

KEY

CHEMISTRY UNIT 3 Review

1. Dissolving P_4O_{10} in water produces phosphoric acid (H_3PO_4). What mass of phosphoric acid is produced from 552 g of water? $P_4O_{10} + 6 H_2O \rightarrow 4 H_3PO_4$

$$5.52g H_2O \left(\frac{1 \text{ mol } H_2O}{18.02g H_2O} \right) \left(\frac{4 \text{ mol } H_3PO_4}{6 \text{ mol } H_2O} \right) \left(\frac{98.00g H_3PO_4}{1 \text{ mol } H_3PO_4} \right) = 20.0g H_3PO_4$$

2. 23.0 ~~liters~~^{grams} of hydrochloric acid (HCl) reacts with zinc to form hydrogen gas and zinc chloride ($ZnCl_2$). How many liters of hydrogen gas will be produced at STP?

$$23.0g HCl \left(\frac{1 \text{ mol } HCl}{36.46g HCl} \right) \left(\frac{1 \text{ mol } H_2}{2 \text{ mol } HCl} \right) \left(\frac{22.4L H_2}{1 \text{ mol } H_2} \right) = 7.07 L H_2(g)$$

$2HCl + Zn \rightarrow H_2 + ZnCl_2$

3. 10.0 grams of an aqueous zinc chloride reacts with a sodium sulfide solution in a double replacement reaction. Write and balance this equation and then calculate the molecules of sodium chloride produced. $ZnCl_{2(aq)} + Na_2S_{(aq)} \rightarrow ZnS + 2NaCl$

$$10.0g ZnCl_2 \left(\frac{1 \text{ mol } ZnCl_2}{136.29g ZnCl_2} \right) \left(\frac{2 \text{ mol } NaCl}{1 \text{ mol } ZnCl_2} \right) \left(\frac{6.022 \times 10^{23} \text{ NaCl molecules}}{1 \text{ mol } NaCl} \right) = 8.84 \times 10^{22} \text{ NaCl molecules}$$

4. Complete and balance the following reactions

A.) Aluminum nitrate reacts with copper (I) sulfate in a double replacement reaction.



B.) Zinc reacts with silver phosphate in a single replacement reaction.



5. Find the empirical formula for a compound that contains 48.6% carbon, 43.2% oxygen, and 8.11% hydrogen.

$$48.6g C \left(\frac{1 \text{ mol } C}{12.01g} \right) = \frac{4.05 \text{ mol } C}{2.7} \quad 43.2g O \left(\frac{1 \text{ mol } O}{16.00g} \right) = \frac{2.7 \text{ mol } O}{2.7} \quad 8.11g H \left(\frac{1 \text{ mol } H}{1.01g} \right) = \frac{8.03 \text{ mol } H}{2.7}$$

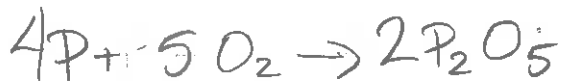
$$(C_{1.5}O_1H_{2.97}) \times 2 = \boxed{C_3O_2H_6}$$

6. The molecular mass of the compound in #5 is 222.0 g/mol. What is the molecular formula for the compound?

$$C_3O_2H_6 \rightarrow m.m. = 74.09g/mol \quad \frac{222.0g/mol}{74.09g/mol} = 3$$



$$P_2O_5 = 141.94 \text{ g/mol}$$



7. Phosphorus, when reacted with oxygen gas in a synthesis reaction yields diphosphorus pentoxide. If the reaction is begun with 205 grams of phosphorus and 12.6 L of oxygen gas, how much product can be made? How much of the excess reactant is remaining at the end of the reaction? (use either grams or liters depending on which reactant is in excess)

$$205 \text{ g P} \left(\frac{1 \text{ mol P}}{30.97 \text{ g}} \right) \left(\frac{2 \text{ mol } P_2O_5}{4 \text{ mol P}} \right) \left(\frac{141.94 \text{ g}}{1 \text{ mol } P_2O_5} \right) = 470. \text{ g } P_2O_5$$

$$12.6 \text{ L } O_2 \left(\frac{1 \text{ mol } O_2}{22.4 \text{ L } O_2} \right) \left(\frac{2 \text{ mol } P_2O_5}{5 \text{ mol } O_2} \right) \left(\frac{141.94 \text{ g}}{1 \text{ mol } P_2O_5} \right) = 31.9 \text{ g } P_2O_5$$

O_2 is L.R.

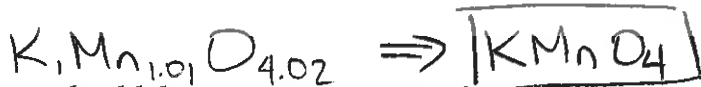
$$12.6 \text{ L } O_2 \left(\frac{1 \text{ mol } O_2}{22.4 \text{ L } O_2} \right) \left(\frac{4 \text{ mol P}}{5 \text{ mol } O_2} \right) \left(\frac{30.97 \text{ g}}{1 \text{ mol P}} \right) = 13.9 \text{ g P}$$

$$205 \text{ g P} - 13.9 \text{ g P} = 191 \text{ g P}$$

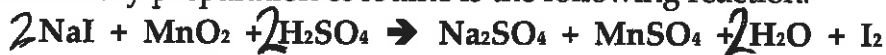
$$\Rightarrow 191 \text{ g P left}$$

8. Find the empirical formula for the compound that has: K = 24.6%, Mn = 34.8%, O = 40.6%

$$24.6 \text{ g K} \left(\frac{1 \text{ mol K}}{39.10 \text{ g}} \right) = \frac{0.629 \text{ mol K}}{0.629} \quad 34.8 \text{ g Mn} \left(\frac{1 \text{ mol Mn}}{54.94 \text{ g}} \right) = \frac{0.633 \text{ mol Mn}}{0.629} \quad 40.4 \text{ g O} \left(\frac{1 \text{ mol O}}{16.00 \text{ g}} \right) = \frac{2.53 \text{ mol O}}{0.629}$$



9. A standard laboratory preparation of iodine is the following reaction:



When 62.55 g of NaI are used with excess amounts of the other reactants, the actual yield of iodine (I_2) was 39.78 g. What is the percent yield?

$$62.55 \text{ g NaI} \left(\frac{1 \text{ mol NaI}}{149.89 \text{ g}} \right) \left(\frac{1 \text{ mol } I_2}{2 \text{ mol NaI}} \right) \left(\frac{253.8 \text{ g } I_2}{1 \text{ mol } I_2} \right) = 52.96 \text{ g } I_2$$

$$\frac{39.78 \text{ g}}{52.96 \text{ g}} (100) = 75.11\% \text{ yield}$$

10. Coal gasification is a process that converts coal into methane gas. If this reaction has a percent yield of 85.0%, how much methane can be obtained from 1250 g of carbon?



$$1250 \text{ g C} \left(\frac{1 \text{ mol C}}{12.01 \text{ g}} \right) \left(\frac{1 \text{ mol } CH_4}{2 \text{ mol C}} \right) \left(\frac{16.05 \text{ g } CH_4}{1 \text{ mol } CH_4} \right) = 32.1 \text{ g } CH_4$$

theoretical

$$32.1 \text{ g} (85.0\%) = \left(\frac{\text{actual}}{32.1 \text{ g}} \right) 32.1 \text{ g}$$

$$\text{actual yield} = 27.3 \text{ g } CH_4$$