Warm Up

Lesson Presentation

Lesson Quiz

Warm Up

Evaluate.

1. $-\dfrac{2}{3} + 4\dfrac{1}{3}$ $\quad$ $3\dfrac{2}{3}$

2. $-0.51 + (-0.29)$ $\quad$ -0.8

Give the opposite of each number.

3. 8 $\quad$ -8 $\qquad\qquad$ **4.** $-\dfrac{2}{3}$ $\quad$ $\dfrac{2}{3}$

Evaluate each expression for $a = 3$ and $b = -2$.

5. $a + 5$ $\quad$ 8 $\qquad\qquad$ **6.** $12 - b$ $\quad$ 14

Objective

Solve one-step equations in one variable by using addition or subtraction.

Vocabulary

equation

solution of an equation

An **equation** is a mathematical statement that two expressions are equal.

A **solution of an equation** is a value of the variable that makes the equation true.

To find solutions, *isolate the variable*. A variable is isolated when it appears by itself on one side of an equation, and not at all on the other side.

Isolate a variable by using inverse operations which "undo" operations on the variable.

An equation is like a balanced scale. To keep the balance, perform the same operation on both sides.

Inverse Operations	
Operation	**Inverse Operation**
Addition	Subtraction
Subtraction	Addition

Example 1A: Solving Equations by Using Addition

Solve the equation. Check your answer.

$y - 8 = 24$

$\underline{+ 8 \quad + 8}$ *Since 8 is subtracted from y, add 8 to*

$y = 32$ *both sides to undo the subtraction.*

Check

$y - 8 =$	24
$32 - 8$	24
24	24 ✓

To check your solution, substitute 32 for y in the original equation.

Example 1B: Solving Equations by Using Addition

Solve the equation. Check your answer.

$$\frac{5}{16} = z - \frac{7}{16}$$
$$+\frac{7}{16} \qquad +\frac{7}{16}$$
$$\frac{3}{4} = z$$

Since $\frac{7}{16}$ is subtracted from z, add $\frac{7}{16}$ to both sides to undo the subtraction.

Check

$$\frac{5}{16} = z - \frac{7}{16}$$
$$\frac{5}{16} \; \bigg| \; \frac{3}{4} - \frac{7}{16}$$
$$\frac{5}{16} \; \bigg| \; \frac{5}{16} \; ✓$$

To check your solution, substitute $\frac{3}{4}$ for z in the original equation.

Check It Out! Example 1a

Solve the equation. Check your answer.

$$n - 3.2 = 5.6$$

$$\underline{+\ 3.2}\quad \underline{+\ 3.2}$$

$$n = 8.8$$

Since 3.2 is subtracted from n, add 3.2 to both sides to undo the subtraction.

Check

$n - 3.2 = 5.6$	
$8.8 - 3.2$	5.6
5.6	5.6 ✓

To check your solution, substitute 8.8 for n in the original equation.

Check It Out! Example 1b

Solve the equation. Check your answer.

$$-6 = k - 6$$

$$\underline{+\ 6} \qquad \underline{+\ 6}$$ *Since 6 is subtracted from k, add 6 to both sides to undo the subtraction.*

$$0 = k$$

Check

$$-6 = k - 6$$

-6	$0 - 6$
-6	-6 ✓

To check your solution, substitute 0 for k in the original equation.

Check It Out! Example 1c

Solve the equation. Check your answer.

$$16 = m - 9$$

$$\underline{+\ 9 \qquad\qquad +\ 9}$$ *Since 9 is subtracted from m, add 9 to*

$$25 = m$$ *both sides to undo the subtraction.*

Check

$16 = m - 9$	
16	25 − 9
16	16 ✓

To check your solution, substitute 25 for m in the original equation.

Example 2A: Solving Equations by Using Subtraction

Solve the equation. Check your answer.

$$m + 17 = 33$$
$$\underline{- 17 \quad -17}$$
$$m = 16$$

Since 17 is added to m, subtract 17 from both sides to undo the addition.

Check $m + 17 = 33$

$16 + 17$	33
33	33 ✓

To check your solution, substitute 16 for m in the original equation.

Example 2B: Solving Equations by Using Subtraction

Solve the equation. Check your answer.

$$4.2 = t + 1.8$$

$$\underline{-1.8} \qquad \underline{-\ 1.8}$$

Since 1.8 is added to t, subtract 1.8 from both sides to undo the addition.

$$2.4 = t$$

Check

4.2 = t + 1.8	
4.2	2.4 + 1.8
4.2	4.2 ✓

To check your solution, substitute 2.4 for t in the original equation.

Check It Out! Example 2a

Solve the equation. Check your answer.

$$d + \frac{1}{2} = 1$$

$$\underline{-\frac{1}{2} \quad -\frac{1}{2}}$$

$$d = \frac{1}{2}$$

Since $\frac{1}{2}$ is added to d, subtract $\frac{1}{2}$ from both sides to undo the addition.

Check

$$d + \frac{1}{2} = 1$$

$$\frac{1}{2} + \frac{1}{2} \quad \Big| \quad 1$$

$$1 \quad \Big| \quad 1 \checkmark$$

To check your solution, substitute $\frac{1}{2}$ for d in the original equation.

Check It Out! Example 2b

Solve the equation. Check your answer.

$$-5 = k + 5$$

$$\underline{-\ 5 \qquad\quad -\ 5}$$

$$-10 = k$$

Since 5 is added to k, subtract 5 from both sides to undo the subtraction.

Check

$$
\begin{array}{c|c}
-5 = k + 5 \\
\hline
-5 & -10 + 5 \\
-5 & -5 \checkmark
\end{array}
$$

To check your solution, substitute –10 for k in the original equation.

Check It Out! Example 2c

Solve the equation. Check your answer.

$$6 + t = 14$$

$$\underline{-\ 6} \qquad \underline{-\ 6}$$

Since 6 is added to t, subtract 6 from both sides to undo the addition.

$$t = 8$$

Check $6 + t = 14$

$$6 + 8 \ \big|\ 14$$

$$14 \ \big|\ 14 \ \checkmark$$

To check your solution, substitute 8 for t in the original equation.

Remember that subtracting is the same as adding the opposite. When solving equations, you will sometimes find it easier to add an opposite to both sides instead of subtracting.

Example 3: Solving Equations by Adding the Opposite

Solve $-\dfrac{5}{11} + p = -\dfrac{2}{11}$.

$$+\dfrac{5}{11} \qquad\qquad +\dfrac{5}{11}$$

$$p = \dfrac{3}{11}$$

Since $-\dfrac{5}{11}$ *is added to p, add* $\dfrac{5}{11}$ *to both sides.*

Check

$$-\dfrac{5}{11} + p = -\dfrac{2}{11}$$

$$-\dfrac{5}{11} + \dfrac{3}{11} \quad\bigg|\quad -\dfrac{2}{11}$$

$$-\dfrac{2}{11} \quad\bigg|\quad -\dfrac{2}{11} \checkmark$$

To check your solution, substitute $\dfrac{3}{11}$ *for p in the original equation.*

Check It Out! Example 3a

Solve −2.3 + m = 7. Check your answer.

$$-2.3 + m = 7$$
$$+2.3 \qquad +2.3$$
$$m = 9.3$$

Since −2.3 is added to m, add 2.3 to both sides.

Check $-2.3 + m = 7$
$-2.3 + 9.3 \mid 7$
$7 \mid 7$ ✓

To check your solution, substitute 9.3 for m in the original equation.

Check It Out! Example 3b

Solve $-\dfrac{3}{4} + z = \dfrac{5}{4}$. **Check your answer.**

$$-\dfrac{3}{4} + z = \dfrac{5}{4}$$

$$+\dfrac{3}{4} \qquad +\dfrac{3}{4}$$

$$z = 2$$

Since $-\dfrac{3}{4}$ *is added to z, add* $\dfrac{3}{4}$ *to both sides.*

Check

$$-\dfrac{3}{4} + z = \dfrac{5}{4}$$

$$-\dfrac{3}{4} + 2 \;\Big|\; \dfrac{5}{4}$$

$$\dfrac{5}{4} \;\Big|\; \dfrac{5}{4} \;\checkmark$$

To check your solution, substitute 2 for z in the original equation.

Check It Out! Example 3c

Solve −11 + x = 33. Check your answer.

$$-11 + x = 33$$

$$\underline{+11} \qquad \underline{+11}$$

$$x = 44$$

Since −11 is added to x, add 11 to both sides.

Check

$$\begin{array}{c|c} -11 + x = 33 \\ \hline -11 + 44 & 33 \\ 33 & 33 \checkmark \end{array}$$

To check your solution, substitute 44 for x in the original equation.

Example 4: Application

Over 20 years, the population of a town decreased by 275 people to a population of 850. Write and solve an equation to find the original population.

original population	minus	decrease in population	is	current population
p	$-$	d	$=$	c

$p - 275 = 850$ *Substitute 275 for d and 850 for c.*

$p - 275 = 850$ *Since 275 is subtracted from p, add*
$\underline{+\ 275 \quad +\ 275}$ *275 to both sides to undo the*
$\qquad\qquad p = 1125$ *subtraction.*

The original population was 1125 people.

Check It Out! Example 4

A person's maximum heart rate is the highest rate, in beats per minute, that the person's heart should reach. One method to estimate maximum heart rate states that your age added to your maximum heart rate is 220. Using this method, write and solve an equation to find a person's age if the person's maximum heart rate is 185 beats per minute.

Check It Out! Example 4 Continued

age	added to	maximum heart rate	is	220
a	$+$	r	$=$	220

$a + r = 220$ *Write an equation to represent the relationship.*

$a + 185 = 220$

$\underline{-\ 185 \quad -\ 185}$

$a = 35$

Substitute 185 for r. Since 185 is added to a, subtract 185 from both sides to undo the addition.

A person whose maximum heart rate is 185 beats per minute would be 35 years old.

Properties of Equality

WORDS	**Addition Property of Equality** You can add the same number to both sides of an equation, and the statement will still be true.
NUMBERS	$3 = 3$ $3 + 2 = 3 + 2$ $5 = 5$
ALGEBRA	$a = b$ $a + c = b + c$

Properties of Equality

WORDS	**Subtraction Property of Equality** You can subtract the same number from both sides of an equation, and the statement will still be true.
NUMBERS	$7 = 7$ $7 - 5 = 7 - 5$ $2 = 2$
ALGEBRA	$a = b$ $a - c = b - c$

Lesson Quiz

Solve each equation.

1. $r - 4 = -8$ -4

2. $\dfrac{5}{12} = s - \dfrac{11}{12}$ $\dfrac{16}{12}$, or $\dfrac{4}{3}$

3. $m + 13 = 58$ 45

4. $0.75 = n + 0.6$ 0.15

5. $-5 + c = 22$ 27

6. This year a high school had 578 sophomores enrolled. This is 89 less than the number enrolled last year. Write and solve an equation to find the number of sophomores enrolled last year.
$s - 89 = 578;\ s = 667$