KEY

Limiting Reagent

Name - _____

1a.) What mass of CS_2 is produced when $17.5\ g$ of C are reacted with $39.5\ g$ of SO_2 according to the equation? $5\ C + 2\ SO_2 \rightarrow CS_2 + 4\ CO$

Answer - $17.5\ g\ C \times \frac{1\ mol\ C}{12.01\ g\ C} \times \frac{1\ mol\ CS_2}{5\ mol\ C} \times \frac{76.13\ g\ CS_2}{1\ mol\ CS_2} = 22.18609\ g\ CS_2$

Limiting reagent

$39.5\ g\ SO_2 \times \frac{1\ mol\ SO_2}{64.06\ g\ SO_2} \times \frac{1\ mol\ CS_2}{2\ mol\ SO_2} \times \frac{76.13\ g\ CS_2}{1\ mol\ CS_2} = 23.471237\ g\ CS_2$

Excess reagent

$Product = 22.2\ g\ CS_2$

b.) What mass of the excess reactant will be left over?

Answer - $17.5\ g\ C \times \frac{1\ mol\ C}{12.01\ g\ C} \times \frac{2\ mol\ SO_2}{5\ mol\ C} \times \frac{64.06\ g\ SO_2}{1\ mol\ SO_2} = 37.33721898\ g\ SO_2$

$39.5 - 37.33721898 = 2.2\ g\ SO_2\ excess$

2a.) What mass of NO is produced when $87.0\ g$ of Cu are reacted with $225\ g$ of HNO_3?

The reaction is as follows. $3\ Cu + 8\ HNO_3 \rightarrow 3\ Cu(NO_3)_2 + 2\ NO + 4\ H_2O$

Answer - $225\ g\ HNO_3 \times \frac{1\ mol\ HNO_3}{63.02\ g\ HNO_3} \times \frac{2\ mol\ NO}{8\ mol\ HNO_3} \times \frac{30.01\ g\ NO}{1\ mol\ NO} = 26.78613932\ g\ NO$

Limiting reagent

$87.0\ g\ Cu \times \frac{1\ mol\ Cu}{63.55\ g\ Cu} \times \frac{2\ mol\ NO}{3\ mol\ Cu} \times \frac{30.01\ g\ NO}{1\ mol\ NO} = 27.389142\ g\ NO$

Excess reagent

$Product = 26.8\ g\ NO$

b.) What mass of the excess reactant will be left over?

Answer - $225\ g\ HNO_3 \times \frac{1\ mol\ HNO_3}{63.02\ g\ HNO_3} \times \frac{3\ mol\ Cu}{8\ mol\ HNO_3} \times \frac{63.55\ g\ Cu}{1\ mol\ Cu} = 85.08459616\ g\ Cu$

$87.0 - 85.08459616 = 1.9\ g\ Cu\ exces$

KEY

3a.) What mass of P_4 is produced when $41.5\ g$ of $Ca_3(PO_4)_2$, $26.5\ g$ of SiO_2 and $7.80\ g$ of C are reacted according to the following equation. $2\ Ca_3(PO_4)_2 + 6\ SiO_2 + 10\ C \rightarrow P_4 + 6\ CaSiO_3 + 10\ CO$

Answer -

$$41.5\ g\ Ca_3(PO_4)_2 \times \frac{1\ mol\ Ca_3(PO_4)_2}{310.18\ g\ Ca_3(PO_4)_2} \times \frac{1\ mol\ P_4}{2\ mol\ C} \times \frac{123.88\ g\ P_4}{1\ mol\ P_4} = 8.287155\ g\ P_4$$

Excess reagent

$$26.5\ g\ SiO_2 \times \frac{1\ mol\ SiO_2}{60.09\ g\ SiO_2} \times \frac{1\ mol\ P_4}{6\ mol\ C} \times \frac{123.88\ g\ P_4}{1\ mol\ P_4} = 9.105286\ g\ P_4$$

Excess reagent

$$7.80 g\ C \times \frac{1\ mol\ C}{12.01\ g\ C} \times \frac{1\ mol\ P_4}{10\ mol\ C} \times \frac{123.88\ g\ P_4}{1\ mol\ P_4} = 8.04549542\ g\ P_4$$

Limiting reagent

$$\underline{Product = 8.05\ g\ P4}$$

b.) How many grams of each excess reactant will remain unreacted?

Answer -

$$7.80 g\ C \times \frac{1\ mol\ C}{12.01\ g\ C} \times \frac{2\ mol\ Ca_3(PO_4)_2}{10\ mol\ C} \times \frac{310.18\ g\ Ca_3(PO_4)_2}{1\ mol\ Ca_3(PO_4)_2} = 40.28982515\ g\ Ca_3(PO_4)_2$$

$$7.80 g\ C \times \frac{1\ mol\ C}{12.01\ g\ C} \times \frac{6\ mol\ SiO_2}{10\ mol\ C} \times \frac{60.09\ g\ SiO_2}{1\ mol\ SiO_2} = 23.41558701\ g\ SiO_2$$

$$41.5 - 40.28982515 = \underline{1.21\ g\ Ca_3(PO_4)_2\ excess}$$

$$26.5 - 23.41558701 = \underline{3.08\ g\ SiO_2\ excess}$$

4a.) What mass of Br_2 is produced when $25.0\ g$ of $K_2Cr_2O_7$, $55.0\ g$ of KBr and $60.0\ g$ of H_2SO_4 are reacted.

$$K_2Cr_2O_7 + 6\ KBr + 7\ H_2SO_4 \rightarrow 4\ K_2SO_4 + Cr_2(SO_4)_3 + Br_2 + 7\ H_2O$$

Answer -

$$25.0\ g\ K_2Cr_2O_7 \times \frac{1\ mol\ K_2Cr_2O_7}{294.20\ g\ K_2Cr_2O_7} \times \frac{1\ mol\ Br_2}{1\ mol\ K_2Cr_2O_7} \times \frac{159.80\ g\ Br_2}{1\ mol\ Br_2} = 13.579197\ g\ Br_2$$

$$55.0\ g\ KBr \times \frac{1\ mol\ KBr}{119.00\ g\ KBr} \times \frac{1\ mol\ Br_2}{6\ mol\ KBr} \times \frac{159.80\ g\ Br_2}{1\ mol\ Br_2} = 12.30952381\ g\ Br_2$$

Limiting reagent

$$60.0\ g\ H_2SO_4 \times \frac{1\ mol\ H_2SO_4}{98.08\ g\ H_2SO_4} \times \frac{1\ mol\ Br_2}{7\ mol\ H_2SO_4} \times \frac{159.80\ g\ Br_2}{1\ mol\ Br_2} = 13.965276\ g\ Br_2$$

$$\underline{Product = 12.3\ g\ Br_2}$$

b.) How many grams of each excess reactant will remain unreacted?

Answer -

$$55.0\ g\ KBr \times \frac{1\ mol\ KBr}{119.00\ g\ KBr} \times \frac{1\ mol K_2Cr_2O_7}{6\ mol\ KBr} \times \frac{294.20\ g\ K_2Cr_2O_7}{1\ mol\ K_2Cr_2O_7} = 22.66246499\ g\ K_2Cr_2O_7$$

$$55.0\ g\ KBr \times \frac{1\ mol\ KBr}{119.00\ g\ KBr} \times \frac{1\ mol\ Br_2}{6\ mol\ KBr} \times \frac{159.80\ g\ Br_2}{1\ mol\ Br_2} = 12.30952381\ g\ Br_2$$

$$25.0 - 22.66246499 = \underline{2.3\ g\ K_2Cr_2O_7\ excess}$$

KEY

$$60.0 - 52.88627451 = \underline{7.1\ g\ H_2SO_4 excess}$$

5.) What volume of $CO_{2\ (g)}$ at STP can be made when $0.0250\ L$ of $C_5H_{12\ (l)}$ ($density = 626.0 \frac{g}{L}$), is reacted with $40.0\ L$ of $O_{2\ (g)}$ at STP in the following equation.

$$C_5H_{12\ (l)} + 8\ O_{2\ (g)} \rightarrow 5\ CO_{2\ (g)} + 6\ H_2O_{(l)}$$

Answer – $0.0250\ L\ C_5H_{12} \times \frac{626.0\ g\ C_5H_{12}}{1\ L\ C_5H_{12}} \times \frac{1\ mol\ C_5H_{12}}{72.17\ g\ C_5H_{12}} \times \frac{5\ mol\ CO_2}{1\ mol\ C_5H_{12}} \times \frac{22.41\ L\ CO_2}{1\ mol\ CO_2} = 24.297942\ L\ CO_2$

$$40.0\ L\ O_2 \times \frac{1\ mol\ O_2}{22.41\ L\ O_2} \times \frac{5\ mol\ CO_2}{8\ mol\ O_2} \times \frac{22.41\ L\ CO_2}{1\ mol\ CO_2} = 25.0\ L\ CO_2$$

$$\underline{Product = 24.3\ L\ CO_2}$$

6.) If $50.0\ mL$ of $0.100\ M$ HCl is allowed to react with $30.0\ mL$ of $0.200\ M$ NaOH, which is the reactant in ***excess?***

Answer – $HCl_{(aq)} + NaOH_{(aq)} \rightarrow H_2O_{(l)} + NaCl_{(aq)}$

Moles of NaCl (Based on HCl) $0.050\ L\ HCl \times \frac{0.100\ mol\ HCl}{1\ L\ HCl} \times \frac{1\ mol\ NaCl}{1\ mol\ HCl} = 5.00 \times 10^{-3}\ mol\ NaCl$

Moles of NaCl (Based on NaOH) $0.030\ L\ NaOH \times \frac{0.200\ mol\ NaOH}{1\ L\ NaOH} \times \frac{1\ mol\ NaCl}{1\ mol\ NaOH} = 6.00 \times 10^{-3}\ mol\ NaCl$

Since NaOH makes more NaCl, the NaOH is in EXCESS

7.) If $0.250\ g$ of $Ba(OH)_2$ is mixed with $15.0\ mL$ of $0.125\ M\ HBr$, what mass of $BaBr_2$ can be formed?

Answer – $Ba(OH)_2 + 2\ HBr \rightarrow BaBr_2 + 2\ HOH$

$$0.250\ g\ Ba(OH)_2 \times \frac{1\ mol\ Ba(OH)_2}{171.32\ g\ Ba(OH)_2} \times \frac{1\ mol\ BaBr_2}{1\ mol\ Ba(OH)_2} \times \frac{297.1\ g\ BaBr_2}{1\ mol\ BaBr_2} = 0.4335454\ g\ BaBr_2$$

$$0.0150\ L\ HBr \times \frac{0.125\ mol\ HBr}{1\ L\ HBr} \times \frac{1\ mol\ BaBr_2}{2\ mol\ HBr} \times \frac{297.1\ g\ BaBr_2}{1\ mol\ BaBr_2} = 0.27853125\ g\ BaBr_2$$

$$\underline{Product = 0.279\ g\ BaBr_2}$$