KEY

WLHS / Chem / Monson

Name_____
Date_____Per_____

PROBLEM SET: Limiting Reactants

1) Use the following chemical equation: $2\ H_2 + O_2 \rightarrow 2\ H_2O$

A) Balance the equation. ✓

B) Identify the limiting reactant when 1.22 g of O_2 reacts with 1.05 g of H_2 to produce water.

$1.22\text{g } O_2 \times \frac{1\text{mol } O_2}{32.0\text{g}} \times \frac{2\text{mol } H_2O}{1\text{mol } O_2} \times \frac{18.0\text{g}}{1\text{mol } H_2O} = 1.37\text{g } H_2O$

$1.05\text{g } H_2 \times \frac{1\text{mol } H_2}{2.0\text{g}} \times \frac{2\text{mol}}{2\text{mol}} \times \frac{18\text{g}}{1\text{mol } H_2O} = 9.45\text{g } H_2O$

L.R. is O_2

C) What mass of water will be formed in the reaction?

1.37 g H_2O

D) What mass of the excess reagent will be left over / unused?

$1.22\text{g } O_2 \times \frac{1\text{mol } O_2}{32\text{g}} \times \frac{2\text{mol } H_2}{1\text{mol } O_2} \times \frac{2.0\text{g}}{1\text{mol } H_2} = 0.15\text{g } H_2$ react

$1.05 - 0.15 =$ **0.90 g H_2 left over**

2) Use the following chemical equation: $1\ Fe + 1\ S \rightarrow 1\ FeS$

A) Balance the equation.

B) Identify the limiting reactant when 4.68 g of Fe reacts with 2.88 g of S to produce FeS.

$4.68\text{g Fe} \times \frac{1\text{mol Fe}}{55.85\text{g}} \times \frac{1\text{mol FeS}}{1\text{mol Fe}} \times \frac{87.95\text{g}}{1\text{mol FeS}} = 7.37\text{ g FeS}$

$2.88\text{g S} \times \frac{1\text{mol S}}{32.1\text{g}} \times \frac{1\text{mol FeS}}{1\text{mol S}} \times \frac{87.95\text{g}}{1\text{mol FeS}} = 7.89\text{ g FeS}$

and L.R. is Fe

C) What mass of iron (II) sulfide, FeS, will be formed in the reaction?

7.37 g FeS

D) What mass of the excess reagent will be left over / unused?

$4.68\text{g Fe} \times \frac{1\text{mol Fe}}{55.85\text{g}} \times \frac{1\text{mol S}}{1\text{mol Fe}} \times \frac{32.1\text{g}}{1\text{mol S}} = 2.69\text{g S}$ react

amt. left over: $2.88\text{g} - 2.69\text{g} =$ **0.19 g S**

3) Use the following chemical equation: $1\ Mg(OH)_2 + 2\ HCl \rightarrow 1\ MgCl_2 + 2\ H_2O$

L.R. is $Mg(OH)_2$

A) Balance the equation.

B) Identify the limiting reactant when 5.87 g of $Mg(OH)_2$ reacts with 12.84 g of HCl to form $MgCl_2$.

① $5.87\text{g } Mg(OH)_2 \times \frac{1\text{mol}}{58.3\text{g}} \times \frac{1\text{mol}}{1\text{mol}} \times \frac{95.3\text{g}}{1\text{mol } MgCl_2} = 9.60\text{g } MgCl_2$

C) What mass of magnesium chloride, $MgCl_2$, will be formed in the reaction?

OR ② $12.84\text{g HCl} \times \frac{1\text{mol}}{36.5\text{g}} \times \frac{1\text{mol}}{2\text{mol}} \times \frac{95.3\text{g}}{1\text{mol}} = 16.76\text{ g } MgCl_2$

↳ EXCESS!

9.60 g $MgCl_2$

D) What mass of the excess reagent will be left over / unused?

$5.87\text{g } Mg(OH)_2 \times \frac{1\text{mol}}{58.3\text{g}} \times \frac{2\text{mol HCl}}{1\text{mol}} \times \frac{36.5\text{g}}{1\text{mol HCl}} = 7.35\text{g HCl}$ react

So, amt. left over $= 12.84\text{g} - 7.35\text{g} =$ **5.49 g**

Source: Chemistry: Connections to Our Changing World (Prentice-Hall) Ch 11 "Chem Eq'ns" supplement pp. 19-20

4) Use the following chemical equation: 2 SO_2 + O_2 → 2 SO_3

LR

A) Balance the equation.

B) Identify the limiting reactant when 12.4 g of SO_2 reacts with 3.45 g of O_2.

$12.4\,g\,SO_2 \times \frac{1\,mol}{64.1\,g} \times \frac{2\,mol}{2\,mol} \times \frac{80.1\,g}{1\,mol} = 15.50\,g\,SO_3$

$3.45\,g\,O_2 \times \frac{1\,mol}{32\,g} \times \frac{2\,mol}{1\,mol} \times \frac{80.1\,g}{1\,mol} = 17.27\,g\,SO_3$

C) What mass of sulfur trioxide, SO_3, will be formed in the reaction?

15.50 g SO_3

D) What mass of the excess reagent will be left over / unused?

$12.4\,g\,SO_2 \times \frac{1\,mol}{64.1\,g} \times \frac{1\,mol\,O_2}{2\,mol\,SO_2} \times \frac{32\,g}{1\,mol\,O_2} = 3.10\,g\,O_2$, so react

$3.45\,g - 3.10\,g = 0.35\,g\,O_2$ left over

5) Use the following chemical equation: 1 H_2O + 1 SO_3 → 1 H_2SO_4

LR

A) Balance the equation.

B) Identify the limiting reactant when 6.58 g of SO_3 reacts with 1.64 g of H_2O.

$6.58\,g\,SO_3 \times \frac{1\,mol}{80.1\,g} \times \frac{1\,mol}{1\,mol} \times \frac{97.1\,g}{1\,mol} = 7.98\,g\,H_2SO_4$

$1.64\,g\,H_2O \times \frac{1\,mol}{18\,g} \times \frac{1\,mol}{1\,mol} \times \frac{97.1\,g}{1\,mol} = 8.85\,g\,H_2SO_4$

C) What mass of sulfuric acid, H_2SO_4, will be formed in the reaction?

7.98 g H_2SO_4

D) What mass of the excess reagent will be left over / unused?

$6.58\,g\,SO_3 \times \frac{1\,mol}{80.1\,g} \times \frac{1\,mol}{1\,mol} \times \frac{18\,g}{1\,mol} = 1.48\,g\,H_2O$ react, so

$1.64\,g - 1.48\,g = 0.16\,g\,H_2O$ left over

6) Use the following chemical equation: 1 Cd + 1 S → 1 CdS

LR

A) Balance the equation.

B) Identify the limiting reactant when 8.47 g of Cd reacts with 2.51 g of S.

$8.47\,g\,Cd \times \frac{1\,mol}{112.4\,g} \times \frac{1\,mol}{1\,mol} \times \frac{144.5\,g}{1\,mol\,CdS} = 10.89\,g\,CdS$

$2.51\,g\,S \times \frac{1\,mol}{32.1\,g} \times \frac{1\,mol}{1\,mol} \times \frac{144.5\,g}{1\,mol\,CdS} = 11.30\,g\,CdS$

C) What mass of cadmium sulfide, CdS, will be formed in the reaction?

10.89 g CdS

D) What mass of the excess reagent will be left over / unused?

$8.47\,g\,Cd \times \frac{1\,mol}{112.4\,g} \times \frac{1\,mol}{1\,mol} \times \frac{32.1\,g\,S}{1\,mol\,S} = 2.42\,g\,S$ react, so

$2.51\,g - 2.42\,g = 0.09\,g\,S$ left over

Source: Chemistry: Connections to Our Changing World (Prentice-Hall) Ch 11 "Chem Eq'ns" supplement pp. 19-20