B.Sc. (General) 1ˢᵗ Semester

(1129)

CHEMISTRY

(Same for B.Sc. Microbial and Food Tech.)

Paper—III, Physical Chemistry—A

Time Allowed : Three Hours]   **[Maximum Marks : 22**

Note :— Attempt **five** questions in all, selecting at least **one** question each from Sections A, B, C, D and Section E is compulsory. Use of log tables and simple calculators is allowed.

SECTION—A

I. (a) Evaluate $\dfrac{(6234)^{1/3} \times (62.34)^{1/2}}{(0.006234)^{1/4} \times (6.234)^{1/5}}$.   2

(b) If $y = \sqrt{x} + \dfrac{1}{\sqrt{x}}$, find $\dfrac{dy}{dx}$.   1

(c) Evaluate $\int \dfrac{dx}{1 - \sin x}$.   1

II. (a) The students in a class were asked to determine the normality of the given acid solution by titration against standard NaOH solution. They repeated the results as follows :

0.1025 N, 0.1057 N, 0.1018 N, 0.1042 N

Calculate :

(i) Median

(ii) Average deviation

(iii) Relative average deviation

(iv) Standard deviation. 2

(b) Explain the different ways by which the errors in measurement can be minimised. 1

(c) Briefly explain the terms – accuracy and precision. What is the difference between the two ? 1

SECTION—B

III. (a) Calculate the root mean square velocity of chlorine molecules at 17°C and 800 mm pressure. 1

(b) Briefly explain the terms 'collision number' and 'collision frequency'. Derive expressions for each of them. 1

(c) Explain Maxwell's distribution of velocities. Describe the effect of temperature. 2

IV. (a) The reduced volume and reduced temperature of a gas are 10.2 and 0.7, respectively. What will be its pressure if its critical pressure is 42 atm ? 1

(b) Derive expression for critical constants in terms of van der Waals constants and hence derive the relationship between them. 2

(c) A certain quantity of methane occupies a volume of 0.138 litre under a pressure of 300 atm and 200°C. What will be volume at 600 atm and 0°C ? Compressibility factor under the former conditions is 1.067 whereas under the latter conditions, it is 1.367. 1

SECTION—C

V. (a) Derive an expression for rate constant for reactions of first order. What are the units of rate constant for reactions of first order ?   1

(b) A second order reaction in which the initial concentration of both the reactants are same is 25% complete in 600 sec. How long will it take for the reaction to go to 75% completion ?   2

(c) Briefly describe the half-life period method for determination of order of reaction.   1

VI. (a) At 100°C, the half-life period for the thermal decomposition of N_2O_4 is 4.6 sec. and is independent of the initial pressure of N_2O_5. Calculate the specific rate constant at this temperature.   2

(b) Derive an expression for the rate constant for reactions of second order involving two reactants of different initial concentrations.   1

(c) Derive an expression for the disintegration constant for the decay of a radioactive substance.   1

SECTION—D

VII. (a) Derive Arrhenius equation giving the effect of temperature on the rate constant of a reaction.   2

(b) For a reaction at 27°C, the rate constant is found to be 4.3×10^{-3} s^{-1}, and the frequency factor is found to be 2.785×10^6 s^{-1}. Calculate the entropy and enthalpy of activation.   2

VIII. (a) Derive Michaelis-Menten equation. Deduce the definition of Michaelis constant and explain how its can be determined. 2

(b) What is autocatalysis ? Explain with suitable examples.

1

(c) What are catalytic promoters and inhibitors ? How do they work ? 1

SECTION—E

(Compulsory Question)

IX. (a) How does the activity of an enzyme vary with temperature and at what temperature is it found to be maximum ?

(b) What is a zero order reaction ? Explain with suitable examples.

(c) Does mean free path depend upon the velocity of the molecules ? Justify your answer.

(d) Define Boyle temperature. How is it related to van der Waals constants 'a' and 'b' ?

(e) Solve for x in the relation $\log_{27} x = \dfrac{4}{3}$.

(f) What is the basic principle of least square method for curve fitting ? $6 \times 1 = 6$