

本試題是否可以使用計算機： 可使用， 不可使用（請命題老師勾選）

考試日期：0301，節次：4

請將答案寫在答案卷上。

1. A typical quantitative analysis involves the following steps: choosing an analytical method, acquiring the sample, processing the sample, eliminating interferences, calibrating and measuring concentration, calculating results, evaluating the results by their reliability. Which of the above step is frequently to be the source of greatest error? (10)
2. A class of 30 students determined the activation energy of a chemical reaction to be 27.7 kcal/mol (mean value) with a standard deviation of 5.2 kcal/mol. Are there an error compared with the literature value of 30.8 kcal/mol at the 95% confidence level? (10)
3. Amino acids contain both an acid and a base group. The amine group behaves as a base, while the carboxyl group acts as an acid. In aqueous solution, the amino acid is an internally ionized molecule. Give the name of this kind of ions. Describe how one can determine the pK values of for alanine ( $\text{H}_3\text{C}(\text{H}_2\text{N})\text{CHCOOH}$ ) by titration. (10)
4. Voltammetry is widely used by analytical, inorganic, physical, and biological chemists for fundamental studies of (1) oxidation and reduction processes in various media, (2) adsorption processes on surfaces, and (3) electron transfer mechanisms. Draw a typical voltammogram, indicate the properties that can be used for qualitative and quantitative analysis. (10)
5. Give the numerical criteria and the corresponding "figure of merit" for selecting analytical methods. (10)
6. Draw a circuit for a 4-bit digital-to-analog converter. The voltage is +5 V for logic state 1 and 0 V for logic state 0. The analog output ranges from 0 to -15 V. (10)

(背面仍有題目,請繼續作答)

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7. Direct amplification of a low-frequency or dc signal is particularly troublesome when an instrument exhibits amplifier drift and flicker noise. Often, this  $1/f$  noise is several times larger than the types of noise that predominate at higher frequencies. For this reason, low-frequency or dc signals from transducers are often converted to a higher frequency, where  $1/f$  noise is less troublesome. What is called for this process? (10)
8. A grating monochromator with a reciprocal dispersion ( $D^{-1}$ ) of 1.2 nm/mm is to be used to separate the sodium lines at 588.9950 nm and 589.5924 nm. In theory, what slit width ( $w$ ) would be required? (10)
9. For quantitative analysis in absorption spectroscopy, such as infrared, ultraviolet/visible, and X-ray, the measured quantity, the absorbance is related to the concentration of an analyte by Beer's law. However, with IR radiation, instrumental deviations from Beer's law are more common than with UV/Visible radiations. Why? (10)
10. Draw the Nier-Johnson design of a double-focusing mass spectrometer. Why is it called "double-focusing"? (10)