

**UNIVERSITY EXAMINATIONS****1ST SEMESTER 2022/2023 ACADEMIC YEAR****FIRST YEAR EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE (AGED)****CHEM 113: GENERAL INORGANIC AND PHYSICAL
CHEMISTRY*****STREAM: R******TIME: 2 HRS******DAY: FRIDAY [11.30AM – 13.30]******DATE: 09/12/2022*****THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES****PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.**

INSTRUCTIONS: Answer ALL questions**QUESTION ONE**

- (a) State Four postulates of Daltons atomic theory (4marks)
- (b) Define the following terms
- i) Nuclide (1mark)
 - ii) Isotopes (1mark)
 - iii) Atom (1mark)
- (c) i) Define the term Relative Atomic Mass (1 mark)
- ii) Chlorine consists of two isotopes, Chlorine -35 and Chlorine -37. Its relative atomic mass is 35.48. Find the abundance of each isotope. (3marks)
- (d) A compound containing sulphur and chlorine only, has 31.1% sulphur and the rest is chlorine.
- i) Determine the empirical formula of the compound (S=32, Cl=35.5) ($2\frac{1}{2}$ marks)
 - ii) The mass spectrum of the compound gives a molecular mass of 103. What is it's molecular formula ($1\frac{1}{2}$ marks)
- (e) State
- i) Charles's law (1 mark)
 - ii) Boyles law (1 mark)
- f) i) State Hess's law of heat summation (1mark)
- ii) Calculate the heat of formation of propane (C_3H_8) from the following data:
- $$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} \quad \Delta H = -406kJmol^{-1}$$
- $$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)} \quad \Delta H = -286kJmol^{-1}$$
- $$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(l)} \quad \Delta H = -2209kJmol^{-1} \quad (4 \text{ marks})$$
- (g) Given the standard electrode potentials as
- $$Ag_{(aq)}^+ / Ag_{(s)} \quad E^0 = 0.80 \text{ V}$$
- $$Zn_{(aq)}^{2+} / Zn_{(s)} \quad E^0 = -0.763 \text{ V}$$
- For the cell, $Zn_{(s)} / Zn_{(aq)}^{2+} // Ag_{(aq)}^+ / Ag_{(s)}$
- i) Write the half cell reactions and overall reaction. (2 mark)
 - ii) What is the e.m.f of the cell above under standard conditions? (1 mark)
 - iii) Draw an electrochemical cell for the above reaction showing clearly the salt bridge, anode, cathode, direction of electron flow and indicate the signs of the electrodes. (3 marks)
- (h) Consider the reaction
- $$C_2H_{4(g)} + O_{2(g)} \rightleftharpoons 2CO_{2(g)} + 2H_2O_{(g)} \quad \Delta H = -1394kJmol^{-1}$$
- Explain the effect of the following changes on the above equilibrium

- i) An increase in the reaction temperature (1 marks)
 ii) A decrease in pressure (1 mark)

QUESTION TWO

- (a) State and explain
- Variation of atomic size down a group (2 marks)
 - How the atomic radius varies across the period from Na to Cl (2 marks)
- (b) i) List and explain three factors that influence the magnitude of the first ionization energy of an element. (3 marks)
 ii) Explain why the 2nd ionization energy is always greater than the 1st. (1 mark)
- (c) i) Define the term Molarity (1 mark)
 ii) A concentrated solution of HNO₃ contains 70% HNO₃ (w/w) and has a specific density of 1.40g/cm³
 I) Calculate the molarity of this solution (2 marks)
 II) What volume of concentrated nitric acid is required to make 500ml of 0.1M nitric acid solution? (2 marks)
- (d) Define the term parts per million (1 mark)
 ii) 155.3 g sample of pond water is found to have 1.7x10⁻⁴g of phosphate. What is the concentration in ppm? (2 marks)
 iii) what volume of 1000ppm solution is required to make 500 mL of 100ppm Cl⁻ solution? (2 marks)
- (e) Calculate the percent composition of carbon in C₆H₁₂O₆. (C=12, H=1, O=16) (2 marks)

QUESTION THREE

- (a) Write the Lewis structures of the following compounds
 i) NF₃; ii) CCl₂F₂; iii) PO₄³⁻; iv) NH₄⁺
 (O=8, P=15, N=7, H= 1, C=6, Cl=17, F=9) (6 marks)
- (b) what are intermolecular forces? (1 mark)
- (c) Briefly describe the following intermolecular forces
 i) Van der Waals Forces (1 marks)
 ii) Hydrogen Bonding (1 marks)
 iii) Dipole-Dipole Forces (1 marks)
- (d) Classify the following bonds as ionic, polar covalent or covalent.

- i) The bond in CsCl (1mark)
ii) The bond in HF (1mark)
iii) The NN bond in H_2NNH_2 (1mark)
- (e) State i) Pauli exclusion principle (1mark)
ii) Hund's rule (1mark)
iii) Aufbau principle (1 mark)
- (f) Use Pauli Exclusion principle and Hund's rule to write the electronic configuration of the following
- i) O^{2-} ii) Ni iii) Al^{3+} iv) Cr
(Atomic numbers: O=8, Al=13, Ni=28 and Cr =24)
- (4 marks)

