

U.G. 2nd Semester Examination - 2024**CHEMISTRY****[HONOURS]****Course Code : CHEM-H-CC-T-03****(Inorganic & Physical)****[CBCS]**

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:

 $1 \times 1 = 1$

- a) Write down the structure of a redox indicator.
- b) Explain why methylamine is more basic than ammonia.

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

 $2 \times 2 = 4$

- a) Does metallic copper dissolve in HCl? Give reason. $[E_{\text{Cu}^{2+}/\text{Cu}}^0 = 0.4\text{V}]$

[Turn Over]

- b) Why BCl_3 a better Lewis acid than BF_3 .
- c) What is super acid? Give example.
- d) Calculate the oxidation number of Cr in CrO_5 and O in F_2O .

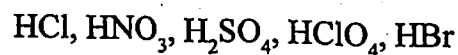
3. Answer any one from the following questions:

$$5 \times 1 = 5$$

- a) i) Balance the equation by oxidation number method.



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



- iii) CH_2ClCOOH is 100 times stronger and CCl_3COOH is 10,000 times stronger acid than CH_3COOH .— Explain. $2+2+1=5$

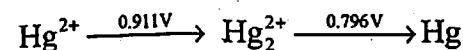
- b) i) Calculate the pH of 0.1 (M) CH_3COONa solution. (Given $K_a = 1.8 \times 10^{-5}$).

- ii) 100 ml of buffer solution of $\text{pH} = 9$ is to be prepared by mixing 0.1 (N) HCl and 0.1 (N) NH_4OH . Calculate the volume of each solution required to prepare the buffer ($K_b = 2 \times 10^{-5}$). $2+3=5$

4. Answer any one from the following questions:

$$10 \times 1 = 10$$

- a) i) Draw the Frost Diagram for mercury in acid solution from the given Latimer diagram.:



Determine the slope of each line and comment on the tendency of any of the species to undergo disproportionation.

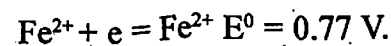
- ii) Show that the equilibrium constant (K) of a redox reaction is given by the equation $\log K = n / 0.0591 (E_1^0 - E_2^0)$

- iii) Explain the role of Zimmermann-Reinhardt solution during the titration of Fe^{2+} vs MnO_4^- in HCl medium.

$$(1+1+3)+3+2=10$$

- b) i) Give the representation of a galvanic cell.

- ii) Given: $\text{Co}^{3+} + e = \text{Co}^{2+}$ $E^0 = 1.81 \text{ V}$



Write appropriate redox reaction.

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

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

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

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

GROUP-B

(Physical).

5. Answer any one question from the following:

$$1 \times 1 = 1$$

a) Define the order and molecularity of a reaction.

b) What is meant by the efficiency of a heat engine?

6. Answer any two questions from the following:

$$2 \times 2 = 4$$

a) Distinguish between a primary and a secondary kinetic isotope effect.

b) Why is the half-life for a first-order reaction independent of the initial concentration?

c) How does rate of a reaction vary with temperature?

d) Show that $(\partial A / \partial V)_T = p$ and $(\partial A / \partial T)_V = -S$.

7. Answer any one question from the following:

$$5 \times 1 = 5$$

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

$$3 + 2 = 5$$

b) Write three important features of homogeneous catalysis. What is Lineweaver-Burk plot in enzyme catalysis? What is acid-base catalyst?

$$2 + 2 + 1 = 5$$

c) "Two Carnot engines working between the same temperature domains have the same efficiency."—Explain. Write the importance of Joule-Thomson co-efficient. Prove that this co-efficient is zero for an ideal gas.

$$2 + 1\frac{1}{2} + 1\frac{1}{2} = 5$$

8. Answer any one question from the following:

$$10 \times 1 = 10$$

a) i) Discuss Mechanism and Kinetics of Enzyme-catalyzed Reactions.

ii) Discuss the primary kinetic salt effect with a suitable example.

- iii) The boiling point of water at a pressure of 50 atmospheres is 265°C . Assume the temperature of the sink to be 35°C in this case. Calculate theoretical efficiency of a steam engine operating under these temperatures.

$$5+3+2=10$$

- b) i) 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.

- ii) 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.

- iii) Explain the thermodynamically and kinetically controlled reactions with the help of energy profile diagram.

- iv) Write any one of the Maxwell relations and discuss its physical interpretations.

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