

TIME: 2 ½ HOURS

MAX.MARKS:60

NB:

- 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, Mg= 24.3, F=19, Cu= 63.5, Cr = 52, Fe = 55.8

Q.1 A Answer any TWO of the following: (8)

- a. What is meant by Six Sigma? Explain in detail the Six Sigma responsibility matrix (DMAIC) process.
- b. Write a short note on the importance of safety in laboratories and discuss the terms PPE, OSHA, Toxic Hazard (TH).
- c. Enumerate responsibilities of a laboratory staff to maintain the quality system of the laboratory.
- d. Distinguish between accuracy and precision with respect to the measured values.

B Answer any ONE of the following: (4)

- a. With respect to the performance characteristics of an instrument explain the following terms:
i) Bias ii) Detection Limit iii) Dynamic Range
- b. With respect to the performance criteria of an analytical instrument discuss the following terms:
i) calibration sensitivity ii) analytical sensitivity
& what are the advantages of analytical sensitivity?

Q.2 A Answer any TWO of the following: (8)

- a. (i) Determine oxidation number of Cl in $\text{Ca}(\text{ClO}_2)_2$ and in Cl_2
(ii) Solid PbSO_4 is dissolved in water at 25°C . Its solubility is $1.25 \times 10^{-4} \text{ g/dm}^3$. Calculate the solubility product (K_{sp}) of the compound.
- b. Calculate the amount of H_2SO_4 (density = 1.84 g/cm^3 , 98% H_2SO_4 by weight) required to prepare 1 dm^3 of 3N H_2SO_4 .
- c. 161g of Ethanol and 145 g of Acetone are mixed together. Find the mole fraction of each compound in the mixture.
- d. 21.7 cm^3 of a solution of $\text{Ca}(\text{OH})_2$ required 45.8 cm^3 of 0.25 M HCl for complete neutralization.
 - a. Write the reaction involved.
 - b. What is the molarity of the $\text{Ca}(\text{OH})_2$ Solution.

B Answer **any ONE** of the following: (4)

- How much volume of 1000 ppm K^+ solution, prepared using KCl , is required to prepare 100 cm^3 of 0.02 M KCl solution.
- Calculate the weight of compound required to prepare 500 cm^3 of a 50 ppm Fe^{2+} solution using
 - $FeSO_4$
 - $FeCl_2$

Q.3 A Answer **any TWO** of the following: (8)

- With the help of schematic diagram, explain the working of Michelson interferometer in FTIR.
- Discuss the charge transfer absorption with respect to UV and Visible spectroscopy.
- Discuss the different techniques for preparation of solid samples for IR absorption measurements.
- Discuss:
 - Optical arrangement of a dual wavelength spectrophotometer.
 - Photoconducting transducers used in IR spectrometer.

B Answer **any ONE** of the following: (4)

- Simultaneous determination of solutions containing ions A and B spectrophotometrically at two different wavelengths gave the following results:

[Given: $b = 1\text{ cm}$]

Solution	Concentration (mol dm^{-3})	Absorbance	
		447nm	650nm
A	1.8×10^{-3}	0.645	0.180
B	5.2×10^{-3}	0.128	0.874
A+ B	-----	0.427	0.412

Calculate the molar concentration of A and B in a mixture of solution containing both the ions.

- Discuss the fiber optics used in optical instruments.

Q.4 A Answer **any TWO** of the following: (8)

- a. Distinguish between DTA and DSC.
- b. With the block diagram, discuss the instrumentation of power compensated DSC.
- c. Describe the role of multilayered films in automated analysis.
- d. Discuss the application of DSC in :
 - i) analysis of polyethylene for its crystallinity
 - ii) in drug analysis

B Answer **any ONE** of the following: (4)

- a. Discuss the factors affecting DSC curves.
- b. What are discrete automatic systems? Discuss any one application of discrete automatic systems.

Q.5 A Answer **any FOUR** of the following: (12)

- a. What is the need for laboratory accreditation? Discuss the Indian Standard 'Hallmark'
- b. Write in brief about the determinate errors and the ways to minimize them.
- c. A solution of $K_2Cr_2O_7$ is prepared by dissolving 1584 mg in distilled water to make up 750 cm^3 . Calculate the concentration of the solution in terms of molarity and w/v.
- d. Calculate the amount of $BaSO_4$ formed when a solution containing 2.00 g of Na_2SO_4 is reacted with a solution containing 3.00 g of $BaCl_2$. Which is the limiting reagent?
- e. What is diffuse reflectance spectroscopy? Explain the diffuse reflectance spectrum.
- f. What are the advantages of an FTIR over dispersive instruments?
- g. Name the different types of thermal methods and discuss any one of the technique.
- h. What is an automatic titrator? What are the benefits of using automatic titrator?
