

化學研究所

PART ONE (33%)

- (1) What are the advantages and disadvantages of weighing samples of a powdered material by difference? (5%)
- (2) Calculate the average deviation in parts per thousand of the following: 51.21; 50.98; 51.26; 50.75; 51.30. Should any of these results be rejected? (8%)
- (3) Calculate the minimum difference in standard potentials ($E_A^{\circ} - E_B^{\circ}$) needed for a quantitative reaction in which both reactants undergo a 1-electron change. (10%)
- (4) An acid HA having an ionization constant K_a of 6.30×10^{-6} is buffered at pH 4.0. Calculate α_A , the fraction of HA present as A^- under these conditions. (10%)

PART TWO (34%)

- (5) True=T, and false=F, pick the correct answer. (4%)
- (a) Radiation is accelerated as it passes through a medium containing atoms, ions, or molecules because its electrical vector interacts momentarily (10^{-14} to 10^{-15} sec) with the electrons of these particles, causing their temporary polarization. (T, F)
- (b) For organic compounds, the most useful transitions in the uv-vis regions are $\sigma \rightarrow \sigma^*$ and $n \rightarrow \sigma^*$ transitions. (T, F)
- (c) Optical rotatory dispersion (ORD) measures the wavelength dependence of the molecular rotation of a compound, while the circular dichroism (CD) depends on the molar absorptivity of an optically active compound. (T, F)
- (d) The phenomenon that arises when a beam of intense monochromatic light passes through a sample, causing the molecules to change in molecular polarizability as they vibrate is the basis for the Raman effect. (T, F)
- (6) Fill in the blanks with the correct terms from the list provided. (3%)
- | | | |
|----------------------|--------------------|---------------------|
| Raman effect, | reverse phase; | Kovat index, |
| anisotropic effect, | isosbestic point, | anti-Stokes effect, |
| McReynolds constant, | isocratic elution. | |
- (e) Wavelength at which the absorbances of two interconvertible species are the same is called _____ (e)
- (f) A separation that employs a single solvent of constant composition is called _____ (f)
- (g) _____ (g) is used widely to characterize the stationary phases available commercially.
- (7) In mass spectrometry, if an ion of mass m_1 decomposes to give an ion of mass m_2 , then a metastable ion may be found at mass m^* by the following relationship: (2%)
_____ (7)
- (8) The magnetic sector mass spectrometer is governed by the formula: $\frac{m}{z} = \frac{B^2 r^2}{2V}$
What are the symbols m , z , B , r , V ? (5%)
- (9) In chromatography, the resolution of two adjacent components is defined as the ratio of the peak separation to the mean peak width. Derive an expression for resolution with a diagram to depict the symbols used. (6%)
- (10) The more useful form of resolution in chromatography is: $R = \frac{\sqrt{N}}{4} \left(\frac{\alpha-1}{\alpha} \right) \left(\frac{k'}{1+k'} \right)$.
(a) Explain the symbols N , k' , α .
(b) Explain what this equation means. (9%)
- (11) List three(3) variables that lead to band broadening in chromatographic separation. (3%)
- (12) (a) What is a mass chromatogram?
(b) How can a mass chromatogram be obtained? (2%)

PART THREE (33%)

化學研究所

- 1) The _____ energy of a molecule is quantized. Thus the absorption of IR radiation gives rise to a transition. The necessary requirement for a transition to occur is that the molecule possesses a _____. (1%)
- 2) A molecule has many degrees of freedom. For CO₂ molecule, the fundamental vibrations equal to _____. For H₂O molecule, this equal to _____. The theoretical number of fundamental vibrations will not be exactly equal to the observed signals because _____ and _____ increase the number of signals whereas _____, _____, _____, _____ reduce the number of signals. (4%)
- 3) In a polyatomic molecule, the accidental degeneracy of two energy levels may interact with each other. Such interaction is known as _____. The necessary requirement for such interaction to occur is _____. (1%)
- 4) Combination transition is _____
Overtone transition is _____ (1%)
- 5) Some of the IR detectors are (a) _____ (b) _____
(c) _____ (d) _____ (2%)
- 6) The range of uv absorption of organic compounds extends from _____ to _____ nm. (1%)
- 7) The shift of uv absorption to longer wavelength due to substitution or solvent effect is _____, the shift to shorter wavelength is _____. (1%)
- 8) An increase in absorption intensity is _____ effect.
A decrease in absorption intensity is _____ effect. (1%)
- 9) The uv detector -- photomultiplier utilizes the fact that _____

_____ (2%)
- 10) In NMR spectroscopy, chemical equivalence means _____
and magnetic equivalence is _____. (2%)
- 11) The factors that influence NMR coupling constant are _____, _____, _____ (2%)
- 12) The resonance equation of NMR is _____. (1%)
- 13) Spin-lattice relaxation is _____
Spin-spin relaxation is _____. (2%)
- 14) FT-NMR is _____. (1%)
- 15) In a 60 MHz magnetic field, the doublets of A signal appear at 80 Hz and 65 Hz, the doublets of B signal appear at 63 Hz and 60 Hz respectively. Calculate the chemical shifts of both A and B. (2%)
- 16) The light source of AA spectroscopy is a _____. The lamp is filled with _____ after evacuation. The cathode is made of _____ if we measure _____. A high voltage is applied, the molecules will be ionized, attracted and accelerated to the _____. The fast-moving ions strike and dislodge the surface atoms of the characteristic spectrum of _____. (4%)
- 17) The functions of a Lundegardh atomizer used in AA spectroscopy are (a) _____
(b) _____ (c) _____ (d) _____ (2%)
- 18) The monochromator of an instrument is used to _____ the ^{light} into _____. The resolution of a prism is defined _____, and that of a grating is defined _____. (3%)