Solving Linear Equations with the Variable on Both Sides **Answers**

Check In

Solve the following equations.

1. $5x = 30$

   $\boldsymbol{x = 6}$

2. $x - 7 = -3$

   $\boldsymbol{x = 4}$

3. $3x + 2 = 8$

   $\boldsymbol{x = 2}$

4. $4(x - 5) = 12$

   $\boldsymbol{x = 8}$

5. $7(x - 3) = 13$

   $\boldsymbol{x = \frac{34}{7}}$

Exam Style Questions

1. Solve the following equations:

   a. $2x - 4 = x + 3$ (2)

   $\boldsymbol{x = 7}$

   b. $3x + 2 = 5x - 6$ (2)

   $\boldsymbol{x = 4}$

   c. $5x - 9 = -3x + 7$ (2)

   $\boldsymbol{x = 2}$

   d. $-7x - 6 = -4x + 3$ (2)

   $\boldsymbol{x = -3}$

2. Solve the following equations:

   a. $5t - 7 = -2t + 3$ (2)

   $\boldsymbol{t = \frac{10}{7}}$

   b. $-6e - 8 = -4e - 3$ (2)

   $\boldsymbol{e = -\frac{5}{2}}$

   c. $-3p + 10 = p + 1$ (2)

   $\boldsymbol{p = \frac{9}{4}}$

   d. $\frac{s}{3} + 7 = 2s - 4$ (2)

   $\boldsymbol{s = \frac{33}{5}}$

3. Solve the following equations:

   a. $5(x + 2) = 3(x + 6)$ (3)

   $\boldsymbol{x = 4}$

   b. $3(x - 2) = 7(x + 3)$ (3)

   $\boldsymbol{x = -\frac{27}{4}}$

c. $4(x + 5) = -6(x - 4)$ (3)

$x = \frac{4}{10}$ or $\frac{2}{5}$

d. $-3(x - 3) = -2(3x + 5)$ (3)

$x = -\frac{19}{3}$

4. Solve the following equations:

a. $\frac{y}{3} + 3 = \frac{y}{5} - 1$ (3)

$y = -30$

b. $\frac{t}{7} - 3 = \frac{t}{3} + 2$ (3)

$t = -\frac{105}{4}$

c. $\frac{3m}{2} - 5 = \frac{3m}{4} - 6$ (3)

$m = -\frac{4}{3}$

d. $\frac{2h}{5} - 4 = \frac{3h - 1}{2}$ (3)

$h = -\frac{35}{11}$

5. Solve the following equations:

a. $\frac{5(x + 2)}{4} = \frac{2(x - 5)}{3}$ (3)

$x = -10$

b. $\frac{3(x + 6)}{2} = \frac{2(x + 4)}{5}$ (3)

$x = -\frac{74}{11}$

c. $\frac{4(x - 2)}{3} = -\frac{3(x + 1)}{2}$ (3)

$x = \frac{7}{17}$

d. $\frac{2(x + 2)}{3} = \frac{7(x + 3)}{4}$ (3)

$x = -\frac{47}{13}$

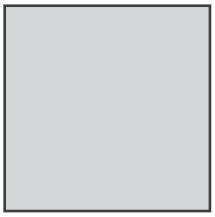
6. Franz is asked to solve the equation $2x + 1 = 5x + 10$, his workings are shown below. What has he done wrong? (1)

$$2x + 1 = 5x + 10$$
$$-3x + 1 = 10$$
$$-3x = 9$$
$$x = 3$$

He forgot the negative when dividing. (He could avoid dividing by a negative by subtracting $2x$ instead of $5x$)

The answer should be $x = -3$

8. Expressions in terms of x are given for 2 sides of the square below. Use them to find the area of the square. (4)



$\frac{8(x + 2)}{7}$ cm

$\frac{8(x - 2)}{3}$ cm

1 mark for equating 2 expressions

1 mark for $56(x - 2) = 24(x + 2)$ or equivalent

1 mark for $x = 5$

1 mark for area = 64cm²

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5. $7(x - 3) = 13$

This guide has everything you need on solving linear equations where the variable (letter) appears on both sides. Once you've mastered this, you may want to move on to solving simultaneous linear equations.

As mentioned in the first linear equation revision sheet, the principle of solving equations is to perform inverse operations until the **variable** (letter) is on one side of the equation, with a **constant** (numerical value) on the other. When the variable appears on both sides, you should first remove the smallest multiple of the variable from both sides.

Example 1

Solve $2x - 4 = -3x + 6$

Exam Tip

Remember, negative values are smaller than positive values.

$$2x - 4 = -3x + 6$$
$$+3x \qquad +3x$$
$$5x - 4 = 6$$
$$+4 \qquad +4$$
$$5x = 10$$
$$\div 5 \qquad \div 5$$
$$x = 2$$

The smallest multiple of the variable is -3 so we start by adding $3x$ to both sides.

Now we have a 2-step equation, we solve by performing inverse operations.

Example 2

Solve $3(x + 2) = -5(x - 7)$

$$3(x + 2) = -5(x - 7)$$

Since we have brackets, we should expand them first.

$$3x + 6 = -5x + 35$$
$$+5x \qquad +5x$$

Now, we identify and eliminate the smallest multiple of the variable, $-5x$.

$$8x + 6 = 35$$
$$-6 \qquad -6$$
$$8x = 29$$
$$\div 8 \qquad \div 8$$

Now we have a 2-step equation, we solve by performing inverse operations.

$$x = \frac{29}{8}$$

Remember to leave non-integer solutions as a fraction.

Example 3

Solve $\frac{x}{3} + 2 = \frac{3x}{4} + 4$

$$\frac{x}{3} + 2 = \frac{3x}{2} + 4$$
$$\times 6 \qquad\qquad \times 6$$
$$\frac{6x}{3} + 12 = \frac{18x}{2} + 24$$

Whenever you have fractions in an equation, you should work to remove the fractions first by multiplying **all terms** on both sides by each denominator.

Since we are multiplying by 3 and by 2, overall, we are multiplying by 6.

$$2x + 12 = 9x + 24$$
$$-2x \qquad\qquad -2x$$
$$12 = 7x + 24$$
$$-24 \qquad\qquad -24$$
$$-12 = 7x$$
$$\div 7 \qquad\qquad \div 7$$
$$-\frac{12}{7} = x$$

Now, we identify and eliminate the smallest multiple of the variable, $2x$.

Now we have a 2-step equation, we solve by performing inverse operations.

Example 4

Solve $\frac{2(x + 3)}{5} = \frac{3(x - 2)}{4}$

Exam Tip

Leave non-integer solutions as fractions.

$$\frac{2(x + 3)}{5} = \frac{3(x - 2)}{4}$$
$$\times 20 \qquad\qquad \times 20$$
$$\frac{40(x + 3)}{5} = \frac{60(x - 2)}{4}$$

When you have fractions and brackets in an equation, you should remove the fractions first by multiplying **all terms** on both sides by each denominator.

$$8(x + 3) = 15(x - 2)$$

Now the denominators are removed, we need to expand the brackets.

$$8x + 24 = 15x - 30$$
$$-8x \qquad\qquad -8x$$
$$24 = 7x - 30$$
$$+30 \qquad\qquad +30$$
$$54 = 7x$$
$$\div 7 \qquad\qquad \div 7$$
$$\frac{54}{7} = x$$

Perform inverse operations, starting with the smallest multiple of the variable.

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3. Solve the following equations:
   a. $5(x + 2) = 3(x + 6)$ (3)
   b. $3(x - 2) = 7(x + 3)$ (3)
   c. $4(x + 5) = -6(x - 4)$ (3)
   d. $-3(x - 3) = -2(3x + 5)$ (3)

4. Solve the following equations:
   a. $\frac{y}{3} + 3 = \frac{y}{5} - 1$ (3)
   b. $\frac{t}{7} - 3 = \frac{t}{3} + 2$ (3)
   c. $\frac{3m}{2} - 5 = \frac{3m}{4} - 6$ (3)
   d. $\frac{2h}{5} - 4 = \frac{3h - 1}{2}$ (3)

5. Solve the following equations:
   a. $\frac{5(x + 2)}{4} = \frac{2(x - 5)}{3}$ (3)
   b. $\frac{3(x + 6)}{2} = \frac{2(x + 4)}{5}$ (3)
   c. $\frac{4(x - 2)}{3} = -\frac{3(x + 1)}{2}$ (3)
   d. $\frac{2(x + 2)}{3} = \frac{7(x + 3)}{4}$ (3)

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$$-3x + 1 = 10$$
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$$x = 3$$

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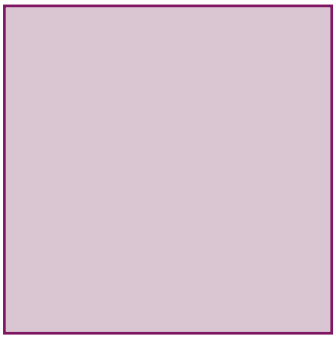

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