Year 12 Chemistry Mini-Assignment Term 1 Week 10

[22/21 marks]

Name: SOLUTIONS

Question 1

Calculate the mass of lime, calcium oxide, which will react completely with 250.0 mL of 1.50 mol L^{-1} hydrochloric acid.

(4 marks)

① $n(HCl) = cV = 0.250 \times 1.50 = 0.375$

① $CaO_{(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + H_2O_{(l)}$

① $n(CaO) = \frac{n(HCl)}{2} = \frac{0.375}{2} = 0.1875$

① $m(CaO) = nM = 0.1875 \times 56.08 = 10.515\,g$

Mass of lime: 10.5g (3 sig fig)

Question 2

A fire extinguisher produces carbon dioxide by the reaction between sodium hydrogencarbonate and sulfuric acid. If a fire extinguisher is designed to hold 600.0 g of sodium hydrogencarbonate, calculate

(a) the mass of sulfuric acid required to react with the sodium hydrogencarbonate, and
(b) the volume of 12.0 mol L^{-1} sulfuric acid required to react with the sodium hydrogencarbonate.

5/8 **marks)**

① $2NaHCO_{3(s)} + H_2SO_{4(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)} + 2CO_{2(g)}$

① $n(NaHCO_3) = \frac{m}{M} = \frac{600}{84.008} = 7.14218\,mol$

① $n(H_2SO_4) = \frac{n(NaHCO_3)}{2} = \frac{7.14218}{2} = 3.5711$

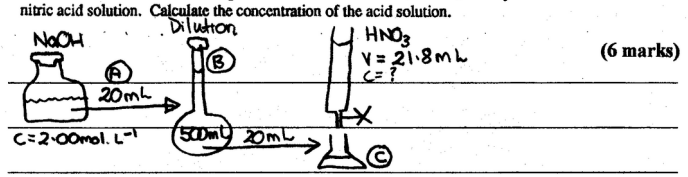
① $m(H_2SO_4) = nM = 3.5711 \times 98.086 = 350.3\,g$ (4 sig figs)

① $V(H_2SO_4) = \frac{n}{c} = \frac{3.5711}{12.0} = 0.298\,L$ (3 sig figs)

Question 3

20.0 mL of 2.00 mol L^{-1} sodium hydroxide solution was diluted to 500.0 mL in a volumetric flask. A 20.0 mL aliquot of the dilute solution was neutralised by 21.8 mL of nitric acid solution. Calculate the concentration of the acid solution.

(6 marks)



① $n(NaOH\ at\ A) = cV = 2.00 \times 0.020 = 0.04\,mol$

① $c(NaOH\ at\ B) = \frac{n}{V} = \frac{0.04}{0.5} = 0.08\,mol.L^{-1}$

① $n(NaOH\ at\ C) = cV = 0.08 \times 0.020 = 1.6 \times 10^{-3}$

① $HNO_{3(aq)} + NaOH_{(aq)} \rightarrow NaNO_{3(aq)} + H_2O_{(l)}$

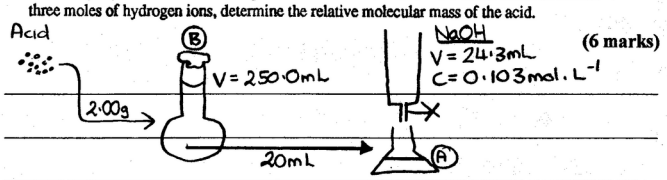
① $n(HNO_3) = n(NaOH) = 1.6 \times 10^{-3}$

① $c(HNO_3) = \frac{n}{V} = \frac{1.6 \times 10^{-3}}{0.0218} = 0.0734\,mol.L^{-1}$ (3 sig figs)

Question 4

2.00 g of an acid was dissolved in water and made up to 250.0 mL of solution in a volumetric flask. 20.0 mL of this acid solution required 24.3 mL of 0.103 mol L^{-1} sodium hydroxide solution for complete neutralisation. If one mole of the acid can release three moles of hydrogen ions, determine the relative molecular mass of the acid.

(6 marks)



① $n(NaOH) = cV = 0.103 \times 0.0243 = 2.5029 \times 10^{-3}$

① $3NaOH_{(aq)} + XH_{3(aq)} \rightarrow 3H_2O_{(l)} + Na_3X_{(aq)}$

① $n(XH_3\ at\ A) = \frac{n(NaOH)}{3} = \frac{2.5029 \times 10^{-3}}{3} = 8.343 \times 10^{-4}$

① $c(XH_3\ at\ B) = \frac{n}{V} = \frac{8.343 \times 10^{-4}}{0.020} = 0.041715\,mol.L^{-1}$

① $n(XH_3\ at\ B) = cV = 0.041715 \times 0.250 = 0.01043\,mol$

① $M(XH_3) = \frac{m}{n} = \frac{2.00}{0.01043} = 192\,g\,mol^{-1}$

∴ Relative Molecular Mass = 192