

## Chemical Quantities Unit Test Review

1. ✓ Let  $x$  represent the amount of H-1  
 ✓ Let  $1-x$  " H-2

$$15 \quad \text{avg. atomic mass} = (\text{amount H-1})(\text{mass H-1}) + (\text{amount H-2})(\text{mass H-2})$$

$$1.01 = x(1.0) + (1-x)(2)$$

$$1.01 = x + 2 - 2x$$

$$\checkmark x = 0.99$$

∴ the isotopic abundance of hydrogen  
is 99% H-1 and 1% H-2 ✓

2. ✓ Assume a 1 mol sample.

$$\begin{aligned} \% \text{H} &= \frac{m_{\text{H}}}{m_{\text{H}_2\text{SO}_4}} \times 100 & \% \text{S} &= \frac{m_{\text{S}}}{m_{\text{H}_2\text{SO}_4}} \times 100 & \% \text{O} &= \frac{m_{\text{O}}}{m_{\text{H}_2\text{SO}_4}} \times 100 \\ &= \frac{2.02}{98.09} \times 100 & &= \frac{32.07}{98.09} \times 100 & &= \frac{64}{98.09} \times 100 \\ \checkmark &= 2.06\% & \checkmark &= 32.69\% & \checkmark &= 65.25\% \end{aligned}$$

∴ percent composition of  $\text{H}_2\text{SO}_4$  is 2.06% H, 32.69% S, 65.25% O

3. ✓ Assume a 100 g sample.

$$m_{\text{C}} = 75 \text{ g} \quad m_{\text{H}} = 5.05 \text{ g} \quad m_{\text{O}} = 20.0 \text{ g}$$

$$\begin{aligned} n_{\text{C}} &= \frac{m}{M} & n_{\text{H}} &= \frac{m}{M} & n_{\text{O}} &= \frac{m}{M} \\ &= \frac{75 \text{ g}}{12.01 \text{ g/mol}} & &= \frac{5.05 \text{ g}}{1.01 \text{ g/mol}} & &= \frac{20.0 \text{ g}}{16.0 \text{ g/mol}} \end{aligned}$$

$$\checkmark = \frac{6.245 \text{ mol}}{1.25} : = \frac{5}{1.25} : = \frac{1.25}{1.25}$$

$$\checkmark = 5 \quad \text{H} \quad 1$$

∴ the EF is  $\text{C}_5\text{H}_4\text{O}$     EFM = 80.09 g/mol

$$\text{multiple} = \frac{\text{EFM}}{\text{EFM}}$$

$$= \frac{240.28 \text{ g/mol}}{80.09 \text{ g/mol}}$$

$$\checkmark = 3$$

∴ the MF is  $\text{C}_{15}\text{H}_{12}\text{O}_3$ .

$$4. \quad m_{\text{Ba}(\text{OH})_2} = 27.2 \text{ g} \quad m_{\text{H}_2\text{O}} = 50 - 27.2 \\ = 22.8 \text{ g}$$

$$\checkmark n_{\text{Ba}(\text{OH})_2} = \frac{m}{M} \quad n_{\text{H}_2\text{O}} = \frac{m}{M}$$

$$= \frac{27.2 \text{ g}}{171.35 \text{ g/mol}} \quad = \frac{22.8 \text{ g}}{18.02 \text{ g/mol}}$$

$$= 0.1587 \text{ mol Ba(OH)}_2 : \quad = \frac{1.2653 \text{ mol H}_2\text{O}}{0.1587}$$

✓ 1 : 8 ✓

∴ the hydrate is  $\text{Ba}(\text{OH})_2 \cdot 8 \text{ H}_2\text{O}$

$$5. \quad \checkmark \text{Zn(s)} + 2 \text{HCl(g)} \rightarrow \text{ZnCl}_2(\text{s}) + \text{H}_2(\text{g})$$

$$3.76 \text{ g} \quad 8.93 \times 10^{23}$$

$$\checkmark n_{\text{Zn}} = \frac{m}{M} \quad n_{\text{HCl}} = \frac{N}{N_A}$$

$$= \frac{3.76 \text{ g}}{65.37 \text{ g/mol}} \quad = \frac{8.93 \times 10^{23}}{6.023 \times 10^{23}}$$

$$= 0.05752 \text{ mol Zn} \quad = 1.4826 \text{ mol HCl}$$

$$\frac{1 \text{ mol Zn}}{0.05752} = \frac{1 \text{ mol ZnCl}_2}{x} \quad \frac{2 \text{ mol HCl}}{1.4826} = \frac{1 \text{ mol ZnCl}_2}{x}$$

$$\checkmark x = 0.05752 \text{ mol ZnCl}_2 \quad \checkmark 2x = 1.4826$$

$$x = 0.74132 \text{ mol ZnCl}_2$$

∴ HCl is present in excess.

$$6. \quad \text{HBrO}_3(\text{aq}) + 5 \text{HBr(aq)} \rightarrow 3 \text{H}_2\text{O(l)} + 3 \text{Br}_2(\text{aq})$$

$$20 \text{ g} \quad 47.3 \text{ g}$$

$$\checkmark n_{\text{HBrO}_3} = \frac{m}{M}$$

$$= \frac{20}{128.914} \checkmark$$

$$\checkmark = 0.1551 \text{ mol HBrO}_3$$

$$\frac{1 \text{ mol HBrO}_3}{0.1551 \text{ mol}} = \frac{3 \text{ mol Br}_2}{x}$$

$$\checkmark x = 0.4654 \text{ mol Br}_2$$

$$\left. \begin{aligned} m &= n M \\ &= (0.4654)(159.81) \\ &= 74.37 \text{ g of Br}_2 \\ \% Y &= \frac{AY}{TY} \times 100 \\ &= \frac{47.3 \text{ g}}{74.37 \text{ g}} \times 100 \\ &= 63.60\% \text{ yield} \end{aligned} \right\}$$

∴ 47.3 g of  $\text{Br}_2$  represents a 63.60% yield.