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, Cr = 52 = 108. Ba = 137, Pb = 207

1 (a) Attempt **any two** of the following:

    (i) Explain briefly the following terms with respect to quantitative   4
        performance criteria of an analytical instrument:
        1) Detection Limit   2) Dynamic range.

    (ii) What do you understand by 'Quality management System'? Discuss   4
        Quality assurance and Quality control with respect to quality
        management system

    (iii) With respect to quantitative performance criteria of an analytical   4
        instrument, explain the terms, 'Calibration sensitivity' and 'Analytical
        sensitivity'. What are the advantages of analytical sensitivity?

    (iv) Discuss the types of quality standards for analytical laboratories.   4

(b) Attempt **any one** of the following:

    i) Define data Domain. Differentiate between analog domain and time   4
      domain.

    ii) Determination of 'Vitamin C' content of Citrus fruit drink gave the   4
      following results:
      % of Vitamin C : 0.218, 0.219, 0.230, 0.220, 0.225, 0.224
      Calculate figures of merit for precision.

2 a) Attempt **any two** of the following:

    i) 1) 1748 Kg of soil sample contains 19 mg of Molybdenum (Mo).   2
        Calculate the concentration of Molybdenum in ppm and ppb.
      2) How many milligrams of K_2SO_4 are present in 100 cm^3 of its   2
        0.35 M solution?

    ii) 12.0 gm of aluminium sulphide reacts with 8 gm of water to give   4
      aluminum hydroxide and hydrogen sulphide as per the reaction
      $Al_2S_3 + 6H_2O \rightarrow 2Al(OH)_3 + 3H_2S$ Which is limiting reagent in
      reaction? Calculate the amount of $Al(OH)_3$ formed in the reaction.

    iii) 0.36g of Na_2CO_3 reacted completely with 25.7 cm^3 of H_2SO_4 solution.   4
      Calculate the molarity of H_2SO_4 solution.

iv) The pH of $Mg(OH)_2$ solution is 11.35 at 25°C. Calculate the solubility product of $Mg(OH)_2$.   4

b) Attempt **any one** of the following:

i) Calculate the mass of sodium acetate that should be added to $0.5 dm^3$ of an aqueous solution containing 0.02mol of acetic acid to obtain a buffer solution of pH= 4.5 (Given Ka for acetic acid= 1.8×10^{-5})   4

ii) 1.0 mol of H_2 was mixed with 1.0 mol I_2 in 50.0 L container and allowed to react at 448°C. The equilibrium constant for the reaction $H_{2(g)} + I_{2(g)} \rightarrow 2HI_{(g)}$ is 50.0 at 448°C. How many moles of H_2 and I_2 will be formed at equilibrium? How many moles of H_2 and I_2 will remain unreacted?   4

3 a) Attempt **any two** of the following:

i) What are the characteristics of solvent used in solvent extraction? What are the advantages of solid phase extraction over solvent extraction?   4

ii) Derive mathematical expression to relate distribution ratio (D) to pH of aqueous solution in solvent extraction involving chelation.   4

iii) Describe the technique of extraction by solvation with suitable example.   4

iv) Discuss any two factors affecting extraction by chelate formation.   4

b) Attempt **any one** of the following:

i) With the help of neat labeled diagram describe the construction and working of double beam densitometer used in HPTLC.   4

ii) $100 cm^3$ of an aqueous solution containing 120 mg of solute, when extracted once with $20 cm^3$ of an organic solvent, 80 mg of the solute was transferred to the organic solvent. Calculate the minimum number of extractions required to transfer more than 98% of the solute, by using same volume of organic solvent.   4

4. a) Attempt **any two** of the following:

i) Give an account of mobile phase reservoirs and solvent treatment systems used in HPLC.   4

ii) With the help of neat labeled diagram, describe construction and working of electrochemical detector used in HPLC.   4

iii) Give an account of different columns used in GLC.   4

iv) What are the factors that are to be considered for the selection of   4
liquid stationary phase in GLC?

b) Attempt **any one** of the following:

i) How normal phase chromatography and reverse phase   4
chromatography influence the separation of compounds? Explain
with suitable example.

ii) The following data was obtained on liquid chromatographic column   4
using a 25 cm packed column and a flow rate of mobile phase 0.412
cm^3/min.

Component	Retention time, min	Peak width, min
Non-retained	1.4	–
A	7.1	0.51
B	12.7	1.16

Calculate 1) The number of plates for each peak
2) The plate height for the column.

5. Attempt **any four** of the following: 12
  a) What are non electrical domains?
  b) What is a quality audit? How is it carried out?.
  c) 87.4 cm^3 of 0.135 M perchloric acid neutralized 50.0 cm^3 of
Manganese (II) hydroxide solution. What is the concentration of
Manganese (II) hydroxide?
  d) Calculate the mass of anhydrous HCl in 5.0 cm^3 of HCl solution
(density 1.19g/cm^3) containing 37.23% HCl by weight.
  e) Explain the principle of electrochromatography.
  f) Distinguish between TLC and HPTLC.
  g) On the basis of van Deemeter equation, explain the effect of Eddy
diffusion on band broadening.
  h) GSC has limited applications as compared to GLC. Explain.