Higher Chemistry Calculations for the Prelim

1. $2Ag_2O\,(s) \rightarrow 4Ag\,(s) + O_2\,(g)$

Calculate the volume of oxygen that is produced when 46.36 g of silver oxide completely decomposes.

2. $Zn\,(s) + 2HCl\,(aq) \rightarrow ZnCl_2\,(aq) + H_2\,(g)$

Calculate the volume of hydrogen gas that is produced when 6.54 g of zinc is added to excess dilute hydrochloric acid.

3. Calculate which reactant is in excess and therefore identify the limiting reactant in the following.

(a) $Zn\,(s) + H_2SO_4\,(aq) \rightarrow ZnSO_4\,(aq) + H_2\,(g)$

6.54 g of zinc added to 25 cm^3 of dilute sulphuric acid, concentration 2 mol l^{-1}.

(b) $Mg\,(s) + 2HCl\,(aq) \rightarrow MgCl_2\,(aq) + H_2\,(g)$

2.43 g of magnesium added to 100 cm^3 of dilute hydrochloric acid, concentration 1 mol l^{-1}.

4.

Gas syringes are graduated to allow the volume of gases to be measured. A heated box kept a syringe at a temperature greater than 100 ^oC. The syringe contained 150 cm^3 of hydrogen and 50 cm^3 of carbon monoxide mixed with 200 cm^3 of oxygen. When ignited the gases reacted as shown.

$CO\,(g) + 3H_2\,(g) + 2O_2\,(g) \rightarrow CO_2\,(g) + 3H_2O\,(g)$

(a) Name the reactant gas which was in excess and give the remaining volume of this gas.
(b) What was the volume and composition of the products of the reaction?
(c) What would have been the reading on the gas syringe if, at the end of the reaction, the gases had been allowed to cool to room temperature?

5. Calculate the percentage yield of 1,2-dibromopropane.

$$C_3H_6 + Br_2 \rightarrow C_3H_6Br_2$$

In a preparation, 20.4 g of 1,2-dibromopropane is obtained from 5.2 g of propene.

6. Calculate the mass of ester produced in the following reaction.

$$C_2H_5OH + CH_3COOH \rightleftharpoons \underset{\textbf{ethylethanoate}}{CH_3COOC_2H_5} + H_2O$$

The percentage yield from 4.6 g of ethanol is 81%.

7. Calculate the enthalpy of combustion using the following information.

(a) The temperature of 50 cm^3 of water is increased by 15 ^oC.

(b) The temperature of 100 cm^3 of water is increased by 23.6 ^oC.

In part (a), 0.24 g of ethanol was burned. In part (b), 0.18 g of propanol was burned.

8. Calculate the atom economy for each of the following reactions.

(a) Making ethanol from ethene

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

(b) Making iron from iron(III) oxide

$$Fe_2O_3 + 3CO \rightarrow 2Fe + CO_2$$

(c) Making calcium oxide from calcium carbonate

$$CaCO_3 \rightarrow CaO + CO_2$$