6.32 g $KMnO_4$ = 6.32/158 moles $KMnO_4$ = 0.04 moles $KMnO_4$

Concentration of the solution = 0.04 mol l^{-1} (= 0.04 M)

Question 8

A solution contains 4 g of NaOH in 250 cm^3 of solution. Calculate the concentration of the solution in moles per litre.

Answer:

4 g of NaOH in 250 cm^3 of solution is equivalent to 4 x 1000/250 = 16 g in 1 litre

16 g NaOH = 16/40 moles NaOH = 0.4 moles NaOH

Concentration of the solution = 0.4 mol l^{-1} (= 0.4 M)

Question 9

A solution contains 4.9 g H_2SO_4 in 100 cm^3 of solution. Calculate the concentration of the solution in moles per litre.

Answer:

4.9 g of H_2SO_4 in 100 cm^3 of solution is equivalent to 4.9 x 1000/100 = 49 g in 1 litre

49 g H_2SO_4 = 49/98 moles H_2SO_4 = 0.5 moles H_2SO_4

Concentration of the solution = 0.5 mol l^{-1} (= 0.5 M)

Question 10

A bottle of wine contains 49 g of ethanol (C_2H_5OH) in 700 cm^3 of solution. Calculate the concentration of ethanol in moles per litre.

Answer:

49 g of C_2H_5OH in 700 cm^3 of solution is equivalent to 49 x 1000/700 = 70 g in 1 litre

70 g C_2H_5OH = 70/46 moles C_2H_5OH = 1.52 moles C_2H_5OH

Concentration of the solution = 1.52 mol l^{-1} (= 1.52 M)

Question 11

What mass of potassium hydroxide (KOH) is contained in 500 cm^3 of 0.05 M potassium hydroxide solution?

Answer:

1,000 cm^3 of 0.05 M KOH solution contains 0.05 moles

500 cm^3 of 0.05 M KOH solution contains 0.05 X 500 / 1,000 moles

= 0.025 moles

Molar mass of KOH = 56 g mol^{-1}

Mass of KOH contained in 500 cm^3 solution = 56 X 0.025 g

Question 52

Crystals of hydrated sodium carbonate ($Na_2CO_3.xH_2O$) of mass 3.15 g were dissolved in water and made up to 250 cm^3 in a volumetric flask. 25 cm^3 of this solution required 15 cm^3 of a 0.15 M hydrochloric acid solution for complete neutralisation. The equation for the reaction is

$$2HCl_{(aq)} + Na_2CO_{3\,(aq)} \rightarrow 2NaCl_{(aq)} + H_2O_{(l)} + CO_{2(g)}$$

Find (a) the concentration of the sodium carbonate solution (b) the value of x in the formula $Na_2CO_3.xH_2O$ (c) the percentage of water of crystallisation in the hydrated sodium carbonate.

Answer:

(a) $V_1 \times M_1 \times n_2 = V_2 \times M_2 \times n_1$

$15 \times 0.15 \times 1 = 25 \times M_2 \times 2$

$M_2 = 15 \times 0.15 \times 1 / (25 \times 2)$

$= 0.045$ mol l^{-1}

Concentration of the sodium carbonate solution = 0.045 mol l^{-1}

(b) Molar mass of $Na_2CO_3.xH_2O = 46 + 12 + 48 + 18x = 106 + 18x$

Concentration of sodium carbonate in mol l^{-1} = 0.045

Concentration of sodium carbonate in g l^{-1} = 3.15 x 4 = 12.6

Mass of 0.045 moles of $Na_2CO_3.xH_2O$ = 12.6 g

Molar mass of $Na_2CO_3.xH_2O$ = 12.6 / 0.045 g mol^{-1}

= 280 g mol^{-1}

$106 + 18x = 280$

$18x = 174$

$x = 9.7$

(c) Molar mass of hydrated sodium carbonate = 280 g mol^{-1}

Percentage of water of crystallisation in the compound = 174 x 100 / 280% = 62.14%

Question 53

In a titration, 25 cm^3 of a potassium hydroxide solution required 27 cm^3 of a 0.12 M sulfuric acid solution for complete neutralisation. Calculate the concentration of the potassium hydroxide solution in (a) mol l^{-1} (b) g l^{-1}. The equation for the reaction is

$$H_2SO_{4(aq)} + 2KOH_{(aq)} \rightarrow K_2SO_{4(aq)} + 2H_2O_{(l)}$$

Answer: