2015

(3rd Semester)

CHEMISTRY

(CHEM–231)

(Physical Chemistry—I)

Full Marks : 55

Time : 2½ hours

(PART : B—DESCRIPTIVE)

(*Marks* : 35)

The figures in the margin indicate full marks for the questions

1. *(a)* What are extensive and intensive properties? Give examples. 2

(b) Define the terms molar heat capacity at constant volume (C_v) and molar heat capacity at constant pressure (C_p). Derive the relation between C_p and C_v of an ideal gas. 2

(c) Calculate q, W, Δu and ΔH for the reversible isothermal expansion of one mole of an ideal gas at 27 °C for a volume change of 10 dm^3 to 20 dm^3. 3

OR

2. (a) Derive Kirchhoff equation. 3

(b) Explain the term Joule-Thomson coefficient. Show that Joule-Thomson coefficient is zero for an ideal gas. 2

(c) What are state functions? How do they differ from path functions? Explain with examples. 2

3. (a) Derive an expression for the velocity constant of a second-order reaction of the type $2A \rightarrow P$. 4

(b) Define and explain the term temperature coefficient of a reaction. 1

(c) What is meant by energy of activation? How is the rate constant of a reaction related to its activation energy? 2

OR

4. *(a)* Starting from the full rate equation, determine the units of rate constant k for *(i)* a third-order reaction and *(ii)* a half-order reaction. 2

(b) 50% of a first-order reaction is complete in 23 minutes. Calculate the time required to complete 90% of the reaction. 2

(c) What are zero-order reactions? Give one example. 1

(d) What are meant by the terms molecularity and order of a reaction? 2

5. *(a)* What is an adsorption isotherm? Discuss Freundlich adsorption isotherm of a gas on a solid surface. 3

(b) Write notes on the following : 1×2=2

(i) Tyndall effect

(ii) Electrophoresis

(c) Describe briefly any one method for the purification of colloids. 2

OR

6. *(a)* Describe the determination of specific surface area of an adsorbent by BET method. 3

(b) What is meant by peptization? Give an example. 1

(c) Explain the Schulze-Hardy rule for coagulation. 2

(d) Write the difference between gels and emulsions. Give examples. 1

7. *(a)* Deduce Avogadro's law and Graham's law of diffusion from kinetic gas equation. 3

(b) Two moles of NH_3 are enclosed in a five-litre flask at 27 °C. Calculate the pressure exerted by the gas using *(i)* ideal gas equation and *(ii)* van der Waals' equation.
(Given, $R = 0{\cdot}08206\ dm^3\ atm\ K^{-1}\ mol^{-1}$) 2

(c) Define the terms critical temperature and critical pressure. 2

OR

8. *(a)* Derive the van der Waals' equation for n moles of a gas. 4

(b) What is compressibility factor? How does it account for the nature of a gas? 2

(c) What is the law of corresponding state? 1

9. *(a)* Describe the Carnot's reversible cycle for establishing the maximum convertibility of heat into work (efficiency). 4

(b) 5 moles of an ideal gas expand reversibly from a volume of $8\ dm^3$ to $80\ dm^3$ at a temperature of 27 °C. Calculate the change in entropy. (Given, $R = 8{\cdot}314\ JK^{-1}\ mol^{-1}$) 2

(c) State the second law of thermodynamics. 1

OR

10. *(a)* Derive an expression for the entropy change of an ideal gas associated with temperature and volume change. 3

(b) An engine operating between 150 °C and 25 °C takes 500 J heat from a high temperature reservoir. Calculate the work that can be done by this engine. 2

(c) Distinguish between reversible and irreversible processes. 2

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(PART : A—OBJECTIVE)

(*Marks* : 20)

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided for it : 1×5=5

1. For an irreversible process

(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) $(\Delta S_{sys} + \Delta S_{surr}) = 1$ ( )

2. The unit of rate constant for a first-order reaction is

(a) mole L^{-1} s^{-1} ( )

(b) $mole^{-1}$ L s^{-1} ( )

(c) s^{-1} ( )

(d) $mole^{-2}$ L^2 s^{-1} ( )

3. For the reaction $H_2 + I_2 \rightleftharpoons 2HI$, ΔH is equal to

(a) Δu ( )

(b) $\Delta u + 2RT$ ( )

(c) $\Delta u - 2RT$ ( )

(d) $\Delta u + RT$ ( )

4. The charge on As_2S_3 sol is due to the

(a) absorption of H^+ ions ( )

(b) adsorption of H^+ ions ( )

(c) absorption of S^{2-} ions ( )

(d) adsorption of S^{2-} ions ( )

5. A gas can be liquified

(a) above its critical temperature ( )

(b) below its critical temperature ( )

(c) at any temperature ( )

(d) None of the above ( )

SECTION—B

(*Marks* : 15)

Answer the following questions : 3×5=15

1. What do you mean by pseudounimolecular reactions? Give examples.

2. Distinguish between physisorption and chemisorption.

3. Discuss the significance of gas constant *R*. Calculate its value in joule K^{-1} mol^{-1}.

4. Write a note on Clausius inequality.

5. State the first law of thermodynamics. Deduce its mathematical form and explain the terms involved.

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