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**SARDAR PATEL UNIVERSITY**

M. Sc. (Chemistry) Examination, Fourth Semester (NC) (CBCS)

Tuesday, 19<sup>th</sup> November, 2019

Time: 02.00 p.m. to 05.00 p.m.

Subject: Electro-Analytical Methods Paper: PS04CANC22

N.B. (1) Figures to the right indicates full marks [Total Marks: 70]

(2) Attempt all questions

1. Choose appropriate answer of the following: [08]

- i) Which of the following is not the characteristic of ion selective electrodes?
- (a) It is fragile (b) It is easy to use  
(c) Available in different sizes and shapes (d) Insensitive to many ions
- ii) The pH of a  $10^{-10}$  M HCl solution is approximately
- (a) 1 (b) 7 (c) 10 (d) 14
- iii) Which pairing of quantity and unit is incorrect?
- (a) Resistivity;  $\Omega$  m (b) Molar conductivity;  $S\ m^2\ mol^{-1}$   
(c) Resistance;  $\Omega$  (d) Conductance;  $S\ m^{-1}$
- iv) In conductance measurements, the platinum electrodes are ordinarily platinized
- (a) to increase their effective surface (b) to increase their capacitance  
(c) to minimize faradic currents (d) all
- v) The current due to supporting electrolyte is called
- (a) Residual current (b) Diffusion current  
(c) Migration current (d) Half wave potential
- vi) The polarographic method can be used for the determination of organic functional groups in
- (a) organic chemistry (b) food industry  
(c) pharmacy and medicine (d) All
- vii) Potentiometry is a technique used to determine the amount of substance in solution by measuring the electromotive force:
- (a) at the cathode (b) at the anode  
(c) between the cathode and anode (d) none of the above
- viii) Which of the following liquid membrane electrode is particularly useful?
- (a)  $Ca^{2+}$  (b)  $Na^+$  (c)  $K^+$  (d)  $Mg^{2+}$

(1)

(P.T.O.)

**Q. 2** Attempt any SEVEN of the following: [14]

- i) Write about the relation between Specific conductance and Equivalent conductance.
- ii) Write a note on Calomel electrode.
- iii) What are the factors that govern diffusion current?
- iv) Obtain the relation for dissociation constant for weak acid and weak base using pH metry measurements.
- v) Explain about metal-metal ion electrode.
- vi) Write the applications of amperometry titrations.
- vii) Differentiate between Direct potentiometric measurements and Potentiometric titrations.
- viii) Write about the Kohlrausch's law for infinite dilution.
- ix) Write about Ilkovic equation and explain the terms involved in it.

**Q. 3** [A] Deduce the relation:  $E = E^0 - \frac{0.0591}{n} \log K$  for the general reaction  $aA + bB \leftrightarrow cC + dD$  utilizing 1<sup>st</sup> and 2<sup>nd</sup> law of thermodynamics. [06]

[B] Write a note on: (i) Glass membrane electrode [06]  
(ii) Solid-state membrane electrode

OR

[B] (i) Calculate the pH of an aqueous solution obtained by mixing 25 ml of 0.2 M HCl with 50 ml of 0.25 M NaOH. [03]

(ii) Discuss the liquid membrane electrode. [03]

**Q. 4** [A] What are Concentration cells? Discuss the electrolytic cell with and without transference. [06]

[B] Write a note on: (i) applications of electrogravimetry and (ii) Hydrogen-Oxygen coulometer [06]

OR

[B] (i) Explain how activity coefficient can be calculated from potentiometry measurements. [03]

(ii) Consider the electrochemical cell: Fe, Fe<sup>2+</sup> (0.1 M) / Cd<sup>2+</sup> (0.001 M), Cd [03]

(a) Write the cell reactions (b) Calculate emf of the cell and (c) Calculate the equilibrium constant of the cell.

(Given:  $E_{Cd^{2+}/Cd}^0 = -0.40$  V &  $E_{Fe^{2+}/Fe}^0 = -0.44$  V)

(2)

- Q. 5 [A] Write about the conductometric titrations involving: [06]  
 (i) Precipitation and (ii) Complex formation
- [B] Explain how: [06]  
 (i) Solubility and solubility product of sparingly salts and  
 (ii) Hydrolysis and hydrolysis constant can be determined from conductometric measurements.

OR

- [B] Answer the following:
- (i) Differentiate between Conductometric titrations and Potentiometric titrations. [03]
- (ii) At 25 °C, the specific conductance of a saturated solution of AgCl is  $2.68 \times 10^{-4} \text{ Sm}^{-1}$  and that of water with which the solution was made is  $0.86 \times 10^{-4} \text{ Sm}^{-1}$ . If the molar conductance at infinite dilution of AgNO<sub>3</sub>, HNO<sub>3</sub> and HCl are  $133.0 \times 10^{-4}$ ,  $421.0 \times 10^{-4}$  and  $426.0 \times 10^{-4} \text{ Sm}^2\text{mol}^{-1}$  respectively, calculate the solubility of AgCl in gm dm<sup>-3</sup> in water at a given temperature. [03]

- Q. 6 [A] What is Half-wave potential? Deduce the relation for its identification. [06]
- [B] Explain the amperometric and polarographic titrations for: [06]  
 (i) electro-reducible ion vs non-reducible ion  
 (ii) non-reducible ion vs electro-reducible ion  
 (iii) electro-reducible vs electro reducible ion

OR

- [B] (i) Write about the Polarographic maxima. [03]
- (ii) The following data collected for 3 dropping electrodes. Complete the data for electrode A and C. [03]

DME	A	B	C
Flow rate (mg/sec)	0.982	3.92	6.96
Drop time (sec)	6.53	2.36	1.37
$i_d/C$ ( $\mu\text{A}/\text{m mole}$ )	?	4.86	?

\*\*\*X\*\*\*

(3)

