

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Describe how the six numerical criteria of an ICPOES (inductively coupled plasma optical emission spectroscopy) method for measuring arsenic levels in human blood samples can be assessed. List appropriate terms first, and then explain what they mean and how they can be calculated. (10%)
2. Draw block diagrams to illustrate the components of the following three types of instruments for optical spectroscopy: absorption, fluorescence, and chemiluminescence spectrometers. Use the diagrams to explain how these instruments work and the major differences among them. (10%)
3. Construct a hypothetical van Deemter plot and the related equation for a packed liquid chromatographic column. Explain the meanings of A, B, and C terms. Then use the equation to explain how and why the particle size in a packed HPLC column affects the column efficiency and the pressure required for pumping mobile phase through the column. (10%)
4. What is the range of wavelength in nanometer (nm) for visible light? Convert the range into the corresponding wave numbers per cm ( $\text{cm}^{-1}$ ) and frequencies (Hz) of the electromagnetic wave. (5%)
5. Calculate the photon flux (number of photons/second) required to be detectable by an optical spectrometer that is equipped with a photomultiplier with a gain of  $10^7$  and a pico-Amp current meter. (5%)
6. Provide reasonable explanations to the fact that laser-induced fluorescence detectors, as detectors for liquid chromatography, are often able to yield much lower detection limits than those operated using UV-VIS absorption. (8%)
7. Describe the applications and working principles of the following two important ionization methods. (12%)
  - (A) ESI
  - (B) MALDI
8. Describe the definitions, working principles, and/or applications of the following two related term/devices. Then point out the similarity and/or difference, if any, between them. (40%)
  - (A) SDS-PAGE and IEF
  - (B) Fluorescence and chemiluminescence
  - (C) Internal standard and standard addition
  - (D) TOF and FT-ICR mass spectrometers
  - (E) Temperature gradient in GC and solvent gradient in LC
  - (F) Partition chromatography and adsorption chromatography
  - (G) Detectors used in chromatography: ECD in GC and ECD in LC
  - (H) The definitions of signal resolution in chromatography and mass spectrometry