題號：180
科目：物理化學
節次：4

國立臺灣大學 112 學年度碩士班招生考試試題

題號：180
共 1 頁之第 1 頁

1. **(Total 25 pts)** Mass Spectroscopy (MS) is a widely applied analytical technique in biomedical analysis. In particular, most of the achievements in proteomics and related researches are mainly using MS-based analytical approaches. In MS analysis, sample ionization is the first step of the measurement. **(1)** Please write down three different ionization methods (3 pts). After the ionized sample is introduced into MS, **(2)** name two mass-selection methods (2 pts) and please explain their working principle (6 pts). In the acquired mass spectrum, **(3)** what is nominal mass? (2 pts) what is monoisotopic mass? (2 pts) what is the most abundant mass? (2 pts) and what is average mass? (2 pts) You can answer this question by defining the terms or mark the terms in an illustration. If you have a protein sample in solution form, **(4)** how would you design your experiment using MS analysis to acquire the information of protein structure? Please explain the ionization method, mass selector and possible combination of MS necessary in your design (6 pts).

2. **(Total 25 pts)** Ion concentration in a physiological system is critical to biochemical reactions that keep organs functioning. For an example, the hydronium ion (H^+) concentration is fine tuned to about 10^{-7} M. In general lab practice knowing, how to prepare a solution that is able to provide an environment with stable pH is crucial. **(1)** What is this kind of solution? (2 pts) To prepare this kind of solution, **(2)** what components do you need for the preparation? (3 pts) Henderson-Hasselbalch equation is able to find out how to prepare it, **(3)** please shortly describe the equation formula and its meaning (5 pts). **(4)** Please define the "range" and "capacity" of the pH stabilization feature using the mentioned concept (5 pts). During the preparation, pH meter is very often used to monitor the pH value of the solution, **(5)** what is the working principle of pH meter, please detail the device design and measuring principle (10 pts).

3. **(Total 25 pts)** In electrochemistry, three-electrode system is often used to replace two-electrode system, **(1)** Please draw a schematic set-up for each system, and explain the advantage of using three-electrode system (10 pts). For probing an electrochemical reaction in solution, one could use cyclic voltammetry (CV) to identify the feature of the reaction. **(2)** Please describe what is CV and discuss minimum two type of electrochemical reaction features that can be identified (10 pts). **(3)** Why is it necessary to add non-reactive electrolytes into the solution with relative high concentration of about 100 times more than your analyte (5 pts)?

4. **(Total 25 pts)** Spectrophotometry analysis provides valuable information in material analysis. In example of the absorption spectroscopy, the wavelength region of the absorbed light can be used to predict molecular orbital structure. **(1)** Please correlate the excitation mode of a molecule with the necessary wavelength region used, ranging from X-ray, UV-Vis, IR to microwave (10 pts). The mentioned absorption spectrophotometries require an energy tunable light source to conduct wavelength scan, unlike those, Raman spectroscopy is using a narrow energy band LASER to perform measurements that are able to provide information similar to IR spectroscopy. **(2)** Please describe the physical principle of Raman spectroscopy and how can molecular information be acquired (10 pts). In case of characterization of surface adsorbed molecules or thin film materials, conventional transmission mode spectroscopy is not applicable due to very short light path that is not able to provide good sensitivity, in this regards, one could use attenuated total reflection IR (ATR-IR) as an alternative way. **(3)** What is evanescence wave in ATR-IR measurement and why is it important (5 pts)?