

※ 考生請注意：本試題不可使用計算機

1. Describe the applications and working principles of the following two related techniques/terms. Try to explain the major similarity and/or difference between them. (48%)
  - (a) APCI and APPI
  - (b) SDS-PAGE and IEF
  - (c) Internal standard and Standard addition method
  - (d) Ion chromatography and Ion mobility mass spectrometry
  - (e) Orbitrap mass spectrometer and Ion trap tandem mass spectrometer
  - (f) Electrospray ionization and Matrix-assisted laser desorption ionization
2. What are the analytical methods or devices for inducing ion fragmentation in mass spectrometry? Describe briefly their working principles and compare the analytical advantages provided by these techniques. (9%)
3. What are effects of poor vacuum conditions to the operations of mass spectrometers? List three major pumping systems that are commonly used in mass spectrometry to achieve high vacuum. Describe briefly their working principles. (9%)
4. Describe how the confidence limit (uncertainty) of a measurement can be assessed and reported. Then write down an equation that describes how the measurement uncertainties of three measurements,  $p$ ,  $q$ , and  $r$ , propagate into the uncertainty of  $x$ , where  $x = f(p, q, r)$  (8%)
5. Describe how the precision, bias, sensitivity, detection limit, dynamic range, and selectivity of an ICP-MS for measuring trace chromium levels in human blood samples can be assessed. If chemical speciation is intended in the analysis, how can the speciation be carried out? (9%)
6. Draw a hypothetical van Deemter plot for a packed liquid chromatographic column. Write down an equation to describe the shape of the plot and explain the meanings of A, B, and C terms in the equation. How does the particle size in a packed HPLC column affect the column efficiency and the pressure required for pumping mobile phase through the column? (8%)
7. Answer the following questions related to "signal resolution" (9%)
  - (1) How is chromatographic resolution calculated?
  - (2) How is mass spectrometric resolution calculated?
  - (3) Discuss why different procedures are used to calculate chromatographic and mass spectrometric resolutions. Also list the advantages and disadvantages of these two procedures.