

U.G. 2nd Semester Examination - 2023

CHEMISTRY

[HONOURS]

Course Code : CHEM-H-CC-T-03

(Inorganic & Physical)

Full Marks : 40

Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP-A

(Inorganic)

1. Answer any one from the following questions:

1×1=1

- Explain why methylamine is more basic than ammonia.
- What is the difference between standard potential and formal potential.

2. Answer any two of the following questions:

2×2=4

- Explain: Despite its higher dielectric constant, fewer salts dissolve in liquid HF than in H_2O .

[Turn Over]

- b) Why iodide salts are more soluble in liquid SO_2 than are salts of other anions.
- c) Write a note on auto oxidation.
- d) Why BCl_3 a better Lewis acid than BF_3 .

3. Answer any one from the following questions:

$5 \times 1 = 5$

- a) i) Considering the following E° values predict which would react with acid?

$\text{A}^+/\text{A}; E^\circ = -1.1; \text{B}^+/\text{B}; E^\circ = 1.2$ and $\text{C}^+/\text{C}; E^\circ = -2.3$ volt.

- ii) Aqueous solution of Fe^{3+} and Fe^{2+} ions, shows the potential +0.70 volt. Taking the E° value of $\text{Fe}^{3+}/\text{Fe}^{2+}$ as +0.77 volt calculate the $\text{Fe}^{3+}/\text{Fe}^{2+}$ ratio in the solution.

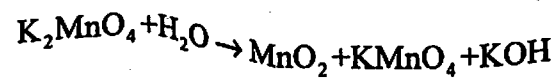
- iii) State the difference between valency and oxidation number.

$2+2+1=5$

- b) i) Arrange the following in the increasing order of acidity. Hence state how can you measure the relative strength of those.

$\text{HCl}, \text{HNO}_3, \text{H}_2\text{SO}_4, \text{HClO}_4, \text{HBr}$

- ii) Balance the equation by oxidation number method.



(2)

- iii) $\text{CH}_2\text{Cl COOH}$ is 100 times stronger and CCl_3COOH is 10,000 times stronger acid than CH_3COOH .— Explain. $2+2+1=5$

4. Answer any one from the following questions:

$10 \times 1 = 10$

- a) i) What is the function of salt bridge in galvanic cell?

- ii) Given: $\text{Co}^{3+} + e = \text{Co}^{2+} E^\circ = 1.81 \text{ V}$
 $\text{Fe}^{2+} + e = \text{Fe}^{2+} E^\circ = 0.77 \text{ V}$.

Write appropriate redox reaction.

- iii) Give the representation of a galvanic cell.

- iv) What are metal ion indicators? Explain its role in complexometric titration.

- v) Why pH is an important factor for selecting an indicator in a complexometric titration?

$2+2+2+(1+1)+2=10$

- b) i) Discuss the application of HSAB principle.

- ii) On the basis of Ostwald theory explain the working of phenolphthalein as indicator.

- iii) What are hard and soft acid and bases.

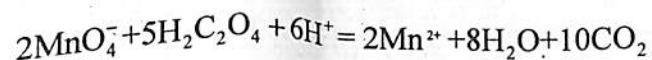
- iv) What do you mean by superacid? Discuss their characteristic.

(3)

- v) H_3BO_3 is a weak acid in aqueous media but it acts as a strong acid in H_2SO_4 . Justify.

$$2+2+2+(1+1)+2=10$$

- c) i) Why HF is a poorer solvent than water?
 ii) Discuss the factors that affect the strength of oxyacids.
 iii) The solution of NH_4Cl is weakly acidic but it becomes strongly acidic with addition of CuCl_2 or formaldehyde—Explain.
 iv) Many organic synthetic reactions can be easily carried out in liquid SO_2 —Explain.
 v) Calculate the equilibrium constant of the reaction.



(Given, E^0 for $2\text{MnO}_4^-/\text{Mn}^{2+} = +1.51 \text{ V}$, E^0 for $\text{CO}_2/\text{H}_2\text{C}_2\text{O}_4 = -0.49 \text{ V}$)

$$2+2+2+2+2=10$$

(4)

GROUP-B

(Physical)

5. Answer any **one** question from the following:

$$1 \times 1 = 1$$

- a) Write the expression for entropy changes in an isothermal reversible process.
 b) Define the order and molecularity of a reaction.

6. Answer any **two** questions from the following:

$$2 \times 2 = 4$$

- a) Show that the total entropy of the universe always increases for an irreversible process.
 b) Write down the criteria of spontaneity and equilibrium for a chemical reaction.
 c) Distinguish between a primary and a secondary kinetic isotope effect.

7. Answer any **one** question from the following:

$$5 \times 1 = 5$$

- a) Derive the rate equation for the hydrolysis of ester in presence of dilute acid or alkali and explain that the rate equation follows the pseudo-first order condition.
 b) Write down the postulates of the collision theory of reaction rates and state the final rate expression for a bimolecular gaseous reaction explaining all the terms involved.

$$3+2=5$$

$$3+2=5$$

(5)

- c) State the conditions and derive the expression of Joule-Thomson effect. Why the cooling effect is observed for the real gases only.

$$3+2=5$$

8. Answer any one question from the following:

$$10 \times 1 = 10$$

- a) i) Show that for a first order reaction, the time required for 99.9% completion of the reaction is 10 times the time for 50.0% completion.
- ii) One mole of an ideal gas expands reversibly from a volume of 20 dm^3 and temperature 298 K to a volume of 35 dm^3 and temperature 290 K . Assuming that $C_v = \frac{3}{2} R$, calculate the entropy change for the process.
- iii) Write any one of the Maxwell relations and discuss its physical interpretations.
- iv) Explain the thermodynamically and kinetically controlled reactions with the help of energy profile diagram.

$$2+2+3+3=10$$

- b) i) The rate constant for a second-order reaction is $8.00 \times 10^{-5} \text{ M}^{-1} \text{ min}^{-1}$. How long will it take for a 1.0 M solution to be reduced to 0.5 M in the reactant? How long will it take from that point until the solution is 0.25 M in reactant?

- ii) Derive the final rate equation of an enzyme catalyzed reaction in terms of the initial concentration of the enzyme.

- iii) One mole of nitrogen gas is mixed with three moles of oxygen gas at 25°C to form a mixture at the final pressure of 1 atm , the initial pressure of each being also $.1 \text{ atm}$. Calculate the molar entropy of mixing.

$$3+5+2=10$$