

系所組別： 地球科學系甲、乙組

考試科目： 普通化學

考試日期：0226 · 節次：2

請將答案寫在答案卷上，並清楚註明題號。

一、選擇題（每小題 2 分，共 50 分）

- Which of the experiments listed below did *not* provide the information stated about the nature of the atom?
  - The Rutherford experiment proved that the Thomson "plum pudding" model of the atom was essentially correct.
  - The Rutherford experiment determined the charge on the nucleus.
  - Millikan's oil-drop experiment showed that the charge on any particle was a simple multiple of the charge on the electron.
  - The cathode-ray tube proved that electrons have a negative charge.
- Which pair of ions would *not* be expected to form a precipitate when dilute solutions of each are mixed?
  - $\text{Cu}^{2+}, \text{S}^{2-}$
  - $\text{Ag}^+, \text{Cl}^-$
  - $\text{Ca}^{2+}, \text{PO}_4^{3-}$
  - $\text{Mn}^{2+}, \text{OH}^-$
  - $\text{Mg}^{2+}, \text{SO}_4^{2-}$
- The kinetic-molecular theory of gases does *not* assume that
  - gases are made up of tiny particles in constant chaotic motion.
  - gas particles are very small compared to the average distance between the particles.
  - gas particles collide with the walls of their container in elastic collisions.
  - the average velocity of gas particles is directly proportional to the absolute temperature.
  - All of these are correct.
- For the reaction  $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{H}_2\text{O}(\text{g})$ , what is the relationship between  $K$  and  $K_p$  at temperature  $T$ ?
  - $K = K_p$
  - $K = K_p(RT)^2$
  - $K_p = K(RT)^2$
  - $K = K_p(RT)$
  - $K_p = K(RT)$
- Which of the following represents a conjugate acid-base pair?
  - $\text{H}_2\text{PO}_4^-$  and  $\text{PO}_4^{3-}$
  - $\text{HSO}_4^-$  and  $\text{SO}_3^{2-}$
  - $\text{HNO}_3$  and  $\text{NO}_3^-$
  - $\text{HCl}$  and  $\text{NaOH}$
  - none of these
- As water is heated, its pH decreases. This means that
  - the water is no longer neutral.
  - $[\text{H}^+] > [\text{OH}^-]$ .
  - $[\text{OH}^-] > [\text{H}^+]$ .
  - Two of these are correct.
  - None of these is correct.
- You are given a solution of the weak base Novocain, Nvc. Its pH is 11.00. You add to the solution a small amount of a salt containing the conjugate acid of Novocain,  $\text{NvcH}^+$ . Which statement is true?
  - The pH and the pOH both increase.
  - The pH and the pOH both decrease.
  - The pH and the pOH remain unchanged.
  - The pH increases and pOH decreases.
  - The pH decreases and the pOH increases
- Which of the following ionic compounds has the largest lattice energy; that is, which has the lattice energy most favorable to a stable lattice?
  - CsI
  - LiI
  - LiF
  - CsF
  - MgO

(背面仍有題目,請繼續作答)

系所組別： 地球科學系甲、乙組

考試科目： 普通化學

考試日期： 0226，節次： 2

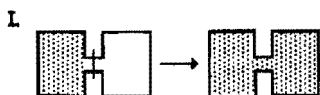
9. Which of the following are state functions?

- A) work, heat      B) work, heat, enthalpy, energy      C) enthalpy, energy  
D) work, heat, enthalpy      E) heat, enthalpy, energy

10. Which statement is true of a process in which 1 mol of a gas is expanded from state A to state B?

- A) When the gas expands from state A to state B, the surroundings are doing work on the system.  
B) The amount of work done in the process must be the same, regardless of the path.  
C) It is not possible to have more than one path for a change of state.  
D) The final volume of the gas will depend on the path taken.  
E) The amount of heat released in the process will depend on the path taken.

11. Which of the following result(s) in an increase in the entropy of the system?

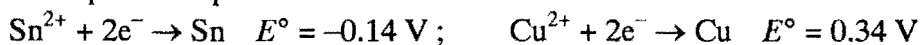
I. (See diagram.);    II.  $\text{Br}_2(g) \rightarrow \text{Br}_2(l)$ ;    III.  $\text{NaBr}(s) \rightarrow \text{Na}^+(aq) + \text{Br}^-(aq)$ IV.  $\text{O}_2(298 \text{ K}) \rightarrow \text{O}_2(373 \text{ K})$ ;    V.  $\text{NH}_3(1 \text{ atm}, 298 \text{ K}) \rightarrow \text{NH}_3(3 \text{ atm}, 298 \text{ K})$ 

- A) I                      B) II, V                      C) I, III, IV                      D) I, II, III, IV  
E) I, II, III, V

12. Which statement is true?

- A) All real processes are irreversible.  
B) A thermodynamically reversible process takes place infinitely fast.  
C) In a reversible process, the state functions of the system are always much greater than those of the surroundings.  
D) There is always more heat given off to the surroundings in a reversible process than in an unharnessed one.  
E) All these statements are true.

13. The following two half-reactions take place in a galvanic cell. At standard conditions, what species are produced at each electrode?



- A) Sn is produced at the anode, and  $\text{Cu}^{2+}$  is produced at the cathode.  
B) Sn is produced at the anode, and Cu is produced at the cathode.  
C) Sn is produced at the cathode, and  $\text{Cu}^{2+}$  is produced at the anode.  
D) Cu is produced at the cathode, and  $\text{Sn}^{2+}$  is produced at the anode.  
E) Cu is produced at the anode, and  $\text{Sn}^{2+}$  is produced at the cathode.

14. Which of the following shows these molecules in order from most polar to least polar?

- A)  $\text{CH}_4 > \text{CF}_2\text{Cl}_2 > \text{CF}_2\text{H}_2 > \text{CCl}_4 > \text{CCl}_2\text{H}_2$   
B)  $\text{CH}_4 > \text{CF}_2\text{H}_2 > \text{CF}_2\text{Cl}_2 > \text{CCl}_4 > \text{CCl}_2\text{H}_2$   
C)  $\text{CF}_2\text{Cl}_2 > \text{CF}_2\text{H}_2 > \text{CCl}_2\text{H}_2 > \text{CH}_4 = \text{CCl}_4$   
D)  $\text{CF}_2\text{H}_2 > \text{CCl}_2\text{H}_2 > \text{CF}_2\text{Cl}_2 > \text{CH}_4 = \text{CCl}_4$   
E)  $\text{CF}_2\text{Cl}_2 > \text{CF}_2\text{H}_2 > \text{CCl}_4 > \text{CCl}_2\text{H}_2 > \text{CH}_4$



系所組別： 地球科學系甲、乙組

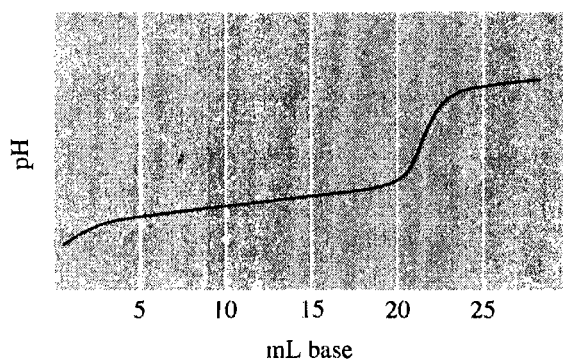
考試科目： 普通化學

考試日期： 0226，節次： 2

20. Which of the following is optically active (that is, chiral)?  
 A) diethylamine      B) difluoromethane      C) 2-bromopropane  
 D) 2-chloropentane      E) 1-chlorohexane
21. A salt solution sits in an open beaker. Assuming constant temperature and pressure, the vapor pressure of the solution  
 A) increases over time.      B) decreases over time.      C) stays the same over time.  
 D) We need to know which salt is in the solution to answer this.  
 E) We need to know the temperature and pressure to answer this.
22. Which of the following is best explained by the fact that the SO molecule is very unstable, whereas O<sub>2</sub> is stable.  
 A) The S-O bond is inherently unstable.  
 B) Sulfur lacks the ability to form double bonds.  
 C) The difference in electronegativity between the sulfur atom and the oxygen atom makes it unlikely for the S-O bond to form.  
 D) There exists much stronger  $\pi$  bonding between oxygen atoms than between a sulfur atom and an oxygen atom.  
 E) none of these
23. Which of the following are structural isomers?  
 I. coordination isomers      II. linkage isomers  
 II. geometric isomers      IV. optical isomers  
 A) I, III      B) II, IV      C) I, III, IV      D) II, III  
 E) I, II
24. What is the most likely decay for the Fe-53 nucleus?  
 A)  $\beta$  decay      B) positron emission      C)  $\alpha$  decay  
 D)  $\gamma$ -ray emission      E) two of these
25. Which of the following is paramagnetic?  
 A)  $[\text{Zn}(\text{H}_2\text{O})_6]^{2+}$       B)  $[\text{Co}(\text{NH}_3)_6]^{3+}$  (strong field)      C)  $[\text{Cu}(\text{en})_3]^+$   
 D)  $[\text{Mn}(\text{en})_3]^{2+}$  (strong field)      E)  $[\text{Fe}(\text{en})_3]^{2+}$  (strong field)

二、非選擇題 (50 分)

1. Consider the titration of generic weak acid HA with a strong base that gives the following curve: (10%, 2% each)



On the curve indicate the points that correspond to the following.

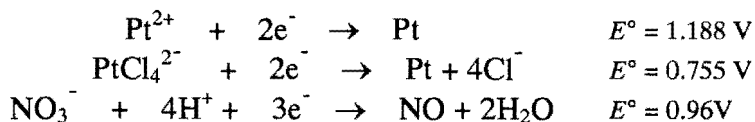
- a. the equivalent point      b.  $\text{pH} = \text{p}K_a$       c. the maximum buffering region  
 d.  $\text{pH}$  depends only on  $[\text{HA}]$       e.  $\text{pH}$  depends only on  $[\text{A}^-]$

系所組別： 地球科學系甲、乙組

考試科目： 普通化學

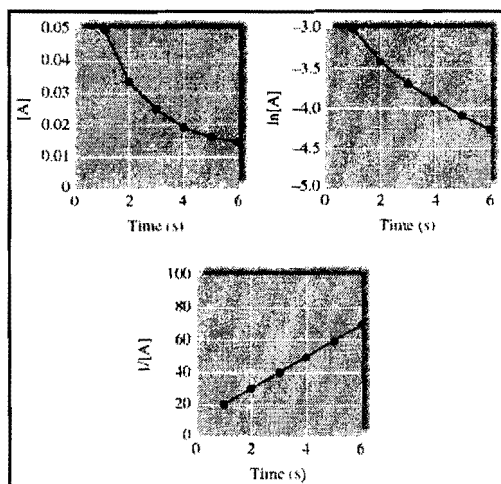
考試日期： 0226，節次： 2

2. Consider the following half-reactions:

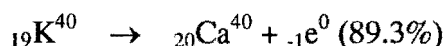
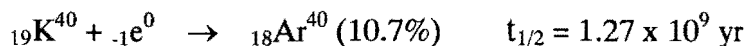


Explain why platinum metal will dissolve in aqua regia ( a mixture of concentrated HCl and HNO<sub>3</sub>) but not in either concentrated HNO<sub>3</sub> or concentrated HCl individually. (10%)

3. Experimental data for the reaction, A → 2B + C, have been plotted in the following three ways (with concentration units in mol/L):



- What is the order of the reaction with respect to A, and what is the initial concentration of A? (3%)
  - What is the concentration of A after 9 seconds? (4%)
  - What are the first three half-lives for the experiment? (3%)
- Compounds of copper(II) are generally colored, but compounds of Cu(I) are not. Explain. (atomic number of Cu: 29) (5%)
    - Would you expect Cd(NH<sub>3</sub>)<sub>4</sub>Cl<sub>2</sub> to be colored? Explain. (5%)
  - The mass ratios of Ar<sup>40</sup> to K<sup>40</sup> can also be used to date geological materials. Potassium-40 decays by two processes:



- Why are Ar<sup>40</sup>/K<sup>40</sup> ratios rather than Ca<sup>40</sup>/K<sup>40</sup> ratios used to date materials? (4%)
- A sedimentary rock has a Ar<sup>40</sup>/K<sup>40</sup> ratio of 0.95, what is the age of the rock? (6%)