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No. of printed pages: 03

[65]

SARDAR PATEL UNIVERSITY, VALLABH VIDYANAGAR

Eng.

Bachelor of Science (Semester-5) Examination – 2025

US05CCHE53: PHYSICAL CHEMISTRY

Date: 7/10/2025 Tuesday

Time: 10:00 am to 01:00 pm

Total: 70 Marks

NOTE: 1. Figure to the right indicate full marks of the questions.

2. All the questions are attempt to be compulsory.

Q.-1. Select the appropriate option for the following multiple choice questions. [10]

- Concept of _____ is the result of study of second law of thermodynamics.
(a) Free energy (b) Enthalpy (c) Entropy (d) Heat capacity
- The entropy of mixing of gases are always, _____.
(a) Negative (b) Positive (c) Constant (d) Zero
- Which of the following equation is called Boltzmann entropy equation?
(a) $S = k \ln W$ (b) $S = \ln W$ (c) $S = W \ln k$ (d) None of these
- The salt-bridge in the electrochemical cell serves to _____.
(a) Increase the rate at which equilibrium is attained.
(b) Increase the voltage of the cell.
(c) Maintain the electrical neutrality of the solution.
(d) Maintain the oxidation-reduction rate.
- Which of the following is called calomel?
(a) Sodium chloride (b) Potassium chloride
(c) Mercurous chloride (d) None of these
- $n C_2 H_2 \xrightarrow{h\nu} (C_2 H_2)_n$, which type of example of photochemical reaction?
(a) Polymerization (b) Addition
(c) Dissociation (d) Isomerisation
- Luminescence resulting from chemical reaction is known as _____.
(a) Fluorescence (b) Phosphorescence
(c) Chemiluminescence (d) Cathodoluminescence
- Photochemistry light radiations range from _____ to _____.
(a) 20 to 80 A° (b) 2000 to 8000 A° (c) 2 to 8 A° (d) 200 to 800 A°
- The maximum number of phases in any equilibrium state of one component system having zero degree of freedom will be _____.
(a) 1 (b) 2 (c) 3 (d) 4
- Which of the following method used to determine the transition point experimentally _____?
(a) Solubility method (b) Vapour pressure method
(c) Thermometric method (d) All of these

Q.-2. Answer the following questions. (Any Ten).

[20]

- Write the different statements of second law of thermodynamics.
- State the Carnot theorem.
- Define the term Isochoric process with necessary entropy equation.
- Write the half cell reactions and draw the schematic cell representation for the cell in which the following reaction could occur :
$$Cd(Hg) + Hg_2SO_4 + \frac{8}{3} H_2O(l) \longrightarrow CdSO_4 + \frac{8}{3} H_2O + 2Hg(l)$$
- What is electrochemical series? Give its uses.

[P.T.O.]

6. What is electrolyte concentration cell? Give example.
7. Define Photochemical reaction. Give its example also.
8. Define luminescence. Give their types.
9. State the Lambert's law. Give the mathematical equation.
10. What is phase reaction? State types of phase reactions.
11. Determine the number of components, number of phases and the degree of freedom for the system in which $\text{CaCO}_{3(s)}$ dissociate into $\text{CaO}_{(s)}$ and $\text{CO}_{2(g)}$ by the action of heat.
12. Explain why the fusion curve of ice has a negative slope in the phase diagram of water.

Q.-3. Answer the following

- (a) What do you mean by cyclic process? Describe in detail the Carnot-reversible cycle for establishing the maximum convertibility of heat into work. [06]
- (b) "Decrease in the function 'A' gives the maximum work that can be done by the system during the given change". Justify the statement. [04]

[OR]

Q.-3. Answer the following

- (a) "Entropy of the system and surrounding taken together remains constant in a reversible process while it increases in case of irreversible process." Justify. [06]
- (b) One mole of an ideal mono atomic gas expands reversibly from a volume of 10 dm^3 and temperature 298 K to a volume of 20 dm^3 and temperature 250 K . Assuming that $C_V = 1.5R$. Calculate the entropy change for the process. [Given: $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$]. [04]

Q.-4. Answer the following

- (a) Derive an expression for emf of the following electrode concentration cells. [06]
 - (1) $\text{Pb-Hg}(a_1)/\text{PbSO}_{4(\text{soln})}/\text{Hg-Pb}(a_2)$
 - (2) $\text{Pt}/\text{H}_2(p_1)/\text{HCl}/\text{H}_2(p_2)/\text{Pt}$
- (b) Discuss any four types of reversible electrodes giving electrode reaction. [04]

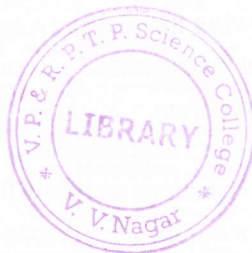
[OR]

Q.-4. Answer the following

- (a) How activity and activity coefficient are determined by emf measurements. [06]
- (b) For the $\text{Zn}/\text{Zn}^{+2} \parallel \text{Fe}^{+3}, \text{Fe}^{+2}/\text{Pt}$, cell, write the cell reaction and calculate the equilibrium constant of the cell reaction. [04]
[Given: $E^0_{\text{Fe}^{+3}/\text{Fe}^{+2}} = +0.771 \text{ V}$ and $E^0_{\text{Zn}^{+2}/\text{Zn}} = -0.7626 \text{ V}$].

Q.-5. Answer the following

- (a) Define Phosphorescence. Write the characteristics & any two examples of Phosphorescence. [06]
- (b) Calculate the energy in calories per mole or per Einstein for radiations of wavelength $1000 \text{ \AA}$. (Given: $N = 6.02 \times 10^{23} \text{ molecule/mole}$, $C = 3 \times 10^{10} \text{ cm/sec}$, $h = 6.62 \times 10^{-27} \text{ erg .sec}$) [04]



[OR]

Q.-5. Answer the following

- (a) Define Quantum yield. Explain the reasons for high & low quantum yield. [06]
(b) For the photochemical reaction $B \longrightarrow C$, 1.0×10^{-5} mole of B was formed on absorption of 6.62×10^7 ergs at $3600 \text{ \AA}$. Calculate the quantum yield or efficiency. (Given: $C = 3 \times 10^{10} \text{ cm/sec}$, $h = 6.62 \times 10^{-27} \text{ erg Sec}$) [04]

Q.-6. Answer the following

- (a) Derive the Gibbs phase rule equation viz, $F = C - P + 2$. What are the advantages of phase rule? [06]
(b) Draw and discuss the phase diagram of two components form a compound with congruent melting point. [04]

[OR]

Q.-6. Answer the following

- (a) Draw and discuss the phase diagram of sulphur system. [06]
(b) State and explain the important conditions for equilibrium between various phases in a heterogeneous system. [04]

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