國立高雄大學 115 學年度研究所碩士班招生考試試題

科目：普通化學　　系所：應用化學系　　是否使用計算機：是

考試時間：100 分鐘　　本科原始成績：100 分

－作答注意事項－

考試時間：100分鐘

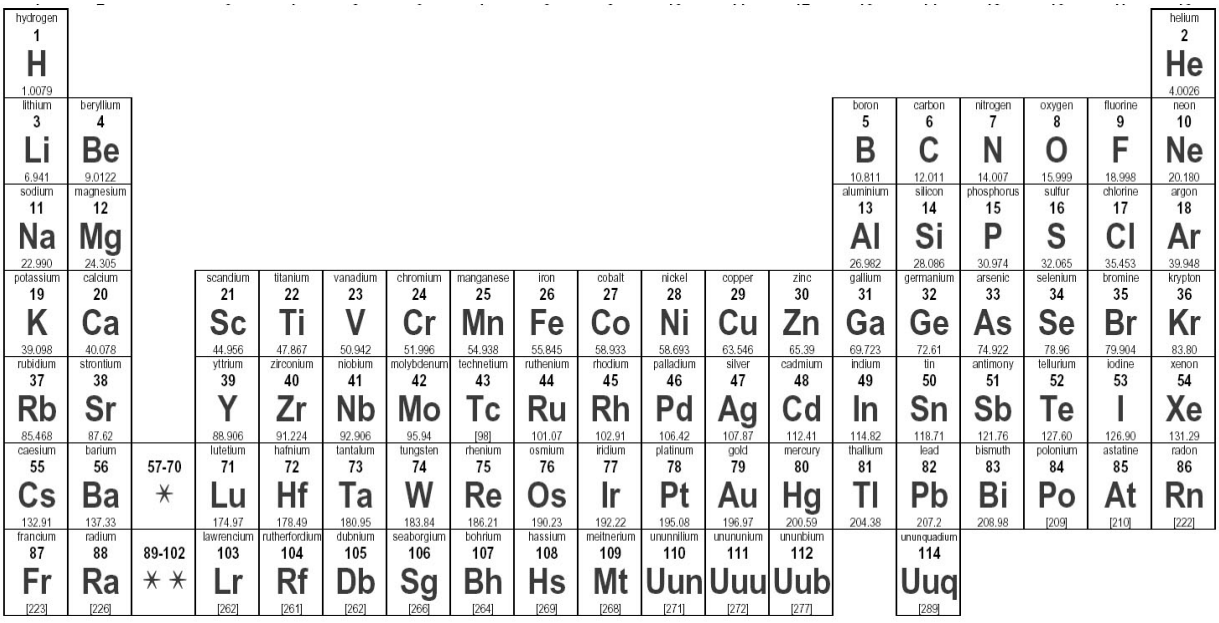
作答方式：總分：100分

作答方式：

- 選擇題用原子筆在「答案卷」上作答。
- 答案卷每人一張，不得要求增補。
- 第 1 題至第 30 題為單選題，每題三分。
- 第 31 題為計算題, 請列出計算步驟共十分。

參考資料

一、元素週期表



理想氣體常數和亞佛加厥常數

$$R = 8.314\ J/mol{\cdot}K = 0.0821\ L{\cdot}atm/K{\cdot}mol;\ Avogadro's\ number = 6.022 \times 10^{23}$$

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For Questions 1~30, each question has only one correct answer.

1. Which of the following is an example of a quantitative observation?
a. The piece of metal is longer than the piece of wood.
b. Solution 1 is much darker than solution 2.
c. The liquid in beaker A is blue.
d. The temperature of the liquid is 60°C.
e. At least two of the above (A-D) are quantitative observations.

2. You are asked to determine the perimeter of the cover of your textbook. You measure the length as 36.71 cm and the width as 24.83 cm. How many significant figures should you report for the perimeter?
a. 1;　b. 2;　c. 3;　d. 4;　e. 5

3. Which of the following pairs of compounds can be used to illustrate the law of multiple proportions?
a. NH_4 and NH_4Cl; b. ZnO_2 and $ZnCl_2$; c. H_2O and HCl; d. CH_4 and CO_2; e. NO and NO_2

4. Which of the following statements are true of uranium-238?
I. Its chemical properties will be exactly like those of uranium-235.
II. Its mass will be slightly different from that of an atom of uranium-235.
III. It will contain a different number of protons than an atom of uranium-235.
IV. It is more plentiful in nature than uranium-235.
a. III, IV;　b. I, II, III;　c. I, II, IV;　d. II, III, IV;　e. all of these

5. Iron is biologically important in the transport of oxygen by red blood cells from the lungs to the various organs of the body. In the blood of an adult human, there are approximately 2.63×10^{13} red blood cells with a total of 2.90 g of iron. On the average, how many iron atoms are present in each red blood cell?
a. 1.19×10^{9};　b. 8.41×10^{-10};　c. 3.13×10^{22};　d. 2.63×10^{13};　e. 6.16×10^{-2}

6. Which compound contains the highest percent by mass of hydrogen?
a. HCl;　b.H_2O;　c. H_2SO_4;　d. H_2S;　e. HF

7. The interaction between solute particles and water molecules, which tends to cause a salt to fall apart in water, is called
a. hydration; b. polarization; c. dispersion; d. coagulation; e. conductivity

8. You have two solutions of sodium chloride. One is a 2.00 M solution, the other is a 4.00 M solution. You have much more of the 4.00 M solution and you add the solutions together. Which of the following could be the concentration of the final solution?
a. 2.20 M; b. 3.00 M; c. 3.20 M; d. 6.00 M; e. 6.60 M

9. Aqueous solutions of sodium sulfide and copper(II) chloride are mixed together. Which statement is correct?

a. Both NaCl and CuS precipitate from solution.
b. No reaction will occur.
c. CuS will precipitate from solution.
d. NaCl will precipitate from solution.
e. A gas is released.

10. A gas sample is held at constant pressure. The gas occupies 3.62 L of volume when the temperature is 21.6 °C. Determine the temperature at which the volume of the gas is 3.43 L.

a. 311 K; b. 279 K; c. 20.5 K; d. 295 K; e. 552 K

11. Consider a sample of gas in a container on a comfortable spring day. The Celsius temperature suddenly doubles, and you transfer the gas to a container with twice the volume of the first container. If the original pressure was 12 atm, what is a good estimate for the new pressure?

a. 3 atm; b. 5.5 atm; c. 15 atm; d. 12 atm; e. 6.4 atm

12. For a particular process q = –17 kJ and w = 21 kJ. Which of the following statements is false?

a. Heat flows from the system to the surroundings.
b. The system does work on the surroundings.
c. $\Delta E = +4$ kJ
d. The process is exothermic.
e. None of the above is false.

13. A 47.4 g sample of a metal is heated to 95.2°C and then placed in a calorimeter containing 120.0 g of water (c = 4.18 J/g°C) at 21.5°C. The final temperature of the water is 24.5°C. Which metal was used?

a. Aluminum (c = 0.89 J/g°C)
b. Iron (c = 0.45 J/g°C)
c. Copper (c = 0.20 J/g°C)
d. Lead (c = 0.14 J/g°C)
e. none of these

14. Which of the following frequencies corresponds to light with the longest wavelength?

a. $3.00 \times 10^{13}\ s^{-1}$; b. $4.12 \times 10^{5}\ s^{-1}$; c. $8.50 \times 10^{20}\ s^{-1}$; d. $9.12 \times 10^{12}\ s^{-1}$; e. $3.20 \times 10^{9}\ s^{-1}$

15. Atoms with greatly different electronegativity values are expected to form

a. no bonds; b. covalent bonds; c. triple bonds; d. ionic bonds; e. none of these

16. Based on electronegativities, which of the following would you expect to be most ionic?

a. N_2; b. CaF_2; c. CO_2; d. CH_4; e. CF_4

17. In the molecule C_2H_4 the valence orbitals of the carbon atoms are assumed to be

a. not hybridized; b. *sp* hybridized; c. sp^2 hybridized; d. sp^3 hybridized; e. *dsp* hybridized

18. Cubic closest packing is another name for _____.

a. simple cubic packing

b. body-centered cubic packing

c. face-centered cubic packing

d. hexagonal closest packing

e. more than one of these

19. Which of the following is true?

a. By spontaneous we mean that the reaction or process will always proceed to the right (as written) even if very slowly. Increasing the temperature may speed up the reaction, but it does not affect the spontaneity of the reaction.

b. By spontaneous we mean that the reaction or process will always proceed to the left (as written) even if very slowly. Increasing the temperature may speed up the reaction, but it does not affect the spontaneity of the reaction.

c. By spontaneous we mean that the reaction or process will always proceed to the left (as written) even if very slowly. Increasing the temperature may speed up the reaction and it generally affects the spontaneity of the reaction.

d. By spontaneous we mean that the reaction or process will always proceed to the right (as written) even if very slowly. Increasing the temperature may speed up the reaction, and it generally affects the spontaneity of the reaction.

e. None of the above is true.

20. 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. 2 anions and 3 cations

b. 5 anions and 3 cations

c. 5 anions and 6 cations

d. 3 anions and 4 cations

e. 2 anions and 2 cations

21. In a 0.1 molar solution of NaCl in water, which one of the following will be closest to 0.1?

a. The molality of NaCl.

b. The mass fraction of NaCl.

c. The mass percent of NaCl.

d. The mole fraction of NaCl.

e. All of these are about 0.1.

22. Rank the following compounds according to increasing solubility in water.

I. $CH_3–CH_2–CH_2–CH_3$; II. $CH_3–CH_2–O–CH_2–CH_3$; III. $CH_3–CH_2–OH$; IV. $CH_3–OH$

a. I < III < IV < II
b. I < II < IV < III
c. III < IV < II < I
d. I < II < III < IV
e. None of these (A-D) is correct.

23. Consider the following rate law: $Rate = k[A]^n[B]^m$ How are the exponents n and m determined?

a. by using the balanced chemical equation
b. by using the subscripts for the chemical formulas
c. by using the coefficients of the chemical formulas
d. by educated guess
e. by experiment

24. For a reaction in which A and B react to form C, the following initial rate data were obtained:

[A] (mol/L)	**[B] (mol/L)**	**Initial Rate of Formation of C (mol/L·s)**
0.10	0.10	1.00
0.10	0.20	4.00
0.20	0.20	8.00

What is the rate law?

a. Rate = k[A][B]
b. Rate = $k[A]^2[B]$
c. Rate = $k[A]^3$
d. Rate = $k[A]^2[B]^2$
e. Rate = $k[A][B]^2$

25. Which of the following is true about chemical equilibrium?

a. It is microscopically and macroscopically static.
b. It is microscopically and macroscopically dynamic.
c. It is microscopically static and macroscopically dynamic.
d. It is microscopically dynamic and macroscopically static.
e. None of these are true about chemical equilibrium.

26. Consider the reaction: $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ at constant temperature. Initially a container is filled with pure $SO_3(g)$ at a pressure of 2 atm, after which equilibrium is reached. If y is the partial pressure of O_2 at equilibrium, the value of Kp is:

a. $\frac{(2-2y)^2}{(y^2)(2y)}$; b. $\frac{(2-y)^2}{(y^2)(y/2)}$; c. $\frac{(2-y)^2}{(2y)^2(y)}$; d. $\frac{(2-2y)^2}{(2y)^2(y)}$; e. none of these

27. Which of the following is a conjugate acid/base pair?

a. HCl/OCl^-; b. H_2SO_4/SO_4^{2-}; c. NH_4^+/NH_3; d. H_3O^+/OH^-; e. more than one of these

28. The solubility of $Cd(OH)_2$ in water is 1.69×10^{-5} mol/L. The Ksp value for $Cd(OH)_2$ is

a. 1.93×10^{-14}; b. 4.83×10^{-15}; c. 5.71×10^{-10}; d. 1.69×10^{-5}; e. none of these

29. Which of the following statements is true?

a. The total energy of the universe is constant, but the entropy is increasing.

b. The total energy of the universe is increasing, but the entropy is constant.

c. The total energy of the universe increases, while the entropy decreases.

d. The total energy and entropy of the universe are both increasing

e. None of these.

30. How many electrons are transferred in the following reaction?

$$2ClO_3^- + 12H^+ + 10I^- \rightarrow 5I_2 + Cl_2 + 6H_2O$$

a. 12; b. 5; c. 2; d. 30; e. 10

Calculation Question

31. Calculate the lattice energy for LiBr(s) given the following:

- sublimation energy for Li(s): +166 kJ/mol
- ΔH_f for Br(g) : +97 kJ/mol
- first ionization energy of Li(g): +520. kJ/mol
- electron affinity of Br(g): –325 kJ/mol
- enthalpy of formation of LiBr(s): –351 kJ/mol