# 國立嘉義學九十五學年度
應用化學系碩士班招生考試(甲組)試題

科目：綜合化學-II

Ⅰ.Physical chemistry :

1. Calculate the activation energy for a reaction whose rate constant at 300K is tripled by 10℃ increase in temperature. (R = 1.987 cal mol^{-1} K^{-1})(ln 3 = 1.1) (10%)

2. A solution of hexane and heptane at 25℃ with hexane mole fraction 0.250 has a vapor pressure of 80.0 torr and a vapor-phase hexane mole fraction of 0.50. Find the vapor pressures of pure hexane and heptane at 25℃. (10%)

3. Suppose 0.100 mol of a perfect gas having $C_{v,m}$ = 1.50 R (independent of temperature) Calculate q, w, ΔU, and ΔH for a process (P_1 = 1.00 atm, V_1 = 1000 cm^3) to (P_2 = 3.00 atm, V_2 = 1000 cm^3). (J has an only acceptable unit in the question.) (R = 8.314 Jmol^{-1}K^{-1} or 82.06cm^{3}atm.mol^{-1}K^{-1}) (10%)

4. A laser rated at 0.30 J can generate radiation in 1.0 ns pulses at a pulse repetition rate of 10 Hz. Assuming that the pulses are rectangular, calculate the peak power output and the average power output of this laser. (10%)

5. Estimate the value of the rotational and vibrational partition function of H^{35}Cl at 25℃, and pick your answer from the following： a. 0, b. 1, c. 20, d. 10^{23}. (5%)

6. Find the degree of freedom for an aqueous solution of HCN and KCN? (5%)

Ⅱ. Analytical chemistry：

1. You are in charge of a case about developing a method for determination of dioxins in environment in Environmental Protection Agency. During the process development, you should provide data about LOD (limit of detection) and LOQ (limit of quantitation) of the method. **Please tell us the definitions of LOD and LOQ; and how you determine the LOD and LOQ. (List all the possible approaches.)** (10%)

2. Alanine is a diprotic amino acid with $K_1 = 4.49 \times 10^{-3}$, $K_2 = 1.36 \times 10^{-10}$.
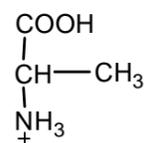
Find the pH values of 0.10 M H$_2$Anl$^+$, 0.10 M. HAnl, and 0.10 M. Anl$^-$. (15%)

3. Fajans titration of Cl$^-$ with Ag$^+$ uses a weak acid dichlorofluorescein as an adsorption indicator. During the titration, the pH of the solution must be controlled in a basic range. **Please give an explanation for the absorption process.** (5%)

4. There are many phenolic compounds with antioxidative activities presented in olive oils. These phenolic compounds are much more polar then triacylglycerols, the major components in the oils. Your boss asks you to extract the phenolic compounds from the oils for further study. You have a vacuum evaporator, separation funnel and solvents, **ethyl acetate**, **acetone**, **methanol**, and **water** in your laboratory. **Please design a reasonable extraction procedure and tell us which solvent you will choose for the extraction. Explain your design and tell us why you choose this solvent for extraction instead of the others .** (10%)

A triacylglycerol   A phenolic compound
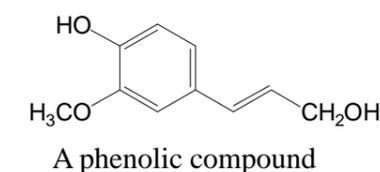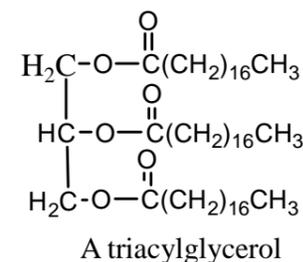
5. Fumarate and maleate can be separated by reversed-phase HPLC with an octadecylsilane (C$_{18}$) column. The mobile phase usually contains CH$_3$CN/H$_2$O with pH adjusted to 2.5.

fumarate   maleate
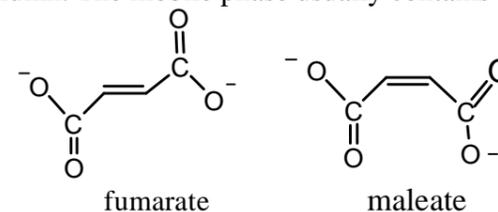
Explain why the pH of the mobile phase should maintain at 2.5? (8%)
Predict which one will come out first? (2%)