1. Describe the working principles, applications, and/or definitions in chemical instrumentation of the following techniques, devices, or terminologies. If the terms are acronyms, give their full names (in English). (60%)
   (1) MALDI
   (2) FID
   (3) ESI
   (4) TOF
   (5) AED
   (6) ECD
   (7) FT-ICR
   (8) Precision and accuracy
   (9) van Deemter plot
   (10) Analytical selectivity
   (11) Retention factor
   (12) Internal standard

2. Briefly answer the following questions: (40%)
   (1) How standard addition method can be applied to measure the concentration of a benzene metabolite, SPMA, in urinary matrix?
   (2) How the detection limit of an ICPOES (inductively coupled plasma optical emission spectroscopy) method for measuring trace arsenic levels in drinking water can be assessed?
   (3) 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 $x = f(p, q, r)$?
   (4) Why molecular absorption spectra are band spectra, in contrast to that atomic absorption spectra are line spectra?
   (5) 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.
   (6) What are the characteristics of an ideal detector for a GC instrument?
   (7) What are effects of poor vacuum conditions to the operations of mass spectrometers?
   (8) What is the definition of resolution of a mass analyzer? How to measure and calculate the resolution for a specific mass analyzer? Calculate the resolution required to resolve the mass spectral peaks for $^{116}Sn^{+}$ and $^{232}Th^{2+}$. Atomic weights: Sn (115.90219 Da) and Th (232.03800 Da).