一、 單選題：(45% total, 3% each)

1. What is the correct expression of the percent relative error, where x_i represents the individual values from the measurements, and x_t is the true or accepted value of the quantity?

A) $x_i - x_t$　　B) $x_t - x_i$　　C) $(x_i - x_t) \times 100\% / x_t$

D) $(x_i - x_t) \times 100\% / x_i$　　E) $(x_t - x_i) \times 100\% / x_i$

2. Which of the following is a strong acid?

A) H_3BO_3　　B) $HClO_3$　　C) H_2CO_3　　D) H_3PO_4　　E) none of these

3. Which of the following properties of activity coefficients is correct?

A) In very dilute solutions in which the ionic strength is minimal, the activity coefficient is 1.

B) In solutions that are not too concentrated, the activity coefficient is independent of the ionic strength.

C) For a given ionic strength, the activity coefficient of an ion increases more dramatically from 1 as the charge on the species increases.

D) At any given ionic strength, the activity coefficients of ions of the same charge are different significantly.

4. Gravimetric methods are

A) based on determining the quantity of charge required to complete a reaction with the analyte.

B) based on determining the quantity of current required to complete a reaction with the analyte.

C) based on determining the volume of a reagent of known concentration required to react completely with the analyte.

D) quantitative methods based on determining the mass of a pure compound to which the analyte is chemically related.

5. The equivalence point is the point in a titration when

A) a physical change occurs that is associated with the condition of chemical equivalence.

B) a chemical change occurs that is associated with the condition of physical equivalence.

C) the mass of added standard reagent is equivalent to the mass of analyte.

D) the volume of added standard reagent is equivalent to the volume of analyte.

E) the amount of added standard reagent is equivalent to the amount of analyte.

6. Which of the following is a primary standard for acids?

A) Benzoic acid　　B) Potassium hydrogen iodate　　C) Potassium hydrogen phthalate (KHP)

D) Sodium carbonate　　E) Sodium hydroxide

7. The pH transition range of most acid type indicators is roughly $pK_a \pm$

A) 0.1　B) 1　C) 3　D) 5　E) 10

8. For oxalic acid, $K_{a1} = 5.6 \times 10^{-2}$, and $K_{a2} = 5.42 \times 10^{-5}$. The aqueous solution of $NaHC_2O_4$ is

A) acidic　B) basic　C) neutral　D) cannot tell

9. What is the most commonly used indicator for EDTA titrations?

A) Bromcresol Green　B) Methyl red　C) Eriochrome Black T

D) Bromthymol Blue　E) Phenolphthalein

10. Standard electrode potentials can be used for

A) calculating equilibrium constants for redox reactions.

B) calculating thermodynamic cell potentials.　C) constructing redox titration curves.

D) none of these.　E) all of these.

11. Potentiometric methods

A) are based on measuring the potential of electrochemical cells without drawing appreciable current.

B) are electrolytic methods in which there is a net current and a net cell reaction.

C) are based on measuring current as a function of the potential applied to a small electrode.

D) are based on measuring current as a function of the potential applied to a dropping mercury electrode.

E) are based on measuring current at a fixed potential.

12. What is the advantages of Fourier transform?

A) rapid.　B) higher signal-to-noise ratios.　C) high throughput.

D) all of these.　E) none of these.

13. Which of the following is the most commonly used method of atomization in atomic emission spectrometry and atomic mass spectrometry?

A) Direct-current plasma.　B) Electric arc.　C) Electrothermal.

D) Flame.　E) Inductively coupled plasma.

14. Which of the following is the most commonly used gas chromatography detector for organic compounds?

A) Electron capture.　B) Flame ionization.　C) FTIR.

D) Photoionization.　E) Thermal conductivity.

15. Which of the following resolution is able to separate the ions with masses of 49.9921 and 50.0071?

A) 1500.　B) 2500.　C) 3500.　D) 500.　E) none of these.

二、 簡答題：(55%)

1. Make a clear distinction between the followings: (40% total, 5% each)
   (a) redu ction and reducing agent.
   (b) linear-scan voltammetry and pulse voltammetry
   (c) absorbance and transmittance.
   (d) fi lters and monochromators as wavelength selectors
   (e) electron impact and electrospray ionization as ionization sources of mass spectrometers
   (f) scanning electron microscopy and atomic force microscope.
   (g) capillary zone electrophoresis and micellar electrokinetic chromatography
   (h) differential thermal analysis and differential scanning calorimetry

2. What is general elution problem? How to solve this general elution problem in gas chromatography and supercritical fluid chromatography? (8% total, 4% each)

3. Describe the difference between ion-pair chromatography, ion-exchange chromatography, and ion-exclusion chromatography. (7%)