closer the darts land to the bull's-eye, the more accurately they were thrown. The closer they land to one another, the more precisely they were thrown. Thus, the set of results shown in Figure 2-8(a) is both accurate and precise because the darts are close to the bull's-eye and close to each other. In Figure 2-8(b), the set of results is inaccurate but precise because the darts are far from the bull's-eye but close to each other. In Figure 2-8(c), the set of results is both inaccurate and imprecise because the darts are far from the bull's-eye and far from each other. Notice also that the darts are not evenly distributed around the bull's-eye, so the set, even considered on average, is inaccurate. In Figure 2-8(d), the set on average is accurate compared with the third case, but it is imprecise. That is because the darts are distributed evenly around the bull's-eye but are far from each other.

Percent Error

The accuracy of an individual value or of an average experimental value can be compared quantitatively with the correct or accepted value by calculating the percent error. **Percent error** *is calculated by subtracting the experimental value from the accepted value, dividing the difference by the accepted value, and then multiplying by 100.*

$$\text{Percent error} = \frac{\text{Value}_{\text{accepted}} - \text{Value}_{\text{experimental}}}{\text{Value}_{\text{accepted}}} \times 100$$

Percent error has a positive value if the accepted value is greater than the experimental value. It has a negative value if the accepted value is less than the experimental value. The following sample problem illustrates the concept of percent error.

SAMPLE PROBLEM 2-3

A student measures the mass and volume of a substance and calculates its density as 1.40 g/mL. The correct, or accepted, value of the density is 1.30 g/mL. What is the percent error of the student's measurement?

SOLUTION

$$\text{Percent error} = \frac{\text{Value}_{\text{accepted}} - \text{Value}_{\text{experimental}}}{\text{Value}_{\text{accepted}}} \times 100$$

$$= \frac{1.30\ \cancel{\text{g/mL}} - 1.40\ \cancel{\text{g/mL}}}{1.30\ \cancel{\text{g/mL}}} \times 100 = -7.7\%$$

PRACTICE

1. What is the percent error for a mass measurement of 17.7 g, given that the correct value is 21.2 g? *Answer* 17%
2. A volume is measured experimentally as 4.26 mL. What is the percent error, given that the correct value is 4.15 mL? *Answer* –2.7%