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63/2 (SEM-3) CHM 302

2021

(held in 2022)

CHEMISTRY

(Theory Paper)

Paper Code : CHM-302

(Analytical Techniques)

Full Marks – 80

Time – Three hours

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

1. Choose the correct answers : 1×6=6

(i) Mass spectrometers are used to determine
which of the following ?

- (a) Composition in sample
- (b) Concentration of elements in sample
- (c) Relative mass of atoms
- (d) Properties of sample

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(ii) AFM can be used for imaging

- (a) very rough samples
- (b) inside of a material
- (c) something that cannot be deposited on a solid material
- (d) hard nanostructures

(iii) Which is not correct about SE ?

- (a) Generated from the collision between the incoming electrons and the loosely bonded outer electrons
- (b) Generated close to surface escape
- (c) Number of SE is greater than the number of incoming electrons
- (d) Deep inside information of material is obtained

(iv) Which is generally used to study thermal transitions in material ?

- (a) Differential Scanning Calorimetry (DSC)
- (b) Thermogravimetric Analysis (TGA)
- (c) Differential Thermal Analysis (DTA)
- (d) Evolved Gas Analysis (EGA)

(v) Which is not a characteristic for ideal detector of GC ?

- (a) Good stability and reproducibility
- (b) A linear response to solutes over several orders of magnitude
- (c) Temperature range from room temperature to 100°C
- (d) A short response time independent of flow rate

(vi) Find the correct statements

- (a) Efficiency is a measure of chemical separation power
- (b) Selectivity is a measure of mechanical separation power
- (c) Efficiency is a measure of both, mechanical and chemical separation power
- (d) Selectivity is a measure of chemical separation power.

2. Answer the following questions : $2 \times 5 = 10$

- (a) What is the recommended scan rate for the linear sweep voltammetry and cyclic voltammetry?
- (b) How can we calculate surface area of electrode using cyclic voltammetry?
- (c) What are the different modes of action in AFM?
- (d) Define resolution and contrast.
- (e) What is resolution and resolving power?

3. Answer any *six* of the following questions :

$$5 \times 6 = 30$$

- (a) What are the information, those may be obtained from SEM analysis?
- (b) Sketch and explain the TGA pattern for decomposition of calcium oxalate.
- (c) Sketch a typical DSC thermogram and show different transitions.
- (d) Write briefly about the requirements of a carrier gas used in GC.

- (e) What are ion-exchange resins? Discuss briefly along with the principle of ion-exchange chromatography.
- (f) Provide a brief overview of the method of X-ray diffraction and its application.
- (g) How does Inductively Coupled Plasma Mass Emission Spectroscopy work?
- (h) How can you determine trace amount of phenol in water? Give the complete methodology.
- (i) Write a short note on "Column" used in GC and HPLC with reference to their size, shape and purpose.

4. Answer any *two* of the following questions : $10 \times 2 = 20$

- (a) Discuss the relevant factors for a sampling programme in the chemical analysis of polluted water and soil.
- (b) Explain one method of sample preparation for determining trace elements in the leaves of a plant. What precautions are necessary?
- (c) How separation performance of HPLC column may be enhanced to get better resolution. Explain.

5. Answer any *one* of the following questions :

14×1=14

- (a) What are the factors that affect the results of TGA analysis ? Describe.
- (b) Discuss the principle of separation, instrumentation and application of gel permeation chromatography.