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[64]

SARDAR PATEL UNIVERSITY

Eng:

Bachelor of Science (Semester-5) Examination – 2025

US05CCHE23 : PHYSICAL CHEMISTRY

Date: 7/10/2025 Tuesday

Time: 10:00 AM to 01:00 PM

Total: 70 Marks

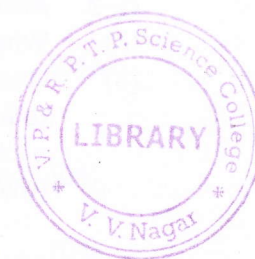
NOTE:

- Figure to the right indicate full marks of the questions.
- All the questions are attempt to be compulsory.

Q.-1. Multiple Choice Questions.

[10]

- The second law of thermodynamics is a statement of _____
 (a) Probability (b) Enthalpy
 (c) Conservation of an energy (d) Momentum
- Which of the following condition is necessary for a reaction to be spontaneous? _____
 (a) $\Delta S_{sys} + \Delta S_{surr} = 0$ (b) $\Delta S_{sys} + \Delta S_{surr} > 0$
 (c) $\Delta S_{sys} + \Delta S_{surr} < 0$ (d) All are correct
- Which of the following used to elucidating the mechanism of the complex reaction? _____
 (a) The steady state approximation (b) The mode of operation
 (c) (a) and (d) both (d) The equilibrium approximation
- Which of the following are called Arrhenius parameters? _____
 (a) k and A (b) k and T
 (c) E_a and T (d) E_a and A
- In the equation : $k = A e^{-E_a/RT}$, which term is dimensionless? _____
 (a) k (b) A (c) RT (d) $-(E_a)/RT$
- Luminescence resulting from chemical reaction is known as _____
 (a) Cathodoluminescence (b) Chemiluminescence
 (c) Fluorescence (d) Phosphorescence
- The factor which does not affect the quantum yield is _____
 (a) Pressure (b) Temperature
 (c) Wavelength (d) Light intensity
- From the Freundlich equation, the plot of $\log(x/m)$ versus $\log(P)$ is linear with slope equal to _____
 (a) $1/n$ (b) $\log(k)$
 (c) k (d) n
- The reverse of adsorption is called _____
 (a) Absorption (b) Desorption
 (c) Sorption (d) All of these
- The nature of chemisorption are _____
 (a) Dissociative (b) None-dissociative
 (c) Reactive (d) All of these



[P. T. O.]

Q.-2. Short answer questions. (Attempt TEN out of TWELVE).

[20]

1. Write the Carnot theorem.
2. Write the different statements of the second law of thermodynamics.
3. Define the term isochoric process with necessary entropy equation.
4. Explain the term cage-effect or Frank Rabinovich effect.
5. Can the activation energy of a reaction be zero or negative? Explain.
6. Define the terms: Catalyst and Temperature coefficient.
7. Define the terms: Incandescence and Luminescence.
8. Write the Grotthus-Draper and Stark-Einstein law of photochemical equivalence.
9. Write any two characteristics of the phenomenon of fluorescence.
10. Distinguish: Adsorption and Absorption.
11. What are the limitations of Freundlich equation of adsorption isotherm.
12. What is adsorption curve? Define adsorption isotherm.

Q.-3. Answer the following:

- (A) What is cyclic process? Discuss in detail Carnot cycle. [06]
- (B) 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 one atm, the initial pressure of each being also one atm. Calculate the molar entropy of mixing. [04]
[Given that: $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$].

OR

Q.-3. Answer the following:

- (A) Derive an expression for entropy change during the change of state of an ideal gas depends on the initial and final volumes as well as on the initial and final temperatures. [06]
- (B) "Decrease in work function 'A' gives the maximum work that can be done by the system during the given change". Justify the statement. [04]

Q.-4. Answer the following:

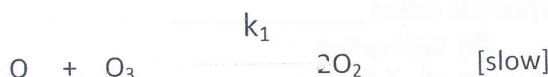
- (A) Discuss the kinetics of opposing (reversible) reaction in which the forward as well as the reverse reactions are both first order. [06]
- (B) The activation energy of a reaction is $94.140 \text{ KJ mol}^{-1}$ and the value of rate-constant at 40°C is $1.8 \times 10^{-5} \text{ sec}^{-1}$. Calculate the frequency factor, A. [04]
[Given that: $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$]

OR

Q.-4. Answer the following:

- (A) The gaseous decomposition of ozone, $2\text{O}_3 \longrightarrow 3\text{O}_2$, obey the rate law, $r = -d[\text{O}_3]/dt = k [\text{O}_3]^2/[\text{O}_2]$. [06]

Mechanism :



- (a) Show that the above mechanism is consistent with the above rate law.
(b) If $k = 5 \times 10^{-4} \text{ s}^{-1}$, calculate the time required for the concentration of ozone to be reduced to 20% of its original value.

- (B) Discuss the Lindemann theory of uni-molecular reaction. [04]

Q.-5. Answer the following:

- (A) What is quantum yield? Explain the reasons for high and low quantum yield. [06]
(B) Write a note on: Deviation from Beer's law. [04]

OR

Q.-5. Answer the following:

- (A) Derive and discuss the Beer-Lambert's law. [06]
(B) The bond energy of a molecule is 142.95 kcal mol⁻¹. What is the longest wavelength of light capable of dissociating this molecule? [04]
[Given: $N_A = 6.02 \times 10^{23}$, $h = 6.626 \times 10^{-27}$ erg.sec, $c = 3.0 \times 10^{10}$ cm sec⁻¹].

Q.-6. Answer the following:

- (A) Derive the Langmuir's equation of adsorption isotherm. Discuss the method of testing and its various forms under different conditions of pressure. [06]

- (B) Discuss the factors responsible for the physical adsorption. [04]

OR

Q.-6. Answer the following:

- (A) What are the characteristics (difference) between the physical adsorption and chemical adsorption? [06]
(B) Write a note on: "Adsorption indicators" [04]

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