Total number of printed pages–15

3 (Sem–5/CBCS) CHE HE 1/2

2023

CHEMISTRY

(Honours Elective)

Answer the Questions from any one Option.

OPTION–A

(Applications of Computers in Chemistry)

Paper : CHE–HE–5016

OPTION–B

(Analytical Method in Chemistry)

Paper : CHE–HE–5026

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

Contd.

OPTION–B

(Analytical Method in Chemistry)

Paper : CHE–HE–5026

1. Answer the following questions : 1×7=7

(a) What is the applicability of Q-test in data analysis ?

(b) Why quartz cuvettes are used for UV-visible spectroscopy ?

(c) What is the mid-IR wavelength range ?

(d) Why is atomic absorption spectroscopy (AAS) more sensitive than atomic emission spectroscopy ?

(e) State *true* **or** *false* :

Thermal analysis gives information about changes in material properties as function of temperature.

(f) How does the change in temperature affect the end-point of conductometric titration ?

(g) Give an example of chelating agent used in solvent extraction process.

2. Answer the following questions : 2×4=8

(a) The mean of four determinations of the copper content of a sample of an alloy was 8.27% with a standard deviation 0.17%. Calculate the 95% confidence limit for the true value. Given, from the *t*-tables, the value of *t* for the 95% confidence level with three degrees of freedom is 3.18.

(b) What are the limitations of Beer-Lambert's law ?

(c) What is Potentiometry ? Mention *one* application of potentiometry.

(d) Mention *two* advantages of thin layer chromatography (TLC) over paper and column chromatography.

3. Answer ***any three*** of the following questions : 5×3=15

(a) Discuss with an example how the strength of an acid can be determined by pH metric titration against a standard base.

(b) A mixture of CaO and $CaCO_3$ is analysed by TGA. The result indicates that mass of the sample decreases from 250.6 *mg* to 190.8 *mg* only between 600°C and 900°C. Calculate the percentage of calcium carbonate in the mixture.

(c) Discuss how Job's method of continuous variation can be used to determine the composition of the Ferric-thiocyanate complex.

(d) Analyses of a sample of iron ore gave the following percentage values for the iron content :

7.08, 7.21, 7.12, 7.09, 7.16, 7.14, 7.07, 7.14, 7.18, 7.11

Calculate the mean, standard deviation and coefficient of variation for the values. 1+2+2=5

(e) What are the different techniques used in solvent extraction ? Elaborate *any one* of the techniques. 1+4=5

4. Answer ***any three*** of the following questions : 10×3=30

(a) (i) Discuss how thermogravimetric analysis (TGA) can be utilized for the quantitative estimation of calcium (*Ca*) and magnesium (*Mg*) from a mixture of $CaCO_3$ and $MgCO_3$. 5

(ii) Discuss the principle of colorimetric estimation of metal ions from aqueous solution. 5

(b) (i) Discuss the effect of temperature, nature of ions, concentration of ions and size of the electrodes on the conductance of a solution. 5

(ii) Discuss with an example how *pKa* of an acid can be determined by electroanalytical methods. 5

(c) (i) What are the advantages of Fourier-Transform Infrared spectrometer over dispersive Infrared spectrometer ? 2

(ii) Vibrational frequency of *HCl* molecule is found at 2885 cm^{-1}. If the hydrogen atom of this molecule is substituted with deuterium, what will be the vibrational frequency of the molecule ? 2

(iii) How can we differentiate primary, secondary and tertiary amines using IR spectroscopy ? 2

(iv) What is the effect and importance of isotopic substitution in IR spectroscopy ? 2

(v) What is the fingerprint region in IR spectroscopy ? Why it is called so ? 1+1=2

(d) (i) What is the basic principle of Atomic absorption spectroscopy ? What are the different atomization processes commonly employed in the atomic absorption spectroscopy (AAS) ? 3+2=5

(ii) What is the purpose of monochromator and nebulizer in Inductively coupled plasma atomic emission spectroscopy (ICP-AES) ? What are the advantages of ICP-AES over AAS ? 3+2=5

(e) (i) What is meant by development of a chromatogram ? Discuss the different methods used for development of a chromatogram. 1+6=7

(ii) A sample of S-(+) enantiomer of a compound has an observed rotation of +19.2°. If the specific rotation of the pure enantiomer is +24° then what is the optical purity of the sample ? What is the composition of the mixture ? 3

(f) (i) Discuss the principle of conductometric titration for the determination of equivalence points of acid-base reaction. 5

(ii) What is a chiral shift reagent ? Discuss its role in NMR spectroscopy with a suitable example. 1+4=5
