

# Revision

If  $a = 4$ ,  $b = -1$ , and  $c = -3$ , evaluate:

a)  $3a$

b)  $2a - 3b$

c)  $2ac$

d)  $ac - 3c$

e)  $\frac{a}{2b}$

f)  $\frac{2ac}{b - c}$

g)  $(2c)^2$

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h)  $2c^2$

## Solution

a) 12

b) 11

c) -24

d) -3

e) -2

f) -12

g) 36

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If  $a = 4$ ,  $b = -1$ , and  $c = -3$ , evaluate:

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d)  $ac - 3c$

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f)  $\frac{2ac}{b - c}$

g)  $(2c)^2$

h)  $2c^2$

## Solution

a) 12

b) 11

c) -24

d) -3

e) -2

f) -12

g) 36

h) 18

# Solving Equations

## Standard

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MS-A1 Formulae and Equations

updated: 2021-01-21

## **Learning Outcome**

### **Topic:**

Solving Equations

### **Syllabus:**

- develop and solve linear equations, including those derived from substituting values into a formula, or those developed from a word description

### **Activities/Tasks:**

- Cambridge Ex 3C Q1-22

# Equations

## Definition 1 Equation

A statement asserting that two *expressions* are equal.

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A statement asserting that two *expressions* are equal.

$$\begin{array}{ccc} 3n - 3 & = & n + 1 \\ \uparrow & & \uparrow \\ \text{expression 1} & & \text{expression 2} \end{array} \text{ is an equation.}$$



## Definition 1 Equation

A statement asserting that two *expressions* are equal.

$$\begin{array}{ccc} & \text{is equal to} & \\ & \downarrow & \\ 3n - 3 & \doteq & n + 1 \\ \uparrow & & \uparrow \\ \text{expression 1} & & \text{expression 2} \end{array} \text{ is an equation.}$$

# Solving equations

## Definition 2

To **solve** an equation means to find the value of the unknown.

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To **solve** an equation means to find the value of the unknown.

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# Solving equations

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To **solve** an equation means to find the value of the unknown.

In order to solve an equation we need to rearrange the equation to **isolate** the unknown. We do this by unpacking the equation using **inverse operations**. The inverse operations are performed on *both sides* of the equation to **maintain the balance**.

Once you have found a solution, you can check it is correct by **substituting** back into the original equation.

### Example 1

Solve for  $x$ :

a)  $2x - 3 = 5$

b)  $8 - 4x = -2$

c)  $\frac{x}{4} + 7 = 5$

d)  $\frac{1}{3}(x + 2) = 6$

### Example 1

Solve for  $x$ :

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### Solution

a)  $2x - 3 = 5$



### Example 1

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### Solution

a)  $2x - 3 = 5$

$$2x - 3 + 3 = 5 + 3$$

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### Solution

a)  $2x - 3 = 5$

$$2x - 3 + 3 = 5 + 3$$

$$2x = 8$$

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### Solution

a)  $2x - 3 = 5$

$$2x - 3 + 3 = 5 + 3$$

$$2x = 8$$

$$2x \div 2 = 8 \div 2$$

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a)  $2x - 3 = 5$

$$2x - 3 + 3 = 5 + 3$$

$$2x = 8$$

$$2x \div 2 = 8 \div 2$$

$$x = 4$$

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### Solution

a)  $2x - 3 = 5$

$$2x - 3 + 3 = 5 + 3$$

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### Solution

a)

$$2x - 3 = 5$$

$$2x - 3 + 3 = 5 + 3$$

$$2x = 8$$

$$2x \div 2 = 8 \div 2$$

$$x = 4$$

b)

$$8 - 4x = -2$$

$$8 - 4x + 4x = -2 + 4x$$

### Example 1

Solve for  $x$ :

a)  $2x - 3 = 5$

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### Solution

a)

$$2x - 3 = 5$$

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$$2x = 8$$

$$2x \div 2 = 8 \div 2$$

$$x = 4$$

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$$8 - 4x = -2$$

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### Solution

a)

$$2x - 3 = 5$$

$$2x - 3 + 3 = 5 + 3$$

$$2x = 8$$

$$2x \div 2 = 8 \div 2$$

$$x = 4$$

b)

$$8 - 4x = -2$$

$$8 - 4x + 4x + 2 = -2 + 4x + 2$$

$$10 = 4x$$



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Solve for  $x$ :

a)  $2x - 3 = 5$

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a)

$$2x - 3 = 5$$

$$2x - 3 + 3 = 5 + 3$$

$$2x = 8$$

$$2x \div 2 = 8 \div 2$$

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### Solution

a)  $2x - 3 = 5$

$$2x - 3 + 3 = 5 + 3$$

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$$10 = 4x$$

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$$\frac{10}{4} = x$$

**Note** It is best practice to have the unknown on the left hand side (LHS) in your answer.

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b)  $8 - 4x = -2$

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c)  $\frac{x}{4} + 7 = 5$

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b)  $8 - 4x = -2$

$$8 - 4x + 4x + 2 = -2 + 4x + 2$$

$$10 = 4x$$

$$10 \div 4 = 4x \div 4$$

$$2.5 = x$$

$$x = 2.5$$

c)  $\frac{x}{4} + 7 = 5$

$$\frac{x}{4} + 7 - 7 = 5 - 7$$

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c)  $\frac{x}{4} + 7 = 5$

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c)  $\frac{x}{4} + 7 = 5$

$$\frac{x}{4} + 7 - 7 = 5 - 7$$

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c)  $\frac{x}{4} + 7 = 5$

$$\frac{x}{4} + 7 - 7 = 5 - 7$$

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$$x = -8$$

d)  $\frac{1}{3}(x + 2) = 6$

$$\frac{1}{3}(x + 2) \times 3 = 6 \times 3$$

$$x + 2 = 18$$

### Example 1

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### Solution

$$\begin{aligned}\text{c)} \quad & \frac{x}{4} + 7 = 5 \\ & \frac{x}{4} + 7 - 7 = 5 - 7 \\ & \frac{x}{4} = -2 \\ & \frac{x}{4} \times 4 = -2 \times 4 \\ & x = -8\end{aligned}$$

$$\begin{aligned}\text{d)} \quad & \frac{1}{3}(x + 2) = 6 \\ & \frac{1}{3}(x + 2) \times 3 = 6 \times 3 \\ & x + 2 = 18 \\ & x + 2 - 2 = 18 - 2\end{aligned}$$

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### Solution

$$\begin{aligned}\text{c)} \quad & \frac{x}{4} + 7 = 5 \\ & \frac{x}{4} + 7 - 7 = 5 - 7 \\ & \frac{x}{4} = -2 \\ & \frac{x}{4} \times 4 = -2 \times 4 \\ & x = -8\end{aligned}$$

$$\begin{aligned}\text{d)} \quad & \frac{1}{3}(x + 2) = 6 \\ & \frac{1}{3}(x + 2) \times 3 = 6 \times 3 \\ & x + 2 = 18 \\ & x + 2 - 2 = 18 - 2 \\ & x = 16\end{aligned}$$

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1. Expand brackets and collect like terms.
2. If the unknown appears on both sides of the equation, remove it from one side using inverse operations.
3. Isolate the unknown and solve the equation.

### Example 2

Solve  $4(2x + 5) - 3(x - 2) = 16$  for  $x$ .

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$$5x = -10$$

### Example 2

Solve  $4(2x + 5) - 3(x - 2) = 16$  for  $x$ .

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$$4(2x + 5) - 3(x - 2) = 16$$

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$$5x + 26 - 26 = 16 - 26$$

$$5x = -10$$

$$5x \div 5 = -10 \div 5$$

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$$4(2x + 5) - 3(x - 2) = 16$$

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$$5x + 26 - 26 = 16 - 26$$

$$5x = -10$$

$$5x \div 5 = -10 \div 5$$

$$x = -2$$

### Example 3

Solve for  $x$ :

a)  $4x - 3 = 3x + 7$

b)  $5 - 3(-1 + x) = x$

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a)  $4x - 3 = 3x + 7$

b)  $5 - 3(-1 + x) = x$

### Solution

a)  $4x - 3 = 3x + 7$

### Example 3

Solve for  $x$ :

$$\text{a) } 4x - 3 = 3x + 7$$

$$\text{b) } 5 - 3(-1 + x) = x$$

### Solution

$$\text{a) } 4x - 3 = 3x + 7$$

$$4x - 3x - 3 + 3 = 3x - 3x + 7 + 3$$

### Example 3

Solve for  $x$ :

$$\text{a) } 4x - 3 = 3x + 7$$

$$\text{b) } 5 - 3(-1 + x) = x$$

### Solution

$$\text{a) } 4x - 3 = 3x + 7$$

$$4x - 3x - 3 + 3 = 3x - 3x + 7 + 3$$

$$x = 10$$

### Example 3

Solve for  $x$ :

$$\text{a) } 4x - 3 = 3x + 7$$

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### Solution

$$\text{a) } 4x - 3 = 3x + 7$$

$$4x - 3x - 3 + 3 = 3x - 3x + 7 + 3$$

$$x = 10$$

$$\text{b) } 5 - 3(-1 + x) = x$$



### Example 3

Solve for  $x$ :

$$\text{a) } 4x - 3 = 3x + 7$$

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### Solution

$$\text{a) } 4x - 3 = 3x + 7$$

$$4x - 3x - 3 + 3 = 3x - 3x + 7 + 3$$

$$x = 10$$

$$\text{b) } 5 - 3(-1 + x) = x$$

$$5 + 3 - 3x = x$$

### Example 3

Solve for  $x$ :

a)  $4x - 3 = 3x + 7$

b)  $5 - 3(-1 + x) = x$

### Solution

a)  $4x - 3 = 3x + 7$

$$4x - 3x - 3 + 3 = 3x - 3x + 7 + 3$$

$$x = 10$$

b)  $5 - 3(-1 + x) = x$

$$5 + 3 - 3x = x$$

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For example:

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- In  $\frac{3}{x} = \frac{5}{2x-1}$  the lowest common denominator is  $x(2x-1)$ .

Once the fractions have common denominators you can **equate the numerators**

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Solve  $\frac{2-x}{3} = \frac{x}{5}$  for  $x$ .

Solution

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$$\begin{aligned}\frac{2-x}{3} &= \frac{x}{5} \\ \frac{2-x}{3} \times \frac{5}{5} &= \frac{x}{5} \times \frac{3}{3} \\ \frac{5(2-x)}{15} &= \frac{3x}{15}\end{aligned}$$

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(equating the numerators)

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$$10 = 8x$$

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$$\frac{10}{8} = x$$

$$x = \frac{10}{8} = \frac{5}{4} = 1.25$$

### Example 5

Solve  $\frac{7}{x+1} = \frac{3}{x}$  for  $x$ .

Solution

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### Example 5

Solve  $\frac{7}{x+1} = \frac{3}{x}$  for  $x$ .

### Solution

$$\begin{aligned}\frac{7}{x+1} &= \frac{3}{x} \\ \frac{7}{x+1} \times \frac{x}{x} &= \frac{3}{x} \times \frac{x+1}{x+1} \\ \frac{7x}{x(x+1)} &= \frac{3(x+1)}{x(x+1)}\end{aligned}$$

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$$7x = 3(x+1) \quad (\text{equating the numerators})$$



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$$7x = 3(x+1) \quad (\text{equating the numerators})$$

$$7x = 3x + 3$$

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$$7x - 3x = 3x - 3x + 3$$

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$$7x = 3x + 3$$

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$$7x = 3x + 3$$

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$$4x \div 4 = 3 \div 4$$

$$x = \frac{3}{4} = 0.75$$

# Today's work

- Cambridge Ex 3C Q1-22