# 2017

## CHEMISTRY

## [ Honours ]

## PAPER – VII

*Full Marks* : 45

*Time* : 2 hours

*The figures in the right hand margin indicate marks*

*Candidates are required to give their answers in their own words as far as practicable*

*Illustrate the answers wherever necessary*

## [OLD SYLLABUS]

## GROUP – A

Answer any **one** question from the following : 15 × 1

1. (*a*) For a certain reaction, the plot of ln $k$ versus $\frac{1}{T}$, the plot is linear. Assuming the validity

of Arrhenius equation, What quantities are obtained from the slope and the intercept of the plot ? 4

(*b*) Derive the expression for rotational energy for the $j^{th}$ level of a diatomic molecule-considering the rigid rotator model. 4

(*c*) A solution of $10^{-3}$ (M) '*A*' and some *B*. When it place in 2 cm cell absorp 80% of the incident light at a certain wavelength. If the extinction coefficient of *A* and *B* at this wavelength are 250 and 1000 $dm^3 mol^{-1} cm^{-1}$, find the concentration of *B* in the soln. 4

(*d*) State Hardy-Schulz rule and explain how this rule explains the effect of charge on the Coagulating power of an electrolyte. 3

2. (*a*) Derive Bragg's equation stating the necessary conditions. 3

(*b*) In an acid catalysed reaction

$$A + H_2O + H^+ \longrightarrow \text{product.}$$

Where $[H^+] = 0{\cdot}1$ (M) and $H_2O$ present in large excess the pseudo first order rate constant is found to be $1{\cdot}5 \times 10^{-5}\ s^{-1}$. Calculate the true rate constant. 4

(*c*) Define lyophilic and lyophobic colloids with example. State the difference between the two. 2 + 2

(*d*) Evaluate the commutator $\left[\hat{x}, \hat{p}_x^2\right]$. 4

## GROUP – B

Answer any **two** questions from the following : $10 \times 2$

3. (*a*) From the reaction

$$NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$$

$$K_a = 5{\cdot}6 \times 10^{-10}$$

$$NH_4^+ + HO^- \underset{k_b}{\overset{k_f}{\rightleftharpoons}} NH_3 + H_2O$$

$$K_f = 3{\cdot}4 \times 10^{10}\ mol^{-1}\ s^{-1}.$$

Calculate '$k_b$'. 4

(*b*) Explain what is meant by CMC ? Give a schematic diagram of the molar conductance ($\mu$) vs concentration ($c$) to detect CMC and explain the curve. 3

(*c*) Determine the eigenvalue, when

$$\psi(x) = A^* e^{-\frac{x^2}{2}} \text{ and } \hat{H} = -\frac{d^2}{dx^2} + x^2. \quad 3$$

4. (*a*) A reaction is carried out at 500 K. In presence of catalyst the reaction is caried out at the same rate at 400 K. If the catalyst lowers the activation energy by 20 kJ $mol^{-1}$. What will be the activation energy of the reaction ? 4

(*b*) Establish the relation between radius ($r$) of a particle and edge length '$a$' of a body centred cubic lattice. 3

(*c*) Write the BET equation and explain the terms involved. How this equation is used in the determination of surface area of solid ? 3

5. (*a*) State and explain the 'rule of mutual exclusion' in the case $CO_2$ molecule with reference to Raman and infrared spectroscopy. 1 + 3

(*b*) The rate constant for the first order decomposition of a certain reaction is described by the equation.

$\ln (k_r / s^{-1}) = 33{\cdot}025 - (5{\cdot}43 \times 10^3\ K)/T$

Find out the ration $E_a/R$. 2

(*c*) State and explain Heisenberg's uncertainty principle. Comment on the uncertainty between $p_x$ and $y$. 2 + 2

6. (*a*) The rotational constant for $^1H^{35}Cl$ is observed to be $10{\cdot}5909\ cm^{-1}$. What is the value of rotational constant for $^2D^{35}Cl$? State the assumptions involved in the calculation. 4

(*b*) For the reaction $N_2 + 3H_2 = 2NH_3$, if $\frac{d[H_2]}{dt} = -0{\cdot}012\ mol\ L^{-1}s^{-1}$. What are the $\frac{d[N_2]}{dt}$ and $\frac{d[NH_3]}{dt}$ at that instant? 3

(c) Define the term electrophoresis. What is its importance ? 1 + 2

## GROUP – C

7. Answer any **five** question : 2 × 5

(a) $aA + bB \longrightarrow$ product can one write Rate $\alpha [A]^a [B]^b$ ; Given reason.

(b) For bimolecular reaction Eyring equation is

$$K_r = \frac{RT}{N_f hc^0} K^*$$

symbols have their usual significance. Find out the unit of '$K_r$'.

(c) Why intensity of Rayleigh lines are more than Stoke's line ?

(d) Calculate the degeneracy of the energy level with energy equal to $\frac{11h^2}{8ma^2}$ for a particle in a cubical box.

(*e*) Define Isoelectric point.

(*f*) Point out the essential difference between Einstein and Debye model of heat capacity of solid.

(*g*) Adsorption is an exothermic process— Comment.

(*h*) What do you mean by Frank-Condon principle.

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