6 What must be done to these to get a?

a $3a + 10$ **b** $15 - 11a$ **c** $20a - 200$

d $\dfrac{a}{3}$ **e** $6 + \dfrac{a}{5}$ **f** $\dfrac{a+3}{4}$

7 What order of inverse operations must be performed to get back to the pronumeral?

a $\dfrac{6a-1}{4}$ **b** $10(7x + 2)$ **c** $\dfrac{7-2a}{3}$ **d** $8(4 - 5x)$

e $\dfrac{5b}{3} - 4$ **f** $6 + \dfrac{10m}{11}$ **g** $\dfrac{7(4-3a)}{10}$ **h** $\dfrac{6(2a-3)}{5}$

7:03 | Solving Simple Equations

prep quiz 7:03

Simplify the following:

1 $9x \div 9$ **2** $x + 2 - 2$ **3** $a - 5 + 5$ **4** $\dfrac{m}{3} \times 3$

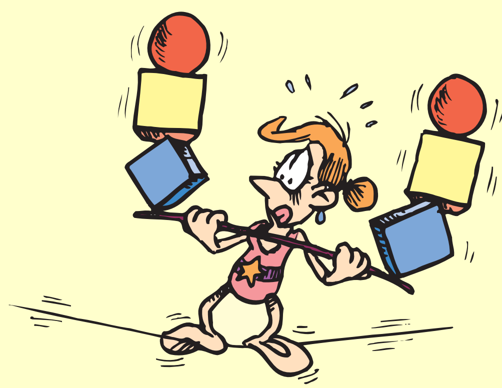
What is the 'inverse' of:

5 multiplying by 7? **6** adding 8? **7** subtracting 1? **8** dividing by 4?

Complete these arrow diagrams.

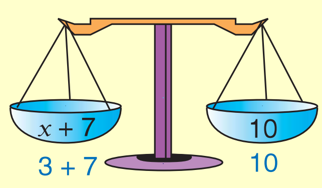
9 $7m + 10 \rightarrow 7m \rightarrow m$ **10** $3a - 2 \rightarrow 3a \rightarrow a$

If one equation can be changed into another by performing the same operation on both sides, then the equations are said to be equivalent.



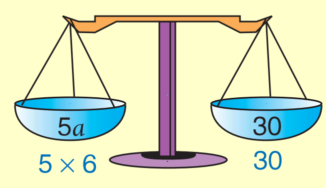
Solving equations is like balancing scales.
With equations, we know that one side is equal to the other. The solution of the equation is the value of the pronumeral that 'balances' the equation.

$x + 7 = 10$



$x = 3$ balances the scale
so $x = 3$ is the solution.

$5a = 30$

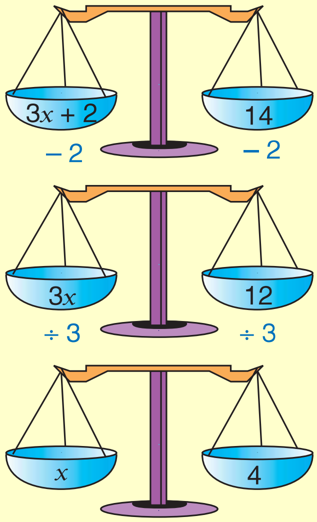


$a = 6$ balances the scale
so $a = 6$ is the solution.

Often, solving an equation requires us to change the equation into a simpler one. We can do this by adding (+), subtracting (−), multiplying (×) or dividing (÷) both sides of the equation by the same number.

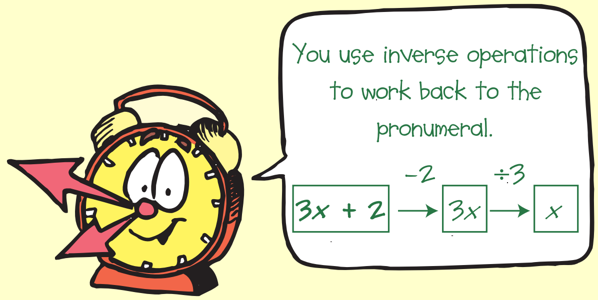
Study the solution to the equations on the next page. Note that the sides remain balanced because we perform the same operation on both sides.

$3x + 2 = 14$

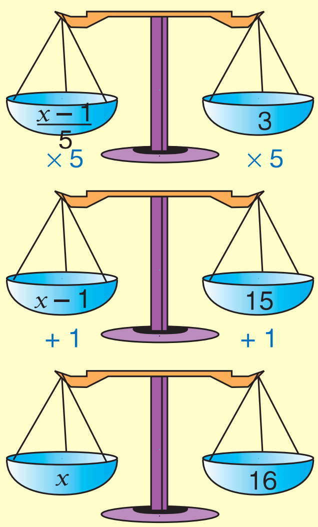


$x = 4$ is the solution.

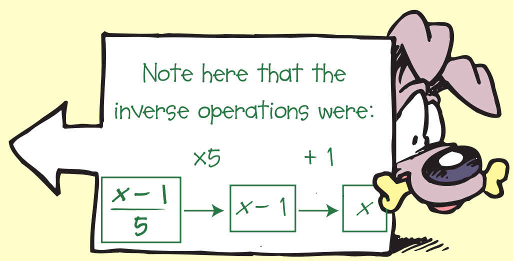
We need to perform operations that will leave only the pronumeral on one side of the equation.

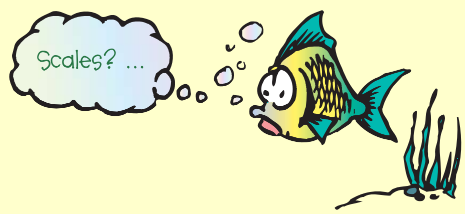


$\dfrac{x-1}{5} = 3$



$x = 16$ is the solution.





In the examples below inverse operations have been used to solve the equations.

worked examples

1 These solutions involve only one step.

a

$m + 17 = 28$

$-17 \quad -17$

$m = 28 - 17$

$\therefore m = 11$

b

$a - 13 = 31$

$+13 \quad +13$

$a = 31 + 13$

$\therefore a = 44$

c

$3p = 5$

$\div 3 \quad \div 3$

$p = \frac{5}{3}$

$\therefore p = 1\frac{2}{3}$

d

$\frac{x}{4} = 8$

$\times 4 \quad \times 4$

$x = 8 \times 4$

$\therefore x = 32$

2 These solutions involve two steps.

a
$$5m - 4 = 16$$
$$+4 \quad +4$$
$$5m = 20$$
$$\div 5 \quad \div 5$$
$$\frac{5m}{5} = \frac{20}{5}$$
$$\therefore\ m = 4$$

b
$$8a + 6 = 15$$
$$-6 \quad -6$$
$$8a = 9$$
$$\div 8 \quad \div 8$$
$$\frac{8a}{8} = \frac{9}{8}$$
$$\therefore\ a = 1\tfrac{1}{8}$$

c
$$1 - 3b = 7$$
$$-1 \quad -1$$
$$-3b = 6$$
$$\div -3 \quad \div -3$$
$$\frac{-3b}{-3} = \frac{6}{-3}$$
$$\therefore\ b = -2$$

d
$$12 = 5x + 4$$
$$-4 \quad -4$$
$$8 = 5x$$
$$\div 5 \quad \div 5$$
$$\frac{8}{5} = \frac{5x}{5}$$
$$\therefore\ 1\tfrac{3}{5} = x$$

Exercise 7:03

Foundation Worksheet 7:03

Solving simple equations

1 Solve:

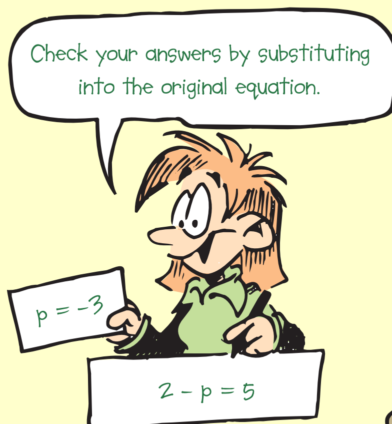
a $m + 15 = 32$ b $n - 12 = 27$ c $3m = 72$

2 Solve:

a $2a + 3 = 9$ b $4x - 1 = 3$ c $7n - 6 = 8$

1 Solve the following equations.

- **a** $x + 72 = 138$
- **b** $y + 37 = 68$
- **c** $72 + m = 145$
- **d** $725 = a + 473$
- **e** $p - 64 = 237$
- **f** $55 = x - 96$
- **g** $x - 125 = 716$
- **h** $a + 412 = 917$
- **i** $\frac{x}{6} = 32$
- **j** $\frac{p}{14} = 20$
- **k** $\frac{a}{7} = 92$
- **l** $\frac{m}{50} = 13$
- **m** $10m = 96$
- **n** $7m = 58$
- **o** $36y = 728$



2 The answer to an equation can be checked by substituting it into the equation. Check to see if the answer to each question below is correct.

- **a** $x + 96 = 123$, $x = 27$
- **b** $18 + y = 21$, $y = 5$
- **c** $m - 13 = 26$, $m = 13$
- **d** $2 - q = 0$, $q = 2$
- **e** $100 - y = 76$, $y = 24$
- **f** $14m = 20$, $m = \frac{10}{7}$
- **g** $-4y = 12$, $y = -3$
- **h** $\frac{x}{2} = 9$, $x = 18$
- **i** $\frac{m}{2} = 1$, $m = 2$

Example

$136 - x = 72$

$x = 64$

LHS $= 136 - 64$

$= 72$

$=$ RHS

3 Solving these equations involves two steps. Clearly show each step in your working. (All the answers are integers.)

a $4x + 1 = 21$ **b** $3a + 2 = 32$ **c** $6m + 7 = 31$
d $3n - 8 = 19$ **e** $5k - 1 = 44$ **f** $2t - 4 = 196$
g $11 + 5a = 26$ **h** $10 + 3w = 25$ **i** $12 + 4q = 16$
j $10 - 3x = 10$ **k** $15 - 2m = 15$ **l** $20 - 5q = 0$
m $10 = 2x - 6$ **n** $7 = 5y - 28$ **o** $-6 = 2 - 4a$
p $6 - x = -7$ **q** $-3 - x = -2$ **r** $3 = 4 - x$

4 The solutions to these equations involve fractions.

a $4x + 1 = 4$ **b** $8a + 5 = 10$
c $2m + 4 = 5$ **d** $7n + 2 = 8$
e $3p - 3 = 2$ **f** $2q - 1 = 2$
g $5n - 5 = 4$ **h** $6y - 3 = 1$
i $5 + 3k = 12$ **j** $1 + 3x = 9$
k $9 + 3a = 10$ **l** $4 + 2a = 4$
m $4m + 6 = 3$ **n** $5p + 7 = 4$
o $1 - 2a = 6$ **p** $8 - 3a = 1$

$$
\begin{aligned}
3a + 2 &= 6 \\
-2 \quad &\quad -2 \\
3a &= 4 \\
\div 3 \quad &\quad \div 3 \\
a &= \tfrac{4}{3} \text{ or } 1\tfrac{1}{3}
\end{aligned}
$$

5 Now try this set of equations which are either one-step or two-step types.

a $7x = 35$ **b** $m + 9 = 24$ **c** $11x + 1 = 89$ **d** $12 - n = 0$
e $3a + 4 = 40$ **f** $a - 6 = -7$ **g** $y + 3 = 1$ **h** $3m - 1 = 5$
i $-8x = 16$ **j** $5 + 3n = 10$ **k** $3x = 2$ **l** $7 - q = 10$
m $6 - 2a = 12$ **n** $3p + 5 = -4$ **o** $420 - 2x = 20$ **p** $10 = 7 - 2p$

- You must perform the same operation on both sides of an equation.

Investigation 7:03 | Solving equations using a spreadsheet

Please use the Assessment Grid on the following page to help you understand what is required for this Investigation.

A spreadsheet such as Excel can be used to solve equations using the 'formula bar'. To solve an equation such as $2x + 5 = 11$ we need to enter the numbers into the appropriate 'cells' and tell the spreadsheet how to arrive at the answer for x.

B2 ▾ fx =(D2–C2)/A2

	A	B	C	D	F
1	a	x	b	c	
2	2	3	5	11	
3					
4					

- The equation $2x + 5 = 11$ is of the form $ax + b = c$.
- Enter the letters a, x, b and c in the first row as shown. These will act as headings.
- The numbers 2, 5 and 11 are then placed in cells A2, C2 and D2.
- To solve $2x + 5 = 11$ we would need to complete these steps:

$$2x + 5 = 11$$
$$2x = 11 - 5$$
$$x = \frac{11 - 5}{2}$$

- Matching the 'cells' with these numbers we would have:

$$x = \frac{\text{D2} - \text{C2}}{\text{A2}}$$

- In cell B2 we type '=(D2 – C2)/A2'. This also shows in the formula bar.
- When we press ENTER the answer 3 appears in cell B2.

	A	B	C	D
1	a	x	b	c
2	2	3	5	11
3				
4				

We can now change any of the values for a, b or c and the value for x, ie the answer will automatically change.

Try entering other values including negative numbers and decimals.

You can also try this with other simple equations of your own.

Assessment Grid for Investigation 7:03 | Solving equations using a spreadsheet

The following is a sample assessment grid for this investigation. You should carefully read the criteria *before* beginning the investigation so that you know what is required.

		Assessment Criteria (C, D) for this investigation		Achieved ✓
Criterion C Communication	a	No working out is shown and presentation is poor with little or no use of diagrams or symbols.	1	
			2	
	b	Working out of the solution steps are shown with some explanation. Presentation is good with some structure.	3	
			4	
	c	Working out of the solution steps is shown and these steps are well structured and well communicated, showing clear progression.	5	
			6	
Criterion D Reflection in Mathematics	a	Some attempt has been made to explain how the solution steps were found and to check the results.	1	
			2	
	b	Justification of how the solution steps were arrived at is given and the results have been checked for reasonableness with some success.	3	
			4	
	c	A precise and reasoned justification is given for the solution steps, and several alternate equation types have been efficiently applied in a variety of contexts to demonstrate understanding and extend the task.	5	
			6	