

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) $(2c)^2$

h) $2c^2$

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a) 12

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

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

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

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

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Solution

a) $2x - 3 = 5$

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a) $2x - 3 = 5$

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

$$2x = 8$$

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

$$x = 4$$

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Solution

a)

$$2x - 3 = 5$$

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

$$2x = 8$$

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

$$x = 4$$

b)

$$8 - 4x = -2$$

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Solution

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Solution

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Solution

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

$$2x = 8$$

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

$$x = 4$$

b) $8 - 4x = -2$

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

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Solution

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$$2x - 3 = 5$$

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

$$2x = 8$$

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

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$$8 - 4x = -2$$

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$$10 = 4x$$

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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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b)

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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) $8 - 4x = -2$

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

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

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

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$$\frac{x}{4} \times 4 = -2 \times 4$$

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$$\frac{x}{4} \times 4 = -2 \times 4$$

$$x = -8$$

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$$x + 2 = 18$$

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Solution

c)

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

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

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d)

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

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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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$$8x + 20 - 3x + 6 = 16$$

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$$5x = -10$$

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$$8x + 20 - 3x + 6 = 16$$

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

$$5x = -10$$

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

Example 2

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$$5x = -10$$

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

$$x = -2$$

Example 3

Solve for x :

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

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

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Solve for x :

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

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

Solution

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

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

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

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

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

$$x = 10$$

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

$$x = 10$$

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

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

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

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

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$$8 - 3x + 3x = x + 3x$$

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$$8 - 3x + 3x = x + 3x$$

$$8 = 4x$$

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

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

$$x = 10$$

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

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

$$8 - 3x + 3x = x + 3x$$

$$8 = 4x$$

$$8 \div 4 = 4x \div 4$$

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

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

$$8 - 3x + 3x = x + 3x$$

$$8 = 4x$$

$$8 \div 4 = 4x \div 4$$

$$2 = x$$

Example 3

Solve for x :

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

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

Solution

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Fractions

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Fractions

For equations involving fractions, first write all fractions with a **common denominator**.

For example:

- For $\frac{2x}{3} = \frac{x}{4}$ the (lowest) common denominator is 12.
- For $\frac{3}{x} = \frac{5}{2x-1}$ the common denominator is $x(2x-1)$.

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

Example 4

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

Solution

$$\frac{2-x}{3} = \frac{x}{5}$$

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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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$$\frac{2-x}{3} = \frac{x}{5}$$

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$$\frac{5(2-x)}{15} = \frac{3x}{15}$$

$$5(2-x) = 3x$$

(equating the numerators)

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$$10 - 5x + 5x = 3x + 5x$$

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$$10 - 5x + 5x = 3x + 5x$$

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(equating the numerators)

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$$10 \div 8 = 8x \div 8$$

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

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

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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$$7x = 3x + 3$$

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$$7x = 3x + 3$$

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

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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