

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE

CHEM 110: INORGANIC CHEMISTRY I

STREAMS: BSC (CHEM); BSC (BIO); BSC (NUTRITION); BSC (MATHS); BSC (ELEC. ENG); BSC (IND CHEM); BSC (BIOMED); BSC (BIOCHEM); BED (SCI)
 TIME: 2 HOURS

DAY/DATE: FRIDAY 13/12/2019

11.30 A.M. – 1.30 P.M.

INSTRUCTIONS:

- Answer question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

- (a) State Postulates of Dalton's atomic theory and discuss their weaknesses if any. (3 marks)
- (b) Describe in details, observations and conclusions of an experiment which explained the evidence that a nucleus is positively charged and occupies a small volume of an atom. (5 marks)
- (c) Define the term atomic mass unit and explain why the atomic mass of carbon is 12.01 amu and not exactly 12.00 amu. (1 marks)
- (d) Zirconium metal (Zr) exists in five (5) isotopes. Over half of all atoms in naturally occurring zirconium metal are ^{90}Zr . The other four stable isotopes of zirconium have the relative atomic masses and abundances given in the table below. Given that the relative atomic mass for natural zirconium is 91.22 amu answer the following questions

| Isotope | Isotope mass in amu | Abundance % |
|---------|---------------------|-------------|
| | 90.9056 | 11.27 |
| | 91.9050 | 17.17 |
| | 93.9063 | 17.33 |
| | 95.9083 | 2.78 |

- (i) Define the term isotope.

(1 mark)

- (ii) Calculate the relative isotopic mass of . (3 marks)
- (iii) From the observation in the above table, comment on the relationship between the isotopic and mass numbers of zirconium isotopes. (marks)
- (iv) Given that 1amu weighs determine how many atoms of zirconium are in 4 g of zirconium. marks)
- (e) Caproic acid, the substance responsible for the aroma of dirty socks and running shoes, contains, carbon, hydrogen and oxygen. On combustion analysis, sample of caproic acid gives The molecular mass of caproic acid is
- Calculate:
- (i) Empirical formula (5 marks)
- (ii) Molecular formula of caproic acid
- (f) The World Health Organization (W.H.O) specifies the maximum allowable concentrations of ions in drinking water as 15 ppb. After three years of drinking water from a borehole, Kamau's blood sample was found to contain What was lead (Pb) concentration in Kamau's blood in
- (i) ppm
- (ii) ppb (2 marks)
- (g) Write the Lewis structure and resonance structure for the following anions. (4 marks)
- (i)
- (ii)

QUESTION TWO (20 MARKS)

- (a) A sample of NaOH weighing 0.14g was dissolved in water and the resulting solution made to mark in volumetric flask. (4 marks)
- (i) Determine the molarity of the resulting NaOH solution.
- (ii) Calculate the volume in of 0.1 that would be required to neutralize of the above NaOH solution.

[Atomic masses H=1.008, O=16.00, Na=23.0

- (b) Define the following terms (2 marks)

- (i) Actual yield
 - (ii) Theoretical yield
 - (iii) Explain why the actual yield is often less than the theoretical yield
- (c) Cisplatin, an anticancer drug used for the treatment of solid tumours is prepared by the reaction of ammonia with potassium tetrachloroplatinate according to the equation shown below:

(Potassium tetrachloroplatinate cisplatin

If 10.0g of and 10.0g of are allowed to react to produce cisplatin, answer the following questions. (5 marks)

- (i) Which reactant is a limiting reagent and which is excess. Explain your answer.
 - (ii) Determine the mass in grammes of cisplatin that that would be produced.
 - (iii) How many grammes of excess reactants are consumed and how many grammes remained?
- (d) (i) List the four quantum numbers and state what each specify. (4 marks)
- (ii) Sketch the shape and orientation of the following types of orbitals
- (i) s
 - (ii) P_z
 - (iii) (1 marks)
- (iii) Give the values for n, l and m_l for each orbital in the 2p subshell. (1 marks)
- (iv) For a given principal quantum number n, how do the energies of the s, p d and f orbitals vary for a hydrogen atom and many-electron atom. (mark)

QUESTION THREE (20 MARKS)

- (a) State the following
- (i) Pauli's exclusion principle
 - (ii) Hund's rule
 - (iii) Modern periodic law (3 marks)
- (b) (i) State the main postulates of Bohr's atomic model. (2

- (ii) List the main shortcomings of model. (2 marks)
- (iii) Explain what is meant when we say energy is quantized? (1 mark)
- (c) Calculate the energy, frequency and the wavelength of radiation from $n=5$ to $n=1$ transition in the hydrogen atom. (3 marks)
- (d) Write the condensed electron configuration for the following atoms using the appropriate noble gas core abbreviations
- (i) Cs
- (ii)
- (iii)
- (iv) Al (4 marks)
- (e) Explain the type(s) of intermolecular forces present in the following compounds. (4 marks)
- (i)
- (ii)
- (iii) HBr
- (iv)

QUESTION FOUR (20 MARKS)

- (a) (i) Define the term Lattice energy. (1 mark)
- (ii) State the two factors that influence the lattice energy of a solid crystal.(2 marks)
- (b) For each of the following pairs of compounds specify the compounds which has the higher lattice energy. In each case give a reason for your answer. (4 marks)
- (i) KCl and MgO
- (ii) LiF and LiBr
- (c) Determine the molecular geometry of the following compounds. (6 marks)
- (i)
- (ii)
- (iii)
- (d) A 4.028m solution of ethylene glycol, , in water has a density of 1.0241 g/ml. Calculate the molarity of the solution. (3 marks)

(e) Give explanation to the following observations: (4 marks)

(i) The first ionization energies generally increase across a period but decrease down a group for the elements in a periodic table. However, the first IE for Be is higher than that for boron.

(ii) Generally, the first ionization energies of elements increase from left to right across a given period, however the first ionization energy of nitrogen is higher than that of oxygen.

Constants: Plank's constant $h = 6.63 \text{ JS}$, Ryberg's constant
Velocity of light .
