

※ 考生請注意，本試題  可  不可 使用計算機

一、選擇題：(66 %，每題 3 分)

- Which of the following is known as wood alcohol?  
(A) methanol, (B) ethanol, (C) propanol, (D) *iso*-propanol
- A radioactive isotope of vanadium,  $^{54}_{23}\text{V}$ , decays by producing  $\beta$  particles and gamma rays. The nuclide formed has the atomic number:  
(A) 53, (B) 54; (C) 23; (D) 24
- Choose the species with the smallest radius.  
(A) F (B)  $\text{F}^-$  (C) Cl (D)  $\text{Cl}^-$
- Which of the following is the oxidation state of nitrogen in nitric acid?  
(A) +5 (B) +4 (C) +3 (D) -2
- Which group shows the correct order of first ionization energy?  
(A)  $\text{Na} > \text{P} > \text{Cl}$  (B)  $\text{Cs} > \text{Na} > \text{K}$  (C)  $\text{K} > \text{Ca} > \text{Ge}$  (D)  $\text{Cs} < \text{Rb} < \text{Na}$
- What element is found in the structural minerals that make up our bones and teeth?  
(A) barium (B) calcium (C) silicon (D) iron
- In a 0.1 molar solution of NaCl in water, which one of the following will be closest to 0.1?  
(A) the mole fraction of NaCl (B) the mass fraction of NaCl  
(C) the mass percent of NaCl (D) the molality of NaCl
- Which of the following chemical or physical changes is an endothermic process?  
(A) the evaporation of water (B) the combustion of gasoline  
(C) the mixing of sulfuric acid and water (D) the freezing of water
- The resistance of a liquid to an increase in its surface area is called  
(A) capillary action (B) surface tension (C) vapor pressure (D) viscosity
- Which of the compounds below is an example of a network solid?  
(A)  $\text{S}_8(\text{s})$  (B)  $\text{SiO}_2$  (C)  $\text{MgO}(\text{s})$  (D)  $\text{NaCl}(\text{s})$

(背面仍有題目,請繼續作答)

系所組別 地球科學系甲組

考試科目 普通化學

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11. Which of the following has two  $\pi$  bonds?  
(A)  $C_2H_6$  (B)  $C_2H_4$  (C)  $C_2H_2$  (D) None of the above
12. Which of the following species has the largest dissociation energy?  
(A)  $O_2$  (B)  $O_2^-$  (C)  $O_2^{2-}$  (D)  $O_2^+$
13. In the gaseous phase, which of the following diatomic molecules would be the most polar?  
(A) CsF (B) CsCl (C) NaCl (D) NaF
14. Buffers in the human body  
(A) help to keep the body temperature constant.  
(B) help to maintain a constant blood pH.  
(C) help change the blood plasma pH when foods are eaten.  
(D) precipitate proteins so enzymes are inactive.
15. The equilibrium constant for the reaction  $A^- + H^+ \rightleftharpoons HA$  is called:  
(A)  $K_a$  (B)  $K_b$  (C)  $1/K_a$  (D)  $K_w/K_b$
16. As water is heated, its pH decreases. This means that  
(A) the water is no longer neutral (B)  $[H^+] > [OH^-]$   
(C)  $[OH^-] > [H^+]$  (D) none of these
17. Calculate the pH of a  $1.0 \times 10^{-8}$  M  $HNO_3$ .  
(A) 8.0 (B) 7.04 (C) 6.98 (D) 6.30
18. The value of the equilibrium constant,  $K$ , is dependent on  
I. The temperature of the system. II. The nature of the reactants and products.  
III. The concentration of the reactants. IV. The concentration of the products.  
(A) I, II (B) II, III (C) III, IV (D) It is dependent on three of the above choices.
19. Three identical 1.0-L flasks contain the gases He,  $Cl_2$ , and  $CH_4$ , each at  $0^\circ C$  and 1.0 atm pressure. For which gas do the molecules have the highest average velocity?  
(A) He (B)  $Cl_2$  (C)  $CH_4$  (D) all gases the same

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20. Three identical 1.0-L flasks contain the gases He, Cl<sub>2</sub>, and CH<sub>4</sub>, each at 0°C and 1.0 atm pressure. For which gas do the molecules have the smallest average kinetic energy?  
(A) He (B) Cl<sub>2</sub> (C) CH<sub>4</sub> (D) all gases the same
21. The empirical formula of styrene is CH; its molar mass is 104.1. What is the molecular formula of styrene?  
(A) C<sub>2</sub>H<sub>4</sub> (B) C<sub>8</sub>H<sub>8</sub> (C) C<sub>10</sub>H<sub>12</sub> (D) C<sub>6</sub>H<sub>6</sub>
22. Consider the element indium, atomic number 49, atomic mass 114.8 g. The nucleus of an atom of indium-112 contains  
(A) 49 protons, 63 neutrons, 49 electrons. (B) 49 protons, 49 neutrons.  
(C) 49 protons, 63 neutrons. (D) 49 protons, 112 neutrons.

**二、問答與計算題 (34 % ; 計算題需寫過程否則不予計分)**

1. Write down an equation to define each of the following thermodynamic property;  
Exp.  $\Delta E = q + w$ , (a). H; (b). S; (c).  $\Delta G$  (6 %)
2. (a) Please write down the Arrhenius equation. (3 %)  
(b) Draw a concentration vs. time plot for a zero-order reaction. (4 %)
3. (a) Write down the de Broglie's equation. (3 %)  
(b) What is photoelectric effect? (3 %)  
(c) Please give the form of Schrödinger equation. (3 %)
4. (a) Use the gas solubility to explain why the boiler scale(鍋垢) was generally formed in hot water? (4 %)  
(b) Describe the methods to remove the colloidal particles in solution. (4 %)
5. Predict an aqueous solution of 1.0 M Fe(NO<sub>3</sub>)<sub>3</sub> will be acidic, basic or neutral. why? (4 %)