國立中央大學八十八學年度碩士班研究生入學試題卷

所別: 化學研究所 不分組 科目: 物化、分析 共二頁 第一頁

Part I: Analytical Chemistry

- 1. More than five types of general mass analyzers are used in mass spectrometry. Please name a describe two of them, from the principles of mass analysis. (10 pts)
- 2. Please define following term: (10 pts; 2 for each)
 - a, isocratic and gradient elution.
 - b. reserved-phase HPLC column.
 - c. gel permeation chromatography.
 - d. retention time.
 - e. chiral stationary phases.
- 3. Which of the following statements with regard to AA are false: (10 pts)
- (a) The so-called Achilles' heel (weakness) in flame-AA mainly addresses atomization process wi flame.
- (b) More than 99.99% of all atoms are in the ground state.
- (c) Increasing flame temperature dramatically decreases the ground state population.
- (d)Increasing flame temperature dramatically improves the sensitivity in alkaline metal detection.
- (e) Increasing flame temperature dramatically increases the number of atoms in the excited states.
- (f) AA methods are primarily concerned with adsorption of radiation by ground state atoms.
- 4. Electrothermal AA has better sensitivity than flame-AA due to: (10 pts)
- (a)Better atomization efficiency than nebulizer
- (b) Average residence time of the atoms in the optical path is longer than in the flame.
- (c) More sample can be introduced per analysis.
- (d) Atomization of the sample occurs in a period of only a few milliseconds.
- (e) Better detector.
- 5. Which of the following statements are false? (10 pts)
- (a) voltammetry is based upon the measurement of a current that develops under complete concentration polarization.
- (b) Voltammety differs from electrogravimetry and coulometry in that with the latter ones the concentration polarization is kept at minimum.
- (c) In voltammety a large consumption of analyte results in the end.
- (d)In electrogravimetry essentially all of the analyte is converted to another state.
- (e)In potentiometry a large current flow through the voltmeter.

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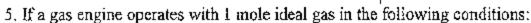
Part II. Physical Chemistry

- 1. Quick questions
 - a. What is the point group symmetry of H₂O? (2pts)
 - b. Does O2 molecule have any pure rotational spectrum in microwave region? (2pts)
 - c. Does CO molecule have any vibrational spectrum in IR region? (2pts)
 - d. What is the number of vibrational degrees of freedom of SO_4^2 . (2pts)
 - e. Please explain the difference between fluorescence and phosphorescence. (2pts)
 - f. What is the difference between Fermions and Bosons in terms of the symmetry of their wave functions? (2pts)
- 2. For an atom with 2s¹2p¹ configuration, please write down all of the term symbols (including multiplicity, total angular momentum) corresponding to this configuration. (8pts)
- For the planar radical: CH₂CHCH₂, please use Hückel molecular orbital approximation to determine π electron energy levels. Please use α to denote the Coulomb integral and β to denote the resonance integral; i.e., please write down the energy values in terms of α and β. (10 pts)
- 4. There is a reaction: $2A\rightarrow 2B+D$. The mechanism is as follows:

 $A \leftrightarrow B+C$ (Rate Constant: $k_1 \rightarrow , k_1 \leftarrow$)

 $A+C \rightarrow B+D$ (Rate Constant: k_2)

Please use Steady State Approximation to show that (if k₂ »k₄) the production rate of D=k[A] (1st order reaction). (8pts)



State (a) : Pressure=2 atm, Volume=1 liter

State (b) : Pressure=1 atm, Volume=2 liter

Path I: State (a) \rightarrow (b), P + V = constant

Path 2: State (a) → (b), PV=RT

Let's suppose every step is reversible. What are \triangle E(change of energy), q(heat), and w(work) for each path? (6pts) (Define: \triangle E=q-w)

6. For the vaporization of 1 mole water at 1atm, $\Delta H_{vap} = 43.54 \text{ kJ Mol}^{-1}$ at 298K, $\Delta H_{vap} = 40.69 \text{ kJ Mol}^{-1}$ at 373K. Heat capacity: $C_p(H_2O_{(3)}) = 75.3 \text{ J Mol}^{-1}\text{K}^{-1}$. What is the heat capacity for $H_2O_{(3)}$? (6pts)

