This question paper contains 7 printed pages]

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **7019**

Unique Paper Code : **217667** **D**

Name of the Paper : **Instrumental Methods of Analysis—VI [ACPT-606]**

Name of the Course : **B.Sc. Applied Physical Sciences (Analytical Chemistry)**

Semester : **VI**

Duration : **3 Hours** Maximum Marks : **75**

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

Attempt *Five* questions in all.

Question No. **1** is compulsory.

1. Answer any *five* : 5×3=15

(*a*) How many translational, rotational and vibrational degree of freedom are there in H_2O and CH_4 molecules ?

(*b*) Arrange the following electromagnetic radiation in the increasing order of their energy :

Radiofrequency, UV, Visible, Microwave and IR.

P.T.O.

(*c*) Which of the following are NMR active and why ?

C^{12}, O^{16}, P^{31}, F^{19}, N^{14}, H^{2} and C^{13}.

(*d*) Give the relationship between Larmor precessional frequency and applied magnetic field.

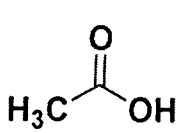
(*e*) Explain, why absorption peaks obtained in UV-spectra are broader than those obtained in IR spectra ?

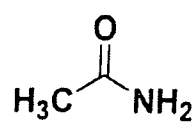
(*f*) Calculate the NMR frequency (in MHz) of the fluorine (^{19}F) in a magnetic field of intensity 1.4092T, given that γ of ^{19}F is 25.179×10^{7} rad T^{-1} s^{-1}.

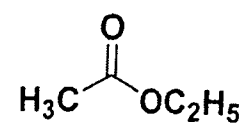
2. (*a*) Sketch the optical path of single beam instrument used in IR spectroscopy and precisely describe its function. 4

(*b*) How is IR spectroscopy useful to distinguish between inter- and intramolecular hydrogen bonding ? 4

(*c*) Arrange the following in the increasing order of C = O absorption frequency (in cm^{-1}) and explain. 4





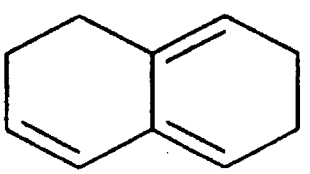


(*d*) How will you distinguish between alkanes, alkenes and alkynes using IR spectroscopy ? 3

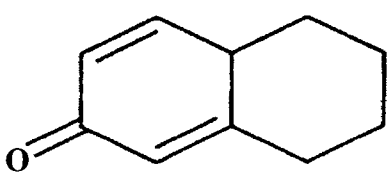
3. (*a*) State Lambert-Beer's Law. A substance when dissolved in water at 10^{-3} M concentration absorb 10% of the incident radiation in the path of 1.0 cm length. What should be the concentration of the solution in order to absorb 90% of the same radiation ? 4

(*b*) n-π^* transition in UV spectroscopy is forbidden, whereas π–π^* transition is allowed. Explain. 3

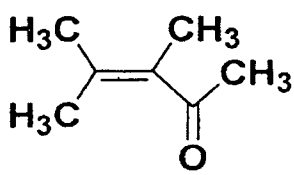
(*c*) Calculate the λ_{max} for the following compounds using Woodward-Fieser rules : 4



(*i*)

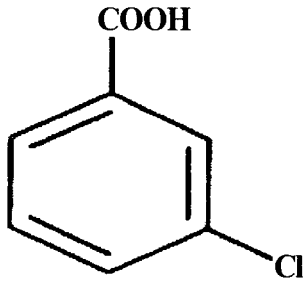


(*ii*)

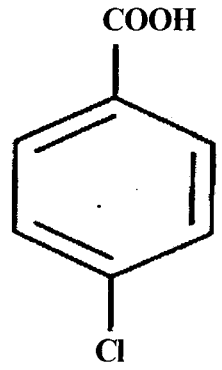


(*iii*)

(*d*) Predict and explain whether UV spectroscopy can be used to distinguish the following pair of compounds : 4



(*i*)



(*ii*)

4. (*a*) A compound with molecular formula $C_{10}H_{12}O$ shows a strong absorption peak at 1715 cm^{-1} and shows four peaks in its ^1H NMR spectrum : 6

δ = 1.02 (3 H, triplet)

δ = 2.35 (2 H, quartet)

δ = 3.60 (2 H, singlet)

δ = 7.25 (5 H, triplet)

Identify the compound.

(*b*) Define the term spectroscopy. Which vector of electromagnetic radiation is responsible for the transition in NMR spectroscopy ? 2

(*c*) Define chemical shift. A proton resonated at 750 Hz from TMS on 500 MHz NMR instrument. Calculate its chemical shift value. 3

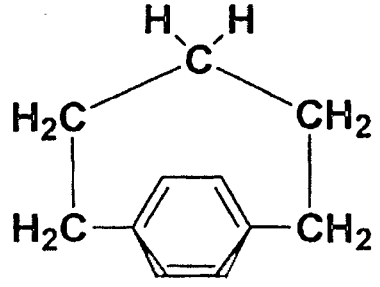
(*d*) What are the common solvents used in NMR spectroscopy ? Why is TMS used as internal reference in NMR spectroscopy ? 4

5. (*a*) What are the differences between AAS and AES ? 4

(*b*) Describe how deuterium lamp can be employed to provide a background corrections in AAS. 4

(*c*) Why is an electrothermal atomizer is more sensitive than flame atomizer ? 4

(*d*) Which protons of the given molecule will resonate at negative δ value (–1.0 ppm) in its ^{1}H NMR spectrum and why ? 3

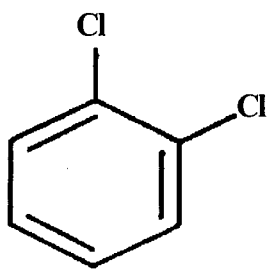


6. (*a*) What are chemically equivalent and magnetically equivalent protons ? Explain with a suitable example. 3

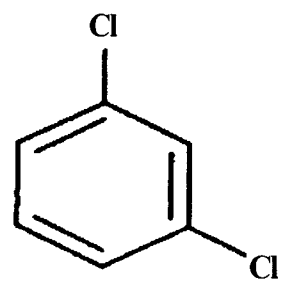
(*b*) What are the different transitions that take place in UV spectroscopy ? Give the energy level diagram. 3

(*c*) In atomic emission spectroscopy why the energy of emission is lower than absorption ? 3

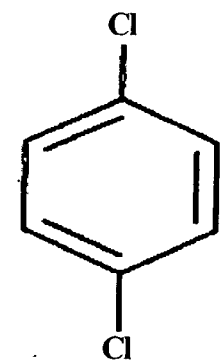
(*d*) How will you distringuish the followings using ^{1}H NMR spectroscopy ? 6



(*i*)



(*ii*)



(*iii*)

7. (*a*) Sketch the diagram of double beam flame spectrophotometer. 4

(*b*) What are the different radiation sources used in AAS ? Explain. 4

(*c*) Write short notes on any *two* of the following : 4

(*i*) Spin-spin relaxation

(*ii*) Phosphorescence

(*iii*) Spin-spin splitting.

(*d*) Define the following terms : 3

(*i*) Doppler broadening

(*ii*) Chemical interference.