# Mixture problems

**Objective A** To solve value mixture problems

A value mixture problem involves combining two ingredients that have different prices into a single blend. For example, a coffee merchant may blend two types of coffee into a single blend, or a candy manufacturer may combine two type of candy to sell as a variety pack.

The solution of a value mixture problem is based on the equation AC = V, where A is the amount of an ingredient, C is the cost per unit of the ingredient, and V is the value of the ingredient.

A coffee merchant wants to make 6 lb of a blend of coffee costing $5 per pound. The blend is made using a $6-per-pound grade and a $3-per-pound grade of coffee. How many pound of each of these grades should be used?

**Strategy for Solving a Value Mixture Problem**
1**.** For each ingredient in the mixture, write a numerical or variable expression for the amount of the ingredient used, the unit cost of the ingredient, and the value of the amount used. For the blend, write a numerical or variable expression for the amount, the unit cost of the blend, and the value of the amount. The results can be recorded in a table.

The sum of the amount is 6 lb.

Amount of $6 coffee: x
Amount of $3 coffee: 6 – x

| | Amount, A | • | Unit Cost, C | = | Value, V |
|---|---|---|---|---|---|
| $6 grade | x | • | $6 | = | 6x |
| $3 grade | 6 – x | • | $3 | = | 3(6 - x) |
| $5 blend | 6 | • | $5 | = | 5(6) |

2. Determine how the values of each ingredient are related. Use the fact that the sum of the values of all the ingredients is equal to the value of the blend.

The sum of the values of the $6 grade and the $3 grade is equal to the value of the $5 blend.

$6x + 3(6 - x) = 5 (6)$
$6x + 18 - 3x = 30$
$3x + 18 = 30$
$3x = 12$
$x = 4$
$6 - x = 6 - 4 = 2$ The merchant must use 4 lb of the $6 coffee and 2 lb of the $3 coffee.

**Objective B** To solve percent mixture problems

The amount of a substance in a solution can be given as a percent of the total solution. For example, a 5% salt-water solution means that 5% of the total solution is salt. The remaining 95% is water.

Solving a percent mixture problem can be done using the equation Ar = Q, where A is the amount of a solution, r is the percent concentration of a substance in the solution, and Q is the quantity of the substance in the solution.

For example, a 500-millilliter bottle is filled with a 4% solution of hydrogen peroxide.

$$Ar = Q$$
$$500(0.04) = Q$$
$$20 = Q$$

The bottle contains 20 ml of hydrogen peroxide.

How many gallon of a 20% salt solution must be mixed with 6 gal of 30% salt solution to make a 22% salt solution?

**Strategy for Solving a Percent Mixture Problem**
1. For each solution, write a numerical or variable expression for the amount of solution, the percent concentration, and the quantity of a substance in the solution. The results can be recorded in a table.

The unknown quantity of 20% solution: x

| | Amount of *Solution, A* | . | Percent *Concentration, r* | = | Quantity of *Substance, Q* |
|---|---|---|---|---|---|
| 20% solution | x | . | 0.20 | = | 0.20x |
| 30% solution | 6 | . | 0.30 | = | 0.30(6) |
| 22% solution | x + 6 | . | 0.22 | = | 0.22(x + 6) |

2. Determine how the quantities of the substances in each solution are related. Use the fact that the sum of the quantities of the substances being mixed is equal to the quantity of the substance after mixing.

The sum of the quantities of the substances in the 20% solution and the 30% solution is equal to the quantity of the substance in the 22% solution.

$$0.20x + 0.30(6) = 0.22(x + 6)$$
$$0.20x + 1.80 = 0.22x + 1.32$$
$$-0.02x + 1.80 = 1.32$$
$$-0.02x = -0.48$$
$$x = 24$$

24 gal of the 20% solution are required.