III/ CHEM (iii)

2016

(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)* Starting from the basic postulates, derive kinetic gas equation. 3

(b) Deduce the Avogadro's law from kinetic gas equation. 2

(c) Calculate from the van der Waals equation the temperature at which 3 moles of SO_2 would occupy a volume of $0 \cdot 01\ m^3$ at 1519875 Nm^{-2} pressure.

$a = 0 \cdot 679\ Nm^4\ mol^{-2}$

$b = 5 \cdot 64 \times 10^{-5}\ m^3\ mol^{-1}$

$R = 8 \cdot 314\ JK^{-1}\ mol^{-1}$ 2

OR

2. *(a)* Derive the van der Waals equation of state for real gases. 3

(b) Derive Boyle's law and Graham's law of diffusion from kinetic gas equation. 2

(c) State the law of corresponding state. 2

3. *(a)* What is zero-order reaction? Give two examples. Derive an expression for the rate constant and half-life period of a zero-order reaction. 1+2=3

(b) If a first-order reaction is 40% complete in 50 minutes, calculate the value of the rate constant. In what time will the reaction be 80% completed? 2

(c) What is meant by activation energy? How is activation energy determined with the help of Arrhenius equation? 2

OR

4. (a) What is pseudounimolecular reaction? Derive an expression for the first-order reaction rate constant

$$k_1 = \frac{1}{t} \ln \frac{a}{a - x}$$ 3

(b) Show that half-life period in first-order reaction is independent of initial concentration. 2

(c) At 100 °C, the half-life period for the thermal decomposition of N_2O_5 is 4·6 seconds and is independent of the initial pressure of N_2O_5. Calculate the specific rate constant at this temperature. 2

5. (a) State and explain *(i)* Tyndall effect and *(ii)* Brownian motion. 2

(b) What are colloids? How would you prepare the colloidal solution of *(i)* gold and *(ii)* Arrhenius sulphide? 3

(c) Describe one method for purifying colloidal solution. 2

OR

6. (a) Derive Langmuir adsorption isotherm and mention its significance. 3

(b) Discuss briefly BET theory of multilayer adsorption. How is this theory used in calculating the surface area of the adsorbent? 3

(c) Define molar enthalpy of adsorption. 1

7. (a) State and explain the first law of thermodynamics. 2

(b) Derive an expression for work done in isothermal reversible expansion of a gas. 3

(c) Calculate the pressure-volume work performed by the system during reversible isothermal expansion of two moles of an ideal gas from 2 litres to 10 litres at 20 °C. 2

OR

8. *(a)* Prove that the enthalpy of the system remains constant in an adiabatic expansion. 3

(b) What is heat of reaction? Find a relationship between q_p and q_v. 2

(c) The enthalpy of reaction (ΔH) for the formation of ammonia according to the reaction $N_2 + 3H_2 = 2NH_3$ at 27 °C was found to be $-91 \cdot 94$ kJ. What will be the enthalpy of reaction (ΔH) at 50 °C? The molar heat capacities at constant pressure and at 27 °C for nitrogen, hydrogen and ammonia are $28 \cdot 45$, $28 \cdot 32$ and $37 \cdot 07$ joules, respectively. 2

9. *(a)* What is cyclic process? With the help of Carnot's cycle, derive an expression for the efficiency of a reversible engine working between temperatures T_1 and T_2. 3

(b) Discuss entropy changes in reversible and irreversible processes. 3

(c) What is meant by efficiency of an engine? 1

OR

10. *(a)* What do you understand by thermodynamic scale of temperature? Prove that the temperatures on the Kelvin scale and ideal gas scale are the same. 3

(b) Prove that in a reversible process, net entropy change for the system and surrounding is zero. 2

(c) Calculate the amount of heat supplied to Carnot's cycle working between 368 K and 288 K, if the maximum work obtained is 895 joules. 2

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Subject Code : III/ CHEM (iii)

Booklet No. A

Date Stamp .....

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To be filled in by the Candidate

DEGREE 3rd Semester
(Arts / Science / Commerce / .....) Exam., **2016**

Subject .....
Paper .....

INSTRUCTIONS TO CANDIDATES

1. **The Booklet No. of this script should be quoted in the answer script meant for descriptive type questions and vice versa.**
2. **This paper should be ANSWERED FIRST and submitted within** *45 minutes* **of the commencement of the Examination.**
3. **While answering the questions of this booklet, any cutting, erasing, over-writing or furnishing more than one answer is prohibited. Any rough work, if required, should be done only on the main Answer Book. Instructions given in each question should be followed for answering that question only.**

To be filled in by the Candidate

DEGREE 3rd Semester
(Arts / Science / Commerce / .....) Exam., **2016**

Roll No. .....
Regn. No. .....

Subject .....
Paper .....

Descriptive Type
Booklet No. B .....

Signature of Scrutiniser(s)

Signature of Examiner(s)

Signature of Invigilator(s)

/55

2016

(3rd Semester)

CHEMISTRY

(CHEM–231)

(Physical Chemistry—I)

(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. In the van der Waals gas equation, the term which accounts for intermolecular forces is

(a) V b ( )

(b) V b ( )

(c) P a / V^2 ( )

(d) P a / V^2 ( )

2. Entropy change of the system is given by

(a) S_{system} q_{rev} / T ( )

(b) S_{system} q_{rev} / T ( )

(c) S_{system} q_{rev} / T q_{rev} / T ( )

(d) S_{system} q_{rev} / T q_{rev} / T ( )

3. Which method is preferred for the preparation of gold sol?

(a) Double decomposition ( )

(b) Reduction ( )

(c) Oxidation ( )

(d) Hydrolysis ( )

4. For an ideal gas, C_p and C_v are related as

(a) $C_p \quad C_v \quad R$ ( )

(b) $C_p / C_v \quad R$ ( )

(c) $C_p \quad C_v \quad R$ ( )

(d) $C_v \quad C_p \quad R$ ( )

5. The half-life period of any first-order reaction

(a) is half the specific rate constant ( )

(b) is always the same irrespective of the reaction ( )

(c) is independent of initial concentration ( )

(d) is directly proportional to initial reactant's initial concentration ( )

SECTION—B

(*Marks* : 15)

Answer the following questions : 3×5=15

1. Explain compressibility factor and critical compressibility factor. What do they signify?

2. Define heat capacity at constant volume and constant pressure of gaseous system.

3. Differentiate between lyophilic and lyophobic colloids.

4. State and explain Clausius inequality.

5. How do you determine the half-life of an *n*th-order reaction?

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