3.6 Writing Algebraic Expressions

Lesson Objectives

- Translate verbal descriptions into algebraic expressions with one or more variables.
- Translate verbal descriptions into algebraic expressions with parentheses.

\[
\begin{align*}
\times & \quad \text{product} \\
\text{times} & \quad \text{multiplied by} \\
\text{of} & \\
\underline{\text{difference}} & \quad \text{sum} \\
\text{minus} & \quad \text{plus} \\
\text{subtracted by} & \quad \text{more/\textgreater \ more than} \\
\text{less/\textless \ than} & \\
\div & \quad \text{quotient} \\
\text{divided by} & \quad \text{in each} \\
\text{per} & \\
\end{align*}
\]
Translate Verbal Descriptions into Algebraic Expressions with One Variable.

You have learned to translate verbal descriptions into algebraic expressions.

You can translate verbal descriptions with variable terms that have decimal, fractional, and negative coefficients as in the following problem.

Amy used two-thirds of a ribbon that is $y$-inches long to tie her hair. Write an algebraic expression for the length of the ribbon she used.

\[
\frac{2}{3} \cdot y
\]

Combine.

The length of the ribbon is \( \frac{2}{3} y \) inches.
A retailer doubles the value of a coupon worth \( t \) dollars on a purchase of $15. Write an algebraic expression for the final cost of the purchase.

\[
-2t \quad \text{plus} \quad 15
\]

\[
-2t + 15 \quad \text{Translate by parts. Combine.}
\]

The final cost of purchase is \((-2t + 15)\) dollars.

You can translate verbal descriptions into algebraic expressions using more than one operation. Simplify algebraic expressions when you can.
Seven sticks of clay are shared equally among 28 students. Each stick of clay weighs \(c\) grams. Write an algebraic expression for the weight of the clay that each student receives.

\[ \frac{7c}{28} = \frac{c}{4} \]

Each student receives \(\frac{c}{4}\) grams of clay.

\(\text{Product of 7 and } c\) divided by \(28\)

\(\frac{7c}{28}\)

Combine and simplify.
Example 16  Translate verbal descriptions into algebraic expressions.

a) A fruit punch makes seven quarts when made with \( r \) quarts of orange juice. This time it is being made with 30% less orange juice. Write an expression for the number of quarts of the fruit punch made this time.

\[
\frac{3}{10}r + 7 - r \quad 0.7r + (7 - r) \quad 7(0.7r) \text{ qts.} = 4.9r \\
30\%r \left( \frac{7}{r} \right) (7 - 0.3r) \text{ qts.} \quad \frac{7r}{30} \text{ qts.} 7 - 0.7r
\]

Solution

7 adds to \(-0.3\) times \( r \)

\[
7 + (-0.3r) = 7 - 0.3r
\]

\((7 - 0.3r)\) quarts of fruit punch is made.

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Math Note

1. Percent is written as \%, which means out of 100. It can be written as a decimal.

   \[
   30\% = \frac{30}{100} = 0.3
   \]
b) James paid $x$ dollars plus 3% sales tax for a pen. Write an algebraic expression for the amount of money he paid for the pen.

$$\# \ 1.03x \ \checkmark$$

\[
x + 0.03x = \frac{1.03x}{103\% \text{ of } x}
\]

**Solution**

\[
x + \text{ increased by } 3\%
\]
\[
3\% \text{ of } x
\]
\[
= \frac{1.03x}{103\% \text{ of } x}
\]
\[
\begin{align*}
x + 0.03x & \quad \text{Translate by parts.} \\
= 1.03x & \quad \text{Combine.}
\end{align*}
\]

He paid 1.03x dollars for the pen.
c) Seven watermelons each weighs \( w \) pounds. A basket can hold 11 pounds less than two-fifths of the weight of the watermelons. What weight can the basket hold?

\[
\left(\frac{14}{5}w - 11\right) \text{ lbs.}
\]

\[
\frac{2}{5}(7w) - 11
\]

**Solution**

Because \( w \) represents the weight of one watermelon, \( 7 \cdot w \) represents the weight of seven watermelons.

\[
\text{Two-fifths} \quad \frac{2}{5} \quad \text{of the} \quad 7w
\]

\[
\frac{14}{5}w \quad \text{less} \quad 11
\]

\[
\frac{14}{5}w - 11
\]

Translate by parts.

Combine.

The basket can hold \( \frac{14}{5}w - 11 \) pounds.
Guided Practice

Complete.

1. The price of a ring was \( w \) dollars. Wendy bought it at a discount of 25%. Write an algebraic expression for the discounted price of the ring.

\[
\text{Orig.} - \text{disc.} = \text{Sale price} \quad w - 0.25w = 0.75w
\]

\[w \quad \text{reduced by} \quad 25% \quad \underbrace{\? \% \text{ of } w}_{=}
\]

\[w - \underbrace{? \quad w}_{=} \quad \text{Translate by parts.}
\]

\[? - ? = ? \quad \text{Combine.}
\]

\[\text{The discounted price of the ring is } ? \text{ dollars.}\]
2. 6n blocks of clay are shared among 14 students. Write an algebraic expression for the number of blocks of clay that each student will get.

\[
\frac{6n}{14} = \frac{3n}{7} \text{ blocks of clay}
\]

\[
\frac{6n}{14} \div \frac{14}{14} = \frac{3n}{7}
\]

Translate by parts.

Combine.

Simplify.

Each student gets \(\frac{3n}{7}\) blocks of clay.
Desmond has $w$ marbles and Mandy has $\frac{1}{2}w$ marbles. Desmond gives one-tenth of his marbles and Mandy gives two-fifths of her marbles to their cousin Joel. Write an expression for the number of marbles Joel receives.

$$\text{Des} \quad \frac{1}{10}w \quad \text{Mandy} \quad \frac{2}{5} \left(\frac{1}{2}w\right) \quad \text{Joel} \quad \frac{3}{10}w$$
4. After baking some bread, Janis has \( \frac{2}{3}b \) pounds of butter left. Then she uses \( \frac{3}{4} \) pound for a white sauce. Write an algebraic expression for the amount of butter left.

\[
\left( \frac{2}{3}b - \frac{3}{4} \right) \text{ lbs.}
\]

\[0.6b - 0.75\]

\( ? \) – \( ? \)

Subtract \( \frac{3}{4} \) from \( \frac{2}{3}b \).

There are \( ? \) pounds of butter left.

**Caution**

a subtracted from b is not \( a - b \).