Chemistry 11 Stoichiometry Review Worksheet

Name: Key

1. If 25.0 g of hydrogen sulphide reacts with 50.0 g of potassium permanganate to produce potassium sulphate, manganese (IV) oxide and hydrogen gas.

a) Write the balanced chemical equation for this reaction.

$$H_2S + 2KMnO_4 \rightarrow K_2SO_4 + 2MnO_2 + H_2$$

b) Determine which reactant is limiting and which is in excess.

FW H_2S 34.1 u
FW $KMnO_4$ 158.0 u

$25.0\,g\ H_2S \div 34.1\,g/mol = 0.733\,mol$

$50.0\,g\ KMnO_4 \div 158.0\,g/mol = 0.316\,mol$

	H_2S : $KMnO_4$
equation	1 : 2
data	0.733 : 0.316
	2.3 : 1

mole ratio

H_2S IN XS
$KMnO_4$ LR

c) What mass of the excess reactant will be left over at the end of the reaction?

$0.316\,mol\ KMnO_4 \times \frac{1\,mol\ H_2S}{2\,mol\ KMnO_4} = 0.158\,mol\ H_2S$

moles excess = 0.733 mol
− moles needed = 0.158 mol
moles excess = 0.575 mol

mass of excess = $0.575\,mol \times 34.1\,g/mol =$ **19.6 g**

d) What mass of manganese (IV) oxide will be produced?

FW MnO_2 86.9 u

$0.316\,mol\ KMnO_4 \times \frac{2\,mol\ MnO_2}{2\,mol\ KMnO_4} = 0.316\,mol\ MnO_2$

$0.316\,mol \times 86.9\,g/mol =$ **27.5 g**

e) If all the potassium sulphate produced were dissolved in1.5 L of water what would be the concentration of the potassium sulphate solution?

$0.316\,mol\ KMnO_4 \times \frac{1\,mol\ K_2SO_4}{2\,mol\ KMnO_4} = 0.158\,mol\ K_2SO_4$

$[K_2SO_4] = \frac{0.158\,mol}{1.5\,L} =$ **0.11 M**

2. If 9.25 g of zinc are reacted with 100 mL of 1.00 M HCl, then zinc chloride and hydrogen gas are formed.

a) Write a balanced chemical equation for this reaction.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

b) Show which reactant is in excess and which is the limiting factor.

$9.25\,g\ Zn \div 65.4\,g/mol = 0.141\,mol\ Zn$

$0.100\,L \times 1.00\,M\ HCl = 0.100\,mol\ HCl$

Zn : HCl
1 : 2
0.141 : 0.100
1.4 : 1

mole ratio

Zn IN XS
HCl LR

c) Calculate the mass of zinc chloride that should be formed from the limiting factor.

FW $ZnCl_2$ 136.4 u

$0.100\,mol\ HCl \times \frac{1\,mol\ ZnCl_2}{2\,mol\ HCl} = 0.0500\,mol\ ZnCl_2$

$0.0500\,mol\ ZnCl_2 \times 136.4\,g/mol =$ **6.82 g**

d) Calculate the volume of hydrogen gas that should be formed at STP.

$0.100\,mol\ HCl \times \frac{1\,mol\ H_2}{2\,mol\ HCl} = 0.0500\,mol\ H_2$

$0.0500\,mol\ H_2 \times 22.4\,L/mol =$ **1.12 L**

e) What volume of hydrogen gas would be formed if the percentage yield is 89%?

$\frac{x\,L}{1.12\,L} \times 100 = 89\%$ **x = 0.997 L**

Key.

3. Gold dissolves in the acid mixture known as aqua regia according to the following reaction:

$$Au + HNO_3 + 3\ HCl \rightarrow AuCl_3 + NO + 2\ H_2O$$

a) If you had 1.25 mg of gold, what volume of 18 M HNO_3 would you need to react with the gold, assuming excess HCl is available?

1.25×10^{-3} g Au ÷ 197.0 g/mol = 6.35×10^{-6} mol Au

6.35×10^{-6} mol Au × $\frac{1\ mol\ HNO_3}{1\ mol\ Au}$ = 6.35×10^{-6} mol HNO_3

$V = \frac{n}{M} = \frac{6.35 \times 10^{-6}\ mol}{18\ M}$ = $\boxed{3.5 \times 10^{-7}\ L}$

b) How many grams of gold (III) chloride would be produced?

FW $AuCl_3$ 303.5 u

6.35×10^{-6} mol Au × $\frac{1\ mol\ AuCl_3}{1\ mol\ Au}$ = 6.35×10^{-6} mol $AuCl_3$

6.35×10^{-6} mol × 303.5 g/mol = $\boxed{1.93 \times 10^{-3}\ g}$

4. Phosphorus pentachloride decomposes to produce phosphorus trichloride and chlorine gas.

a) Write a balanced chemical equation for this reaction.

$PCl_5 \longrightarrow PCl_3 + Cl_2$

b) If you react 18.5 grams of phosphorus pentachloride, what mass of phosphorus trichloride should be produced?

FW PCl_5 208.5 u

FW PCl_3 137.5 u

18.5 g PCl_5 ÷ 208.5 g/mol = 0.0887 mol PCl_5

0.0887 mol PCl_5 × $\frac{1\ mol\ PCl_3}{1\ mol\ PCl_5}$ = 0.0887 mol PCl_3

0.0887 mol PCl_3 × 137.5 g/mol = $\boxed{12.2\ g\ PCl_3}$

5. Glucose, $C_6H_{12}O_6$, can be converted to ethanol, CH_3CH_2OH, and CO_2 gas by fermentation.

a) Write a balanced chemical equation for the reaction.

$\boxed{C_6H_{12}O_6 \longrightarrow 2CH_3CH_2OH + 2CO_2}$

b) If 1.00 kg of glucose was used, what would be the concentration of the ethanol if 20.0 L of ethanol was produced?

FW $C_6H_{12}O_6$ = 180 u

1.00×10^3 g glucose ÷ 180 g/mol = 5.56 mol glucose

5.56 mol glucose × $\frac{2\ mol\ ethanol}{1\ mol\ glucose}$ = 11.1 mol ethanol

[ethanol] = $\frac{11.1\ mol}{20.0\ L}$ = $\boxed{0.556\ M}$

6. When hydrogen is exposed to a flame, it combusts to form water.

a) Write a balanced chemical equation for this reaction.

$\boxed{2H_2 + O_2 \longrightarrow 2H_2O}$

b) If you had 22.4 mL of hydrogen gas at STP, how many grams of water would be produced?

22.4×10^{-3} L ÷ 22.4 L/mol = 1.00×10^{-3} mol H_2

FW H_2O = 18.0 u

1.00×10^{-3} mol H_2 × $\frac{2\ mol\ H_2O}{2\ mol\ H_2}$ = 1.00×10^{-3} mol H_2O

1.00×10^{-3} mol × 18.0 g/mol = $\boxed{0.0180\ g}$