

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.

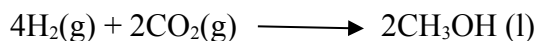
**INSTRUCTIONS: Answer ALL questions**

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  
iii) 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  $20 \text{ Ag}$  silver atoms ( $\text{Ag} = 107.9 \text{ g}$ , Avogadro's no. =  $6.022 \times 10^{23}$  atoms) (2 marks)

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5. Methanol (CH<sub>3</sub>OH) is the simplest alcohol known. It is used as a fuel in race cars and is a potential replacement for petrol. Methanol can be manufactured by combining gaseous carbon monoxide and hydrogen as shown



If 68.5 kg of CO is reacted with 8.60 kg of H<sub>2</sub>(g)

- Deduce the limiting reagent in the above reaction. Explain your answer (2 marks)
  - Determine the mass in grammes of methanol that would be produced (2 marks)
  - Calculate the number of moles of excess reagent at the end of the reaction (2 marks)
  - If  $5.57 \times 10^4$  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 (20 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)
- State the postulates and limitations of Bohr's atomic theory (4 marks)
  - Calculate the energy of one photon of a microwave radiation with a wavelength of 1.20 cm (2 marks)
- (2 marks)
- Calculate the de Broglie wavelength of an electron with a speed of  $1.00 \times 10^6$  m/s (electron mass =  $9.11 \times 10^{-31}$  kg;  $h = 6.626 \times 10^{-34}$  kg·m<sup>2</sup>/s) (2 marks)
  - Calculate the wavelength of UV light in the Balmer series corresponding to a value of  $n = 7$  (2 marks)
- (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<sup>4+</sup>      (iv) S<sup>2-</sup>

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

(i) O

(ii) [Ar]4S<sup>2</sup>3d<sup>8</sup>

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

3 (a) Consider the following species: CO<sub>3</sub><sup>2-</sup>, BeF<sub>2</sub>, PF<sub>5</sub> and SF<sub>4</sub>.

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

(ii) Draw the resonance structures of CO<sub>3</sub><sup>2-</sup> (3 marks)

(iii) Determine the formal charge of S in SF<sub>4</sub> (1 mark)

(iv) Determine the molecular geometry of PF<sub>5</sub> (1 mark)

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

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