BINDURA UNIVERSITY OF SCIENCE EDUCATION
SCIENCE AND MATHEMATICS EDUCATION DEPARTMENT
DIPLOMA IN SCIENCE EDUCATION

NOV 2024

DCH001: GENERAL CHEMISTRY

TIME: 2 HOURS

ANSWER QUESTION ONE AND TWO QUESTIONS FROM EACH OF SECTIONS A AND B. EACH QUESTION CARRIES 20 MARKS

1. Use the exponential notation to express each of the following measurements in terms of an SI base unit

   (i) 4.12cm
   (ii) 947microsecond
   (iii) 3.17nm [3x2marks]

   (b) Element W has 11 electrons and 12 neutrons
   (i) Find the atomic number of W [2 marks]
   (ii) Find the mass number of W [2 marks]
   (iii) Give the complete symbol of W [2 marks]

   (c) Write dot and cross diagrams for the following species
   (i) PH_3 [2 marks]
   (ii) NaCl [2 marks]
   (iii) HBr [2 marks]
   (iv) CO_2 [2 marks]

SECTION A: ANSWER ANY TWO QUESTIONS FROM THIS SECTION

2. (a) Describe the charges and relative masses of the three sub-atomic particles, protons, neutrons and electrons. [6 marks]
   (b) By means of a diagram describe how the paths of separate beams of the following particles are affected on passing through an electric field which is at right angles to their direction of travel.
   Electron
   proton
   neutron [6 marks]
   (c) Define the following terms:
   (i) Isotopes [2 marks]
   (ii) Relative atomic mass [2 marks]
   (iii) Lewis base [2 marks]
   (iv) Mass number [2 marks]
3. (a) Giving appropriate examples define the following terms
   (i) Weak acid [2 marks]

(ii) Strong base [2 marks]

(b) Identify and indicate the reducing and oxidizing agent in each of the following reactions

(i) $Fe^{2+} + Cl_2 \longrightarrow Fe^{3+} + 2Cl^-$ [2 marks]

(ii) $2H_2 + O_2 \longrightarrow 2H_2O$ [2 marks]

(c) Calculate pH for each of the following:

(i) 0.01 M H_2SO_4 [3 marks]

(ii) 0.01 M NaOH [3 marks]

(iii) 0.01 M $Ca(OH)_2$ [3 marks]

(iv) 0.01 M HNO_3 [3 marks]

4. (a) Calculate the M_r of the following compounds

(i) $(NH_4)_2SO_4$

(ii) $Fe_2(SO_4)_3$ [2x2marks]

(b) Ammonium dichromate, $(NH_4)_2Cr_2O_7$ decomposes forming Cr_2O_3, water and nitrogen

(i) write a balanced equation for the decomposition of ammonium dichromate [2marks]

(ii) calculate the mass of water and

(iii)volume of nitrogen obtained by heating 50,4g of ammonium dichromate [2x3marks]

(c) Define the following terms

(i) empirical formula

(ii) molecular formula [2x2marks]

(d) Given that a hydrocarbon contains 80% Carbon and 20% hydrogen and its M_r is 30, calculate the empirical formula and hence deduce the molecular formula

[4marks]

SECTION B: ANSWER ANY TWO QUESTIONS FROM THIS SECTION.

5. (a) (i) Write complete equations representing the first and second ionization energies of calcium, (Ca). [4 marks]

(ii) Give the electron configuration of the ion resulting from the first ionization energy of Ca. [2 marks]

(b) Using values from the Data Booklet plot a graph of the 1st ionization energy of the nine elements Na to K. [5 marks]

(c) Comment on the shape of the graph, in particular explaining the reasons for:

(i) The general trend from Na to Ar. [4 marks]

(ii) The discontinuities between Mg and Al. [3 marks]

(iii) The difference between the 1st ionization energies of Na and K. [2 marks]

6. (a) Use the species given in brackets to explain how the named types of bonds are formed:

(i) Ionic bond (Mg and Cl). [4 marks]

(ii) Metallic bond (Cu). [4 marks]

(iii) Covalent bond (C and O). [4 marks]

(b) Use the VSEPR theory to predict the shapes and bond angles in the following molecules:

(i) CO_2 [2 marks]

(ii) BF_3 [2 marks]

(i) H_2O [2 marks]

(ii) CH_4 [2 marks]

7. (a) Explain the following observations:

(i) The boiling points of group VII elements increase down the group.

Element	Boiling point / ^0C
Cl_2	-35
Br_2	+59
I_2	+184

[3 marks]

(ii) Electrical conductivity of period 3 elements increases from Na to Al. [4 marks]

(iii) Aqueous solutions of ionic compounds conduct electricity whilst those of covalent substances do not. [3 marks]

(b) (i) Give the formulae of the chlorides of the period three elements, Na to Si. [4 marks]

(ii) Write equations to show the reactions of the following oxides with water; SO_2, P_4O_6 and P_4O_{10}. [6 marks]

END OF PAPER