※ 考生請注意:本試題 □可　☑不可 使用計算機

1. Describe applications and working principles of the following devices. (20%)
   (a) Reverse phase chromatography
   (b) Electron capture detector
   (c) Quadrupole-time-of-flight hybrid tandem mass spectrometer
   (d) Matrix-assisted laser desorption ionization source

2. Answer the following questions. (20%)
   (a) 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?
   (b) What are the advantages provided by a temperature-controlled oven in gas chromatography?
   (c) What are effects of poor vacuum conditions to the operations of mass spectrometers?
   (d) What are the analytical advantages and disadvantages provided by ion fragmentation in an EI source?

3. 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. (15%)

4. Describe how standard addition method can be applied to measure the concentration of di(2-ethylhexyl) phthalate in human urinary matrix and the advantages provided by the method. (15%)

5. 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. (18%)

6. 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 $x = f(p, q, r)$. (12%)