國立臺灣大學99學年度碩士班招生考試試題

1.(8%) Define (a) ionic strength, (b) retardation factor, (c) Volhard method, (d) van Deemter equation

2.(6%) Give the answers to the following calculations (Note: the concepts of significant figure and analytical statistics have to be applied): (a) 0.002000 + 0.03000 + 0.4000 + 5.000 + 60.00 + 700.0
(b) antilog(-2.00)
(c) the pH and its uncertainty of a solution containing hydrogen ion concentration of $(1.00 \pm 0.01) \times 10^{-4}$ M.

3.(10%) Make a clear distinction (a) between chelate and ligand, (b) between a primary standard and a secondary standard, (c) among excitation spectrum, absorption spectrum, and emission spectrum.

4.(10%) (a) Show the related equation and your calculation to obtain the standard deviation of the following set of data: 0.23, 0.17, 0.30, and 0.20. (b) Assume that the set of data shown in (a) is the readings of four blanks prepared for determining lead concentration in a sample using a spectroscopic method and that a 1.50 ppm lead standard solution gives a reading of 1.75. (i) Calculate the detection limit of the method. (ii) What would be the total reading at the detection limit?

5.(6%) AAS method is suitable for analyzing polluted samples with high levels of metals. Discuss the process and the characteristics of two different atomization methods used in AAS.

6.(8%) The reaction of Ni^{2+} with the chelating reagent G produces NiG_2^{2+} ($Ni^{2+} + 2G \leftrightharpoons NiG_2^{2+}$), whose solutions absorb radiation at 450 nm and obey Beer's law over a wide range. Assume that the analytical concentration of G is significantly higher than that of Ni^{2+} and the cation exists entirely in the form of the complex. Use the data below to calculate (a) the molar absorptivity of the reaction solution, (b) the equilibrium concentration of Ni^{2+} in Experiment 2, and (c) the formation constant for the reaction.

	Analytical concentration, M		
Experiment	G	Ni^{2+}	A_{450} (1.00-cm cells)
1	2.20×10^{-1}	2.00×10^{-4}	0.844
2	1.50×10^{-3}	2.00×10^{-4}	0.316

7.(7%) (a) Write down the full name (in English) of the following detectors: (i) ECD, (ii) FID, (iii) TCD. (b) Discuss the operational principle of TCD.

8.(12%) A vitamin C tablet contains 1000.0 mg of ascorbic acid ($C_6H_8O_6$), which is a diprotic acid with $Ka_1 = 6.76\times10^{-5}$, $Ka_2 = 2.68\times10^{-12}$. (a) Calculate the pH of the solution made by dissolving two tablets of vitamin C in 100.0 mL water. (b) A vitamin C syrup is made by dissolving two tablets of vitamin C and 100.0 g saccharin ($HC_7H_4NO_3S$, a sugar substitute, $K_{asaccharin} = 2.09 \times 10^{-12}$) in 100.0 mL water. Assume the vitamin C tablets are pure ascorbic acid, calculate the concentration of saccharin ion in the syrup solution at equilibrium.

9.(12%) (a) Describe how (i) UV-VIS spectrometry and (ii) IR spectrometry can be used to identify nitrite ion. (Note: Your answer should include the type of spectroscopic transitions involved and the number of peaks usually detected in each spectrometry.) (b) Explain which of these two spectrometries can better distinguish nitrite ion from nitrate ion.

10.(12%) (a) Describe the operational principle of Nuclear Magnetic Resonance (NMR) spectroscopy. (b) The magnetogyric ratio for ^1H nucleus is 2.67520×10^8 rad/Tesla-s. Show your calculation to obtain the frequency at which ^1H nucleus absorbs in a field of strength 1.4092 Tesla. (c) Discuss why an intense magnetic field is preferred in NMR analysis.

11.(9%) (a) Identify the analytical information that can be obtained from voltammetry and discuss how voltammetry works to obtain the information. (b) Sketch (with proper labeling) and discuss the design and the operation of the Clark oxygen sensor.

試題隨卷繳回