

ALGEBRAIC EQUATIONS**OUTCOMES:**

- Identify variables and constants in given equations.
- Solve equations by inspection.
- Determine the numerical value of an expression by substitution.
- Solve equations by using additive and multiplicative inverses.

ALGEBRAIC LANGUAGE - EQUATIONS

Think of an equation as a set of masses that must be balanced. The two sides of the scale have equal masses, so the scale is balanced. This is shown by the equal sign ($=$) in the equation $12 + 13 = 25$. Hence the LHS = RHS.



- A closed number sentence is a true statement about numbers for example, $21 + 5 = 26$. In this example all numbers are given.
- In an open number sentence, for example, $15 + y = 21$, one or more numbers are unknown. An open number sentence is also called an equation.
- An equation is a mathematical sentence that is true for some numbers. The following are example of equation:
 - $x + 3 = 11$, this equation is true if $x = 8$
 - $x - 4 = 2$, this equation is true if $x = 6$
 - $2x = 10$, this equation is true if $x = 5$

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1	Solve the following equations by inspection.
a)	$3 + x = 14$, this equation is true if $x = ?$
b)	$x - 2 = 4$, this equation is true if $x = ?$
c)	$x - 4 = 8$, this equation is true if $x = ?$
d)	$x - 4 = 10$, this equation is true if $x = ?$
e)	$x + 7 = 2$, this equation is true if $x = ?$
f)	$2 + a = 10$, this equation is true if $a = ?$
g)	$5 + b = -11$, this equation is true if $b = ?$
h)	$c + 7 = -3$, this equation is true if $c = ?$
i)	$x - 4 = -8$, this equation is true if $x = ?$
j)	$-4 + b = 8$, this equation is true if $b = ?$
k)	$3x = 6$, this equation is true if $x = ?$
l)	$2a = 6$, this equation is true if $a = ?$
m)	$3x = 9$, this equation is true if $x = ?$
n)	$4m = 12$, this equation is true if $a = ?$
o)	$2a + 3a = 15$, this equation is true if $a = ?$
p)	$3x + 3x = 12$, this equation is true if $x = ?$

Notes:

- The numbers **+2** and **-2** are **additive inverses** of each other.
When we add a number and its additive inverse we always get 0.
- The numbers **3** and $\frac{1}{3}$ are **multiplicative inverses** of each other.
When we multiply a number and its multiplicative inverse we

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always get 1, so, $3 \times \frac{1}{3} = 1$

- The additive and multiplicative inverses help us to isolate the unknown value or the input value.

EXAMPLES:

1) $x + 8 = 12$

$$x + 8 - 8 = 12 - 8 \quad \text{[add the additive inverse of 8 on both sides]}$$

$$x = 4$$

$$\text{CHECK: LHS} = 4 + 8 = 12$$

$$\therefore \text{LHS} = \text{RHS, EQUATION IS TRUE FOR } x = 4$$

2) $x - 5 = 10$

$$x - 5 + 5 = 10 + 5 \quad \text{[add the additive inverse of } -5 \text{ on both sides]}$$

$$x = 15$$

$$\text{CHECK: LHS} = 15 - 5 = 10$$

$$\therefore \text{LHS} = \text{RHS, EQUATION IS TRUE FOR } x = 15$$

3) $3x = 21$

$$3x \times \frac{1}{3} = 21 \times \frac{1}{3} \quad \text{[multiply by the multiplicative inverse of 3 on both sides]}$$

$$x = 7$$

$$\text{CHECK: LHS} = 3(7) = 21$$

$$\therefore \text{LHS} = \text{RHS, EQUATION IS TRUE FOR } x = 7$$

4) $-2x = 6$

$$-2x \times -\frac{1}{2} = 6 \times -\frac{1}{2} \quad \text{[multiply by the multiplicative inverse of } -2 \text{ on both sides]}$$

$$x = -3$$

$$\text{CHECK: LHS} = -2(-3) = 6$$

$$\therefore \text{LHS} = \text{RHS, EQUATION IS TRUE FOR } x = -3$$

5) $2x + 4 = 10$

$$2x + 4 - 4 = 10 - 4 \quad \text{[add } -4 \text{ on both sides of the equation]}$$

$$2x \times \frac{1}{2} = 6 \times \frac{1}{2} \quad \text{[multiply both sides by } \frac{1}{2}]$$

$$x = 3$$

$$\text{CHECK: LHS} = 2(3) + 4 = 6 + 4 = 10$$

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$\therefore LHS = RHS$, EQUATION IS TRUE FOR $x = 3$

6) $-4x + 10 = -6$

$-4x + 10 - 10 = -6 - 10$ [add -10 on both sides of the equation]

$-4x = -16$

$-4x \times -\frac{1}{4} = -16 \times -\frac{1}{4}$ [multiply both sides by $-\frac{1}{4}$]

$x = 4$

CHECK: $LHS = -4(4) + 10 = -16 + 10 = -6$

$\therefore LHS = RHS$, EQUATION IS TRUE FOR $x = 4$

7) $17 - 2x = 1$

$17 - 17 - 2x = 1 - 17$ [add -17 on both sides of the equation]

$-2x = -16$

$-2x \times -\frac{1}{2} = -16 \times -\frac{1}{2}$ [multiply both sides by $-\frac{1}{2}$]

$x = 8$

CHECK: $LHS = 17 - 2(8) = 17 - 16 = 1$

$\therefore LHS = RHS$, EQUATION IS TRUE FOR $x = 8$

2. Solve the following equations using additive and multiplicative inverses and check your work.

a) $a + 7 = 13$

b) $x + 7 = 3$

c) $5a - 2 = 8$

d) $-2b + 4 = 10$

e) $4 - 3x = 10$

f) $2x - 5 = -9$

g) $-3a + 8 = 2$

h) $-4x + 6 = -6$

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i)	$18 - 2x = 0$
j)	$2a - 1 = 9$
k)	$11 - a = 13$
l)	$-\frac{1}{4}x = 2$
m)	$\frac{2}{3}b = 6$
n)	$\frac{3}{4}a - 5 = -2$
o)	$-\frac{2}{3}b + 2 = -4$
p)	$\frac{3}{4}x - 1 = 2$
q)	$\frac{2}{5}m + 1 = -3$