

2017

CHEMISTRY

[ Honours ]

PAPER – IV

Full Marks : 45

Time : 2 hours

Answer any **one** from Group-A and any **two** from  
Group-B and any **five** from Group-C

*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*

[ NEW SYLLABUS ]

GROUP – A

Answer any **one** question : 15 × 1

1. (a) Show that two different - non degenerate eigen-functions  $\psi_1$  and  $\psi_2$  of a hermitian operator are orthogonal. 3

( Turn Over )

- (b) What is stationary state in quantum mechanics ? Does the function

$$\psi(x, t) = e^{iEt} \cdot \psi(x)$$

represent the stationary state ? 1 + 2

- (c) What do you mean by isotonic solution ?  $K_4Fe(CN)_6$  is 45% dissociated in 0.1 M aqueous solution at 27°C. What would be its osmotic pressure of the solution. 3

- (d) Derive Clapeyron equation from suitable Maxwell's relation. Using this equation explain the effect of pressure on melting of ice. 2 + 1

- (e) Depict, with explanation, the conductometric titration curve, for the titration of oxalic acid with NaOH. 1 + 2

2. (a) Derive the expression for osmotic pressure using the concept of chemical potential. 5

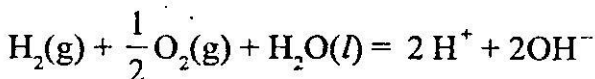
- (b) The solubility product of  $CaF_2$  at 25°C is  $1.6 \times 10^{-10}$ . Should precipitation occur when

( 3 )

50 ml of  $5 \times 10^{-2}$  (M)  $\text{Ca}(\text{NO}_3)_2$  is mixed with 50 ml of  $4 \times 10^{-4}$  (M) NaF solution. If precipitation occurs, how much  $\text{CaF}_2$  will be precipitated? 4

(c) Show that if  $\psi$  is an eigen function of two operators  $\hat{A}$  and  $\hat{B}$ , then they must commute. 3

(d) Construct the cell for the given cell reaction.



Calculate the standard reduction potential of Pt ( $\text{O}_2$ )/ $\text{OH}^-$  electrode, where

$$\Delta G_{\text{cell}}^{\circ} = -18600 \text{ cal.} \quad 1 + 2$$

GROUP - B

Answer any two questions : 10 x 2

3. (a) Is  $\psi = e^{-x}$  an acceptable wave function in the range zero to infinity. Discuss with reasons. 2

- (b) Discuss the moving boundary method for the determination of transport number of an ion. 3
- (c) How can you prepare 100 ml buffer solution of pH = 9.0 from 0.1 (N)  $\text{NH}_4\text{OH}$  and 0.1(N) HCl. ( $K_b = 2 \times 10^{-5}$ ). 3
- (d) Show that the equilibrium constant depends on the stoichiometry of the reaction. 2
4. (a) The transport number of  $\text{Na}^+$  is 0.385. The equivalent conductance of NaCl at infinite dilution is  $126.5 \text{ Ohm}^{-1} \cdot \text{cm}^2 \cdot \text{equiv}^{-1}$ . Estimate the distance traversed in one hour by  $\text{Na}^+$  in very dilute solution in a cell of electrodes of 1 cm apart and the potential difference of 30 volt is applied between the electrodes. 3
- (b) Define buffer capacity. Show that buffer capacity is maximum when  
[salt] : [acid] = 1 : 1. 1 + 2

( 5 )

(c) What is meant by ionic mobility? Obtain its expression in term of ion conductance at infinite dilution. 1 + 3

5. (a) What is the basic difference between compton effect and photo-electriceffect. 2

(b) At 2000 K temperature the standard free energy change in calories for the reaction :



$\Delta G^\circ = 22000 - 2.5 T$ . Calculate  $K_p$  and  $K_c$ . 3

(c) State Kohlrausch's Law of independent migration of ions and explain how the equivalent conductance of a weak electrolyte can be determined with the help of this law. 3

(d) An aqueous solution of ammonium acetate can act as buffer. Explain. 2

6. (a) A buffer solution is made from 0.06 mole of acetic acid ( $p^{ka} = 4.76$ ) and 0.04 moles per litre sodium acetate. What is the change of pH when (i) 0.015 mole HCl per litre and (ii) 0.03 moles NaOH per litre are added separately to the given buffer. 3
- (b) Show that for a solution of two components, if one component obeys Raoult's law then another component will also obey Raoult's law. 3
- (c) What is meant by liquid junction potential? Derive its expression considering suitable cells. 1 + 3

GROUP – C

7. Answer any five questions : 2 × 5
- (a) Electrode potential is intensive. Explain. 2
- (b) State and explain the Le Chatelier's principle. 2
- (c) Define linear operator. Give example. 2

- (d) What is the value of pH of the solution, when 75 % of 0.1(N)  $\text{CH}_3\text{COOH}$  is titrated by 0.1 (N)  $\text{NaOH}$ .  $\text{pK}_a = 4.76$ . 2
- (e) Express calomel electrode and mention with respect to which ion this electrode is reversible ? 2
- (f) Construct the Cell, where cell reaction is,  
 $\text{Ag}^+ + \text{Cl}^- = \text{AgCl}$ . 2
- (g) Why an electron can't exist in nucleus ? 2
- (h) Calculate the ionic strength of the solution which is 0.1 M in  $\text{Na}_2\text{SO}_4$ , 0.2 M in  $\text{AlCl}_3$  and 0.15 M in  $\text{KNO}_3$ . 2
-