Chapter 11 – Equations

Study Guide

11.1 Expressions and Equations

Literacy Link

Writing Expressions

An expression can be written using a single constant, a single variable, or a combination of operations with constants, variables, or numerical coefficients. For example,

$2y - 7$ ← constant

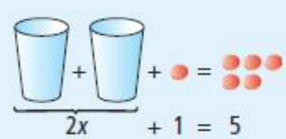
numerical coefficient   variable

equation

- a mathematical statement with two expressions that have the same value
- $x + 2 = 3$, $y - 7 = -4$, $3a - 2 = a + 2$, and $b = 4$ are examples of equations

Key Ideas

- An expression can be a single constant, a single variable, or a combination of operations with constants, variables, or numerical coefficients.
- An equation is made up of two expressions that are equal in value to each other.
- Expressions and equations both contain variables, numerical coefficients, and constants.
- Always identify what your variable stands for. For example, in the equation shown x represents the unknown number of counters in each cup.



11.2 Solve One-Step Equations by adding or Subtracting

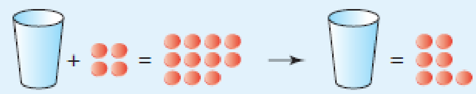
Key Ideas

- Equations can be solved in several ways. You can:
  - solve by inspection, using mental math

    $x - 5 = 16$

    The answer is $x = 21$.

  - model the equation to help balance it

  - isolate the variable by performing the opposite operation on both sides of the equal sign

    $$y - 14 = 17$$
    $$y - 14 + 14 = 17 + 14$$
    $$y = 31$$

- To check your solution, substitute your answer into the equation. Compare the left side of the equation to the right side. If the solution is correct, both sides should have the same value.

  Left Side $= 31 - 14$ Right Side $= 17$

  $= 17$

  Left Side $=$ Right Side

11.2 Solve One-Step Equations by Multiplying or Dividing

Example 3: Multiply to Apply the Opposite Operation

Sylvie and Murray earn money delivering groceries. Last weekend, Murray earned \$29. This was one third of the amount Sylvie earned. How much money did Sylvie earn?

Solution

Let g represent the amount of money Sylvie earned.

Murray earned one third of the amount Sylvie earned, or $\frac{g}{3}$.

$$\frac{g}{3} = 29$$

$$\frac{g}{3} \times 3 = 29 \times 3$$

$$g = 87$$

$\frac{g}{3}$ means $g \div 3$.
The opposite operation is $\times$ 3.

$g \div 3 \times 3 = g$

Sylvie earned \$87.

Check:

Left Side $= \frac{g}{3}$ Right Side $= 29$

$= \frac{87}{3}$

$= 29$

Left Side $=$ Right Side

The answer is correct.

Example 2: Divide to Apply the Opposite Operation

Suppose that Donovan Bailey could run at a constant speed of 9 m/s. The distance travelled is modelled by the formula $d = 9t$, where d represents distance, in metres, and t represents time, in seconds. How long would it take him to run 900 m?

Solution

Since the distance d is 900 m, substitute 900 into the formula $d = 9t$. Then, solve the equation.

$$
\begin{aligned}
900 &= 9t \\
\frac{900}{9} &= \frac{9t}{9} \\
100 &= t
\end{aligned}
$$

$9t$ means $9 \times t$.
The opposite operation is $\div\ 9$.

It would take Donovan Bailey 100 s to run 900 m.

Check:

Left Side $= 900$ Right Side $= 9t$

$= 9(100)$

$= 900$

Left Side = Right Side

The answer is correct.

11.4 Solving Two-Step Equations

Key Ideas

- To solve an equation, isolate the variable on one side of the equal sign.
- When undoing the operations performed on the variable, follow the reverse order of operations:
  – subtract and/or add
  – multiply and/or divide

Example 2: Apply the Reverse Order of Operations

The formula $R = 9T - 70$ models the chirping rate of a cricket at various temperatures. The variable R represents the number of chirps per minute, and T represents the temperature, in degrees Celsius. When the rate is 20 chirps per min, what is the approximate temperature?

Solution

Substitute 20 for R in the formula. Then, isolate the variable T, to solve the equation.

To solve, apply the reverse order of operations. Add or subtract first, then multiply or divide.

$$
\begin{aligned}
20 &= 9T - 70 \\
20 + 70 &= 9T - 70 + 70 && \text{Add 70 to both sides of the equation.} \\
90 &= 9T \\
\frac{90}{9} &= \frac{9T}{9} && \text{Divide both sides of the equation by 9.} \\
10 &= T
\end{aligned}
$$

The approximate temperature is 10°C.

Check:

$$
\begin{aligned}
\text{Left Side} = 20 \qquad \text{Right Side} &= 9T - 70 \\
&= 9(10) - 70 \\
&= 90 - 70 \\
&= 20
\end{aligned}
$$

Left Side = Right Side

The answer is correct.