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Unit 6 Review: Honors

Chemical Reactions and Stoichiometry

I. States of Matter

1. What are the three states of matter? For each state, say whether it is compressible, or if the state will fill the container?
   solid- not compressible, won't fill container
   liquid- not compressible, will fill container
   gas - compressible, will fill container

II. Chemical and Physical Changes:

1. Is each of the following a PHYSICAL or CHEMICAL change? Explain your reasoning with evidence.
   a. P Paper is torn shape Δ
   b. C Fireworks burst color Δ
   c. P Cocoa powder dissolves in milk dissolves
   d. C when iron and sulfur are heated, and black solid forms that's not magnetic
   new product formed w/ different magnetic properties.

III. Reaction Types:

1. Classify the reaction, predict the products, and balanced the chemical equation.
   a. Aluminum combines with nitrogen

   $2Al + N_2 \longrightarrow 2AlN$ SYNTHESIS

   b. Chloric acid reacts with barium hydroxide

   HOH

   $2HClO_3 + Ba(OH)_2 \longrightarrow 2H_2O + Ba(ClO_3)_2$ NEUTRALIZATION

   c. Bromine reacts with potassium iodide

   $Br_2 + 2KI \longrightarrow I_2 + 2KBr$ HALOGEN S.R.

   d. Aluminum chloride reacts with sodium phosphate

   $AlCl_3 + Na_3PO_4 \longrightarrow 3NaCl + AlPO_4$ D.R.

IV. Mole Ratios

1. Use the following balanced chemical equation to answer the following questions.

   $$C_5H_{12} + 8O_2 \rightarrow 6H_2O + 5CO_2$$

   a. If 0.20 mol of C_5H_{12} reacts, determine the moles of O_2 reacting

   $$0.20 \text{ mol } C_5H_{12} \times \frac{8 \text{ mol } O_2}{1 \text{ mol } C_5H_{12}} = 1.6 \text{ mol } O_2$$

   b. If 4.8 mol of O_2 reacts, determine the moles of H_2O produced

   $$4.8 \text{ mol } O_2 \times \frac{6 \text{ mol } H_2O}{8 \text{ mol } O_2} = 3.6 \text{ mol } H_2O$$

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c. If 30 mol of H_2O is produced, determine the moles of CO_2 produced

$$30 \text{ mol } H_2O \times \frac{5 \text{ mol } CO_2}{6 \text{ mol } H_2O} = 25 \text{ mol } CO_2$$

d. If 0. 015 mol of CO_2 is produced, determine the moles of C_5H_{12} reacting

$$0.015 \text{ mol } CO_2 \times \frac{1 \text{ mol } C_5H_{12}}{5 \text{ mol } CO_2} = 0.0030 \text{ mol } C_5H_{12}$$

2. Calcium iodide is reacted with sodium. Write a balanced chemical equation for this reaction, and then answer the following questions.

metallic S.R

$$\_CaI_2 + \underline{2} Na \longrightarrow \_Ca + \underline{2} NaI$$

a. If 2.2 mol of calcium iodide reacts, determine the moles of sodium reacting and the moles of each product.

$$2.2 \text{ mol } CaI_2 \times \frac{2 \text{ mol } Na}{1 \text{ mol } CaI_2} = 4.4 \text{ mol } Na$$

$$2.2 \text{ mol } CaI_2 \times \frac{1 \text{ mol } Ca}{1 \text{ mol } CaI_2} = 2.2 \text{ mol } Ca$$

$$2.2 \text{ mol } CaI_2 \times \frac{2 \text{ mol } NaI}{1 \text{ mol } CaI_2} = 4.4 \text{ mol } NaI$$

b. If 0.016 mol of sodium reacts, determine the moles of calcium iodide reacting and the moles of each product.

$$0.016 \text{ mol } Na \times \frac{1 \text{ mol } CaI_2}{2 \text{ mol } Na} = 0.0080 \text{ mol } CaI_2$$

$$0.016 \text{ mol } Na \times \frac{1 \text{ mol } Ca}{2 \text{ mol } Na} = 0.0080 \text{ mol } Ca$$

$$0.016 \text{ mol } Na \times \frac{2 \text{ mol } NaI}{2 \text{ mol } Na} = 0.016 \text{ mol } NaI$$

V. Mass-Mass stoichiometry

1. Antimony and iodine can be combined to form antimony triiodide. If 60.09 g of antimony are present, what mass of iodine will be required in the reaction? What mass of antimony triiodide will be predouced?

$$\underline{2} Sb + \underline{3} I_2 \longrightarrow \underline{2} SbI_3$$

SYNTHESIS

$$60.09 \text{ g } Sb \times \frac{1 \text{ mol } Sb}{121.8 \text{ g } Sb} \times \frac{3 \text{ mol } I_2}{2 \text{ mol } Sb} \times \frac{253.8 \text{ g } I_2}{1 \text{ mol } I_2} = 187.8 \text{ g } I_2$$

$$60.09 \text{ g } Sb \times \frac{1 \text{ mol } Sb}{121.8 \text{ g } Sb} \times \frac{2 \text{ mol } SbI_3}{2 \text{ mol } Sb} \times \frac{502.5 \text{ g } SbI_3}{1 \text{ mol } SbI_3} = 247.9 \text{ g } SbI_3$$

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$\_ SrCl_2 + \_ Na_2C_2O_4 \longrightarrow \underline{2} NaCl + \_ SrC_2O_4$ D.R.

2. Strontium chloride reacts with sodium oxalate to produce strontium oxalate and sodium chloride. Write a balanced chemical equation for this reaction. If 3.20 g of strontium chloride are present, determine the mass of sodium oxalate required in the reaction. What mass of strontium oxalate and sodium chloride will be produced?

$$3.20\,g\ SrCl_2 \times \frac{1\ mol\ SrCl_2}{158.52\,g\ SrCl_2} \times \frac{1\ mol\ Na_2C_2O_4}{1\ mol\ SrCl_2} \times \frac{134\ g\ Na_2C_2O_4}{1\ mol\ Na_2C_2O_4} = 2.71\ g\ Na_2C_2O_4$$

$$'' \quad '' \times \frac{2\ mol\ NaCl}{1\ mol\ SrCl_2} \times \frac{58.44\ g\ NaCl}{1\ mol\ NaCl} = 2.36\ g\ NaCl$$

$$'' \quad '' \times \frac{1\ mol\ SrC_2O_4}{1\ mol\ SrCl_2} \times \frac{175.64\ g\ SrC_2O_4}{1\ mol\ SrC_2O_4} = 3.55\ g\ SrC_2O_4$$

VI. Percent Yield

1. Silver nitrate is reacted with sodium sulfate. Write a balanced chemical equation for this reaction.

$\underline{2} AgNO_3 + \_ Na_2SO_4 \rightarrow \underline{2} NaNO_3 + \_ Ag_2SO_4$ D.R.

a. If 98.6 g of silver nitrate react with a percent yield of 75.5 %, what mass would actually be obtained for each of the products?

$$98.6\,g\ AgNO_3 \times \frac{1\ mol\ AgNO_3}{169.91\,g\ AgNO_3} \times \frac{2\ mol\ NaNO_3}{2\ mol\ AgNO_3} \times \frac{85\ g\ NaNO_3}{1\ mol\ NaNO_3} = 49.3 \times 0.755 = 37.2\,g\ NaNO_3$$

$$'' \quad '' \times \frac{1\ mol\ Ag_2SO_4}{2\ mol\ AgNO_3} \times \frac{311.86\,g\ Ag_2SO_4}{1\ mol\ Ag_2SO_4} = 90.5 \times 0.755 = 68.3\,g\ Ag_2SO_4$$

b. If 30.0 g of sodium sulfate yields 25.0 g of sodium nitrate, determine the percent yield of the reaction. What mass of silver sulfate will actually be obtained?

$$30.0\,g\ Na_2SO_4 \times \frac{1\ mol\ Na_2SO_4}{142.04\,g\ Na_2SO_4} \times \frac{2\ mol\ NaNO_3}{1\ mol\ Na_2SO_4} \times \frac{85\ g\ NaNO_3}{1\ mol\ NaNO_3} = 35.9\,g\ NaNO_3 \text{ (theoretical)}$$

$$\frac{25.0\,g\ NaNO_3}{35.9\,g\ NaNO_3} \times 100 = 69.6\%$$

$$25.0\,g\ NaNO_3 \times \frac{1\ mol\ NaNO_3}{85\,g\ NaNO_3} \times \frac{1\ mol\ Ag_2SO_4}{2\ mol\ NaNO_3} \times \frac{311.86\,g\ Ag_2SO_4}{1\ mol\ Ag_2SO_4} = 45.9\,g\ Ag_2SO_4$$

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VII. Limiting and Excess Reactants

1. Iron (III) iodide reacts with bromine. Write a balanced chemical equation for this reaction.
   a. If 218 g of iron (III) iodide reacts with 90.0 g of bromine, which reactant is limiting and which is in excess?
   b. What is the mass of each of the products?
   c. What mass of the excess reactant is used in the reaction, and what mass of the excess reactant remains after the reaction?
   d. If the reaction has a percent yield of 92.5 % for iodide, determine the actual yield of iodide. What mass of iron (III) bromide would actually be obtained?

$2 FeI_3 + 3 Br_2 \rightarrow 3 I_2 + 2 FeBr_3$ — Halogen single rep.

$218 g\ FeI_3 \times \frac{1 mol\ FeI_3}{436.55 g\ FeI_3} \times \frac{3 mol\ I_2}{2 mol\ FeI_3} \times \frac{253.8 g\ I_2}{1 mol\ I_2} = 191 g\ I_2$

$90.0 g\ Br_2 \times \frac{1 mol\ Br_2}{159.82 g\ Br_2} \times \frac{3 mol\ I_2}{3 mol\ Br_2} \times \frac{253.8 g\ I_2}{1 mol\ I_2} = 143 g\ I_2$ (b) theoretical yield

Limiting Reagent = Br_2 (a)
excess reactant = FeI_3

$90.0 g\ Br_2 \times \frac{1 mol\ Br_2}{159.82 g\ Br_2} \times \frac{2 mol\ FeBr_3}{3 mol\ Br_2} \times \frac{295.58 g\ FeBr_3}{1 mol\ FeBr_3} = 111 g\ FeBr_3$ (b) theoretical yield

(c) $90.0 g\ Br_2 \times \frac{1 mol\ Br_2}{159.82 g\ Br_2} \times \frac{2 mol\ FeI_3}{3 mol\ Br_2} \times \frac{436.55 g\ FeI_3}{1 mol\ FeI_3} = 164 g\ FeI_3$ of excess used

$218 g - 164 g = 54 g$ of excess left over.

(d) $0.925 = \frac{actual}{143 g}$

actual = 132 g I_2

$132 g\ I_2 \times \frac{1 mol\ I_2}{253.8 g\ I_2} \times \frac{2 mol\ FeBr_3}{3 mol\ I_2} \times \frac{295.58 g\ FeBr_3}{1 mol\ FeBr_3}$

= 102 g $FeBr_3$ actually produced