ATOMIC STRUCTURE AND BONDING

1999 U 01 Sp 01

1. **(a)** Define the terms **(i)** 'Mole' **(ii)** 'Molar Mass' **[2 marks]**

(b) 20 cm^3 of a solution of phosphorus(V) acid containing 1.96 g dm^{-3} reacted with 25 cm^3 of a solution containing 1.28 g dm^{-3} sodium hydroxide. [A_r values: H = 1.0, Na = 23.0, O = 16.0, P = 31.0]

Calculate the number of moles of

(i) phosphorus(V) acid that reacted **[2 marks]**

(ii) sodium hydroxide that reacted **[1 mark]**

(iii) sodium hydroxide that reacted with 1 mole of the acid **[1 mark]**

(c) Derive the equation for the reaction that occurred in part (b) above. **[1 mark]**

(d) **(i)** State Avogadro's Law. **[1 mark]**

(ii) 0.068 g of a gas occupied 48 cm^3 at room temperature and pressure.

Calculate the molar mass of the gas. [The molar volume of a gas at r.t.p. = 24 dm^3] **[2 marks]**

2. **(a)** **(i)** Draw dot and cross diagrams to show the bonding in molecules of: **a)** AlF_3; **b)** NH_3. **[2 marks]**

(ii) State the shapes of these molecules. **[2 marks]**

(iii) Explain the shapes of the molecules identified in part (ii) above. **[2 marks]**

(b) **(i)** What type of bonding would occur between AlF_3 and NH_3 molecules? **[1 mark]**

(ii) Using a dot and cross diagram, show how the bond noted in part (b)(i) is formed. **[2 marks]**

(iii) Predict the shape of the molecule resulting from the bond in part (b)(i). **[1 mark]**

3. **(a)** Explain what is meant by the term 'radioactivity'. **[1 mark]**

(b) **(i)** Define the term 'isotopes'. **[1 mark]**

(ii) Give TWO uses of radioisotopes. **[2 marks]**

(c) The element, Z, has two isotopes of masses 63.0 and 65.0 with relative abundances 75 and 25 respectively.

Calculate the relative atomic mass of Z. **[2 marks]**

(d) Write an equation to represent the first ionisation energy of element Z. **[1 mark]**

(e) Assume that Z has an atomic number of 29.

(i) Write the electron configuration of Z. **[2 marks]**

(ii) To which period of the periodic table does element Z belong? **[1 mark]**