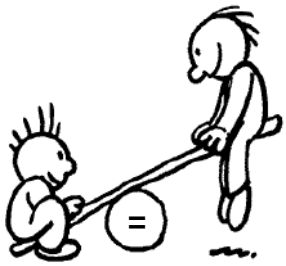
Algebra Basics – One-Step Equations

In algebra, one-step equations can often be solved "in your head," without using formal algebraic steps. However, it's important to learn how to use formal algebraic steps with these simpler equations so if the numbers get tricky to do in your head, you'll have a backup plan. Also, as equations get more complex (with more steps), it's less likely you'll be able to solve them in your head. So, it's important to know how to use algebraic steps to solve them.



Since the variable in an equation represents what we don't know (and also what we're trying to find!), it's important to know the main goal, which is…

GOAL: Get the variable by itself on its own side of the equation.

If we accomplish this goal, then the numerical solution will be on the other side of the equation. How we accomplish this goal varies from problem to problem, but the main goal remains the same. Do your best to remember it always and you'll be a better equation solver.

Some Questions and Answers

Question: **Why** is the goal to get the variable by itself?

Answer: If you get the variable by itself on one side, then a number is on the other side. This means you now know that the variable is equal to that number!

Question: So, in general, **how** do we get the variable by itself?

Answer: We focus on what we want to "get rid of" that is near the variable and make this happen by doing the opposite operation that we see **on both sides of the equation**.

Question: Why do we have to do the opposite operation on both sides of the equation if we only want to get rid of something on one side?

Answer: An equation is like a balance scale or a see-saw. To keep it balanced, whatever we do to one side of the equation, we must also do to the other side to keep the equation balanced. (Otherwise, the equation makes no mathematical sense and is useless to us.)

⚠ Important Note: The equals sign is always the border between the left and right sides of an equation.

Over (for some examples) →

Example 1: If the equation that we're trying to solve is $x+15=36$, first we focus on the variable x. It's a great idea to circle it. We want to get it by itself on the left; it will then be equal to whatever number is on the right. It's important to remember, though, that we must use correct mathematics (algebra, really) to make this happen.

So, we have $x+15=36$. We want to get rid of the $+15$ so we do the opposite, which is to subtract 15 from the left side of the equation (⚠ Remember that the equals sign is always the border between the left and right sides of an equation.) However, an equation is like a balance scale or a see-saw. To keep it balanced, we must also subtract 15 from the right side. The work usually looks like this:

$$\begin{aligned} x+15&=36\\ -15\ &-15\\ \hline x&=21 \end{aligned}$$

Check: It's a great idea to check to make sure your solution actually works. Do this by replacing x in the original equation with the number you got for your solution (in this case, 21) and then see if the equation is true…

$$\begin{aligned} x+15&=36\\ (21)+15&=36\\ 36&=36 \end{aligned}$$

√ ***Good Job!*** ☺

Example 2:

$$\begin{aligned} x-7&=3\\ +7\ &+7\\ \hline x&=10 \end{aligned}$$

Example 3:

$$\begin{aligned} -4&=x+3\\ -3\ &\ \ -3\\ \hline -7&=x\\ x&=-7 \end{aligned}$$

Example 4:

$$\begin{aligned} -3.2+x&=8\\ +3.2\ &\ \ +3.2\\ \hline x&=11.2 \end{aligned}$$

Name:_____

Algebra Basics – One-Step Equations (+/-) (A)

Read and follow these directions for EACH exercise:

1. Show appropriate adding or subtracting on both sides of the equation.
2. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises:

1. $x-5=10$
2. $x-4.7=11$
3. $-2.5+x=22$
4. $-9=x-9$
5. $x+55=98$
6. $x-9=16$
7. $x+22=-33$
8. $x-22=-33$
9. $-14+x=9$
10. $x+5=9$
11. $x+10=19$
12. $-10+x=35$
13. $x+13=49$
14. $x-15=2$
15. $-60+x=30$

Name:_____

Algebra Basics – One-Step Equations (+/-) (B)

Read and follow these directions for EACH exercise:

1. Show appropriate adding or subtracting on both sides of the equation.
2. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises:

1. $x-7=19$
2. $x-5.1=15$
3. $-4.5+x=18$
4. $-32=x-27$
5. $x+76=82$
6. $x-4=13$
7. $x+26=-51$
8. $x-23=-36$
9. $-34+x=19$
10. $x-8=12$
11. $x+5=17$
12. $25=x+11$
13. $14=x-13$
14. $16=x+2$
15. $0=x-8$

Name:_____

Algebra Basics – One-Step Equations (x/÷) (C)

Read and follow these directions for EACH exercise:

1. Show appropriate multiplication or division on both sides of the equation.
2. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises:

1. $4x = 44$
2. $4x = 43$
3. $2.5x = 20$
4. $-9 = 3x$
5. $-5x = 65$
6. $7x = 16$
7. $-x = -342$
8. $7x = 0$
9. $-9x = 981$
10. $\frac{x}{2} = 44$
11. $\frac{x}{5} = 5$
12. $\frac{x}{3} = -20$
13. $-9 = \frac{x}{2}$
14. $\frac{x}{7} = 4.5$
15. $\frac{x}{4} = 0.5$
16. $\frac{x}{11} = 44$
17. $\frac{x}{12} = 0$
18. $\frac{x}{43} = -2$

Name:_____

Algebra Basics – One-Step Equations (x/÷) (D)

Read and follow these directions for EACH exercise:

1. Show appropriate multiplication or division on both sides of the equation.
2. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises:

1. $2x = 24$
2. $2x = 13$
3. $1.5x = 9$
4. $-18 = 3x$
5. $5x = 75$
6. $-3x = 14$
7. $-x = -24$
8. $9x = 0$
9. $-3x = 126$
10. $\frac{x}{3} = 14$
11. $\frac{x}{6} = 7$
12. $\frac{x}{4} = -10$
13. $-11 = \frac{x}{3}$
14. $\frac{x}{2} = 9.5$
15. $\frac{x}{7} = 1.5$
16. $\frac{x}{12} = 9$
17. $\frac{x}{32} = -2$
18. $\frac{x}{13} = 0$

Name:_____

Algebra Basics – One-Step Equations (+/-/x/÷) (E)

Read and follow these directions for EACH exercise:

1. Show appropriate addition, subtraction, multiplication or division on both sides of the equation.

2. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises:

1. $y+7=-3$

2. $4=h-6$

3. $8x=24$

4. $\frac{x}{2}=5$

5. $-6+t=5$

6. $\frac{n}{-9}=4$

7. $128=4x$

8. $c-8=-2$

9. $8+k=5$

10. $\frac{x}{3}=-8$

11. $4.5y=-9$

12. $y+12=-2.5$

13. $0=\frac{x}{-9}$

14. $-4=w-4$

15. $-8=x+8$

16. $-12w=0$

17. $1.5c=6$

18. $\frac{x}{1.5}=-6$

Name:_____

Algebra Basics – One-Step Equations (+/-/x/÷) (F)

Read and follow these directions for EACH exercise:

1. Show appropriate addition, subtraction, multiplication or division on both sides of the equation.

2. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises:

1. $y-5=-8$
2. $4=h+16$
3. $-6x=30$
4. $\frac{x}{3}=6$
5. $8+t=6$
6. $\frac{n}{-4}=7$
7. $65=-5x$
8. $c+13=-7$
9. $-15+k=15$
10. $\frac{x}{-2}=-9$
11. $-3.5y=-10.5$
12. $y-14=-6.5$
13. $0=\frac{x}{7}$
14. $-9=w+9$
15. $-17=x-17$
16. $5.9w=0$
17. $2.5c=10$
18. $\frac{x}{2.5}=5$

Algebra Basics – Two-Step Equations

In algebra, some equations require more than one step to solve. Sometimes, it might be confusing to know what to do first.

Remember our main goal when solving an equation is to…

GOAL: Get the variable by itself on its own side of the equation.

If we accomplish this goal, then the numerical solution will be on the other side of the equation. How we accomplish this goal varies from problem to problem, but the main goal remains the same. Do your best to remember it always and you'll be a better equation solver.

To solve 2-step equations, it's important to remember to use the order of operations **backwards**. Why backwards? Take a look at this example:

$$2x+5=17$$

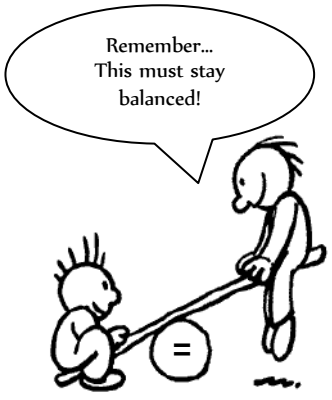
If you were to substitute a value for x, you would first need to multiply by 2, and then add 5 to the result, according to the order of operations. Starting with the variable, x, and building from bottom to top, that might look a little like this:

add 5
multiply by 2
x

To solve the equation, you have to remove the operations that have been applied to x. Remove them in the reverse order, top to bottom, one-at-a-time, by doing the opposite of what you see.

So, first, to remove "add 5" you need to subtract 5. Remember to do this **on both sides of the equation**.

$$\begin{array}{r} 2x+5=17 \\ -5\ \ -5 \\ \hline 2x=12 \end{array}$$



Next, to remove "multiply by 2" you need to divide by 2.

$$\frac{2x}{2}=\frac{12}{2}$$

$$x=6$$

√ ***Good Job!*** ☺ Over →

The same strategy can be used to solve a slightly different example. Let's try to solve this one:

$$\frac{x}{3} - 2 = -7$$

If you were to substitute a value for x, you would first need to divide by 3, and then subtract 2 from the result. Starting with the variable, x, and building from bottom to top, that might look a little like this:

subtract 2
divide by 3
x

So, again, to solve the equation, you have to remove the operations that have been applied to x. You remove them in the reverse order, one-at-a-time, by doing the opposite of what you see.

So, first, to remove "subtract 2" you need to add 2. Remember to do this **<u>on both sides of the equation</u>**.

$$\frac{x}{3} - 2 = -7$$
$$+2 \quad +2$$
$$\frac{x}{3} = -5$$

~~**subtract 2**~~
divide by 3
x

Next, to remove "divide by 3" you need to multiply by 3.

$$\frac{x}{3} = -5$$
$$3 \cdot \frac{x}{3} = -5 \cdot 3$$
$$x = -15$$

~~**divide by 3**~~
x

√ ***Good Job!*** ☺

Name:_____

Algebra Basics – Two-Step Equations (A)

Read and follow these directions for EACH exercise:

3. Appropriate work is shown for each of the two steps required to solve.
4. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises:

1. $2x+1=13$
2. $3x-2=16$
3. $\frac{x}{3}+2=10$
4. $5a-12=3$
5. $\frac{x}{4}-2=9$
6. $\frac{x}{2}-11=-12$
7. $-2a+3=5$
8. $3a+6=6$
9. $5a+11=6$
10. $3x+5=35$
11. $5a+17=47$
12. $4x-1=15$

Name:_____

Algebra Basics – Two-Step Equations (B)

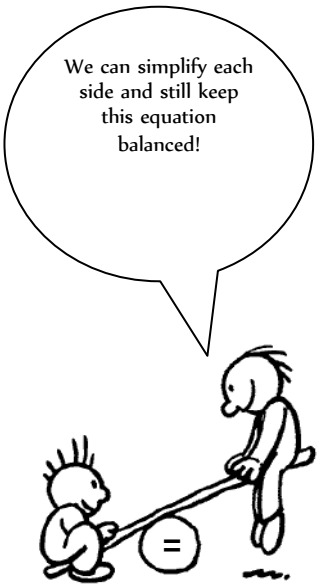
Read and follow these directions for EACH exercise:

1. Appropriate work is shown for each of the two steps required to solve.
2. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises:

1. $3y-5=16$
2. $55=6a+7$
3. $17=8c-7$
4. $15x+14=19$
5. $75=11+2x$
6. $14=12x+8$
7. $\frac{x}{4}-9=1$
8. $\frac{3x}{8}=12$
9. $\frac{x}{3}+4=13$
10. $5=\frac{y}{6}-8$
11. $12=\frac{x}{5}+3$
12. $\frac{4w}{9}=20$

Algebra Basics – Simplify then Solve Equations



To solve an equation, it's important to get the variable by itself. Sometimes, though, before we can do this, we have other work to do. This work involves simplifying expressions on one or both sides of the equation. This might mean doing math such as: computational work (using the order of operations), combining like terms, or using the distributive property.

After we have simplified as much as possible on each side, then we can work to try to solve the equation by getting the variable by itself on its own side of the equation.

> ⚠ Remember: The equals sign is always the border between the left and right sides of an equation.

Examples…

Example 1: $2x + x + 5 - 7 + 2 = -6 + 21$

Solution:

$$2x + x + 5 - 7 + 2 = -6 + 21$$
$$3x = 15$$
$$\boxed{x = 5}$$

Example 2: $2(x + 3) - 2 = -14$

Solution:

$$2(x + 3) - 2 = -14$$
$$2x + 6 - 2 = -14$$
$$2x + 4 = -14$$
$$2x = -18$$
$$\boxed{x = -9}$$

Name:_____

Algebra Basics – Simplify then Solve Equations (A) (one step)

Read and follow these directions for EACH exercise:

5. Both sides of the equation are shown simplified before any solving is done.
6. Show appropriate addition, subtraction, multiplication or division is shown on both sides of the equation.
7. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises (Simplify. Then Solve.):

1. $2x+15-22+7=-22$

2. $3-x-3=43$

3. $n+54+98+68=360$

4. $2b=360-(112+62)$

5. $\frac{x}{2}=34\cdot 3$

6. $6+5+a=18$

Over→

7. $y + 120 + 32 = 180$

8. $2x + 3x = 180 - 40$

9. $5(k + 2) - 10 = 40$

10. $2(w - 3) + 6 = 25 - (5 + 12)$

11. $t + 3^2 = 16$

12. $2j + 2^3 - 22 - j = 16 - 10$

13. $47 + 44 + 22 = t + 27$

14. $2^4 - 2 = 7y$

Name:_____

Algebra Basics – Simplify then Solve Equations (B) (one step)

Read and follow these directions for EACH exercise:

1. Both sides of the equation are shown simplified before any solving is done.
2. Show appropriate addition, subtraction, multiplication or division is shown on both sides of the equation.
3. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises (Simplify. Then Solve.):

1. $2x+11-9-2=-15$

2. $5+2x-5=13$

3. $12+n-44=30$

4. $2y - y = 300-(100+101)$

5. $\frac{x}{3}=3\cdot 3$

6. $6+10+a-2=18$

Over→

7. $-2y+200-30+3y=180$

8. $3x=190-40$

9. $4(x+1)+x-4=20$

10. $2(a-1)+2=30-(-10+12)$

11. $t+4^2=25$

12. $y+5^2-20=26-12$

13. $47+31=t-27$

14. $3^4+3=7y$

Name:_____

Algebra Basics – Simplify then Solve Equations (C) (two steps)

Read and follow these directions for EACH exercise:

1. Both sides of the equation are shown simplified before any solving is done.
2. Show appropriate addition, subtraction, multiplication or division is shown on both sides of the equation.
3. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises (Simplify. Then Solve.):

1. $3x+15+12=33$

2. $-2x-7+3=34-10$

3. $5n+54+2=259-8$

4. $2b+6=160-(122+56)$

5. $\frac{x}{2}-3=13\cdot 3$

6. $-2a+8-12+5a=17$

Over→

7. $-5y+210+2=180$

8. $2(x-5)+2x=150$

9. $-5(k+2)=40$

10. $2(w-3)=25-(19+12)$

11. $-2t+4^2=30$

12. $4k+4^3-22=15-7$

13. $81=-t+27-2t$

14. $5^3-104=7(y-6)$

Name:_____

Algebra Basics – Simplify then Solve Equations (D) (two steps)

Read and follow these directions for EACH exercise:

1. Both sides of the equation are shown simplified before any solving is done.
2. Show appropriate addition, subtraction, multiplication or division is shown on both sides of the equation.
3. Write the correct solution like "x = 5", where x is the variable and 5 is the solution that makes the equation true. Circle your solution… (x = 5)

Exercises (Simplify. Then Solve.):

1. $-10x+15-5=84-14$

2. $-2x-9+2=35$

3. $-6n+55+8=141$

4. $c+6+2c=71-56$

5. $\frac{y}{3}-8=22\bullet 4$

6. $a+9-23-4a=19$

Over→

7. $-4c+55=159$

8. $2(h-4)=240$

9. $-4(x+3)+2x=40$

10. $3(y-4)=12$

11. $-7t+3^2=37$

12. $3n+2^4=-11$

13. $73=-t+37$

14. $5^2-52=6(y-1)+y$

Algebra Basics – Equations with Variables on Both Sides

Sometimes, equations have variables on both sides. It's important to get the variables on one side using proper algebraic steps. Then, we can get the variable by itself. Always remember our main goal…

> ***GOAL: Get the variable by itself on its own side of the equation.***

Since there are a variety of different algebraic steps we may need to use, it's helpful to have an idea of what to do first. In general, it's a good strategy to take care of the different types of steps in the following order:

1. Simplify each side of the equation (if possible) by doing things like using the distributive property and combining like terms.

2. Get the variables on one side (by subtracting/adding on both sides of the equation as appropriate)

3. Get the variable by itself by focusing on what we want to "get rid of" that is near the variable. We make this happen by doing the opposite operation that we see **on both sides of the equation**.

> ⚠ Don't Forget: The equals sign is always the border between the left and right sides of an equation.

Example 1: If the equation that we're trying to solve is $6x = 72 - 3x$, first we notice that there are variables on both sides. We decide to add $3x$ to both sides (to get rid of the $-3x$ on the right side). The work usually looks like this:

$$\begin{array}{r} 6x = 72 - 3x \\ +3x \qquad +3x \\ \hline 9x = 72 \end{array}$$

So, we have $9x = 72$. We want to get rid of the 9 so we do the opposite, which is to divide 9 on both sides. It might look like this:

$$\frac{9x}{9} = \frac{72}{9}$$

$$\boxed{x = 8}$$

Over (for another example) →

Example 2: If the equation that we're trying to solve is $13x-5+8=9+2(5x+3)$, first we notice that we have some simplifying to do. We combine the numbers on the left side and perform distribution with the "2" on the right side like this:

$$13x-5+8=9+2(5x+3)$$
$$13x+3=9+10x+6$$

Then, we combine the numbers on the right side like this:

$$13x+3=9+10x+6$$
$$13x+3=15+10x$$

Now, we notice that we have variables on both sides, so we subtract $10x$ from both sides:

$$\begin{array}{r} 13x+3=15+10x \\ -10x \qquad\quad -10x \\ \hline 3x+3=15 \end{array}$$

So, we now have $3x+3=15$, a more basic 2-step equation. Next, we get rid of the "$+3$" by subtracting 3 from both sides:

$$\begin{array}{r} 3x+3=15 \\ -3 \quad -3 \\ \hline 3x=12 \end{array}$$

Finally, we get rid of the "3" by dividing both sides by 3:

$$\frac{3x}{3}=\frac{12}{3}$$
$$\boxed{x=4}$$

Check: It's a great idea to check to make sure your solution actually works. Do this by replacing x in the original equation with the number you got for your solution (in this case, 4) and then see if the equation is true…

$$13x-5+8=9+2(5x+3)$$
$$13(4)-5+8=9+2(5(4)+3)$$
$$52-5+8=9+2(20+3)$$
$$47+8=9+2(23)$$
$$55=9+46$$
$$55=55$$

√ ***Good Job!*** ☺

Name:_____

Algebra Basics – Equations with Variables on Both Sides (A)

Read and follow these directions for EACH exercise:

1. Get the variables on one side (by subtracting/adding on both sides of the equation as appropriate)

2. Get the variable by itself by focusing on what you want to "get rid of" that is near the variable. Make this happen by doing the opposite operation that you see **on both sides of the equation**.

Exercises:

1. $7x = 10 + 2x$
2. $9x = 44 - 2x$
3. $12y = 3y + 27$
4. $8c = 6 - c$
5. $6x = 2x + 20$
6. $5c = 28 + c$
7. $9x = 3x - 54$
8. $y = 4y + 30$
9. $2d = 36 + 5d$
10. $6.5c = 7 - 0.5c$
11. $2.25y = 1.25y - 8$
12. $8m = 2m + 24$
13. $8y = 90 - 2y$
14. $4a - 55 = 9a$
15. $7m + 36 = 11m$

Over→

16. $4-2y=6y$

17. $3-y=8y$

18. $2.3x+36=0.3x$

19. $5a-40=3a$

20. $5c=2c-81$

21. $x=9x-72$

22. $y=9y-56$

23. $5m-30=11m$

24. $7r+10=3r+50$

25. $8y+17=5y+35$

26. $4x+20=5x+9$

27. $8w+56=14w+26$

28. $37+x=5x+9$

29. $6f+11=2f+47$

30. $7r+8=6r+1$

31. $y+4=9y+4$

32. $9z-3=2z+46$

33. $x+30=12x-14$

34. $6y-7=4y+3$

35. $2x+2=10x-2$

36. $f+20=55-4f$

Name:_____

Algebra Basics – Equations with Variables on Both Sides (B)

Read and follow these directions for EACH exercise:

1. Simplify each side of the equation (if possible) by doing things like using the distributive property and combining like terms.

2. Get the variables on one side (by subtracting/adding on both sides of the equation as appropriate)

3. Get the variable by itself by focusing on what you want to "get rid of" that is near the variable. Make this happen by doing the opposite operation that you see **on both sides of the equation**.

Exercises:

1. $7y-4=5y-y+35$
2. $10-c-3c=7c-23$
3. $8x-15-6x=85-3x$
4. $5y+9-4y=51-5y$
5. $5f-2f+13=f+1$
6. $8x+1=7x-14-2x$
7. $9w-2w+8=4w+38$
8. $6x-12-x=9x+53+x$
9. $12y-5=8y-y+50$
10. $8c-4+7=6c+c+9$
11. $3x-5x-12=7x-88-5$
12. $5-3y-18=-1+9y$

Over→

13. $15x-4(3x+2)=13$

14. $28y-6(3y-5)=40$

15. $22x-3(5x+4)=16$

16. $3x-5+2x=13-2(x+2)$

17. $2(w-3)-17=13-3(w+2)$

18. $2(f+1)-3f=3(3+2f)$

19. $4(2x+1)-3(2x-5)=29$

20. $2-7(g-1)=3(g-2)-5(g+3)$

21. $4(x-3)-6(x+1)=4(3x+4)-2(8+6x)$

22. $6(2w+1)-3(4w-3)-(6w+10)=-(4w-3)+3$