Stoichiometry

Unit 8

Practice Free Response 1

Directions: The suggested time is about 15 minutes for answering the constructed response section of the chemistry test. The parts within a question may not have equal weight. For calculations, show all your work in the spaces provided after each part. Pay particular attention to the proper use of units. Be sure your final answer is rounded to the correct number of significant figures. Make sure your work is legible. Illegible work will receive a grade of zero.

Question 1 [10 POINTS]

In order to generate hydrogen gas for a combustion reaction, a student places a 2.00 g piece of magnesium metal in an Erlenmeyer flask with a concentrated hydrochloric acid, HCl, solution. After 20 minutes, only a colorless solution remains in the flask.

A. Write the balanced chemical equation that describes the reaction of magnesium with hydrochloric acid, HCl. **[3 POINTS]**

$Mg(s) + 2HCl(aq) \rightarrow H_2(g) + MgCl_2(aq)$

B. Which reactant was the limiting reactant? Justify your response. **[2 POINTS]**

Mg was limiting. There was no metal left over at the end of the reaction, it must have all been used up.

C. Calculate the theoretical number of moles of hydrochloric acid that reacted. *You **must** show a numerical setup using dimensional analysis to receive credit.* **[2 POINTS]**

$$2.00\text{ g Mg} \times \frac{1\text{ mol Mg}}{24.30\text{ g Mg}} \times \frac{2\text{ mol HCl}}{1\text{ mol Mg}} = \boxed{0.165\text{ mol HCl}}$$

The student ignites all of the hydrogen gas generated by combusting it with excess oxygen gas to form water vapor according to the unbalanced chemical equation below.

$$\underline{2}\,H_2(g) + \underline{1}\,O_2(g) \rightarrow \underline{2}\,H_2O(g)$$

D. Balance the equation by placing the appropriate coefficients in the spaces above. **[1 POINT]**

E. Calculate the theoretical number of grams of water vapor that was produced. *You **must** show a numerical setup using dimensional analysis to receive credit.* **[2 POINTS]**

$$2.00\text{ g Mg} \times \frac{1\text{ mol Mg}}{24.30\text{ g Mg}} \times \frac{1\text{ mol } H_2}{1\text{ mol Mg}} = 0.0823045\text{ mol } H_2$$

produced in first rxn

$$0.0823045\text{ mol } H_2 \times \frac{2\text{ mol } H_2O}{2\text{ mol } H_2} \times \frac{18.016\text{ g } H_2O}{1\text{ mol } H_2O}$$

$$= \boxed{1.48\text{ g } H_2O}$$