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B.Sc. (Hons.) Chemistry/II Sem.   A

Paper CHHT-204

ANALYTICAL METHODS IN CHEMICAL ANALYSIS

(Admission of 2010 and onwards)

Time : 3 Hours   *Maximum Marks* : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *six* questions in all including Q. No. 1 which

is compulsory. Use of scientific calculators is allowed.

Be brief and to the point.

1.   (*i*)   Give *one* word or phrase for any *five* of the following :

       (*a*)   The square of standard deviation;

       (*b*)   A solution prepared from all the reagents but no analyte;

(c) The distance travelled by the mobile phase in unit time;

(d) Wavelength of maximum absorbance.

(e) pH at which 50% extraction takes place;

(f) A reagent that combines with and prevents the interference by matrix species that would other-wise interfere with the determination of an analyte.

(ii) Define (any *five*) : Bank; nebulizer; coefficient of variation; plasma; elution; dark current; outlier; masking agent.

(iii) Describe an atomic absorption spectrophotometer and mention its uses. 5,5,5

2. (a) Explain the difference between systematic errors and random errors. Suggest the ways to reduce systematic errors.

(b) Draw the Gaussian error curve and explain what is the probability that a result from a population lies between 0 and $+\sigma$ of the mean. What is the probability of a result occurring between σ and $+2\sigma$ of the mean.

(c) The following replicate weighings were obtained, 29.9, 30.2, 28.6 and 29.7 mg. Calculate standard deviation of the individual values and standard deviation of the mean. Express these as absolute and relative values. 4,4,4

3. (a) What is meant by the term 'sampling' ? What is the object of the sampling operation ? With the help of examples, explain the difference between homogeneous and heterogeneous samples.

(b) How many significant figures does each of the following numbers have ?

(i) 1.9030

(ii) 0.03910

(iii) 9.08×10^9.

(c) Conductance is an additive property of a solution. Explain. 6,3,3

4. (a) State the Nernst distribution law. Give the conditions under which the law is applicable. Explain the role of ion-association in the extraction of a solute from aqueous to organic solvents.

(b) 100 mL of a 0.01 M aqueous solution of A is extracted with toluene. What fraction of A remains in the aqueous phase :

(i) if extraction with 500 mL is performed; and

(ii) if five extractions with 100 mL are performed ? Assume that $[A]_{toluene}/[A]_{water} = 3$.

(c) Name the different methods of solvent extraction and explain any *one* of them : 6,4,2

5. (a) Define the term chromatography. Explain the different sorption mechanisms involved in the chromatographic techniques.

(b)   What is thin layer chromatography (TLC) ? What are two-dimensional TLC and high-performance TLC ?

(c)   What do you understand by the term R_f value ? 6,4,2

6.   (a)   Discuss the factors affecting pH measurements using glass electrode. Why is the glass electrode stored in water or buffer solution ?

(b)   What are the advantages of conductometric titrations over ordinary titrations ?

(c)   Draw and explain the conductometric curves for the following titrations :

(i)   Hydrochloric acid against sodium hydroxide;

(ii)   Sulphuric acid against sodium hydroxide.   4,4,4

7.   (a)   What is the function of a prism or a grating in an ultra violet visible spectrophotometer ? Give the mathematical expression for the resolving power of a prism.

(d) State Beer's law. Give the mathematical expression of Beer-Lambert's law and explain the terms involved.

(c) A 5.00×10^{-4} M solution of a nickel complex is put into a sample cuvette with a path length of 1.00 cm. The absorbance at 592 nm is found to be 0.446. What is the molar absorptivity at this wavelength ?　4,4,4

8. Differentiate between any *four* of the following :

(i) Atomic emission and atomic absorption spectroscopy;

(ii) Filters and monochromators as wavelength selectors;

(iii) Photocells and photomultipliers;

(iv) Photometers and spectrophotometers;

(v) Single beam and double beam instruments of absorption measurements.

(vi) Hollow cathode lamp and graphite furnace.　　3×4

9. (a) What is thermogravimetry ? What is the importance of a thermogram in thermogravimetry ?

(b)   What are the criteria for a good thermobalance ?

(c)   The weight, particle size and mode of preparation of a sample all govern the thermogravimetric results. Explain.   4,4,4

10.   (a)   Analytical chemistry is a unique experimental science. Comment.

(b)   Computers play an important role in chemical analysis. Elucidate. What are the advantages of interfacing the instruments with computers ?

(c)   A set of precise measurements need not necessarily be accurate, while an 'accurate' measurement may contain a large error. Explain.   4,4,4