

Name: \_\_\_\_\_ Class &amp; Sec: \_\_\_\_\_ Roll No. \_\_\_\_\_ Date: 28.04.2020

## 2.4 Solving Equations having the Variable on both Sides

An equation is the equality of the values of two expressions. In the equation  $2x - 3 = 7$ , the two expressions are  $2x - 3$  and  $7$ . In most examples that we have come across so far, the RHS is just a number. But this need not always be so; both sides could have expressions with variables. For example, the equation  $2x - 3 = x + 2$  has expressions with a variable on both sides; the expression on the LHS is  $(2x - 3)$  and the expression on the RHS is  $(x + 2)$ .

- We now discuss how to solve such equations which have expressions with the variable on both sides.

**Example 12:** Solve  $2x - 3 = x + 2$

**Solution:** We have

$$\begin{aligned} & 2x = x + 2 + 3 \\ \text{or} & 2x = x + 5 \\ \text{or} & 2x - x = x + 5 - x \quad (\text{subtracting } x \text{ from both sides}) \\ \text{or} & x = 5 \quad (\text{solution}) \end{aligned}$$

Here we subtracted from both sides of the equation, not a number (constant), but a term involving the variable. We can do this as variables are also numbers. Also, note that subtracting  $x$  from both sides amounts to transposing  $x$  to LHS.

**Example 13:** Solve  $5x + \frac{7}{2} = \frac{3}{2}x - 14$

**Solution:** Multiply both sides of the equation by 2. We get

$$\begin{aligned} & 2 \times \left( 5x + \frac{7}{2} \right) = 2 \times \left( \frac{3}{2}x - 14 \right) \\ & (2 \times 5x) + \left( 2 \times \frac{7}{2} \right) = \left( 2 \times \frac{3}{2}x \right) - (2 \times 14) \\ \text{or} & 10x + 7 = 3x - 28 \\ \text{or} & 10x - 3x + 7 = -28 \quad (\text{transposing } 3x \text{ to LHS}) \\ \text{or} & 7x + 7 = -28 \\ \text{or} & 7x = -28 - 7 \\ \text{or} & 7x = -35 \\ \text{or} & x = \frac{-35}{7} \quad \text{or} \quad x = -5 \quad (\text{solution}) \end{aligned}$$

### EXERCISE 2.3

Solve the following equations and check your results.

1.  $3x = 2x + 18$

2.  $5t - 3 = 3t - 5$

3.  $5x + 9 = 5 + 3x$

4.  $4z + 3 = 6 + 2z$

5.  $2x - 1 = 14 - x$

6.  $8x + 4 = 3(x - 1) + 7$

7.  $x = \frac{4}{5}(x + 10)$

8.  $\frac{2x}{3} + 1 = \frac{7x}{15} + 3$

9.  $2y + \frac{5}{3} = \frac{26}{3} - y$

10.  $3m = 5m - \frac{8}{5}$

### 2.5 Some More Applications



Chapter 2: Linear Equations in One Variable **Answer 3**

Class: VIII

Exercise 2.3

**Question 1**Solve the following equations and check your results:  $3x = 2x + 18$ **Answer 1**

$$\begin{aligned} 3x &= 2x + 18 \\ \Rightarrow 3x - 2x &= 18 \\ \Rightarrow x &= 18 \end{aligned}$$

To check:

$$\begin{aligned} 3x &= 2x + 18 \\ \Rightarrow 3 \times 18 &= 2 \times 18 + 18 \\ \Rightarrow 54 &= 36 + 18 \\ \Rightarrow 54 &= 54 \\ \Rightarrow \text{L.H.S} &= \text{R.H.S} \end{aligned}$$

Hence, it is correct.

**Question 2**Solve the following equations and check your results:  $5t - 3 = 3t - 5$ **Answer 2**

$$\begin{aligned} 5t - 3 &= 3t - 5 \\ \Rightarrow 5t - 3t &= -5 + 3 \\ \Rightarrow 2t &= -2 \\ \Rightarrow t &= \frac{-2}{2} = -1 \end{aligned}$$

To check:

$$\begin{aligned} 5t - 3 &= 3t - 5 \\ \Rightarrow 5 \times (-1) - 3 &= 3 \times (-1) - 5 \\ \Rightarrow -5 - 3 &= -3 - 5 \\ \Rightarrow -8 &= -8 \end{aligned}$$

$$\Rightarrow \text{L.H.S} = \text{R.H.S}$$

Hence, it is correct.

**Question 3**Solve the following equations and check your results:  $5x + 9 = 5$ **Answer 3**

$$\begin{aligned} 5x + 9 &= 5 + 3x \\ \Rightarrow 5x - 3x &= 5 - 9 \\ \Rightarrow 2x &= -4 \\ \Rightarrow x &= \frac{-4}{2} = -2 \end{aligned}$$

To check:

$$\begin{aligned} 5x + 9 &= 5 + 3x \\ \Rightarrow 5 \times (-2) + 9 &= 5 + 3 \times (-2) \\ \Rightarrow -10 + 9 &= 5 - 6 \end{aligned}$$

$$\begin{aligned} 5x + 9 &= 5 + 3x \\ \Rightarrow 5x - 3x &= 5 - 9 \\ \Rightarrow 2x &= -4 \\ \Rightarrow x &= \frac{-4}{2} = -2 \end{aligned}$$

To check:

$$\begin{aligned} 5x + 9 &= 5 + 3x \\ \Rightarrow 5 \times (-2) + 9 &= 5 + 3 \times (-2) \\ \Rightarrow -10 + 9 &= 5 - 6 \\ \Rightarrow -1 &= -1 \\ \Rightarrow \text{L.H.S} &= \text{R.H.S} \end{aligned}$$

Hence, it is correct.

**Question 4**Solve the following equations and check your results:  $4z + 3 = 6 + 2z$ **Answer 4**

$$\begin{aligned} 4z + 3 &= 6 + 2z \\ \Rightarrow 4z - 2z &= 6 - 3 \\ \Rightarrow 2z &= 3 \\ \Rightarrow z &= \frac{3}{2} \end{aligned}$$

To check:

$$\begin{aligned} 4z + 3 &= 6 + 2z \\ \Rightarrow 4 \times \frac{3}{2} + 3 &= 6 + 2 \times \frac{3}{2} \\ \Rightarrow 2 \times 3 + 3 &= 6 + 3 \\ \Rightarrow 6 + 3 &= 9 \\ \Rightarrow 9 &= 9 \\ \Rightarrow \text{L.H.S} &= \text{R.H.S} \end{aligned}$$

Hence, it is correct.

**Question 5**Solve the following equations and check your results:  $2x - 1 = 14 - x$ **Answer 5**

$$\begin{aligned} 2x - 1 &= 14 - x \\ \Rightarrow 2x + x &= 14 + 1 \\ \Rightarrow 3x &= 15 \\ \Rightarrow x &= \frac{15}{3} = 5 \end{aligned}$$

To check:

$$\begin{aligned} 2x - 1 &= 14 - x \\ \Rightarrow 2 \times 5 - 1 &= 14 - 5 \\ \Rightarrow 10 - 1 &= 9 \\ \Rightarrow 9 &= 9 \\ \Rightarrow \text{L.H.S} &= \text{R.H.S} \end{aligned}$$

Hence, it is correct.

**Question 6**

Solve the following equations and check your results:  $8x + 4 = 3(x-1) + 7$

**Answer 6**

$$\begin{aligned} 8x + 4 &= 3(x-1) + 7 \\ \Rightarrow 8x + 4 &= 3x - 3 + 7 \\ \Rightarrow 8x - 3x &= -3 + 7 - 4 \\ \Rightarrow 5x &= 0 \\ \Rightarrow x &= \frac{0}{5} = 0 \end{aligned}$$

To check:

$$\begin{aligned} 8x + 4 &= 3(x-1) + 7 \\ \Rightarrow 8 \times 0 + 4 &= 3(0-1) + 7 \\ \Rightarrow 0 + 4 &= 3 \times (-1) + 7 \\ \Rightarrow 4 &= -3 + 7 \\ \Rightarrow 4 &= 4 \\ \Rightarrow \text{L.H.S} &= \text{R.H.S} \end{aligned}$$

Hence, it is correct.

**Question 7**

Solve the following equations and check your results:  $x = \frac{4}{5}(x+10)$

**Answer 7**

$$\begin{aligned} x &= \frac{4}{5}(x+10) \\ \Rightarrow 5x &= 4(x+10) \\ \Rightarrow 5x &= 4x + 40 \\ \Rightarrow 5x - 4x &= 40 \\ \Rightarrow x &= 40 \end{aligned}$$

To check:

$$\begin{aligned} x &= \frac{4}{5}(x+10) \\ \Rightarrow 40 &= \frac{4}{5}(40+10) \\ \Rightarrow 40 &= \frac{4}{5} \times 50 \\ \Rightarrow 40 &= 4 \times 10 \\ \Rightarrow 40 &= 40 \\ \Rightarrow \text{L.H.S} &= \text{R.H.S} \end{aligned}$$

Hence, it is correct.

**Question 8**

Solve the following equations and check your results:  $\frac{2x}{3} + 1 = \frac{7x}{15} + 3$

**Answer 8**

$$\begin{aligned}\frac{2x}{3} + 1 &= \frac{7x}{15} + 3 \\ \Rightarrow \frac{2x}{3} - \frac{7x}{15} &= 3 - 1 \\ \Rightarrow \frac{10x - 7x}{15} &= 2 \\ \Rightarrow 3x &= 30 \\ \Rightarrow x &= \frac{30}{3} = 10\end{aligned}$$

To check:

$$\begin{aligned}\frac{2x}{3} + 1 &= \frac{7x}{15} + 3 \\ \Rightarrow \frac{2 \times 10}{3} + 1 &= \frac{7 \times 10}{15} + 3 \\ \Rightarrow \frac{20}{3} + 1 &= \frac{14}{3} + 3 \\ \Rightarrow \frac{20+3}{3} &= \frac{14+9}{3} \\ \Rightarrow \frac{23}{3} &= \frac{23}{3} \\ \Rightarrow \text{L.H.S} &= \text{R.H.S}\end{aligned}$$

Hence, it is correct.

**Question 9**

Solve the following equations and check your results:  $2y + \frac{5}{3} = \frac{26}{3} - y$

**Answer 9**

$$\begin{aligned}2y + \frac{5}{3} &= \frac{26}{3} - y \\ \Rightarrow 2y + y &= \frac{26}{3} - \frac{5}{3} \\ \Rightarrow 3y &= \frac{26-5}{3} \\ \Rightarrow 3y &= \frac{21}{3} \\ \Rightarrow y &= \frac{21}{3 \times 3} = \frac{7}{3}\end{aligned}$$

To check:

$$\Rightarrow 3y = \frac{21}{3}$$

$$\Rightarrow y = \frac{21}{3 \times 3} = \frac{7}{3}$$

To check:

$$2y + \frac{5}{3} = \frac{26}{3} - y$$

$$\Rightarrow 2 \times \frac{7}{3} + \frac{5}{3} = \frac{26}{3} - \frac{7}{3}$$

$$\Rightarrow \frac{14}{3} + \frac{5}{3} = \frac{26}{3} - \frac{7}{3}$$

$$\Rightarrow \frac{14+5}{3} = \frac{26-7}{3}$$

$$\Rightarrow \frac{19}{3} = \frac{19}{3}$$

$$\Rightarrow \text{L.H.S} = \text{R.H.S}$$

Hence, it is correct.

### Question 10

Solve the following equations and check your results:  $3m = 5m - \frac{8}{5}$

### Answer 10

$$3m = 5m - \frac{8}{5}$$

$$\Rightarrow 3m - 5m = \frac{-8}{5}$$

$$\Rightarrow -2m = \frac{-8}{5}$$

$$\Rightarrow m = \frac{-8}{5 \times (-2)}$$

$$\Rightarrow m = \frac{4}{5}$$

To check:

$$3m = 5m - \frac{8}{5}$$

$$\Rightarrow 3 \times \frac{4}{5} = 5 \times \frac{4}{5} - \frac{8}{5}$$

$$\Rightarrow \frac{12}{5} = 4 - \frac{8}{5}$$

$$\Rightarrow \frac{12}{5} = \frac{20-8}{5}$$

$$\Rightarrow \frac{12}{5} = \frac{12}{5}$$

$$\Rightarrow \text{L.H.S} = \text{R.H.S}$$

Hence, it is correct.