2 PLAN

You must start with a balanced equation.

$$6CO_2(g) + 6H_2O(l) \longrightarrow C_6H_{12}O_6(s) + 6O_2(g)$$

Given the amount in mol of H_2O, you need to get the mass of $C_6H_{12}O_6$ in grams. Two conversion factors are needed—the mole ratio of $C_6H_{12}O_6$ to H_2O and the molar mass of $C_6H_{12}O_6$.

$$\text{mol } H_2O \times \frac{\overset{\text{mol ratio}}{\text{mol } C_6H_{12}O_6}}{\text{mol } H_2O} \times \frac{\overset{\text{molar mass factor}}{\text{g } C_6H_{12}O_6}}{\text{mol } C_6H_{12}O_6} = \text{g } C_6H_{12}O_6$$

3 COMPUTE

Use the periodic table to compute the molar mass of $C_6H_{12}O_6$.

$$C_6H_{12}O_6 = 180.18 \text{ g/mol}$$

$$3.00 \cancel{\text{ mol } H_2O} \times \frac{1 \cancel{\text{ mol } C_6H_{12}O_6}}{6 \cancel{\text{ mol } H_2O}} \times \frac{180.18 \text{ g } C_6H_{12}O_6}{1 \cancel{\text{ mol } C_6H_{12}O_6}} = 90.1 \text{ g } C_6H_{12}O_6$$

4 EVALUATE

The answer is correctly rounded to three significant figures, to match those in 3.00 mol H_2O. The units cancel in the problem, leaving g $C_6H_{12}O_6$ as the units for the answer, which matches the unknown. The answer is reasonable because it is one-half of 180.

SAMPLE PROBLEM C

For more help, go to the Math Tutor at the end of this chapter.

What mass of carbon dioxide, in grams, is needed to react with 3.00 mol H_2O in the photosynthetic reaction described in Sample Problem B?

SOLUTION

1 ANALYZE

Given: amount of H_2O = 3.00 mol
Unknown: mass of CO_2 (g)

The chemical equation from Sample Problem B is

2 PLAN

$$6CO_2(g) + 6H_2O(l) \longrightarrow C_6H_{12}O_6(s) + 6O_2(g).$$

Two conversion factors are needed—the mole ratio of CO_2 to H_2O and the molar mass factor of CO_2.

3 COMPUTE

$$\text{mol } H_2O \times \frac{\overset{\text{mol ratio}}{\text{mol } CO_2}}{\text{mol } H_2O} \times \frac{\overset{\text{molar mass factor}}{\text{g } CO_2}}{\text{mol } CO_2} = \text{g } CO_2$$

Use the periodic table to compute the molar mass of CO_2.

$$CO_2 = 44.01 \text{ g/mol}$$

4 EVALUATE

$$3.00 \cancel{\text{ mol } H_2O} \times \frac{6 \cancel{\text{ mol } CO_2}}{6 \cancel{\text{ mol } H_2O}} \times \frac{44.01 \text{ g } CO_2}{1 \cancel{\text{ mol } CO_2}} = 132 \text{ g } CO_2$$

The answer is rounded correctly to three significant figures to match those in 3.00 mol H_2O. The units cancel to leave g CO_2, which is the unknown. The answer is close to an estimate of 120, which is 3×40.