科目：分析化學(1005)　　　　　　　　校系所組：中央大學化學學系
　　　　　　　　　　　　　　　　　　　　　　　　交通大學應用化學系（甲組）
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台聯大 分析考題-101 學年度
單選題：每題 5 分 (請將答案寫在電腦答案卡上)

1. Which of the following definitions are correct?
   (1) Accuracy: a measure of how close a measured value is to the mean value.
   (2) Precision: how well replicate measurements agree with each other.
   (3) t-test: use to decide whether the results of two experiments are within experimental uncertainty of each other.
   (4) Degree of freedom: usually the number of data point (N) minus the number of observations.
   (5) Above definitions are all correct.
   Your answer: A. (5); B. (1), (2) and (3); C. (2) and (3); D. (1), (3) and (4); E. (1) and (4).

2. Which of the following definitions are correct?
   (1) Method blank: a sample contains all components, and it is taken through all steps of the analytical procedure.
   (2) Field blank: a sample is similar to a method blank, but it has been exposed to the site of sampling.
   (3) Linear range: concentration range over which calibration curve is linear.
   (4) Internal standard: a known amount of a compound, same as the analyte, that is added to the unknown.
   (5) Above statements are all correct.
   Your answer: A. (5); B. (2) and (3); C. (1), (2) and (3); D. (2), (3) and (4); E. (1) and (2).

3. For ionic strength and activity coefficients, which of the following statements is not true?
   A. For 1:1 electrolytes, ionic strength equals the molarity.
   B. At low ionic strength, activity coefficients approach unity.
   C. Activity coefficients increase with increasing ionic strength.
   D. Activity coefficients are assumed to be unity for neutral molecules.
   E. The region of solution around an ion or a charged particle is called ionic atmosphere.

4. Which of the following statements is not correct?
   A. Many diprotic acids can be treated as a monoprotic acid, with $K_a \approx K_{a1}$.
   B. A dibasic salt, such as $[CO_3^{-2}]$, can generally be treated as monobasic, with $K_b \approx K_{b1}$.
   C. A molecule that can both donate or accept a proton (e.g., HCO_3^-) is said to be an amphiprotic.
   D. The pH of an intermediate form of a diprotic acid can be determined as $\approx \frac{1}{2}(pK_1 + pK_2)$.
   E. All these statements are not correct.

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5. Kjeldahl nitrogen analysis is one of the most widely used methods for determination of nitrogen in organic substances. There are four major reactions involved in this analysis, as listed below:

(1) Neutralization of NH_4^+　　　　$NH_4^+ + OH^- \rightarrow NH_3(g) + H_2O$

(2) Titration of unreacted HCl　　　$H^+ + OH^- \rightarrow H_2O$

(3) Kjeldahl digestion by H_2SO_4 and boiling　**organic C, H, N → NH_4^+ + CO_2 + H_2O**

(4) Distillation of NH_3 into standard HCl　　$NH_3 + H^+ \rightarrow NH_4^+$
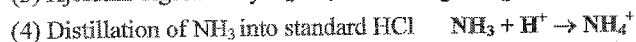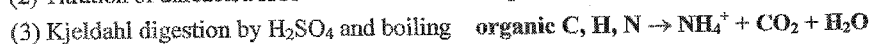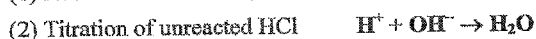
The order of the analytical procedure of Kjeldahl nitrogen analysis should be:

A. (1), (2), (3) and (4); B. (1), (3), (2) and (4); C. (3), (4), (1) and (2);

D. (3), (1), (4) and (2); E. (3), (1), (2) and (4).

6. An acid solution that has a formal concentration of 0.001M; at this concentration the acid is 10% dissociated.　What is the pH of the solution?

A. pH= 3; B. pH= 3.5; C. pH= 4; D. pH= 4.5; E. pH= 5.

7. Which of the following statements about titrations are correct?

(1) Before and after the equivalence point of a weak monoprotic acid, we are dealing with a buffer solution.

(2) Greater pK_a values allow the titration of lower concentrations of weak acids.

(3) The pH at the equivalence point of titrations of weak acids or bases should be 7.

(4) If the first equivalence point of a diprotic acid is V_e, the second equivalence point must equal $2V_e$.

(5) It is not practical to titrate an acid or a base that is too weak or too dilute.

Your answer: A. (1), (2) and (5); B. (2), (4) and (5); C. (1), (2), (4) and (5);

D. (1), (2), (3) and (5); E. The statements are all correct.

8. The van Deemter equation tells us how the column and flow rate affect plate height.

$$H \approx A + B/u_x + Cu_x$$　A: multiple path; B/u_x: longitudinal diffusion; and

Cu_x: equilibration time between phases. Which of the following statements are correct?

(1) For open tubular GC column: A = 0, and B, C ≠ 0.

(2) For packed LC column: A, B ≠ 0, and C = 0.

(3) For capillary electrophoresis: A, C = 0, and B ≠ 0.

(4) For term Cu_x, the faster the linear flow, the more complete equilibrium is and the less zone broadening occurs.

(5) For term Cu_x, plate height is decreased by increasing temperature.

Your answer: A. (1), (3) and (5); B. (1), (2) and (4); C. (3), (4) and (5);

D. (1), (3), (4) and (5); E. The statements are all correct.

9. Theoretically, which GC stationary phases suitable for separation of nonpolar compounds, such as hydrocarbons and PCBs:

(1) 50% cyano-polydimethylsiloxane; (2) Polydimethylsiloxane;
(3) 5% diphenyl-polydimethylsiloxane; (4) Poly(ethylene glycol); (5) Aluminosilicate.
Your answer: A. (1) and (2); B. (2) and (3); C. (2), (3) and (5);
　　　　　　　D. (1), (2) and (3); E. (2), (4) and (5)

10. The open tubular GC column is 50 m long and has an inner diameter of 202 μm. It is coated on the inside wall with a layer of stationary phase 1.0 μm thick. Untreated solute passes through in 50 s, whereas benzene required 250 s. **Estimate the partition coefficient ($K = Cs/Cm$)** for benzene between stationary and mobile phase.
(Here, retention factor $k = K(Vs/Vm)$ and $k = (tr - tm)/tm$)
Your answer A. K = 200; B. K = 220; C. K = 250; D. K = 275; E. K = 300.

11. Which of the following statements about the elution process of LC are correct?
　(1) In normal-phase LC, the least polar component is eluted first because it is the most soluble in the mobile phase.
　(2) Increasing the polarity of the mobile phase has the effect of decreasing the elution time in normal-phase LC.
　(3) In reversed-phase LC, more polar solvent has higher eluent strength.
　(4) In reversed-phase LC, increasing the mobile phase polarity increases the elution time of the less polar analyte.
　(5) Above statements are all correct.
Your answer: A. (5); B. (1) and (2); C. (1), (2) and (3); D. (1), (2) and (4); E. (2), (3) and (4).

12. In order to separate four amino acids (Glycine, Arginine, Glutamic acid, Asparagine) by capillary zone electrophoresis, amino acids must be derivatized by a fluorescent agent.

Fluorescent derivative with amino acid
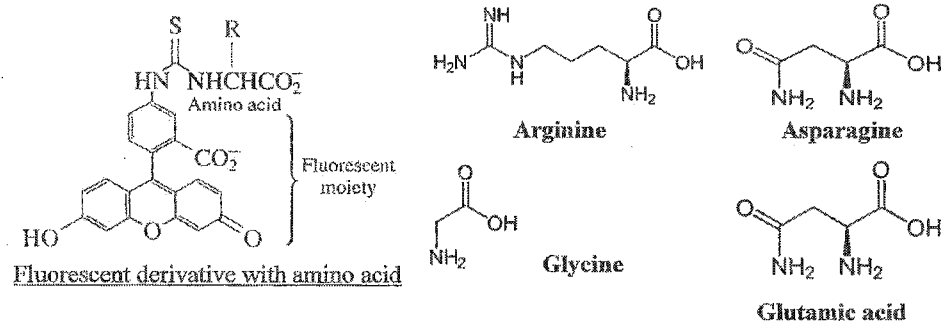
Predict which amino acid has **the shortest** migration time?
A. Glycine; B. Arginine; C. Glutamic acid; D. Asparagine.

注意：背面有試題

參考用

13. A spectrum has a signal-to-noise ratio of 8/1. How many spectra **at least** must be averaged to increase the signal-to-noise ratio to 24/1?
Your answer A. 5; B. 7; C. 9; D. 11; E. 13

14. What is the correct relationship between the output voltage (V_o) and input voltages (V_1 and V_2) of the following circuit based on an operational amplifier? All resistors are equal.
Your answer

A. $V_o = V_2 + V_1$; B. $V_o = V_2 - V_1$; C. $V_o = V_2 \times V_1$; D. $V_o = V_2 / V_1$; E. $V_o = V_1 + 2V_2$
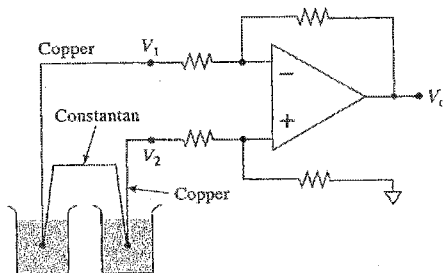
15. How will the current (i) at a stationary working electrode change with time for a typical potential-step electrochemical experiment where the potential of a working electrode (2 mm in diameter) is switched from a positive to a negative enough value to eliminate all reactant at the electrode surface?

For all plots, y- and x-axis are current and time, respectively.

簡答題 (25 分)；請在答案紙上作答

All the following questions refer to cyclic voltammetry of a reversible redox couple denoted by ($O + 1e^- \rightarrow R$).

(1) Name two criteria in the voltammogram that can be used to confirm that this redox reaction is indeed reversible.

(2) What would be the activity ratio of reactant O to product R at the surface of a working electrode when the potential is 120 mV positive of the former potential?

(3) How would peak currents of the oxidation and reduction peaks change with the scan rate of potential?

(4) How can one confirm the oxidation peak associated with the $O + 1e^- \rightarrow R$ reaction is diffusion-controlled?

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