1. Define and explain the following terms. (20%)
   (a) Precision vs. accuracy
   (b) Retention time and adjusted retention time
   (c) Detection limit
   (d) Chemiluminescence

2. Describe applications and working principles of the following devices. (20%)
   (a) Reverse phase chromatography
   (b) Electron capture detector
   (c) Time-of-flight mass analyzer
   (d) Electron impact ionization source

3. Explain: (20%)
   (a) why atomic absorption spectra are line spectra and, on the contrary, molecular absorption spectra are band spectra.
   (b) why HRGC-HRMS is commonly used for the quantitative measurement of trace dioxin levels in biological matrices.
   (c) why selected ion monitoring (SIM) can be used to increase the sensitivity of a mass spectrometer.
   (d) 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.

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 $x = f(p, q, r)$. (20%)

5. Describe how the following methods can be used in quantification of a benzene metabolite in urinary matrix and the advantages provided by these methods. (20%)
   (a) Internal standard
   (b) Standard addition