

高等 分析化學 資格考

1. GC data: column length: 40 cm; flow rate: 20 ml/min.

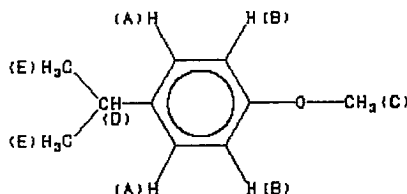
Compound	t_r (retention time)	W (peak width at base)
Air	2	-----
A	10	0.75
B	11	0.80

Calculate (a) the average number of plates, (b) the capacity factor for compound B, (c) the average plate height for the column, (d) the resolution for compound A and B, (e) the selectivity factor for compound A and B. (12%)

2. Determine the concentrations (mol/l) of $\text{Co}(\text{NO}_3)_2$ (A) and $\text{Cr}(\text{NO}_3)_3$ (B) in an unknown sample, the following absorbance data were obtained. (8%)

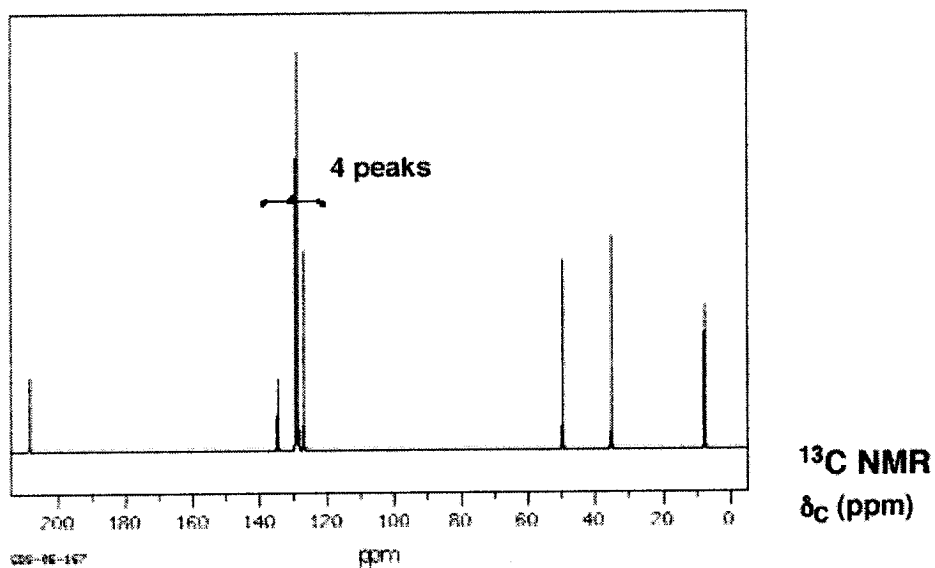
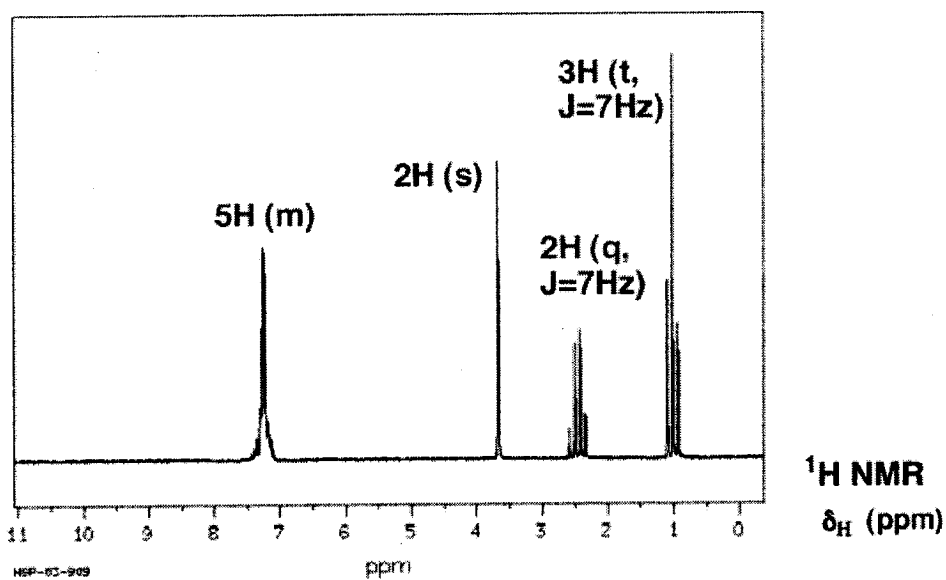
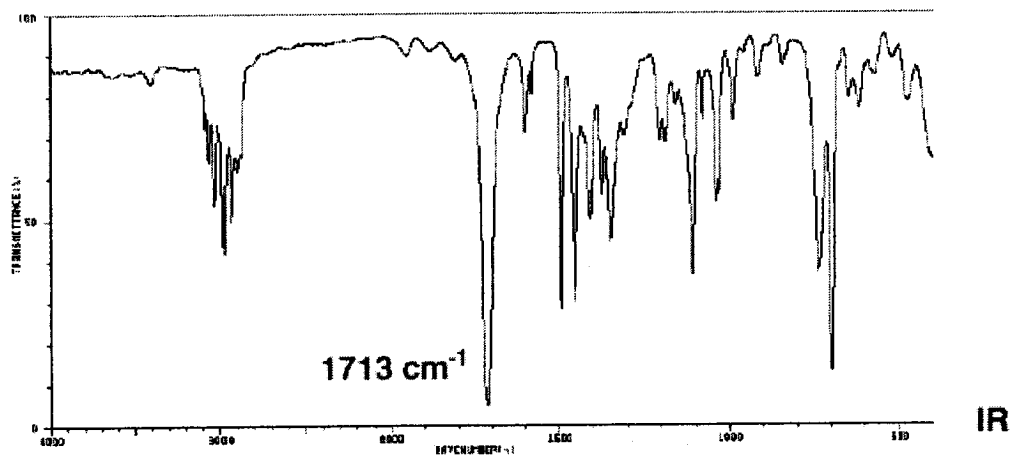
A (mol/l)	B (mol/l)	510 nm	575nm
1.5×10^{-1}	0	0.714	0.097
0	6×10^{-2}	0.298	0.757
Unknown	unknown	0.671	0.330

3. Describe the Standard Addition Method. (6%)
4. Describe the effect of concentration on fluorescence intensity. (6%)
5. Why does the ratio of anti-Stokes intensities (Raman scattering) increases with sample temperature increasing? (5%)
6. Consider an infrared grating with 72 lines per millimeter and 10 mm of illuminated area. (a) Calculate the first-order resolution ($\lambda/\Delta\lambda$) of this grating. How far apart (in cm^{-1}) must two lines centered at 2000 cm^{-1} be if they are to be resolved? (b) Calculate the wavelengths on the first- and second-order diffraction spectra at reflective angles of 20 deg, assuming the incident angle is 50 deg. (8%)
7. For a titration reaction: $\text{A} + \text{B} \rightarrow \text{C}$, if only the product C absorbs at 500 nm, predict the titration curve for the above photometric titration. (5%)
8. How does Scanning Electron Microscope work? (10%)
9. Explain (a) Hypsochromic shift (b) Bathochromic effect, especially in terms of the effect of solvent polarity on the UV/Visible spectra. (10%)
10. (a) Draw the simulated H-NMR spectrum of p-isopropylanisole (5%)
(b) What's the advantage to use higher frequency in NMR (e.g. 300MHz vs. 60MHz) (5%)



11. (a) Explain the theory of chemical shift in H-NMR. What factors would affect the chemical shift? (5%) (b) Explain the theory of spin-spin splitting. (5%) [use the example in problem 10 to illustrate]

12. Given the molecular formula ($C_{10}H_{12}O$) and the IR, 1H -NMR, ^{13}C -NMR spectra, please determine the structure of this unknown, and explain. (10%)



1. For chromatography, (1) write down the van Deemter equation, (2) draw a typical plot of the equation, (3) describe the three parameters that contribute to the shape of the curve, and (4) describe the effect that flow rate has on each parameter. (15%)
 2. Name two types of GC detectors and briefly describe how each works. Use drawings (15%)
 3. (1) Draw a molecular orbital energy level diagram for a molecule that contains sigma bonds, pi bonds, and non-bonding electrons (i.e., formaldehyde). (2) Show the four types of transitions that can occur when this molecule absorbs a photon. (3) Arrange these transitions in order of increasing energy. (10%)
 4. Use dichloroethane (CH_2ClCH_3) as an example, draw a simulated NMR spectrum, explain what are chemical shift and spin-spin coupling? What information are provided by these two parameters? (15%)
 5. Use the above example, how can spin-spin splitting lines be differentiated from chemical shift lines? And what are the advantages of using higher magnetic field strength? (15%)
 6. Li^7 nucleus has a spin quantum number of $3/2$. (1) How many magnetic energy states does this nucleus have? and (2) what are their m_l values? (5%)
 7. In Mass Spectrometry, explain and compare electron-impact vs. chemical ionization methods, what are the advantage of each? (15%)
 8. How many fundamental vibrations should a propane molecule have? And what are the selection rules for IR resonance absorption? (10%)
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