**63/1 (SEM–5) DSE2/CHMHE5026**

**2023**

# CHEMISTRY

Paper : CHMHE5026

***(Instrumental Methods of Chemical Analysis)***

*Full Marks : 60*

*Pass Marks : 24*

Time : Three hours

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

1. Choose the correct answer from the following : ***(any five)*** 1×5=5

   *(a)* Atomic absorption spectroscopy (AAS) is used

   *(i)* to analyse number of C-atoms

   *(ii)* to analyse elements in solution

   *(iii)* to analyse functional groups present in molecules

   *(iv)* to analyse the compounds

(b) In cyclic voltametry, potential is

(i) Dependent variable

(ii) Independent variable

(iii) A constant variable

(iv) Symmetrical variable

(c) Among the following molecules, IR active is

(i) $H_2$

(ii) $N_2$

(iii) $O_2$

(iv) $H_2O$

(d) The value of chemical shift (S) of TMS in ppm is

(i) 0

(ii) 1.1

(iii) 2.1

(iv) 4.5



(e) The electrode used in voltametry is

(i) dropping mercury electrode

(ii) dropping silver electrode

(iii) dropping platinum electrode

(iv) dropping hydrogen electrode

(f) Water can't be used as a solvent in IR, due to

(i) Four high infrared absorption peak

(ii) Three high infrared absoption peak

(iii) Two high infrared absorption peak

(iv) One high infrared absorption peak

(g) The wavenumber for near IR region is

(i) 4000 $cm^{-1}$ – 200 $cm^{-1}$

(ii) 12500 $cm^{-1}$ – 4000$cm^{-1}$

(iii) 200 $cm^{-1}$ – 10 $cm^{-1}$

(iv) 50 $cm^{-1}$ – 1000 $cm^{-1}$

(h) The mass spectroscopy read only

(i) Negative charge fragments

(ii) Positive charge fragments

(iii) Both positive and negative fragments

(iv) Neutral charge fragments

(i) Identify the emission which has low ionisation power.

(i) $\alpha$-particle

(ii) $\beta$-particle

(iii) $\gamma$-particle

(iv) X-ray particle

(j) The solvent that is generally employed in chromatography is

(i) Viscous solvent

(ii) Non-viscous solvent

(iii) Ionic solvent

(iv) Covalent solvent

2. Answer the following questions : ***(any five)*** 2×5=10

(a) Name *two* electrodes that are used in potentiometry.

(b) What is electrophoresis ? How is electrophoresis used to analyse manupulate DNA ?

(c) Write a short note on chemical-ionisation–mass spectroscopy (CI–MS).



(d) Distinguish between auxochrome and bathochrome.

(e) Write *two* conditions for a particular mode of vibration within a molecule to absorb radiation.

(f) What is supercritical fluid ? Give examples.

(g) What is time of flight mass analyzer ? Explain ?

3. Answer the following questions : ***(any five)*** 5×5=25

(a) Why is TMS a good reference compound in NMR spectroscopy ?

(b) Write short notes on : 2½×2=5

(i) Atomic fluorescence

(ii) Gas chromatography

(c) What type of solvent is used in IR spectroscopy ? Why is KBR used in IR ? What are the limitations of IR spectroscopy ?

(d) How can sample be introduced in a flame spectrometer ? Explain with flow-chart.

(e) Write *three* applications and *two* disadvantages of column chromatography.

(f) Describe the fast atom bombardment ionisation process of mass spectroscopy.

(g) Answer the following :

(i) The methyl resonance absorbs 143 *Hz* downfield from the TMS signal on a 60 *MHz* instrument. Find the chemical shift. 2

(ii) Discuss the principle of NMR-spectroscopy. 3

(h) Write the factors that affect the characteristics of group frequency.

(i) Describe about Fourier transform infrared spectrometer with suitable schematic diagrams.

4. Answer the following questions : ***(any two)*** 10×2=20

(a) Discuss chemical shift and spin-spin coupling. Mention *three* characteristics of spin-spin coupling. 7+3=10

(b) Write the principle of scanning electron microscopy (SEM). What are the factors that affect the scanning electron microscopy (SEM) ? Write two uses of it. 5+3+2=10



(c) Write short notes on the following : 5×2=10

(i) Principle of X-ray emission spectrometry

(ii) Principle of immunoassay

(d) Identify the compound which shows sharp absorption peaks at the following frequencies :

710 $cm^{-1}$, 1300 $cm^{-1}$, 1510 $cm^{-1}$, 2700 $cm^{-1}$ if it is saturated alkane, identify the compound.

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