Date:

Registration number:

ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27

B.Sc. CHEMISTRY - V SEMESTER

SEMESTER EXAMINATION: OCTOBER 2021

(Examination conducted in January-March 2022)

CH 5218 – PHYSICAL CHEMISTRY

Time- 2 ½ hrs | Max Marks-70

This question paper contains _3_ printed pages and three parts

Part A

Answer any SIX questions from the following. (2 x 6 = 12 marks)

1. State Beer-Lambert's law.

2. Molar conductance of a weak acid solution at infinite dilution is 500 x 10^{-4} S m^2 mol^{-1} at 25^oC. Molar conductance of 0.007 M of the same acid solution is 150 x 10^{-4} S m^2 mol^{-1}. Calculate the degree of dissociation of 0.007 M of the given acid solution at 25^oC.

3. Explain Kohlrausch's law of independent migration of ions.

4. Account for the abnormal change in the transport number of cadmium in cadmium iodide solution at higher concentrations.

5. Write the functions of salt bridge in an electrochemical cell?

6. State the law of interfacial angles.

7. Which of the following species do not show disproportionation reaction and why?
ClO^-, ClO_2^-, ClO_3^- and ClO_4^-

8. Explain photosensitization with an example of a photosensitizer.

Part B

Answer any EIGHT questions from the following. (6 x 8 = 48 marks)

9. a] The resistance of 0.01 M solution of an electrolyte was found to be 200 ohm at 25^oC. Calculate the molar conductance (in SI units) of the solution at the same temperature. Cell constant is 0.80 cm^{-1}.

b] Consider a cell for which the overall cell reaction is $Zn + Cd^{2+} \rightarrow Zn^{2+} + Cd$.
(i) Write the electrode reactions (ii) Indicate the anode and the cathode.
(iii) Calculate the emf of the cell at 298 K given $[Zn^{2+}]$ = 0.01M and $[Cd^{2+}]$ = 0.1M. E^o of cell = 0.36V. [3+ 3]

10. a] For strong electrolytes, sodium butanoate, sodium chloride and hydrochloric acid (C_3H_7COONa, NaCl and HCl), the molar conductance at infinite dilution are 83×10^{-4} S m^2 mol^{-1}, 127×10^{-4} S m^2 mol^{-1} and 426×10^{-4} S m^2 mol^{-1}, respectively. Calculate λ°_m for butanoic acid (C_3H_7COONa).

b] Draw and label a diagram of standard hydrogen electrode. Explain the functioning of standard hydrogen electrode with equations. [3 + 3]

11. Explain (i) asymmetry effect (ii) electrophoretic effect for a solution of strong electrolyte. Write the mathematical expression of Debye-Huckel-Onsager equation for aqueous solutions of 1:1 electrolytes. Explain the terms.

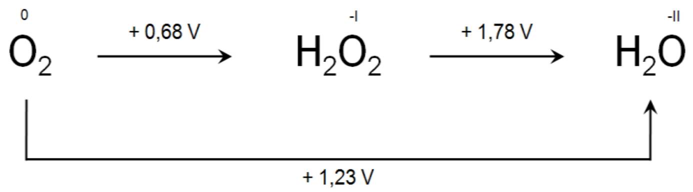
12. What is quinhydrone electrode? Derive an expression for pH of a test solution containing quinhydrone electrode coupled with saturated calomel electrode. Give the cell notation.

13. a] Define specific conductance. What is the effect of dilution on
(i) specific conductance and (ii) molar conductance?
b] Draw the plot of variation of molar conductance with $\sqrt{c}$ (square root of concentration) for
(i) strong electrolyte (ii) weak electrolyte. [3 + 3]

14. Draw and explain the phase diagram of lead-silver system. Explain Pattinson's process of desilverization of lead using phase diagram.

15. a] What are Frost diagrams? Explain with an example.

b] The Latimer diagram of O_2 is given below. Convert it into a Frost diagram of oxygen.



[3 + 3]

16.a] Write all the symmetry elements for a perfect cubic crystal.

b] Derive the Bragg's equation for X-ray diffraction. [3 + 3]

17. a] What are eutectic mixtures? Explain two applications of eutectic mixtures with examples.

b] Define quantum yield of a photochemical process. [4 + 2]

18. Draw Jablonski diagram and indicate the various photophysical processes.
Explain fluorescence and phosphorescence using the above diagram.

Part C

Answer any TWO questions from the following. (5 x 2 = 10 marks)

19. Draw and explain conductometric titration curve between a weak acid (CH_3COOH) and strong base (KOH) in the following cases:

(i) When CH_3COOH is taken in the conductivity cell.

(ii) When CH_3COOH is taken in the burette.

20. a] Write the reduction half reaction of the redox couple ClO_4^-/ClO_3^- (E^o = +1.20V) in acid medium.

b] Sketch the planes in a cube having the Miller indices (111). [3 + 2]

21. a] Give reason: The quantum yield is high for the photochemical combination of H_2 and Cl_2, but low in the case of H_2 and Br_2.

b] From the following standard potentials, arrange the metals in the order of their increasing reducing power. Justify your answer.

$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$: E° = -0.76 V

$Ca^{2+}(aq) + 2e^- \rightarrow Ca(s)$: E° = -2.87 V

$Mg^{2+}(aq) + 2e^- \rightarrow Mg(s)$: E° = -2.36 V

$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$: E° = -0.25V [3 + 2]
