CHEM 110

CHUKA   **UNIVERSITY**

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE

CHEM 110: INORGANIC CHEMISTRY 1

STREAMS: BSC   **TIME: 2 HOURS**

DAY/DATE: WEDNESDAY 03/02/2021   **8.30 A.M. – 10.30 A.M.**

INSTRUCTIONS: Answer ALL questions

QUESTION ONE

1. a) (i). Give three Daltons postulates about atoms   (3 marks)

     (ii) What were the limitations of Daltons atomic theory   (3 marks)

    b) State Daltons Law of   i) Conservation of mass

                                 ii) Definite proportions

                                 iiii) Multiple Proportions   (3 marks)

2. List two properties of i) cathode rays ii) alpha particles iii) beta particles   (3 marks)

3. Using an illustration discuss briefly the J. J. Thompson Plum Pudding model of the atom

                                                                         (4 marks)

4. What is the mass in grams of 20 Ag silver atoms (Ag = 107.9 g, Avogadros. no.= 6.022×10^{23}

    atoms)   (2 marks)

5.   Methanol (CH_3OH) is the simplest alcohol known. It is used as a fuel in race cars and is a potential replacement for petro. Methanol can be manufactured by combining gaseous carbon monoxide and hydrogen as shown

$4H_2(g) + 2CO_2(g) \longrightarrow 2CH_3OH (l)$
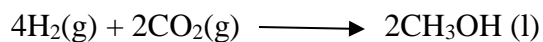
If 68.5Kg of CO is reacted with 8.60Kg of $H_2(g)$

   i)   Deduce the limiting reagent in the above reaction. Explain your answer   (2 marks)
   ii) Determine the mass in grammes of methanol that would be produced   (2 marks)
   iii) Calculate the number of moles of excess reagent at the end of the reaction   (2 marks)
   iv) If 5.57×10^4 g of methanol is actually produced, calculate the percent yield of methanol   (2 marks)

6.   What is the shortest wavelength line (in nm) in the Lyman series for Hydrogen spectrum   (4 marks)

QUESTION 2 (2O marks)

7.   What is the energy and the wavelength in nm of a photon emitted during a transition from $n = 5$ to $n = 2$ level in a hydrogen atom   (4 marks)

   (a) State the postulates and limitations of Bohr's atomic theory   (4 marks)

   (b) Calculate the energy of one photon of a microwave radiation with a wavelength of 1.20 cm   (2 marks)

   (c) Calculate the de Broglie wavelength of an electron with a speed of 1.00×10^6 m/s (electron mass = 9.11×10^{-31} kg; h = 6.626×10^{-34} kg·m²/s)   (2 marks)

   (d)   Calculate the wavelength of UV light in the Balmer series corresponding to a value of $n = 7$ (2 marks)

2 (a) Determine the n, l, and possible m_l values for (i) 2p and (ii) 4d sublevels   (4 marks)

QUESTION THREE (20 MARKS)

(b) Write the full ground-state electronic configurations of the following: (4 marks)

   (i) Se   (ii) Cr   (iii) Mn^{4+} (iv) S^{2-}

(c) Draw the orbital diagrams of the following: (2 marks)

   (i) O   (ii) $[Ar]4S^2 3d^8$

(d) Explain the periodic trend of atomic radii   (2 marks)

3 (a)   Consider the following species: CO_3^{2-} , BeF_2, PF_5 and SF_4.

(i) Write the Lewis structure of each species   (4 marks)

(ii) Draw the resonance structures of CO_3^{2-} (3 marks)

(iii) Determine the formal charge of S in SF_4 (1 mark)

(iv) Determine the molecular geometry of PF_5 (1 mark)

(b) Describe the London dispersion intermolecular forces   (3 marks)