

系所組別：地球科學系

考試科目：普通化學

考試日期：0307，節次：2

※ 考生請注意：本試題 可 不可 使用計算機

一、選擇題：(54%，每題3分)

1. What is the correct formula for aluminum carbonate?

- A)
- AlCO_3
- B)
- $\text{Al}_2(\text{CO}_3)_3$
- C)
- $\text{Al}_3(\text{CO}_3)_2$
- D)
- Al_2CO_3
- E)
- Al_3CO_3

2. Indium has atomic number 49 and atomic mass 114.8 g. Naturally occurring indium contains a mixture of indium-112 and indium-115 in an atomic ratio of approximately

- A) 6/94. B) 25/75. C) 50/50. D) 75/25. E) 94/6.

3. A solution contains the ions Ag^+ , Pb^{2+} , and Ni^{2+} . Dilute solutions of NaCl , Na_2SO_4 , and Na_2S are available to separate the positive ions from each other. In order to effect separation, the solutions should be added in which order?

- A)
- Na_2SO_4
- ,
- NaCl
- ,
- Na_2S
- B)
- Na_2SO_4
- ,
- Na_2S
- ,
- NaCl
- C)
- Na_2S
- ,
- NaCl
- ,
- Na_2SO_4
-
- D)
- NaCl
- ,
- Na_2S
- ,
- Na_2SO_4
- E)
- NaCl
- ,
- Na_2SO_4
- ,
- Na_2S

4. 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 ?

- A)
- $K = K_p$
- B)
- $K = K_p(RT)^2$
- C)
- $K_p = K(RT)^2$
- D)
- $K = K_p(RT)$
- E)
- $K_p = K(RT)$

5. Which of the following species is *not* amphoteric?

- A)
- HSO_4^-
- B)
- H_2PO_4^-
- C)
- HPO_4^{2-}
- D)
- H_2O
- E) All of these are amphoteric.

6. The salt Ag_3PO_4 is _____ soluble in strong acid solution than in water.

- A) more B) less C) neither more nor less (that is,
- AgCl
- is equally soluble in strong acid and in water) D) The
- K_{sp}
- value for
- AgCl
- must be known to answer this question.

7. 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.

8. A concentration cell is constructed using two Ni electrodes with Ni^{2+} concentrations of 1.64 M and 2.85×10^{-4} M in the two half-cells. The reduction potential of Ni^{2+} is -0.23 V. Calculate the potential of the cell at 25°C .

- A) +0.341 V B)
- -0.222
- V C)
- -0.256
- V D) +0.111 V E)
- -0.0078
- V

(背面仍有試題，請繼續作答)

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9. If a constant current of 5.5 amperes is passed through a cell containing Cr^{3+} for 2.5 hour, how many grams of Cr will plate out onto the cathode? (The atomic mass of Cr is 51.996 g/mol.)

- A) 27 g B) 0.15 g C) 8.9 g D) 80 g E) 1.3 g

10. What is the electron configuration of Cr^{3+} ?

- A) $[\text{Ar}] 4s^2 3d^1$ B) $[\text{Ar}] 4s^1 3d^2$ C) $[\text{Ar}] 3d^3$ D) $[\text{Ar}] 4s^2 3d^4$ E) none of these

11. Atoms having greatly differing electronegativities are expected to form

- A) no bonds. B) polar covalent bonds. C) nonpolar covalent bonds.
D) ionic bonds. E) covalent bonds.

12. The decomposition of $\text{N}_2\text{O}_5(\text{g})$ to $\text{NO}_2(\text{g})$ and $\text{O}_2(\text{g})$ obeys first-order kinetics. Assume the form of the rate law is

$$\text{Rate} = -\frac{\Delta[\text{N}_2\text{O}_5]}{\Delta t} = k[\text{N}_2\text{O}_5] \quad \text{where } k = 3.4 \times 10^{-5} \text{ s}^{-1} \text{ at } 25^\circ\text{C}.$$

What is the half-life for the reaction described?

- A) $5.9 \times 10^5 \text{ s}$ B) $2.0 \times 10^4 \text{ s}$ C) $2.4 \times 10^{-5} \text{ s}$ D) $7.4 \times 10^2 \text{ s}$ E) none of these

13. The unit cell in a certain lattice consists of a cube formed by an anion at each corner, an anion in the center, and a cation at the center of each face. The unit cell contains a net

- A) 5 anions and 6 cations. B) 5 anions and 3 cations. C) 2 anions and 3 cations. D) 3 anions and 4 cations. E) 2 anions and 2 cations.

14. A material is made from Al, Ga, and As. The mole fractions of these elements are 0.25, 0.26, and 0.49, respectively. This material would be

- A) a metallic conductor because Al is present. B) an insulator. C) a *p*-type semiconductor.
D) an *n*-type semiconductor. E) none of these

15. The molar mass of a solid as determined by freezing-point depression is 10% higher than the true molar mass. Which of the following experimental errors could *not* account for this discrepancy?

- A) Not all the solid was dissolved.
B) More than the recorded amount of solvent was pipetted into the solution.
C) The solid dissociated slightly into two particles when it dissolved.
D) Some solid was left on the weighing paper.
E) Before the solution was prepared, the container was rinsed with solvent and not dried.

(背面仍有試題，請繼續作答)

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16. Which of the following complexes shows geometric isomerism?

- A) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$ B) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ C) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
 D) $\text{K}[\text{Co}(\text{NH}_3)_2\text{Cl}_4]$ E) $\text{Na}_3[\text{CoCl}_6]$

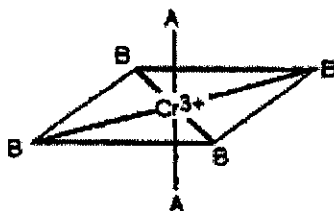
17 If you were to heat pentanoic acid and 2-butanol with an acid catalyst, which of the following would you be most likely discover in your flask?

- A) a ketone B) an ester C) an amine D) an alkane E) an aldehyde

18. What are the building blocks of proteins?

- A) nucleotides B) glucose and sucrose C) lipids D) amino acids

二、問答與計算題：(46%) (計算題需寫過程否則不與計分)

1. Explain why the pH of an aqueous solution of NaHCO_3 is independent of concentration. (7%)2. You have 0.20 M HNO_2 ($K_a = 4.0 \times 10^{-4}$) and 0.20 M KNO_2 . You need 1.00 L of a buffered solution at a pH of 3.00. What volumes of each solution do you add together to make this buffered solution? (7%)3. Using the relation $\Delta G^\circ = -RT \ln K = \Delta H^\circ - T\Delta S^\circ$ to explain why would the K increases as T is decreased for an exothermic reaction. (7%)4. Draw a molecular-orbital diagram for O_2 , explain why the removal of one electron in O_2 strengthens bonding. (7%)5. At 25°C the first-order rate constant for a reaction is $2.0 \times 10^3 \text{ s}^{-1}$. The activation energy is 15.0 kJ/mol. What is the value of the rate constant at 75°C? (7%)6. Consider the pseudo-octahedral complex of Cr^{3+} shown below, where A and B represent Lewis bases and where A produces a stronger crystal field than B. Draw an appropriate crystal field diagram for this complex. (7%)

7. Name the following: (4%)

