

# Solving One-Step Equations

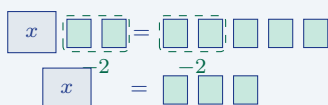
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Think of an equation as a perfectly balanced scale—whatever you do to one side, you must do to the other! In a **one-step equation** the variable is affected by just one operation, so you only need one inverse move to set it free: addition is undone by subtraction, multiplication by division, and so on. Once the idea of *balance and inverse operations* clicks here, every tougher equation you meet later will follow the same logic. This is truly where algebra starts to feel like detective work!

## Key Concepts & Quick Review

**Addition/Subtraction equations:**  $x + a = b \Rightarrow x = b - a$ ;  $x - a = b \Rightarrow x = b + a$ .

**Multiplication/Division equations:**  $ax = b \Rightarrow x = \frac{b}{a}$ ;  $\frac{x}{a} = b \Rightarrow x = ab$ . Always **check** by substituting back into the original equation.



Undo the same amount on both sides.

### Examples

① Solve: (a)  $x - 9 = -4$  (b)  $-6y = 42$

**Think It Through:** In part (a), undo the subtraction by adding 9 to both sides. That isolates the variable and gives  $x = 5$ . In part (b), undo the multiplication by dividing both sides by  $-6$ . That gives  $y = -7$ . A quick check shows both answers work in the original equations, which is a good habit for one-step equations.

**Answer:** (a)  $x = 5$ ; (b)  $y = -7$

② A skateboarder saves the same amount of money each week. After 8 weeks she has saved \$104. Write and solve a one-step equation to find her weekly savings.

**Think It Through:** Let  $w$  represent the amount saved each week. Since the same amount is saved for 8 weeks, write  $8w = 104$ . Now divide both sides by 8 to isolate  $w$ :  $w = 13$ . So she saves \$13 each week. The structure is “number of weeks times weekly amount equals total saved.”

**Answer:**  $w = \$13$  per week

### Practice Problems

Solve each one-step equation.



1.  $x + 7 = 15$  \_\_\_\_\_

2.  $n - 4 = -9$  \_\_\_\_\_

3.  $3y = 21$  \_\_\_\_\_

4.  $\frac{m}{5} = 8$  \_\_\_\_\_

5.  $x - 12 = 0$  \_\_\_\_\_

6.  $-4k = 36$  \_\_\_\_\_

7.  $t + (-6) = 10$  \_\_\_\_\_

8.  $\frac{n}{-3} = 7$  \_\_\_\_\_

9.  $9p = -63$  \_\_\_\_\_

10.  $x + \frac{1}{2} = 3$  \_\_\_\_\_

11.  $-8 + m = 2$  \_\_\_\_\_




12.  $6a = -54$  \_\_\_\_\_

13.  $\frac{x}{4} = -5$  \_\_\_\_\_

14.  $y - (-3) = 11$  \_\_\_\_\_

15.  $1.5x = 9$  \_\_\_\_\_

### Study Tips

-  The goal is to get the variable **alone on one side**. Use the *opposite* (inverse) of whatever operation is applied to it.
-  **Always check** by plugging your answer back in. If both sides are equal, you're correct.
-  When dividing both sides, remember: **negative**  $\div$  **negative** = **positive**. Keep careful track of signs.

### Word Problems

16. A submarine is cruising at a depth of  $-240$  m. The captain orders it to rise to a new depth  $d$  by ascending  $85$  m. Write and solve a one-step equation for the new depth  $d$ . Is the submarine still underwater? How many more meters must it ascend to reach the surface? \_\_\_\_\_
17. An oven is preheating. Its current temperature is  $\frac{5}{8}$  of the target temperature of  $400^\circ\text{F}$ . Write and solve a one-step equation to find the current temperature. If the oven heats at  $20^\circ\text{F}$  per minute, write (but do not yet solve) an equation for how many more minutes  $m$  it needs to reach the target. \_\_\_\_\_



## Answer Keys

- |                                                                                                                     |                                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1) 8</p> <p>2) -5</p> <p>3) 7</p> <p>4) 40</p> <p>5) 12</p> <p>6) -9</p> <p>7) 16</p> <p>8) -21</p> <p>9) -7</p> | <p>10) <math>\frac{5}{2}</math></p> <p>11) 10</p> <p>12) -9</p> <p>13) -20</p> <p>14) 8</p> <p>15) 6</p> <p>16) <math>d = -155\text{ m}</math>; still underwater; needs 155 more meters</p> <p>17) Current <math>250^\circ\text{F}</math>; <math>m = 7.5</math> minutes</p> |
|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Step-by-Step Explanations

**Strategy:** For Percent Increase and Percent Decrease, compare the change to the original amount, then label whether the quantity went up or down. A percent-change setup should show original, change, and new amount separately.

**Practice 1:** A value changes from 20 to 28. Find the percent increase or decrease. **Answer:** 40% increase  
For the first worked item, compare the change to the original amount, then label the change as an increase.

**Practice 15:** Find the new value after increasing 500 by 8%. **Answer:** 540  
Near the end of this topic, multiply the original amount by the increase factor to get the new value.

**Word-problem notes:**

**16. Answer:** Jan→Feb: 15% increase; Feb→Mar:  $\approx 7.9\%$  decrease.

For January to February, find the change first:  $96,600 - 84,000 = 12,600$ . Then divide by the original amount, January's revenue:  $\frac{12,600}{84,000} = 0.15 = 15\%$ . For February to March, the revenue dropped by  $96,600 - 89,000 = 7,600$ . Divide that by February's amount because February is the starting value for that change:  $\frac{7,600}{96,600} \approx 0.0787$ , or about 7.9% decrease. The original amount always goes in the denominator.

**17. Answer:** % increase: 25%; second student's new score:  $75 \times 1.25 = 93.75 \approx 94$ .

First find the increase in the first score:  $80 - 64 = 16$  points. Now compare that increase to the original score:  $\frac{16}{64} = 0.25 = 25\%$ . If the second student has the same percent increase, multiply the original score by 1.25 because  $100\% + 25\% = 125\% = 1.25$ . So  $75 \times 1.25 = 93.75$ , which rounds to 94. Converting a percent increase into a multiplier is often the quickest method.



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