

St. Joseph's College [Autonomous], Bengaluru  
Mid-Semester Test - August 2019  
B.Sc. Chemistry - V Semester  
CH 5218 : Physical Chemistry

Time: 1 hour

Max Marks: 30

Note: The question paper has **THREE** parts and 11 questions. All parts are compulsory.

PART – A

Answer any **FOUR** of the following questions. Each question carries 2 marks. [2 x 4 = 8]

1. Define ionic mobility.
2. Give two advantages of conductometric titrations.
3. Explain the abnormal transport number of cadmium in cadmium iodide solution at higher concentrations.
4. Mention any two differences between Raman and IR spectroscopy.
5. What are the gross and quantum selection rules for a molecule to be IR active?

PART – B

Answer any **THREE** of the following questions. Each question carries 6 marks. [3 x 6 = 18]

6. a] State and explain Kohlrausch's law of independent migration of ions. [2+2+2]  
b] Define molar conductance.  
c] Molar conductances at infinite dilution of:

$$\text{Sodium hydroxide (NaOH)} = 247.8 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$$

$$\text{Sodium chloride (NaCl)} = 126.5 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$$

$$\text{Ammonium chloride (NH}_4\text{Cl)} = 149.7 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$$

Find the molar conductance at infinite dilution of Ammonium hydroxide (NH<sub>4</sub>OH).

7. a] Explain (i) asymmetry effect (ii) electrophoretic effect.  
b] Write the mathematical expression of Debye-Huckel-Onsager equation. [4+2]

8. a] Give the mathematical expression of Born-Oppenheimer approximation. [2+2+2]  
b] Write the expression for Zero Point Energy and explain the terms in it.  
c] Give the pictorial representation of the fundamental vibrations of CO<sub>2</sub> molecule and indicate the IR active modes.

9. Using the energy level expression and selection rules, draw an energy level diagram and the spectral transitions for the microwave (pure rotational) spectrum of a rigid diatomic rotor. Depict the spectrum and explain the spacing between the spectral lines.

### PART – C

Answer any **ONE** of the following questions. Each question carries 4 marks. [4 x 1 = 4]

10. Discuss the titration curves obtained in the estimation of  
(i) a strong base using a strong acid  
(ii) a weak base using a strong acid,  
when the alkali is taken in the conductivity cell and the acid in the burette.
11. The fundamental vibrational frequency of HCl is 2890 cm<sup>-1</sup>. Calculate the force constant of this molecule.  
[Atomic masses: <sup>1</sup>H = 1.673 x 10<sup>-27</sup> kg, <sup>35</sup>Cl = 58.06 x 10<sup>-27</sup> kg; c = 3 x 10<sup>8</sup> ms<sup>-1</sup>]
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