

※ 考生請注意：本試題可使用計算機

請勿在本試題紙上作答，否則不予計分

一、是(O)非(X)題，每題2%。

1. An atom with an even number of electrons is always diamagnetic.
2. Valence electrons are electrons in filled orbits.
3. A chemical bond for which one of the bonded atoms provides both electrons for the bond is referred to as a formal covalent bond.
4. The OF<sub>2</sub> molecule has a bent structure.
5. BeCl<sub>2</sub> the smaller covalent character than CaCl<sub>2</sub>.
6. The inclusion of a small amount of aluminum in a crystal of pure germanium yields a *p*-type semiconductor.
7. H<sub>2</sub>NCH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub> probably has a lower boiling point at 1.00 atm pressure than CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub>.
8. Molality is independent of temperature, molarity is dependent on temperature.
9. A sweetened cup of coffee is an example of a heterogeneous mixture.
10. Water and octyl alcohol (C<sub>8</sub>H<sub>17</sub>OH) can not form a solution.
11. An azeotropic mixture is a liquid mixture of two or more substances in which the vapor has the same composition as the liquid.
12. Enthalpy,  $\Delta H^\circ$ , does not affect the rate of a reaction.
13. When dissolved in water, HNO<sub>3</sub> is a stronger acid than HCl.
14. The solution of NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> is acidic.
15. The pure acid strength increases in order of: HClO<sub>2</sub> < HClO<sub>3</sub> < HClO<sub>4</sub>
16. The pH of a buffer depends mainly on the pK<sub>a</sub> of the weak acid component of the buffer.
17. Addition of CH<sub>3</sub>COONa to a CH<sub>3</sub>COOH solution will not change the pH because it is a buffer solution.
18. When HCl is titrated with NH<sub>3</sub>, the solution will be basic at the equivalence point.
19. The zinc electrode is the anode in a zinc-lead cell the reaction:  

$$\text{Pb}^{2+} + \text{Zn} \rightarrow \text{Pb} + \text{Zn}^{2+} \quad E^\circ = 0.637 \text{ V.}$$
20. The [Fe(CN)<sub>6</sub>]<sup>3-</sup> complex ion exhibits octahedral geometry.
21. Fe(H<sub>2</sub>O)<sub>6</sub><sup>3+</sup> possesses less unpaired electrons than Cu(NH<sub>3</sub>)<sub>4</sub><sup>2+</sup>.
22. The compound with formula C<sub>4</sub>H<sub>7</sub>N has two degree of unsaturation.
23. The IUPAC name of *tert*-butyl group is: 1,1-dimethylethane.
24. S<sub>N</sub>1 reactions are nucleophilic substitution reactions for which the rate determining step is unimolecular.
25. Guanine always pairs with cysteine.

二、計算與簡答題

1. (10%) Draw the molecular-orbitals of NO<sup>-</sup> anion, and calculate the bond order. Is it paramagnetic or diamagnetic?
2. (10%) Calculate the energy (in kJ) required to change the temperature of 100 g of ethane (C<sub>2</sub>H<sub>6</sub>) from 25°C to 73.4°C at constant pressure. (C<sub>v</sub> for C<sub>2</sub>H<sub>6</sub> is 44.60 J K<sup>-1</sup> mol<sup>-1</sup>).

(背面仍有題目,請繼續作答)

3. (5%) 3.00 mmol of a monoprotic weak solid acid is dissolved in 100.0 mL of water and titrated with 0.0500M NaOH. After 30.0 mL of NaOH has been added, the pH is 5.00. What is the  $K_a$  value for the acid?
4. (5 %) If the half-life for a reaction is 20 seconds, what would be the second half-life, if the reaction is zero order?
5. (10%) The polymerization of  $\text{H-C}\equiv\text{C-H}$  produces a conducting polymer. Write the structure of this conducting polymer and explain how it conducts electricity.
6. (10%) Nucleophilic substitution can occur through  $\text{S}_{\text{N}}1$  and  $\text{S}_{\text{N}}2$ .  
Would the reaction:  $(\text{CH}_3)_3\text{CI} + \text{H}_2\text{O} \rightarrow (\text{CH}_3)_3\text{COH}$  occur by  $\text{S}_{\text{N}}1$  or  $\text{S}_{\text{N}}2$ ? Why?