A·A·A·Z

PRESIDENT'S OFFICE
REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT
ILBORU SECONDARY SCHOOL
FORM SIX PRE-NATIONAL EXAMINATION SERIES –I-
CHEMISTRY -2-

TIME: 3:00HOURS **October 21, 2019**

INSTRUCTIONS.

- This paper consists of ten (10) questions in section A, B and C.
- Answer five (05) questions; choose at least one (01) question from each section.
- Each question caries twenty (20) marks
- Mathematical and non-programmable calculator may be used.
- Cellular phones are not allowed in the examination room
- For your calculation you may use the following constants:-
- Rydberg's constant = $1.097\times 10^{7}m^{-1}$Speed of light = $3 \text{ X } 10^{8}$ M/s Planck's constant 6.63×10^{-34}Jsec , Universal gas constant $8.31J\ mol^{-1}K^{-1}$ / $0.0821\ dm^{3}\ Atm\ mol^{-1}K^{-1}$
  Atomic mass; H = 1, N = 14 Na = 23, Mg = 24, F = 19, O = 16, C = 12, Cu = 64, Ag = 108, Fe = 56, Mn = 55, S = 32. Ti = 22, Sc = 21, Ni = 28, Cl = 35.5, Br = 80,

SECTION A

1. (a) Define the following terms
   (i) Oxidation
   (ii) Cathode
   (iii) Reducing agent [06]

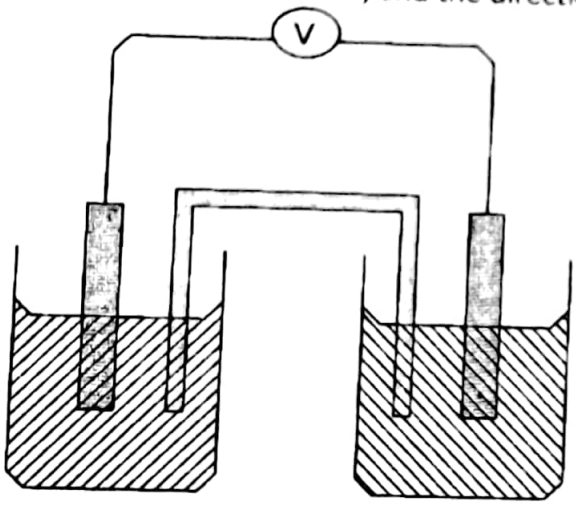
(b) Balance the following oxidation–reduction equation. The reactions occur in acidic or basic aqueous solution,

$$MnO_4^- + C_2O_4^{2-} \longrightarrow MnO_2 + CO_2$$ [03]

(c) You have the following setup to construct a cell under standard conditions. The anode and cathode are iron and silver rods. Using cell notation, the cell is

$$Fe_{(s)} \mid Fe^{2+}_{(aq)} \mid\mid Ag^{+}_{(aq)} \mid Ag_{(s)}$$

(i) Complete the figure of the cell by labeling the anode and cathode and showing the corresponding reactions at the electrodes. Indicate the electron flow in the external circuit, the signs of the electrodes, and the direction of cation migration in the half-cells. [03]



Given

$Fe^{2+}_{(aq)} + 2e^- \longrightarrow Fe_{(S)}$ $E^0 = -0.41$ V

$Ag^{+}_{(aq)} + e^- \longrightarrow Ag_{(s)}$ $E^0 = +0.80$ V

$Cu^{2+}(aq) + 2e^- \longrightarrow Cu_{(s)}$ $E^0 = +0.34$ V

(ii) What is the cell potential, E^0_{cell}? Is this a voltaic or an electrolytic cell? How do you know? [02]

(iii) When you are constructing the cell, what impact does the volume of solution in each of the beakers have on the cell potential? (Assume that there is enough volume to cover at least one-third of the anode and cathode rods.) [01]

(iv) If you were to add distilled water to the solution that contains the $Ag^+_{(aq)}$, would this have any effect on the cell voltage? If so, explain how the cell voltage would change. [01.5]

(v) When constructing the cell, you decide to swap the silver rod; $Ag_{(s)}$ that is used as a cathode for a copper rod, $Cu_{(s)}$. Will this change have any effect on the cell potential or the operation of the cell? Explain. [01.5]

(vi) Starting with the original cell, this time you swap the iron rod used as the anode for a copper rod, Cu(s). How will this change affect the cell potential and the operation of the cell? [02]

2. (a) Define the following terms:
   (i) Solubility
   (ii) Solubility products.

(iii) Precipitates. [06]

(b) In a saturated solution of MgF_2 at 18°C, the concentration of Mg^{2+} is 1.21×10^{-3} molar. The equilibrium is represented by the equation below.

$$MgF_2(s) \rightleftharpoons Mg^{2+}_{(aq)} + 2F^-_{(aq)}$$

(i) Write the expression for the solubility-product constant, Ksp, and calculate its value at 18°C. [02.5]

(ii) Calculate the equilibrium concentration of Mg^{2+} in 1.000 liter of saturated MgF_2 solution at 18°C to which 0.100 mole of solid KF has been added. The KF dissolves completely. Assume the volume change is negligible. [02.5]

(iii) Predict whether a precipitate of MgF_2 will form when 100.0 milliliters of a 3.00×10^{-3} molar $Mg(NO_3)_2$ solution is mixed with 200.0 milliliters of a 2.00×10^{-3} molar NaF solution at 18°C. Calculations to support your prediction must be shown. [02.5]

(iv) At 27°C the concentration of Mg^{2+} in a saturated solution of MgF_2 is 1.17×10^{-3} molar. Is the dissolving of MgF_2 in water an endothermic or an exothermic process? Give an explanation to support your conclusion. [02.5]

(c) The value of Λ_m^∞ for HCl, NaCl and CH_3CO_2Na are 426.1, 126.5 and 91 S cm^2 mol^{-1} respectively.

(i) Calculate the value of Λ_m^∞ for acetic acid. If the equivalent conductivity of the given acetic acid is 48.15S cm^2 $equivalent^{-1}$ at 25°C, [02]

(ii) Calculate its degree of dissociation. [02]

3. (a) Explain the following terms.

i. Salt hydrolysis.
ii. Buffer solution.
iii. Conjugate base.
iv. Common ion effect [08]

(b) How many grams of sodium acetate, $NaC_2H_3O_2$, would have to be added to 1.0 L of 0.15 M acetic acid (pKa 4.74) to make the solution a buffer for pH 4.00? [04]

(c) In an experiment to determine the molecular weight and the ionization constant for ascorbic acid (vitamin C), a student dissolved 1.3717 grams of the acid in water to make 50.00 milliliters of solution. The entire solution was titrated with a 0.2211-molar NaOH solution. The pH was monitored throughout the titration. The equivalence point was reached when 35.23 milliliters of the base had been added. Under the conditions of this experiment, ascorbic acid acts as a monoprotic acid that can be represented as HA.

(i) From the information above, calculate the molecular weight of ascorbic acid. [02]

(ii) When 20.00 milliliters of NaOH had been added during the titration, the pH of the solution was 4.23. Calculate the acid ionization constant for ascorbic acid. [02]

(iii) Calculate the equilibrium constant for the reaction of the ascorbate ion, A^-, with water. [02]

(iv) Calculate the pH of the solution at the equivalence point of the titration. [02]

4. (a) Define order of reaction. How will you prove that a chemical reaction is of first order [04]

(b) For a chemical reaction what is the effect of catalyst on the following

(i) activation energy of the reaction

(ii) rate const. of the reaction [04]

(c) For the reaction $2NO + Cl_2 \rightarrow 2NOCl$ The following data were collected .All the measurements were taken at 263K

Expt no.	Initial [NO](M)	Initial $[Cl_2]$(M)	Initial rate of disappearance of Cl_2 (M/min)
1	0.15	0.15	0.60
2	0.15	0.30	1.20
3	0.30	0.15	2.40
4	0.25	0.25	?

(i) Write the expression for rate law.

(ii) Calculate the value of rate constant and specify its units.

(iii) What is the initial rate of disappearance of Cl_2 in expt.4? [08]

(d) The rate of a reaction increases four times when the temperature changes from 300 K to 320 K. Calculate the energy of activation of the reaction, assuming that it does not change with temperature. [04]

SECTION B

5. Give reasons for the following?
   (a) Nitrogen does not show catenation.
   (b) PCl_5 exists but NCl_5 does not.
   (c) The stability of Hydrides follows the order $NH_3 > PH_3 > Ar_5H_3 > SbH_3$
   (d) PH_3 is a weaker base than NH_3.
   (e) Fluorine forms only one oxoacid, HOF.
   (f) The negative election gain enthalpy of fluorine is less than that of chlorine.
   (g) The stability of hydrides follows the order HF>HCl>HBr>HI.
   (h) The increasing order of acidic character in 16th group hydrides is $H_2O < H_2S < H_2Se < H_2Te$
   (i) H_2O is liquid whereas H_2S is gas at room temperature
   (j) Halogens have smallest atomic radii in their periods. [@ 02 =20 marks]

6. (a) Give reasons for the following:-
   (i) Transition metals and many of their compounds show paramagnetic behaviour.
   (ii) The enthalpies of atomisation of the transition metals are high.
   (iii) The transition metals generally form coloured compounds.
   (iv) Transition metals and their many compounds act as good catalyst.
   (v) Transition metals have a strong tendency to form complexes. [10 marks]

   (b) To what extend do the electronic configuration decide the stability of oxidation state in the first series of the transition elements? Illustrate your answer with an example. [03 marks]

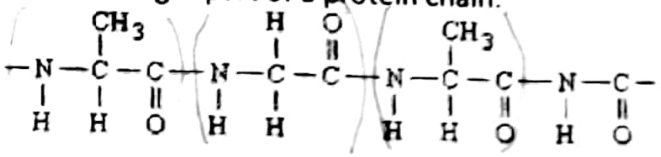
   (c) If theCo^{2+} ion is linked with strong-field ligands to produce an octahedral complex, the complex has one unpaired electron. If Co^{2+} is linked with weak-field ligands, the complex has three unpaired electrons. How do you account for this difference? [03 marks]

   (d) Give the systematic names for the following compounds.
   I. [Ag(NH3)2]Cl
   II. [Fe(en)3]PO4

(c) Distinguish between homopolymer and copolymer. Give example of each. [04]

(d) Name the monomers and write the partial structure of Nylon- 6,6 [02]

(e) The following is part of a protein chain.



(f) Draw the structure of two amino acids obtained on hydrolysis of this protein. [04]