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 $Ca(ClO_2)_2$ and in Cl_2

        (ii) Solid $PbSO_4$ is dissolved in water at $25^{\circ}C$. Its solubility is 1.25×10^{-4} 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 $Ca(OH)_2$ 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 Ca $(OH)_2$ Solution.

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

a. How much volume of 1000 ppm K^+ solution, prepared using KCl, is required to prepare 100 cm^3 of 0.02 M KCl solution.

b. Calculate the weight of compound required to prepare 500 cm^3 of a 50 ppm Fe^{2+} solution using

       (i) $FeSO_4$ (ii) $FeCl_2$

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

a. With the help of schematic diagram, explain the working of Michaelson interferometer in FTIR.

b. Discuss the charge transfer absorption with respect to UV and Visible spectroscopy.

c. Discuss the different techniques for preparation of solid samples for IR absorption measurements.

d. Discuss:

i. Optical arrangement of a dual wavelength spectrophotometer.

ii. Photoconducting transducers used in IR spectrometer.

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

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

[Given: b= 1cm]

Solution	Concentration	Absorbance	
	(mol dm^{-3})	447nm	650nm
A	**1.8 X 10^{-3}**	**0.645**	**0.180**
B	**5.2 X 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.

b. 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 F0UR** 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?

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