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12.2 CHEMICAL CALCULATIONS

Section Review

Objectives

- Construct mole ratios from balanced chemical equations and apply these ratios in mole-mole stoichiometric calculations
- Calculate stoichiometric quantities from balanced chemical equations, using units of moles, mass, representative particles, and volumes of gases at STP

Key Equations

- mole-mole relationship used in every stoichiometric calculation:

$$aG \longrightarrow bW$$

(given quantity) (wanted quantity)

- $$x \text{ mol } G \times \frac{b \text{ mol } W}{a \text{ mol } G} = \frac{xb}{a} \text{ mol } W$$

Given   Mole Ratio   Calculated

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

Mole ratios from balanced equations may be used to solve problems with other units such as numbers of __1__ and __2__ of gases at STP. The __3__ from the balanced equation are used to write conversion factors called __4__. These conversion factors are used to calculate the numbers of moles of __5__ from a given number of moles of __6__. In mass-mass calculations, the molar mass is used to convert mass to __7__.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

________ **8.** In mass-mass calculations, the molar mass is used to convert mass to moles.

________ **9.** The mole ratio 2 mol HF/1 mol SnF_2 can be used to determine the mass of SnF_2 produced according to the equation:
$Sn(s) + 2HF(g) \rightarrow SnF_2(s) + H_2(g)$

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________ **10.** In a volume-volume problem, the 22.4 L/mol factors always cancel out.

________ **11.** In stoichiometric problems, volume is expressed in terms of liters.

________ **12.** For a mass-mole problem, the first conversion from mass to moles is skipped.

________ **13.** For a mass-mass problem, the first conversion is from moles to mass.

________ **14.** Because mole ratios from balanced equations are exact numbers, they do not enter into the determination of significant figures.

Part C Matching

Match each conversion problem in Column A to the correct solution in Column B.

Column A	Column B
________ **15.** moles $O_2 \rightarrow$ grams O_2	**a.** molecules $\times \frac{\text{mol}}{6.02 \times 10^{23}\ \text{molecules}} \times \frac{18.0\ \text{g}}{\text{mol}}$
________ **16.** liters $SO_2 \rightarrow$ grams SO_2 at STP	**b.** liters $\times \frac{\text{mol}}{22.4\ \text{L}} \times \frac{64.1\ \text{g}}{\text{mol}}$
________ **17.** molecules He $\rightarrow$ liters He(*g*) at STP	**c.** mol $\times \frac{32.0\ \text{g}}{\text{mol}}$
________ **18.** grams Sn $\rightarrow$ molecules Sn	**d.** molecules $\times \frac{\text{mol}}{6.02 \times 10^{23}\text{molecules}} \times \frac{22.4\ \text{L}}{\text{mol}}$
________ **19.** molecules $H_2O \rightarrow$ grams H_2O	**e.** grams $\times \frac{\text{mol}}{119\ \text{g}} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{\text{mol}}$

Part D Questions and Problems

Answer the following questions in the space provided.

20. How many liters of carbon monoxide (at STP) are needed to react with 4.8 g of oxygen gas to produce carbon dioxide?

$$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$$

21. What mass of ammonia, NH_3, is necessary to react with 2.1×10^{24} molecules of oxygen in the following reaction?

$$4NH_3(g) + 7O_2(g) \rightarrow 6H_2O(g) + 4NO_2(g)$$