

系所組別： 地球科學系甲、乙組

考試科目： 普通化學

考試日期： 0219，節次： 2

※ 考生請注意：本試題 可 不可 使用計算機 請勿在本試題紙上作答，否則不予計分

一、選擇題：(54 %; 每題 3 分)

- Which is the symbol for the isotope of nitrogen that has 7 protons and 8 neutrons?
(A) ${}^7_8\text{N}$; (B) ${}^8_7\text{N}$; (C) ${}^{15}_7\text{N}$; (D) ${}^7_{15}\text{N}$; (E) None of these.
- Compound X_2Y is 60% X by mass. Calculate the percent Y by mass of the compound X_2Y_2 .
(A) 20%; (B) 30%; (C) 40%; (D) 60%; (E) 80%
- An aqueous solution of silver nitrate is added to an aqueous solution of potassium chromate, and this reaction produces a solid. What is the formula for the solid?
(A) AgK ; (B) AgCrO_4 ; (C) KNO_3 ; (D) K_2NO_3 ; (E) Ag_2CrO_4
- For a particular system at a particular temperature, there are _____ equilibrium constant(s) and _____ equilibrium position(s).
(A) an infinite number of, one; (B) one, an infinite number of; (C) one, one (D) an infinite number of, an infinite number of; (E) none of these
- As water is heated, its pH decreases. This means that
(A) the water is no longer neutral.; (B) $[\text{H}^+] > [\text{OH}^-]$. (C) $[\text{OH}^-] > [\text{H}^+]$.; (D) Two of these are correct.; (E) None of these is correct.
- How many moles of $\text{HCl}(g)$ must be added to 1.0 L of 2.0 M NaOH to achieve a pH of 0.00? (Neglect any volume change.)
(A) 1.0 mol; (B) 2.0 mol; (C) 3.0 mol; (D) 10. mol; (E) none of these
- Given the equation $\text{S}(s) + \text{O}_2(g) \rightarrow \text{SO}_2(g)$, $\Delta H = -296 \text{ kJ}$, which of the following statements is(are) true?
I. The reaction is exothermic.; II. When 0.500 mol of sulfur is reacted, 148 kJ of energy is released.; III. When 32.0 g of sulfur is burned, $2.96 \times 10^5 \text{ J}$ of energy is released.
(A) All are true.; (B) None is true.; (C) I and II are true.; (D) I and III are true.; (E) Only II is true.
- The standard enthalpy of formation of $\text{H}_2\text{O}(l)$ at 298 K is -285.6 kJ/mol . Calculate the change in internal energy for the following process at 298 K:
$$\text{H}_2(g) + 1/2 \text{O}_2(g) \rightarrow \text{H}_2\text{O}(l)$$

(A) -283.1 kJ/mol ; (B) -281.9 kJ/mol ; (C) -285.6 kJ/mol ; (D) -289.3 kJ/mol ;
(E) 283.1 kJ/mol

(背面仍有題目,請繼續作答)

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9. One mole of an ideal gas at 25°C is expanded isothermally and reversibly from 125.0 L to 250.0 L. Which statement is correct?
 (A) $\Delta S_{\text{gas}} = 0$; (B) $\Delta S_{\text{gas}} = R \ln 2$; (C) $\Delta S_{\text{univ}} = 0$; (D) $\Delta S_{\text{surr}} = 0$; (E) $\Delta S_{\text{gas}} = \Delta S_{\text{surr}}$
10. In which of the following cases must cell potential (E) be equal to zero?
 I. In any cell at equilibrium ; II. In a concentration cell ;
 III. E° can never be equal to zero.
 (A) I only ; (B) II only ; (C) III only ; (D) I and II ; (E) None is true
11. The ionization energy for a hydrogen atom is 1.31×10^6 J/mol. What is the ionization energy for He^+ ?
 (A) 8.72×10^{-18} J/mol ; (B) 1.31×10^6 J/mol ; (C) 5.25×10^6 J/mol ;
 (D) 2.18×10^{-18} J/mol ; (E) 2.63×10^6 J/mol
12. How many electrons in an atom can have the quantum numbers $n = 3, l = 1$?
 (A) 10 ; (B) 2 ; (C) 6 ; (D) 18 ; (E) 32
13. Which of the following is polar?
 (A) SiF_4 ; (B) XeF_2 ; (C) BCl_3 ; (D) NBr_3 ; (E) SBr_6
14. Atoms that are sp^3 hybridized form ____ pi (π) bond(s).
 (A) 0 ; (B) 1 ; (C) 2 ; (D) 3 ; (E) 4
15. Which of the following is the correct order of boiling points for NaNO_3 , CH_3OH , C_2H_6 , and Ne?
 (A) $\text{Ne} < \text{CH}_3\text{OH} < \text{C}_2\text{H}_6 < \text{NaNO}_3$; (B) $\text{NaNO}_3 < \text{CH}_3\text{OH} < \text{C}_2\text{H}_6 < \text{Ne}$;
 (C) $\text{Ne} < \text{C}_2\text{H}_6 < \text{NaNO}_3 < \text{CH}_3\text{OH}$; (D) $\text{Ne} < \text{C}_2\text{H}_6 < \text{CH}_3\text{OH} < \text{NaNO}_3$;
 (E) $\text{C}_2\text{H}_6 < \text{Ne} < \text{CH}_3\text{OH} < \text{NaNO}_3$
16. Which of the following is the most abundant metal on earth?
 (A) magnesium ; (B) iron ; (C) copper ; (D) aluminum ; (E) zinc
17. How many different possible tetramethylbenzenes exist?
 (A) 2 ; (B) 3 ; (C) 4 ; (D) 5 ; (E) 6
18. Identify the type of organic compound shown: $\text{CH}_3-\text{C}=\text{O}$
 $\quad\quad\quad |$
 $\quad\quad\quad \text{O}$
 $\quad\quad\quad |$
 $\quad\quad\quad \text{CH}_3$
- (A) aldehyde ; (B) ester ; (C) amine ; (D) ketone ; (E) none of these

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二、問答與計算題 (46 % ; 計算題需寫過程否則不予計分)

- (a). What is the effusion rate (散溢速度) ratio of NH_3 to HCl ? (N:14; Cl:35.5). (4 %)
 - (b). When doing the experiment of $\text{NH}_3(\text{g}) + \text{HCl}(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$, why the $d_{\text{NH}_3}/d_{\text{HCl}} <$ the effusion rate ratio. (d: the distance of a gas traveled.) (3 %)
- A sample of carbon of mass of 0.10 g from wood found in an archaeological site underwent 7900 carbon-14 disintegrations in a period of 20 h. In the same period, 0.10 g carbon from a modern source underwent 18400 disintegrations. Calculate the age of the sample ($t_{1/2}$ of C-14 = 5.00×10^3 y). (7 %)
- (a). What is "greenhouse effect"? (3 %)
 - (b). What are the sources for greenhouse effect for Earth? (3 %)
- Why heat (q) spontaneously transfers from higher T to lower T?
Hint: The 2nd thermodynamic Law (4 %).
- (a) Briefly describe how to get the activation energy of a reaction. (4 %)
 - (b) Draw the energy vs. reaction progress curves for catalyzed and uncatalyzed pathway for an exothermic chemical reaction. (5 %)
- (a). The carbon monoxide CO is a strong-field ligand. Please draw the electron arrangement in the split 3d orbital of the $\text{Fe}(\text{CO})_6^{3+}$, and predict how many unpaired electrons in this complex ion. (5 %)
 - (b). Is the $\text{Fe}(\text{CO})_6^{3+}$ paramagnetic or antimagnetic? Why? (2 %)
- (a) What hybrid atomic orbitals of the carbon atoms in diamond and graphite? (4 %)
 - (b) Draw the MO energies in diamond and graphite to describe the electronic conductivity. (2 %)