CHUKA  **UNIVERSITY**

UNIVERSITY EXAMINATION
RESIT/SUPPLEMENTARY / SPECIAL EXAMINATIONS
EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE

CHEM 110: INORGANIC CHEMISTRY I

STREAMS: **TIME: 2 HOURS**

DAY/DATE: TUESDAY 02/11/2021 **2.30 P.M - 4.30 P.M.**

Answer Question **One** and any other **Two** Questions

QUESTION ONE [30 MARKS]

(a) State the postulates of Dalton's atomic theory of matter **(2 Marks)**

(b) Acetic acid contains the elements carbon, hydrogen, and oxygen. A 4.24 mg sample of acetic acid is completely burned in air to give 6.21 mg of carbon dioxide and 2.54 mg of water.

(i) Determine the empirical formula of acetic acid **(5 Marks)**

(ii) Determine the molecular formula of acetic acid, given that the molecular mass of acetic acid is 60.0 g/mol **(2 Marks)**

(c) A bottle of concentrated hydrochloric acid is labeled 12.3M HCl. The specific density is given as 1.1906. Calculate:

(i) The mole fraction of HCl **(2 Marks)**

(ii) The molality of HCl **(2 Marks)**

(iii) The mass percent of HCl **(2 Marks)**

(d) (i) Calculate the wavelength of the yellow sodium emission with a frequency of 5.09×10^{14} Hz **(2 Marks)**

(ii) Calculate the energy of a photon of the red spectral line of lithium that occurs at 671 nm **(2 Marks)**

(iii) Calculate the wavelength of light emitted when the electron in a hydrogen atom undergoes a transition from energy level n= 4 to level n = 2 **(2 Marks)**

(e) Describe Bohr's atomic model and use it to explains the atomic spectrum of hydrogen **(5 Marks)**

(f) Write the electronic configuration of the following species **(4 Marks)**

(i) Ga (ii) Mn (iii) Fe^{3+} (iv) Cl^-

QUESTION TWO [20 MARKS]

(a) State: (i) Hund's Rule (ii) Pauli's exclusion principle (iii) Aufbau principle **(3 Marks)**

(b) Consider the following sets of quantum numbers (n, l, m_l, m_s). Which ones could not occur? State the reason. For the valid sets, identify the orbital involved. **(4 Marks)**

(i) 3, 1, 0, +1/2 (ii) 1, 1, 0, -1/2 (iii) 4, 3, 2, +1/2 (iv) 2,1,0,0

(c) Consider the species SO_2, ICl_3, and $COCl_2$.

(i) Draw the Lewis structures and determine the molecular geometries (including bond angles) of these species **(6 Marks)**

(ii) Draw the resonance structures of SO_2 **(1 Mark)**

(iii) Give the hybridization of the central atom for each species **(11/2 Marks)**

(iv) Determine the formal charge of the sulfur atom in SO_2 **(11/2 Marks)**

(d) Calculate the de Broglie wavelength of an electron traveling with a velocity of 2.2×10^6 m/s **(3 Marks)**

QUESTION THREE [20 MARKS]

(a) Draw Born-Haber cycle (with relevant equation for each step) for the formation of NaCl(s) from Na(s) and Cl_2 (g) **(5 Marks)**

(b) Discuss the general trends of (i) atomic radius (ii) electron affinity and (iii) ionization energy in the periodic table **[6 Marks]**

(c) Discuss the following intermolecular forces: van der Waals, dipole-dipole and hydrogen bonding **(9 Marks)**

QUESTION FOUR [20 MARKS]

(a) Describe how to prepare 60.0 mL of 0.20 M HNO_3 solution, starting with a 4.00 M HNO_3 stock solution **(2 Marks)**

(b) Write orbital diagrams for the following elements: (i) N (ii) Co **(2 Marks)**

(c) Calculate the number of carbon atoms in 5.0 g of $NaHCO_3$ **(2 Marks)**

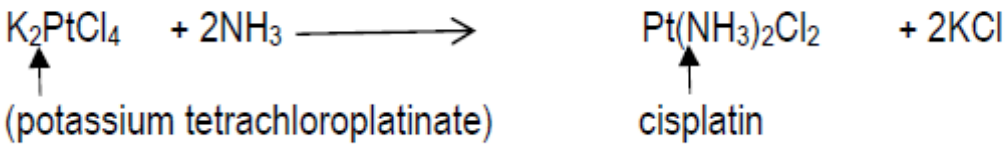
(d) Calculate the percent compostion by mass of each element in CH_2Cl_2 **(3 Marks)**

(e) Define the following terms **(3 marks)**

(i) Actual yield (ii) Theoretical yield

(iii) Explain why the actual yield is often less than the theoretical yield

(f) 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:



If 10.0g of K_2PtCl_4 and 10.0 g of NH_3 are allowed to react to produce cisplatin, answer the following questions **(8 marks)**

(i) Which reactant is a limiting reagent and which is excess. Explain your answer

(ii) Determine the mass in grams of cisplatin that would be produced

(iii) How many grams of excess reactants are consumed and how many grams remained?

Constants: Planck's constant h = 6.63 x 10^{-34} JS, Rydberg's constant R_H = 1.097 x 10^{-2} nm^{-1}, Velocity of light C = 3.0 x 10^{8} ms^{-1} , N_A = 6.022 x 10^{23}

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