

N.B. 1) All questions are compulsory.

2) Figures to the right indicate full marks.

3) Use of logarithmic table/non programmable calculator is allowed.

4) At. Wts: H=1, C=12, N=14, O=16, Na=23, Al=27, S=32, Cl=35.5,
K=39, Ca=40, Ag=108, Ba=137, Pb=207

Q.1. a) Attempt any two of the following: –

i) What do you mean by calibration of instrument? Describe briefly the use of internal standard method for calibration. What difficulties are encountered in this method? 4

ii) Discuss the cost and benefits of introducing Quality system in laboratory. 4

iii) What are the transducers and sensors? Explain the 'piezoelectric effect' that forms the basis of quartz crystal microbalance (QCM) sensor. What is the detection limit for a piezoelectric sensor? 4

iv) Discuss the responsibilities of staff at all levels towards laboratory quality. 4

b) Attempt any one of the following:–

i) Discuss the importance of quality audit in a laboratory. 4

ii) Calculate the figures of merit for precision, when the following results were obtained in replicate measurement of mercury (Hg) in a fish sample. Concentration of Hg in ppm, 0.0332, 0.0333, 0.0335, 0.0334, 0.0336, 0.0335 4

Q.2. a) Attempt any two of the following:–

i) (1) How many milligrams per milliliter of Na_2SO_4 are present in 0.5 M Na_2SO_4 solution? 2

(2) How will you prepare 1.0dm^3 of 50 ppm solution of Ba^{2+} from BaCl_2 ? 2

ii) Calculate the mass of carbon dioxide and water formed when 30 grams of methane is burnt completely in presence of oxygen. 4

iii) Calculate the pH of a solution prepared by mixing 5.0cm^3 of 0.1M NH_3 with 10.0cm^3 of 0.02M HCl . 4

iv) How many moles of MA will dissolve in 1dm^3 of 0.10M HCl , if K_{sp} for MA is 1.0×10^{-8} and K_a for HA is 1.0×10^{-6} ? 4

- b) Attempt **any one** of the following: –
- 10.0 cm³ of 0.05 M AgNO₃ is added to 10.0 cm³ of 0.025 M KCl solution. Calculate 1) the concentration of Cl⁻¹ remaining in the solution at equilibrium and 2) solubility of AgCl 4
 - How many milliliters of 98% by weight of H₂SO₄ that has a density 1.84 g cm⁻², are required to prepare 1 dm³ of a 0.1 M solution? 4

- Q.3. a) Attempt **any two** of the following: –
- Describe the technique of solid phase extraction. What are the advantages and limitations of solid phase extraction? 4
 - Derive mathematical expression to relate distribution ratio (D) to pH of aqueous solution in solvent extraction involving chelation. 4
 - Explain with suitable example extraction by solvation. 4
 - What is the application of crown ethers in solvent extraction? 4
- b) Attempt **any one** of the following: –
- With the help of neat labeled diagram describe the construction and working of single beam densitometer used in HPTLC. 4
 - 100 cm³ of an aqueous solution containing 124 mg of solute, when extracted once with 25 cm³ of ether, 80% of solute was transferred to ether. Calculate the amount of solute that will remain behind in aqueous phase after three extractions by using same volume of ether for each extraction. 4

- Q.4. a) Attempt **any two** of the following: –
- With the help of neat labeled diagram, describe construction and working of pneumatic pump used in HPLC. What are its advantages and limitations? 4
 - Give a brief account of precolumns and guard columns used in HPLC. 4
 - With a neat labeled diagram, describe the construction and working of electron capture detector. Why is it superior to flame ionization detector? 4
 - How will you separate a mixture of He, O₂, N₂, CH₄ and CO₂ at room temperature, using gas chromatographic method? 4

- b) Attempt any one of the following:-
- i) Give a comparative account of WCOT, SCOT and FSOT columns. 4
- ii) Substances A and B have retention times 12.30 and 15.61 minutes respectively on a 30 cm long column. An unretained species passes through in 1.20 minutes. The peak widths at the base for A and B were 1.14 and 1.23 minutes respectively. Calculate the selectivity factor and resolution for A and B. 4

- Q.5. Attempt any four of the following:- 12
- a) Define data domain. Differentiate between analog domain and time domain.
- b) Discuss the types of quality standards for quality systems in laboratories.
- c) The solubility product of AgBr is 5.2×10^{-13} . Calculate its solubility in mol dm^{-3} and g dm^{-3} (Molar mass of AgBr = 187.8)
- d) Calculate the pH of a buffer solution containing 0.06 mole of NaF / dm^3 and 0.018 mole of HF/ dm^3 . $K_a = 7.2 \times 10^{-4}$ for HF.
- e) Explain the principle of ion exchange chromatography.
- f) What are the advantages of HPTLC over TLC?
- g) On the basis of van Deemter equation, explain the effect of Eddy diffusion on band broadening.
- h) What is the difference between normal phase chromatography and reverse phase chromatography?

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