Stoichiometry – 2019 Nov IGCSE

1. 0620/41/O/N/19/No.6

Dilute hydrochloric acid, $HCl(aq)$, reacts with aqueous sodium carbonate, $Na_2CO_3(aq)$.

The chemical equation for the reaction is shown.

$$2HCl + Na_2CO_3 \rightarrow 2NaCl + CO_2 + H_2O$$

(a) A 25.0 cm^3 portion of $Na_2CO_3(aq)$ was placed in a conical flask with a few drops of a suitable indicator. It was titrated against $HCl(aq)$ of concentration 0.180 mol/dm^3.

20.0 cm^3 of $HCl(aq)$ was required to reach the end-point.

Calculate the concentration of the $Na_2CO_3(aq)$, in mol/dm^3, using the following steps.

- Calculate the number of moles of HCl used in the titration.

..... mol

- Calculate the number of moles of Na_2CO_3 contained in the 25.0 cm^3 portion of $Na_2CO_3(aq)$.

..... mol

- Calculate the concentration of the $Na_2CO_3(aq)$ in mol/dm^3.

..... mol/dm^3 [3]

(b) In another experiment, the volume of carbon dioxide, CO_2, produced was 48.0 cm^3, measured at room temperature and pressure.

How many moles of CO_2 is this?

moles of CO_2 = ... mol [1]

(c) A sample of concentrated hydrobromic acid, HBr(aq), was electrolysed using platinum electrodes.
The concentration of the hydrobromic acid was 8.89 mol / dm^3.

(i) Calculate the concentration of the HBr(aq) in g / dm^3.

concentration of HBr(aq) = ... g / dm^3 [1]

(ii) Explain why concentrated HBr(aq) can conduct electricity.

.....

.....

..... [2]

(iii) Magnesium is **not** a suitable material from which to make the electrodes.

Explain why.

.....

..... [1]

(iv) Predict the product formed at the anode when concentrated HBr(aq) is electrolysed.

..... [1]

(v) Write the ionic half-equation for the reaction occurring at the cathode.

..... [2]

[Total: 11]

2. 0620/43/O/N/19/No.5

Nitrates such as ammonium nitrate are used as fertilisers.

The final stage in the production of ammonium nitrate is shown in the equation.

$$Ca(NO_3)_2 + 2NH_3 + CO_2 + H_2O \rightarrow 2NH_4NO_3 + CaCO_3$$

Calculate the maximum mass of ammonium nitrate that can be produced from 820 g of calcium nitrate, $Ca(NO_3)_2$, using the following steps.

The relative formula mass, M_r, of calcium nitrate, $Ca(NO_3)_2$, = 164.

- Calculate the number of moles of $Ca(NO_3)_2$ in 820 g.

..... mol

- Deduce the number of moles of NH_4NO_3 produced.

..... mol

- Calculate the M_r of NH_4NO_3.

M_r of NH_4NO_3 = ...

- Calculate the maximum mass of ammonium nitrate produced.

..... g

[4]