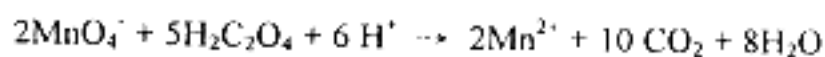


A1. (5%) Titration of 50.00 mL of 0.05251 M $\text{Na}_2\text{C}_2\text{O}_4$ required 38.71 mL of a potassium permanganate solution:



Calculate the molarity of the KMnO_4 solution.

A2. (7%) The arsenic in a 9.13 g sample of pesticide was converted to AsO_4^{3-} and precipitated as Ag_3AsO_4 with 50.00 mL 0.02105 M AgNO_3 . The excess Ag^+ was then titrated with 4.75 mL of 0.04321 M KSCN . Calculate the percentage of As_2O_3 in the sample.

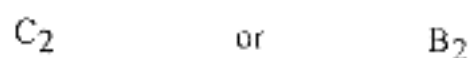
A3. (7%) Iron(III) reacts with SCN^- to form the red complex, $\text{Fe}(\text{SCN})^{2+}$. (a) Please sketch a photometric titration curve for Fe(III) with SCN^- ion when a photometer with a green filter is used to collect data. b) Explain why is a green filter used?

A4. (6%) Why are the liquid stationary phases of gas-chromatography often bonded and cross-linked?

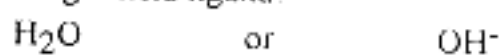
4% I.1 Draw the molecular structure and determine the point group for each of the following species.
 (a) PF_5 (b) H_2O_2

9% I.2. Choose and explain

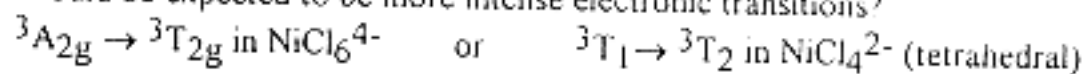
I.2a Which is paramagnetic?



I.2b Which ligand is the stronger field ligand?



I.2c Which would be expected to be more intense electronic transitions?



6% I.3 Determine the number of unpaired electrons and the crystal field stabilization energy for each of the following. (a) $[\text{Fe}(\text{CN})_6]^{3-}$ (b) $[\text{CoF}_6]^{4-}$

3% I.4 Which of following configurations are expected Jahn-Teller distortions in an octahedral field?
 (a) d^3 (b) d^4 (LS) (c) d^5 (HS) (d) d^6 (LS) (e) d^7 (HS) (f) d^8 (g) d^9

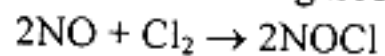
3% I.5 Find an organic fragment isolobal with $\text{Mn}(\text{CO})_5$.

(背面仍有題目,請繼續作答)

P.1 Please explain the following terms: (10%)

- (a) photoelectric effect
- (b) Heisenberg's uncertainty principle
- (c) orbital
- (d) Pauli exclusion principle
- (e) ionization energy

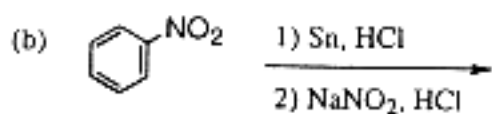
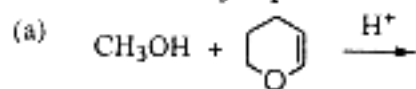
P.2 For the reaction between gaseous chlorine and nitric oxide,



it is found that doubling the concentration of both reactants increases the rate by a factor of eight, but doubling the chlorine concentration alone only doubles the rate. What is the order of the reaction with respect to nitric oxide and chlorine? (6%)

P.3 One mole of an ideal gas at 300 °K expands isothermally and reversibly from 5 to 20 liters. Please calculate the work done and the heat absorbed by the gas. What is ΔE and ΔH for the process? ($R = 1.987 \text{ cal mol}^{-1} \text{ K}^{-1}$) (9%)

O-1. Give the major product for each of the following reactions. (4%)



O-2. Arrange the following quantities in the order of decreasing (4%)

(a) Basicity: (1) CH_3CONH_2 (2) CH_3NH_2 (3) $\text{C}_6\text{H}_5\text{NH}_2$

(b) boiling point: (1) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ (2) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ (3) $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$

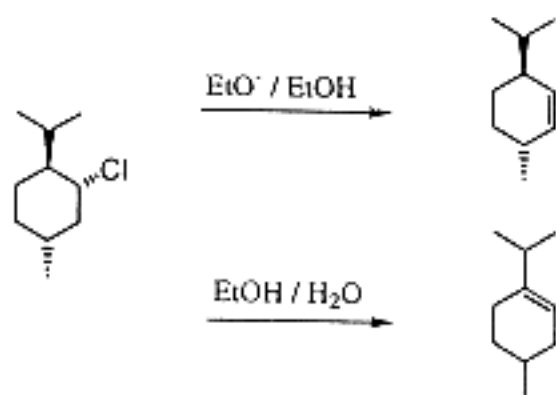
O-3. When benzene is treated with propene and sulfuric acid, two different monoalkylation products are possible. Draw their structures. Which one do you expect to be the major product? (4%)

O-4. Explain each difference in reactivity toward nucleophiles. (4%)

(a) Esters are less reactive than ketones

(b) Primary alkyl halides are less reactive than tertiary alkyl halides

O-5. Menthyl chloride reacts with sodium ethoxide in ethyl alcohol to give a single product as shown. By contrast, menthyl chloride is treated with 80% aqueous ethanol to give an additional, major, product as shown. Explain. (4%)



O-6. Compound A, $\text{C}_4\text{H}_{10}\text{O}$, is oxidized with PCC to compound B which gives a positive Tollens' test and has a strong IR band at 1725 cm^{-1} . The ^1H NMR spectrum of compound A is shown below. What are the structures of compound A and compound B. (5%)

