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[This question paper contains 6 printed pages.]

Your Roll No.

Sr. No. of Question Paper : 1170

Unique Paper Code : 32177904

Name of the Paper : Analytical Methods in Chemistry

Name of the Course : B.Sc. (Hons) Chemistry

Semester : VI

Duration : 3.5 Hours

Maximum Marks : 75



Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **six** QUESTIONS in all.
3. **All** questions carry equal marks.
4. The questions should be answered in accordance with the number in the question paper.
5. Use of scientific calculator and log tables is permitted.

P.T.O.

1. (a) Discuss the various equilibrium processes in the solvent extraction of metal ion from an aqueous phase by solvation.
- (b) A mixture of CaO and CaCO_3 is analyzed by TGA. The result indicates that mass of the sample decreases from 250.6 mg to 190.8 mg between 600-900°C. Calculate the percentage of Calcium Carbonate in the mixture.
- (c) Define chromatography. Define the following terms used in chromatographic analysis :
- (i) retardation factor
 - (ii) retention volume
- (d) Draw the block diagram of thermobalance and name its different component. (4,4,2.5,2)
2. (a) Define accuracy and precision. What is the relation between standard deviation and precision? What is the relation between standard deviation and accuracy?
- (b) Name any three-indicator electrode used for pH metric titrations. Give the systematic diagram of any one indicator electrode.

- (c) How does a double beam spectrophotometer differ from a single beam spectrophotometer? Draw a systematic diagram for a double beam instrument and give its working principles. (4,4,4.5)
3. (a) Distinguish between the following pairs :
- (i) Hydrogen and Deuterium discharge lamp
 - (ii) Filters and Grating as wavelength selector
- (b) Describe the term chemical interference. Explain the different methods of removal of chemical interference in Flame Atomic Absorption spectroscopy.
- (c) What is the principle involved in solvent extraction? Give its significance and conditions under which it is applicable. Also explain how solvent extraction obeys Gibb's phase rule. (4,4,4.5)
4. (a) Suggest the effect on plate height (H) if each of the following changes were incorporated into a column chromatographic experiment :
- (i) An increase in flow rate
 - (ii) An increase in the diameter of the column

- (iii) An increase in the column length
- (iv) An increase in the temperature of the column
- (b) What are the various methods which is used for the determination of pK_a values? Discuss one method in detail.
- (c) Explain the various processes that occur when a sample is injected into the flame in atomic absorption spectroscopy. (4,4,4.5)
5. (a) The peak absorbance of 4.15×10^{-3} M $KMnO_4$ at 555 nm in a 2.000 cm pathlength cell is 6.46.
- (i) Find the molar absorptivity and percent transmittance of this solution.
- (ii) What would be the absorbance if the pathlength were 0.200 cm?
- (b) What is the purpose of flame in flame emission spectroscopy? Why we get line spectra in FES whereas band in UV-Vis spectroscopy?
- (c) What is meant by term confidence limit? How is it determined? What is its significance? (4,4,4.5)

6. (a) Explain the working of Hollow Cathode Lamp with the help of a suitable diagram.
- (b) Define gross sample and grab sample with suitable examples. Explain different steps involve during sampling.
- (c) Draw and explain the conductometric titration curve of :
- (i) CH_3COOH vs $NaOH$.
- (ii) HCl vs $NaOH$ (4,4,4.5)
7. (a) Explain the principle and working of FES (Flame Emission spectrometer) instrument with the help of a suitable diagram. Give its applications.
- (b) In a chromatography method, the retention volume of solute (V_R) is found to be 68.4 mL for a column with the $V_M = 18.6$ mL and $V_S = 14.5$ mL, where V_M and V_S are the volumes of mobile and stationary phase respectively. Calculate the retention factor and the partition coefficient for this solute.
- (c) State Nernst distribution law. A substance X is extracted from its aqueous solution ($V_w = 50$ mL) with an organic solvent ($V_o = 20$ mL). Calculate distribution ratio (D) when extraction (E) percentage is 99.5. (4,4,4.5)

8. (a) Derive the mathematical relation of Beer-Lambert law. What are the limitations of the law?

(b) Sketch out the electromagnetic spectrum. State fundamental law of spectroscopy.

(c) Write detailed note on classification of electroanalytical methods. Discuss applications of conductometric and potentiometric titrations.

(4,4,4.5)

9. (a) Distinguish between the following (**any two**) :

(i) Distribution Coefficient (K_D) and Distribution Ratio (D)

(ii) Standard Deviation and Standard Deviation of mean

(iii) F-test and t-test

(b) Explain how the composition of the flame affects the production of gaseous atoms using suitable example.

(c) Explain how crucible geometry affects the thermogravimetric curve. What is null point balance?

(4,4,4.5)