

※ 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。

Part I Single or multiple choices (4 points for each)

1. Estimate the absolute standard deviation and the coefficient of variation for the results of the following Calculations. Round the result to include only significant figures. The numbers in parentheses are absolute standard deviations. $y = 0.0020(\pm 0.0005) \times 20.20(\pm 0.02) \times 300(\pm 1)$
(a) 12.0(± 3.0) (b) 12(± 3) (c) 10.0(± 3.0) (d) 10(± 3)
2. An atomic absorption method for the determination of the amount of iron present in used jet engine oil was found, from pooling 30 triplicate analyses, to have a standard deviation $s = 2.4 \mu\text{g Fe/mL}$. If s is a good estimate of σ , calculate the 95% confidence intervals for the result, 18.5 $\mu\text{g Fe/mL}$, if it was based on the mean of four analyses.
(a) 18.5(± 2.4) (b) 19(± 2) (c) 15.5(± 2.4) (d) 16(± 2)
3. The method of standard additions was used to determine nitrite in a soil sample. An aliquot of 1.00 mL of the sample was mixed with 24.00 mL of a colorimetric reagent, and the nitrite was converted to a colored product with a blank-corrected absorbance of 0.300. To 50.00 mL of the original sample, 1.00 mL of a standard solution of $1.00 \times 10^{-3} \text{ M}$ nitrite was added. The same color-forming procedure was followed, and the new absorbance was 0.530. What was the concentration of nitrite in the original undiluted sample?
(a) $1.20 \times 10^{-3} \text{ M}$ (b) $3.23 \times 10^{-4} \text{ M}$ (c) $6.23 \times 10^{-4} \text{ M}$ (d) $6.23 \times 10^{-3} \text{ M}$
4. Which factors will the buffer capacity depend on.
(a) total buffer concentration (b) pKa of the acid/base conjugate pair (c) concentration ratio of the acid/base conjugate pair (d) temperature.
5. Neglecting any effects caused by volume changes when NaOH is added to a dilute solution of hydrochloric acid, would you expect the ionic strength to
(a) increase (b) decrease (c) remain essentially unchanged (d) none of these
6. Dilute NaOH is introduced into a solution that is 0.050 M in Cu^{2+} and 0.040 M in Mn^{2+} . What OH^- concentration is needed to initiate precipitation of the first hydroxide? $K_{sp}: \text{Cu}(\text{OH})_2 = 4.8 \times 10^{-20}; \text{Mn}(\text{OH})_2 = 2 \times 10^{-13}$.
(a) $2.5 \times 10^{-10} \text{ M}$ (b) $9.8 \times 10^{-10} \text{ M}$ (c) $2.5 \times 10^{-8} \text{ M}$ (d) $9.8 \times 10^{-8} \text{ M}$
7. What is the pH value for 10^{-8} M HCl solution?
(a) 8 (b) 6 (c) 2 (d) 7.
8. How many grams of $\text{Na}_2\text{HPO}_4 \cdot 2\text{H}_2\text{O}$ must be added to 400 mL of 0.200 M H_3PO_4 to give a buffer of pH 7.30? $[\text{H}_3\text{O}^+][\text{HPO}_4^{2-}]/[\text{H}_2\text{PO}_4^-] = 6.32 \times 10^{-8}$
(a) 20.2 g (b) 50.2 g (c) 49.8 g (d) 101.2 g
9. A 0.6004 g sample of Ni/Cu condenser tubing was dissolved in acid and diluted to 100.0 mL in a volumetric flask. Titration of both cations in a 25.00-mL aliquot of this solution required 45.81 mL of 0.05285 M EDTA. Mercaptoacetic acid and NH_3 were then introduced; production of the Cu complex with the former resulted in the release of an equivalent amount of EDTA, which required a 22.85-mL

titration with 0.07238 M Mg^{2+} . Calculate the percent Cu in the alloy. (atomic weight: 58.693 Ni and 63.546 Cu) (a) 30.00% (b) 50.01% (c) 60.01% (d) 70.02%

10. What information is supplied by a potentiometric acid/base titration ?
(a) the equilibrium concentration of hydronium ions in the sample (b) the amount of reactive protons, both ionized and nonionized, in the sample. (c) the amount of the neutral protons (d) the equilibrium concentration of hydroxyl ions in the sample.
11. Between which two electrodes was almost all current carried out in a three-electrode potentiostat ?
(a) working and counter (b) working and reference (c) counter and reference (d) working and the ground
12. Why not Fourier Transform spectrometry be a preferred method for many emission spectrometry ?
(a) not suitable for long wavelength (b) flicker noise (c) too many signals (d) too many noises
13. Which methods can be used to increase S/N of the spectra ?
(a) ensemble averaging (b) lock-in amplifier (c) high-pass filtering (d) decreasing slit width
14. Which of the following are considered to be major interference with hard-to differentiate emission for Raman spectroscopy?
(a) fluorescence (b) Rayleigh scattering (c) room light (d) diffraction light
15. Which kinds of mass analyzer are commonly used for atomic spectroscopy.
(a) quadrupole (b) time of flight (c) magnetic sector (d) ion trap
16. In reversed phase chromatographic separation, the capacity factor can be varied by which parameters ?
(a) temperature (b) organic solvent composition (c) flowrate (d) column length
17. In a double-focusing mass spectrometer, what kind of force field is commonly used for ion focusing ?
(a) electric field (b) magnetic field (c) centrifugal force field (d) temperature gradient
18. Which of the followings are atmospheric pressure ionization sources?
(a) FAB (b) ESI (c) APCI (d) MALDI

Part II Answer the following questions

1. Describe three general methods for performing EDTA titrations. What are advantages of each? (9%)
2. Describe three major band broadening factors for the line width of atomic spectroscopy. (9%)
3. Draw an energy diagram to differentiate resonance Raman scattering and fluorescence emission. (4%)
4. Draw Van Deemter plot to show how the flowrate, diffusion coefficient, and particle size affect chromatographic separation. (6%)