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RCH–003

Ph. D. IN CHEMISTRY AND M. PHIL. (PHDCHEM/MPHILCHEM) Term-End Examination December, 2025

RCH-003 : ANALYTICAL TECHNIQUES IN CHEMISTRY—II

Time : 3 Hours *Maximum Marks : 100*

***Note** : Answer all the questions.*

1. What is the full form of HETP ? Write the disadvantages of this concept in chromatography and describe how this has been overcome. Illustrate your answer with the help of a diagram. 10

2. Draw a labelled gas chromatogram and explain the different terms used in it. 10

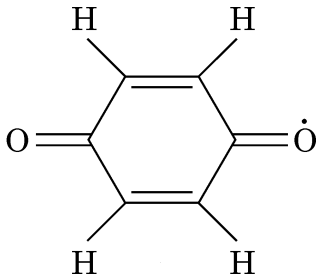
3. List any *four* column efficiency factors in gas chromatography and explain any *two* of the factors. 10

4. Explain why are pressurized gases used in HPLC. How is RPLC different from NPLC with respect to the mobile and stationary phases ? Explain with the help of examples. 10

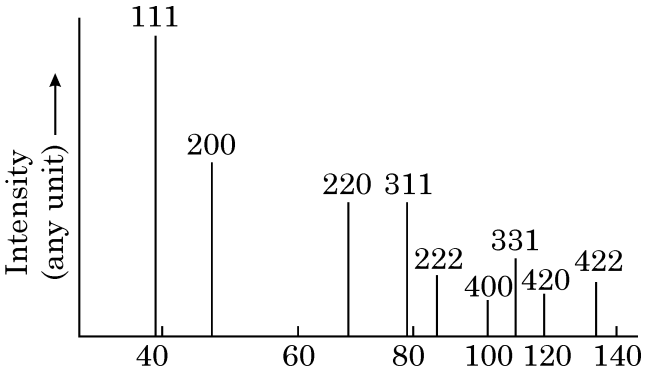
5. In Mössbauer spectroscopy, how is the magnetic hyper fine field affected when Fe^{3+} is substituted by Al^{3+} in the goethite crystal ? Also, for the Mössbauer spectrum of stoichiometric magnetite, it is observed that the 'isomer shift' is a result from Fe^{3+} and some amount of $Fe^{2.5+}$. How this 2.5+ oxidation state arises ? In this case is it possible to distinguish the tetrahedral and octahedral Fe^{3+} components ? Justify your answer. 5+5=10

6. Draw the EPR spectrum of Vanadyl acetylacetonate ($VO(acae)_2$) indicating the hyperfine interactions. Explain the illustration (I for V = 7/2). 10

7. What is the number of peak splittings that can be observed with two equivalent protons (I value is $\frac{1}{2}$) ? What will happen when three equivalent protons are there instead of two ? Describe the ESR spectrum of 1, 4 – benzosemiquinone radical given below : 10



8. Describe in brief the powder XRD technique. What do you infer form the following powder diffraction pattern of Al ? 10



Is this pattern real *or* schematic ? Justify your answer. How can the number of peaks be modified ?

9. Write short notes on the following : 2×5=10

   (a) Atomic force microscopy (AFM)

   (b) Scanning Tunneling Microscopy (STM)

10. Describe the principle of TEM and give its advantages. 10

Or

Write the applications of XRD.

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