

Solving Linear Equations

Golden Rule of Algebra:

“Do unto one side of the equal sign as you will do to the other...”

Whatever you do on one side of the equal sign, you MUST do the same exact thing on the other side. If you multiply by -2 on the left side, you have to multiply by -2 on the other. If you subtract 15 from one side, you must subtract 15 from the other. You can do whatever you want (to get the x by itself) as long as you do it on both sides of the equal sign.

Solving Single Step Equations:

To solve single step equations, you do the *opposite* of whatever the operation is. The opposite of addition is subtraction and the opposite of multiplication is division.

Solve for x:

1) $x + 5 = 12$

2) $x - 11 = 19$

3) $22 - x = 17$

4) $5x = -30$

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

6) $\frac{2}{3}x = -8$

Solving Multi-Step Equations:

$3x - 5 = 22$ To get the x by itself, you will need to get rid of the 5 and the 3.

$\frac{+5}{+5}$ We do this by going in opposite order of PEMDAS. We get rid of addition and subtraction first.

$\frac{3x}{3} = \frac{27}{3}$ Then, we get rid of multiplication and division.

$$x = 9$$

We check the answer by putting it back in the original equation:

$$3x - 5 = 22, x = 9$$

$$3(9) - 5 = 22$$

$$27 - 5 = 22$$

$$22 = 22 \text{ (It checks)}$$

Simple Equations:

$$1) 9x - 11 = -38$$

$$2) 160 = 7x + 6$$

$$3) 32 - 6x = 53$$

$$4) -4 = 42 - 4x$$

$$5) \frac{3}{4}x - 11 = 16$$

$$6) 37 = 25 - \frac{2}{3}x$$

7) $4x - 7 = -23$

8) $12x + 9 = -15$

9) $21 - 4x = 45$

10) $(x/7) - 4 = 4$

11) $(-x/5) + 3 = 7$

12) $26 = 60 - 2x$

Equations with more than 1 x on the same side of the equal sign:

You need to simplify (combine like terms) and then use the same steps as a multi-step equation.

Example:

$9x - 5x = 4x$ and
 $11 + 10 = 21$

$9x + 11 - 5x + 10 = -15$

$4x + 21 = -15$

$\underline{-21} \quad \underline{-21}$

$\frac{4x}{4} = \frac{-36}{4}$

$x = -9$

Now it looks like a multistep eq. that we did in the 1st

Use subtraction to get rid of the addition.

Now divide to get rid of the multiplication

13) $15x - 24 - 4x = -79$

14) $102 = 69 - 7x + 3x$

15) $3(2x - 5) - 4x = 33$

16) $3(4x - 5) + 2(11 - 2x) = 43$

17) $9(3x + 6) - 6(7x - 3) = 12$

18) $7(4x - 5) - 4(6x + 5) = -91$

19) $8(4x + 2) + 5(3x - 7) = 122$

Equations with x's on BOTH sides of the equal sign:

You need to "Get the X's on one side and the numbers on the other." Then you can solve.

Example: $12x - 11 = 7x + 9$

$$\begin{array}{r} -7x \quad -7x \\ \hline 5x - 11 = 9 \\ +11 \quad +11 \\ \hline 5x \quad = 20 \\ \hline 5 \quad 5 \\ \hline x = 4 \end{array}$$

Move the x's to one side.

Now it looks like a multistep equation that we did in the 1st section.

Add to get rid of the subtraction.

Now divide to get rid of the multiplication

20) $11x - 3 = 7x + 25$

21) $22 - 4x = 12x + 126$

23) $\frac{3}{4}x - 12 = \frac{1}{2}x - 6$

24) $5(2x + 4) = 4(3x + 7)$

25) $12(3x + 4) = 6(7x + 2)$

26) $3x - 25 = 11x - 5 + 2x$

Q3 Quiz 6 Review

Part I:

1) $\frac{5}{8}x + 11 = -4$

2) $45 - \frac{3}{4}x = -9$

3) $\frac{2}{3}x - 120 = 80$

4) $54 - \frac{3}{8}x = 63$

5) $7(4x + 3) - 8(3x - 2) = -3$

6) $6(5x - 1) = 4(10x + 16)$

7) $9(6x + 3) + 8(2x - 11) = -271$

8) $6(6x + 1) = 19(3x - 3)$

9) $3(8x + 6) = 8(4x + 2)$

10) $5(11x - 5) - 7(9x - 2) = 37$

11) $10(5x + 15) = 7(8x + 12)$

12) $4(8x + 3) - 6(7x - 8) = 35$

Answer Key:

1) $x = -24$

2) $x = 72$

3) $x = 300$

4) $x = -24$

5) $x = -10$

6) $x = -7$

7) $x = -3$

8) $x = 3$

9) $x = \frac{1}{4}$

10) $x = -6$

11) $x = 11$

12) $x = 2.5$

Part II:

Show all work:

1) $\frac{3}{8}x + 91 = 67$

2) $43 - \frac{2}{3}x = 81$

3) $\frac{3}{4}x - 84 = 9$

4) $54 - \frac{5}{8}x = -1$

5) $6(4x + 3) - 8(4x - 2) = 106$

6) $3(4x - 5) = 5(2x - 1)$

7) $8(8x + 3) + 9(4x - 2) = 306$

8) $5(6x - 5) = 19(2x - 3)$

9) $3(10x - 7) = 11(2x + 1)$

10) $8(11x - 5) - 9(10x - 2) = 8$

11) $6(3x + 5) = 7(2x + 2)$

12) $9(8x + 3) - 8(6x - 2) = -5$

Answer Key:

- 1) $x = -64$ 2) $x = -57$ 3) $x = 124$ 4) $x = 88$ 5) $x = -9$ 6) $x = 5$
7) $x = 3$ 8) $x = 4$ 9) $x = 4$ 10) $x = -15$ 11) $x = -4$ 12) $x = -2$

Solving Absolute Value Equations

Solving absolute value equations is almost the exact same as solving regular equations with one major difference. In most cases you have *2 solutions*.

Example:

$$|x| = 5$$

We know that when $x = 5$, $|5|$ will also equal 5, but it is also true that $|-5|$ will equal 5. So, for $|x| = 5$, $x = \{-5, 5\}$. **They both work.**

How to solve absolute value equations

- 1) Isolate the absolute value.
- 2) Split into two separate equations, setting one to the negative and one to the positive.

Example:

$$|2x + 6| - 3 = 13$$

- 1) Isolate the absolute value:

** The steps are the same as if you were getting the x by itself. You move away all other numbers by doing the opposite operation:**

$$\begin{aligned} |2x + 6| - 3 &= 13 \\ |2x + 6| \quad \underline{+3} \quad \underline{+3} &= 16 \end{aligned}$$

- 2) Now split into two separate equations and solve each.

$$\begin{aligned} 2x + 6 &= -16 \\ \underline{-6} \quad \underline{-6} & \\ \frac{2x}{2} &= \underline{-22} \\ x &= -11 \end{aligned}$$

$$\begin{aligned} 2x + 6 &= 16 \\ \underline{-6} \quad \underline{-6} & \\ \frac{2x}{2} &= \underline{10} \\ x &= 5 \end{aligned}$$

- 3) Check by substituting in the original equation

Solve each equation:

1) $|6x + 12| = 24$

2) $|6 - 2x| = 14$

3) $|8x - 2| = 42$

4) $|\frac{2}{3}x + 6| = 2$

5) $|10 - \frac{3}{4}x| = 16$

6) $|4x - 12| = -36$

On #'s 1-10, notice how the steps of isolating the absolute value are the same as if you were isolating the x.

1) $5x + 9 = 144$

2) $5|3x - 6| + 9 = 144$

3) $\frac{x}{7} - 3 = 1$

4) $\frac{|12x - 8|}{7} - 3 = 1$

5) $\frac{2}{3}x - 11 = -3$

6) $\frac{2}{3}|2x - 10| - 11 = -3$

7) $\frac{4x - 5}{3} = 9$

8) $\frac{4|8x - 16| - 5}{3} = 9$

$$9) \frac{5x + 7}{11} - 8 = -6$$

$$10) \frac{5|6x - 15| + 7}{11} - 8 = -6$$

$$11) |4x - 5| + 15 = 36$$

$$12) 6|3x - 12| - 5 = 49$$

$$13) \frac{5}{8}|2x - 4| + 4 = -11$$

$$14) \frac{4|8x - 16| - 5}{7} = 9$$

Solve each equation:

1) $4|6x - 12| + 9 = 129$

2) $\frac{1}{2} |8x + 4| - 7 = 27$

3) $-7|16x - 8| + 35 = -245$

4) $\frac{2|6x - 9|}{5} + 34 = 4$

$$5) \frac{|4x - 24|}{9} = 8$$

$$6) \frac{3|7x + 28|}{8} - 4 = 17$$

$$7) \frac{3|15 - 5x| + 12}{13} = 9$$

$$8) \frac{5|11x + 33| - 12}{4} = 52$$

9) $-2|\frac{1}{2}x + 8| - 5 = -25$

10) $6|\frac{1}{4}x - 4| - 73 = -13$

11) $4|5x - 10| + 52 = 12$

12) $\frac{3|12x - 36|}{8} - 7 = 11$

$$13) \frac{3|4x + 32| + 4}{10} = 16$$

$$14) \frac{8|9x - 9| + 3}{15} = 5$$

$$15) \frac{2|35 - 7x|}{14} - 26 = -16$$

$$16) \frac{6|2x - 14| - 12}{4} + 11 = 53$$

17) $-2|\frac{1}{3}x - 12| - 5 = -53$

18) $\frac{2}{3}|12 - \frac{1}{2}x| - 13 = 5$

19) $4|3x + 18| + 140 = 8$

20) $\frac{|16x - 4|}{9} - 7 = -3$

Answer Key:

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|------------------------|-----------------------|----------------------|-----------------------|
| 1) $x = \{-3, 7\}$ | 2) $x = \{-9, 8\}$ | 3) $x = \{-2, 3\}$ | 4) No Solution |
| 5) $x = \{-12, 24\}$ | 6) $x = \{-12, 4\}$ | 7) $x = \{-4, 10\}$ | 8) $x = \{-7, 1\}$ |
| 9) $x = \{-36, 4\}$ | 10) $x = \{-24, 56\}$ | 11) No Solution | 12) $x = \{-1, 7\}$ |
| 13) $x = \{-21, 5\}$ | 14) $x = \{0, 2\}$ | 15) $x = \{-5, 15\}$ | 16) $x = \{-8, 22\}$ |
| 17) $x = \{-36, 108\}$ | 18) $x = \{-30, 78\}$ | 19) No Solution | 20) $x = \{-2, 2.5\}$ |

Q3 Quiz 7 Review

Do all problems in NB:

1) $4|3x - 12| + 5 = 65$

2) $6|10x + 25| - 7 = 143$

3) $2|16x - 48| + 38 = 6$

4) $\frac{2|15x - 30|}{5} - 34 = -4$

$$5) \frac{|8x + 2|}{-11} = -6$$

$$6) \frac{4|8x + 12|}{5} - 18 = -2$$

$$7) \frac{3|7x - 35| - 1}{2} = 10$$

$$8) \frac{5|8x - 4| - 8}{4} = 63$$

9) $-2|6x + 18| - 5 = -29$

10) $\frac{2}{3}|6x + 12| - 21 = -5$

11) $4|5x - 10| + 174 = 14$

12) $\frac{3|11x + 33|}{8} - 7 = 26$

$$13) \frac{3|10 - 2x| + 2}{5} = 16$$

$$14) \frac{5|15 - 5x| + 8}{4} = 52$$

$$15) \frac{2|6x - 24|}{-9} + 5 = 17$$

$$16) \frac{6|6x - 6| + 4}{5} + 12 = 56$$

Answer Key:

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|-----------------------|----------------------|------------------------------|----------------------|
| 1) $x = \{-1, 9\}$ | 2) $x = \{-5, 0\}$ | 3) No Solution | 4) $x = \{-3, 7\}$ |
| 5) $x = \{-8.5, 8\}$ | 6) $x = \{-4, 1\}$ | 7) $x = \{4, 6\}$ | 8) $x = \{-6, 7\}$ |
| 9) $x = \{-5, -1\}$ | 10) $x = \{-6, 2\}$ | 11) No Solution | 12) $x = \{-11, 5\}$ |
| 13) $x = \{-18, -8\}$ | 14) $x = \{-5, 11\}$ | 15) $x = \text{No Solution}$ | 16) $x = \{-5, 7\}$ |