

- ※ 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 precision, bias, sensitivity, detection limit, dynamic range, and selectivity of an HRGC-HRMS (high resolution gas chromatography-high resolution mass spectrometry) method for measuring trace dioxin levels in human blood samples can be assessed. (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. Describe how standard addition method can be applied to measure the concentration of mono-(2-ethyl-5-carboxypentyl) phthalate in human urinary matrix and the advantages provided by the method. (10%)
  5. 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  $x = f(p, q, r)$ . (10%)
  6. Draw a diagram showing components of a mass spectrometer system and describe the functions of these components. (10%)
  7. 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) ESI and MALDI
    - (B) FT-ICR and Orbitrap mass spectrometers
    - (C) Calibration sensitivity and analytical sensitivity
    - (D) Partition chromatography and adsorption chromatography
    - (E) The definitions of signal resolution in chromatography and mass spectrometry