Higher Chemistry Calculations for the Prelim

1. $\underline{2Ag_2O} \rightarrow 4Ag + \underline{O_2}$

1. $n(Ag_2O) = \frac{m}{GFM}$

$m = 46.36g$
$GFM = 231.8g$

$= \frac{46.36}{231.8}$

$= \underline{0.2 \text{ mol}}$

Ag_2O
$1 \times 16 = 16$
$2 \times 107.9 = 215.8$
231.8

2. $Ag_2O : O_2$
$2 : 1$
so $0.2 : x \quad x = \underline{0.1 \text{ mol}}$

3. $AV = n \times MV$
$= 0.1 \times 24$
$= \underline{2.4 \, l}$ of O_2

2. $\underline{Zn} + 2HCl \rightarrow ZnCl_2 + \underline{H_2}$

1. $n(Zn) = \frac{m}{GFM}$

$m = 6.54g$
$GFM = 65.4g$

$= \frac{6.54}{65.4}$

$= \underline{0.1 \text{ mol}}$

2. $Zn : H_2$
$1 : 1$
so $0.1 : x \quad x = 0.1$ mol of H_2

3. $AV = n \times MV$
$= 0.1 \times 24$
$= \underline{2.4 \, l}$ of H_2

3. (a) $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

$n(Zn) = \frac{m}{GFM}$ $\quad m = 6.54g$

$= \frac{6.54}{65.4}$ $\quad GFM = 65.4g$

$= \underline{0.1 \text{ mol}}$

$n(H_2SO_4) = CV$ $\quad C = 2 \text{ mol } l^{-1}$

$= 2 \times 0.025$ $\quad V = \frac{25}{1000} = 0.025 l$

$= \underline{0.05} \text{ mol}$

$Zn : H_2SO_4$

$1 : 1$

so $x : 0.05$

$x = 0.05$

∴ We need 0.05 mol of Zn

We have 0.1 mol of Zn

So Zn is in excess and H_2SO_4 is the limiting reactant.

(b) $Mg + 2HCl \rightarrow MgCl_2 + H_2$

$n(Mg) = \frac{m}{GFM}$ $\quad m = 2.43g$

$= \frac{2.43}{24.3}$ $\quad GFM = 24.3g$

$= 0.1 \text{ mol}$

$n(HCl) = CV$ $\quad C = 1 \text{ mol } l^{-1}$

$= 1 \times 0.1$ $\quad V = \frac{100}{1000} = 0.1 l$

$= \underline{0.1 \text{ mol}}$

$Mg : HCl$

$1 : 2$

so $0.1 : x$ $\quad x = \underline{0.2}$ of HCl

∴ We need 0.2 mol of HCl but only have 0.1 mol.

So HCl is the limiting reactant and Mg is in excess.

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

molar ratio	1 :	3 :	2	:	1	:	3
put 50 in!	50 :	150 :	100	:	50	:	150
actually have	50 :	150 :	200				

So oxygen is in excess with 100 cm^3 remaining

(b) Total find volume = 50 cm^3 CO_2
150 cm^3 H_2O
100 cm^3 excess O_2
300 cm^3

(c) At room temperature, water would be a liquid so the gas syringe would read only 150 cm^3.

5. $C_3H_6 + Br_2 \rightarrow C_3H_6Br_2$

Theoretical yield

1. $n(C_3H_6) = \frac{m}{GFM}$ $\quad$ m = 5.2 g
$= \frac{5.2}{42}$ $\quad$ GFM = 42 g
$= 0.124$ mol

C_3H_6
- 6×1 = 6
- 3×12 = 36
- 42

2. $C_3H_6 : C_3H_6Br_2$
1 : 1
so 0.124 : x $\quad$ x = 0.124 mol

3. $m(C_3H_6Br_2) = n \times GFM$
$= 0.124 \times 201.8$
$= 25.02$ g

$C_3H_6Br_2$
- 2×79.9 = 159.8
- 6×1 = 6
- 3×12 = 36
- 201.8

$\% = \frac{20.4}{25.02} \times 100$

$= 81.52\%$

6. $C_2H_5OH + CH_3COOH \rightleftharpoons CH_3COOC_2H_5 + H_2O$

Theoretical

1. $n(C_2H_5OH) = \frac{m}{GFM}$ $\quad m = 4.6g$

$GFM = 46g$

$= \frac{4.6}{46}$

$= 0.1 \text{ mol}$

2. $C_2H_5OH : CH_3COOC_2H_5$

$1 : 1$

so $0.1 : x$ $\quad x = 0.1 \text{ mol}$

3. $m(CH_3COOC_2H_5) = n \times GFM$

$= 0.1 \times 88$

$= 8.8 g$

Actual $= \frac{\%}{100} \times$ Theoretical

$= \frac{81}{100} \times 8.8$

$= 7.13 g$

7. (a) $E = cm\Delta T$ $\quad m = \frac{50}{1000} = 0.05 kg$

$= 4.18 \times 0.05 \times 15$

$= 3.135 kJ$

0.24g of ethanol $\rightarrow$ 3.135 kJ

so 46g (GFM) $\rightarrow$ x

$0.24x = 46 \times 3.135$

$x = -600.88 \text{ kJ mol}^{-1}$

Insert negative sign since reaction is exothermic. We know this because the water temperature increased.

7. (b) $E = cm\Delta T$

$= 4.18 \times 0.1 \times 23.6$

$= 9.8648$ kJ

$m = \frac{100}{1000} = 0.1$ kg.

So 0.18g of propanol → 9.8648 kJ

60g (GFM) → x

$0.18x = 60 \times 9.8648$

$x = -3288.3$ kJ mol^{-1}

8. (a) Atom economy = 100% (only one product)

(b) Total mass of reactants

Fe_2O_3

$3 \times 16 = 48$

$2 \times 55.8 = 111.6$

159.6g

CO

$1 \times 16 = 16$

$1 \times 12 = 12$

28

×3

84g

159.6 + 84 = 243.6g

Mass of 2Fe = 111.6g.

Atom Economy $= \frac{111.6}{243.6} \times 100 = 45.8\%$

(c) Mass of reactants

$1 \times CaCO_3 = 100.1$g

Mass of CaO = 56.1g

Atom Economy $= \frac{56.1}{100.1} \times 100 = 56.04\%$