KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER
SUPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF B.ED (SCIENCE)

COURSE CODE: SCH 211/214*

COURSE TITLE: ATOMIC STRUCTURE AND CHEMICAL BONDING

2:00PM – 4:00PM

DATE: 18/7/2022   **TIME:** ~~8:00AM-10:00AM~~

Important constants

Plank's constant, $h = 6.626 \times 10^{-34}$ Js

Speed of light(in vacuum), $c = 2.998 \times 10^{8} ms^{-1}$

Rydberg's constant, $R_H = 1,0968 \times 10^{7} m^{-1}$

Mass of electron, $m_e = 9.11 \times 10^{-31} kg$

$1A = 10^{-10} m$

$1J = 1\ kgm^{2}s^{-2}$

Electronic charge, $e = 1.602 \times 10^{-19} C$

Permittivity, $\varepsilon_0 = 8.854188 \times 10^{-12}\ C^2/Jm$

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Question 1 (30mks)

a) State two assumptions of Bohr model of the atom   **(2marks)**

b) Using the photoelectric effect, explain the term 'quantum theory'   **(3marks)**

c) Calculate the energy level from which an electron falls in the layman series to yield an energy of - 2.42×10^{18}J.   **(2marks)**

d) State the Heisenberg uncertainty principle   **(2marks)**

e) i) Sketch a Born haber cycle for potassium bromide   **(4marks)**

ii) Describe the trend in lattice energy for the oxides of group 2   **(4marks)**

iii) Calculate the wavelength of the spectral line when an electron drops from n=4 in the Balmer series (3 mks)

f) i) What do you understand with the term shielding constant   **(3marks)**

ii) Calculate the effective nuclear charge on a 3d electron in a nickel atom (Ni=28)   **(4marks)**

iii) Briefly explain how electrons are filled in a multi-electron atom   **(3marks)**

Question 2 (20 marks)

a) i) How does 'penetration effect' vary within n   **(2marks)**

  ii) Write the electron configuration for sodium and nitrogen ions   **(2marks)**

b) i) Explain the trend in atomic radius across period 2 elements   **(2marks)**

  ii) The atomic radius of magnesium is bigger than its ionic radius while that of chlorine in the same period is smaller than the ionic radius. Explain   **(3marks)**

  iii) Explain how electronegativity can be used to predict to explain the difference in polarity between hydrogen fluoride and methane   **(3marks)**

c)i) Define the second ionization energy and explain its trend down group 2   **(4marks)**

ii) The ionization energy of nitrogen is 1402kJ/mole predict that of oxygen. Briefly explain your answer.   **(4marks)**

Question 3 (20 marks)

a) Identify and name the sub-shells with possible combinations from the sets below   (3 marks)

Quantum nos.	N	L	m_l	Valence Sub-shells
Set a	2	0	0	
Set b	3	2	1	
Set c	2	1	-1	
Set d	3	2	2	

b) Sketch the orbitals in $l = 1$ on a single scale   (3marks)

c) Account for the difference in melting points of Sodium chloride, 800°C and calcium chloride 772°C   (3marks)

d) Explain why Phosphorus is able to form phosphorus pentachloride and phosphorus trichloride while nitrogen can only form nitrogen trichloride   (4marks)

e) i) Draw the orbital correlation diagram for homonuclear diatomic molecules of Boron   (3marks)

ii) Write the ground state valence-electron configuration of B_2,   (2marks)

iii) Calculate the bond order in the molecules in e (i)   (2marks)

Question 4 (20 marks)

a) Draw the Lewis structure for magnesium chloride   (2marks)

b) Draw the resonance structures for NO_3^- (3marks)

c) Give three statements of the Valence Shell Electron Pair Repulsion Theory   (3marks)

d) i) Predict the hybridization of carbon in ethyne (CHCH)   (3marks)

ii) Draw and identify sigma and pi bonds in the molecule, CHCH   (3marks)

e) Explain the following physical properties of metals using electron sea model of metallic bonding.

i) Malleability   (3marks)

ii) Luster   **(3marks)**

Question 5(20marks)

a)i) State the major difference between electron affinity and electronegativity   **(3marks)**

ii) Explain why the second electron affinity of oxygen is positive   **(3marks)**

b) Use Compton scattering to show the major differences between classical mechanics and quantum theory   **(5 marks)**

c) Use examples to explain the difference between intermolecular and intramolecular hydrogen bonding   **(3marks)**

d) Identify two limitations to the octet rule   **(3marks)**

e) Describe the Schrodinger's wave equation   **(3marks)**