(2x + 1) - 9x$

g $4 - x = 2 - 3(x + 2)$ **h** $6 - 2(x + 5) = 2(2x - 1) - 5x$

5 Solve for x in each equation.

a $2(x + 1) - 1 = 8$ **b** $5(1 - 3x) = -4$

c $3(x + 2) - 7 = 11$ **d** $2(x + 1) + 3(x - 1) = 6$

e $4(2x - 1) + 7 = 0$ **f** $11 - 2(x - 1) = 7$

g $3 - 2(x + 1) = -4$ **h** $7 - (2 - x) = 2x$

i $5x - 4(4 - x) = x + 1$ **j** $3 - x = 5 - 2(x + 1)$

k $2(x - 1) = 1 - (3 - x)$ **l** $x + 7(4 - x) = 2x + 3(x - 1)$

EXAMPLE 4

If $y = 3 - 5(x + 4)$, find x when $y = -32$.

Solve	Think	Apply
$y = 3 - 5(x + 4)$		Substitute the value, simplify both sides if possible, then solve the equation. The pronumeral is often on the right-hand side of the equation.
$-32 = 3 - 5(x + 4)$	Substitute $y = -32$.	
$= 3 - 5x - 20$	Expand.	
$-32 = -17 - 5x$	Collect like terms.	
$-32 + 17 = -17 - 5x + 17$	Add 17 to both sides.	
$-15 = -5x$		
$\frac{-15}{-5} = \frac{-5x}{-5}$	Divide both sides by -5.	
$3 = x$		
$x = 3$		

6 **a** Given that $y = 7 - 3(x + 2)$, find x when $y = -5$.

b Given that $y = 5 - 4(x - 3)$, find x when $y = 37$.

c Given that $y = 4 - 5(2x - 5)$, find x when $y = 12$.

d Given that $y = 14 - 3(2x - 8)$, find x when $y = 0$.

e Given that $y = 3x - 2(5x + 1)$, find x when $y = -16$.

f Given that $y = 4x - 3(5 - 2x)$, find x when $y = 8$.

g Given that $y = 3(2x - 1) - 4(x + 2)$, find x when $y = -3$.

h Given that $y = 4(1 - 3x) - 2(1 - x)$, find x when $y = 2$.

Check your answers

1 **a** $x = 4$ **b** $x = 1$ **c** $x = 1$
d $x = -1$ **e** $x = -2$ **f** $x = 1$
g $x = 9$ **h** $x = -10$ **i** $x = 3$

2 **a** $x = -\frac{9}{4}$ **b** $x = \frac{4}{5}$ **c** $x = 2$
d $x = -\frac{5}{2}$ **e** $x = -\frac{14}{3}$ **f** $x = \frac{13}{2}$
g $x = 1$ **h** $x = -7$ **i** $x = \frac{3}{10}$
j $a = -1$ **k** $s = -\frac{13}{5}$ **l** $x = \frac{7}{5}$
m $x = \frac{19}{6}$ **n** $y = -\frac{9}{5}$ **o** $p = \frac{3}{2}$

3 **a** No **b** Yes **c** No
d Yes **e** Yes **f** No

4 **a** $x = 2$ **b** $x = -1$ **c** $x = 3$
d $x = 5$ **e** $x = 0$ **f** $x = 2$
g $x = -4$ **h** $x = -2$

5 **a** $x = \frac{7}{2}$ **b** $x = \frac{3}{5}$ **c** $x = 4$
d $x = \frac{7}{5}$ **e** $x = -\frac{3}{8}$ **f** $x = 3$
g $x = \frac{5}{2}$ **h** $x = 5$ **i** $x = \frac{17}{8}$
j $x = 0$ **k** $x = 0$ **l** $x = \frac{31}{11}$

6 **a** $x = 2$ **b** $x = -5$ **c** $x = \frac{17}{10}$
d $x = \frac{19}{3}$ **e** $x = 2$ **f** $x = \frac{23}{10}$
g $x = 4$ **h** $x = 0$