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 8a** is both accurate and precise because the darts are close to the bull's-eye and close to each other. In **Figure 8b,** 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 8c,** 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 8d,** 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.

extension

Chemistry in Action

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Keyword: HC6MEAX

Percentage 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 percentage error. **Percentage error** *is calculated by subtracting the accepted value from the experimental value, dividing the difference by the accepted value, and then multiplying by 100.*

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

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

SAMPLE PROBLEM C

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 percentage error of the student's measurement?

SOLUTION

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

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

PRACTICE

Answers in Appendix E

1. What is the percentage error for a mass measurement of 17.7 g, given that the correct value is 21.2 g?
2. A volume is measured experimentally as 4.26 mL. What is the percentage error, given that the correct value is 4.15 mL?

extension

Go to **go.hrw.com** for more practice problems that ask you to calculate percentage error.

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