KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF B.ED (SCIENCE)

COURSE CODE: SCH 117

COURSE TITLE: FUNDAMENTALS OF CHEMISTRY

DATE: 18/02/2021 **TIME:** 2:00-4:00PM

INSTRUCTIONS TO CANDIDATES:

TIME: 2 HOURS

ANSWER QUESTION ONE AND ANY TWO OF THE REMAINING

KIBU OBSERVES ZERO TOLERANCE TO examination cheating

QUESTION ONE (30MARKS)

1. (a) In cold cathode tubes, the electric discharge in gas has three regions, with distinct current-voltage characteristics: Name the three types of discharges **(3 marks)**

(b) Briefly explain how cathode rays are formed **(3 marks)**

(c) Briefly explain how electrons were discovered and what was the original name given to the electrons? **(2 marks)**

(d) i) Define the term isotope **(1 mark)**

ii) State any three uses of isotopes **(3 marks)**

(e) Below are the isotopes of Silver and their percent abundance. Calculate the average atomic mass of silver. **(2 marks)**

Silver- 107 (32.50%), Silver- 108 (63.30%), Silver- 109

(f) What experiment proved a small dense positively charged nucleus? **(2 marks)**

(g) State any two postulates of Bohr's atomic model **(2marks)**

(h) (I) State the following principles and rule

i. Hund's rule

ii. Aufbau's principle

iii. Pauli's exclusion principle **(3 marks)**

(II) Write the electronic configuration of the following atoms using the orbitals (s,p,d,f) **(4 marks)**

i. Sodium (11)

ii. Phosphorus (15)

iii. Zinc (30)

iv. Nitrogen (7)

(i) Distinguish between ionic bonding and covalent bonding **(2 marks)**

(j) Valence bond theory and molecular orbital theory share many assumptions, but also differ in many ways. State the three similarities between them **(3 marks)**

QUESTION TWO (20 MARKS)

2. (I) (a) Briefly describe the Rutherford Atomic model experiment **(5 marks)**

(b) Based on the observations made during the experiment, state the three conclusions he made **(3 marks)**

(c) State the four postulates of the Rutherford atomic model based on observations and conclusions **(4 marks)**

(II) (a) State the modern periodic Law **(1 mark)**

(b) What is the basic difference in approach between the Mendeleev's and the Modern Periodic Law? **(2marks)**

(c) Using alkali metals as an example explain the cause of periodicity in the modern periodic table **(3 marks)**

(d) Name all the blocks contained in the modern periodic table **(2 marks)**

QUESTION THREE (20 MARKS)

3.(I) (a) State the three basic tenets/principles of valence bond (VB) theory **(4 marks)**

(b) Describe briefly the four postulates of valence bond theory (VBT) **(4 marks)**

(II) When in danger, bombardier beetles can fire a hot, toxic mixture of chemicals at their attacker. This mixture contains Quinone, $C_6H_4O_2$, a compound that is formed by the reaction of hydroquinone, $C_6H_4(OH)_2$, with hydrogen peroxide, H_2O_2. The equation for the overall reaction is:

$$C_6H_4(OH)_{2(aq)} + H_2O_{2(aq)} \rightarrow C_6H_4O_{2(aq)} + 2H_2O_{(\ell)}$$

Use the following data to calculate the enthalpy change, in kJ mol^{-1}, for the above reaction **(3 marks)**

$C_6H_4(OH)_{2(aq)} \rightarrow C_6H_4O_{2(aq)} + H_{2(g)}$ $\Delta H = +177.4$ kJ mol^{-1}
$H_{2(g)} + O_{2(g)} \rightarrow H_2O_{2(aq)}$ $\Delta H = -191.2$ kJ mol^{-1}
$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(g)}$ $\Delta H = -241.8$ kJ mol^{-1}
$H_2O_{(g)} \rightarrow H_2O_{(\ell)}$ $\Delta H = -43.8$ kJ mol^{-1}

(III) Given the following information for magnesium, oxygen, and magnesium oxide.Calculate the second electron gain enthalpy for oxygen {i.e. for $O^-_{(g)} + e \rightarrow O^{2-}_{(g)}$}. **(4 marks)**
For Mg (s), $\Delta H_{sub} = +148$ kJ/mol
Bond dissociation energy for $O_2 = +499$ kJ/mol
1st ionization energy for Mg = +738 kJ/mol
1st electron gain enthalpy for O = –141 kJ/mol
2nd ionization energy for Mg = +1450 kJ/mol
For MgO (s), lattice energy = +3890 kJ/mol
For MgO (s), enthalpy of formation = –602 kJ/mol

(IV) (a) Distinguish between molality and molarity **(2 marks)**
(b) A sulfuric acid solution containing 571.4 g of H_2SO_4 per liter of the solution has a density of 1.329 g/cm^3. Calculate the molality of H_2SO_4 in this solution **(3 marks)**

QUESTION FOUR (20 MARKS)
4.(a) (i)Solids are classified into two categories: Name the two categories **(2 marks)**
(ii) Explain the characteristics of the two categories named in (i) above giving examples **(4 marks)**
(b) (i) State the kinetic theory of matter **(1 mark)**
(ii) (a) what is a redox reaction **(1mark)**
(b) From the following reaction deduce the two half-cell reactions **(2 marks)**
$Co_{(s)} + Ni^{2+}_{(aq)} \rightarrow Co^{2+}_{(aq)} + Ni_{(s)}$
(c) A careful examination of several thousand crystals of various substances reveals that there are only seven possible crystal symmetries exhibited by solids. State the seven systems and explains what they entail **(7 marks)**
(d) State the following laws **(3marks)**
i. Gay Lussac's law
ii. Avogadro's law
iii. Charles law

QUESTION FIVE (20 MARKS)

5.(a)(i) Assume gases are ideal deduce the relationship between K_P and K_C **(5 marks)**

(ii) The equilibrium constant (K_c) for the reaction $H_2+I_2 \leftrightarrow 2HI$ is 60 at 450 °C. Calculate the number of moles of HI in equilibrium with 2 moles of hydrogen and 0.3 moles of I at 450 °C. **(5 marks)**

(b) (i) State Lechatelier's principle **(2 marks)**

(ii) State and explain the four factors that affect the position of the equilibrium **(8 marks)**