

東海大學105學年度碩士班考試入學試題

考試科目：普通化學

科目代碼：22011

應考系組：化學系化學組，化學系化生組

考試日期：105年03月06日第1節

使用計算機：可

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Atomic mass: H=1.008; He=4.002; C=12.01; N=14.01; O=16.00; F=19.00; Na=22.99; Mg=24.31; Si=28.09; P=30.97; Cl=35.45; K=39.10; Ar=39.94; Ca=40.08; Cr=52.00; Fe=55.84; Cu=63.55; Br=79.90; Ag=107.9; Xe=131.3; Ba=137.3; Pb=207.2; U=238.0; Hg=200.6

I.Choice (70%; single answer; 2 % for each question)

- Order the four metric prefixes from smallest to largest.
(A) nano- < milli- < centi- < kilo-
(B) milli- < nano- < centi- < kilo-
(C) kilo- < centi- < nano- < milli-
(D) kilo- < centi- < milli- < nano-
(E) centi- < nano- < kilo- < milli-
- Express the number 6.49×10^{-3} in common decimal form.
(A) 0.00649 (B) 6.49 (C) 6490 (D) 0.0649 (E) 0.000649
- Which of the following is not a fundamental metric unit?
(A) meter (B) second (C) kilogram (D) liter
- An example of a pure substance is
(A) elements
(B) compounds
(C) pure water
(D) carbon dioxide
(E) all of these
- Which metals form cations with varying positive charges?
(A) transition metals
(B) Group 1 metals
(C) Group 2 metals
(D) Group 3 metals
(E) metalloids
- Which of the following compounds is incorrectly named?
(A) $Mg(OH)_2$ is magnesium dihydroxide (D) K_3PO_4 is potassium phosphate
(B) CaO is calcium oxide (E) $MgSO_3$ is magnesium sulfite
(C) NH_4NO_3 is ammonium nitrate
- What fraction of the volume of each corner atom is actually within the volume of a face-centered cubic unit cell?
(A) 1 (B) $\frac{1}{2}$ (C) $\frac{1}{4}$ (D) $\frac{1}{8}$ (E) $\frac{1}{16}$
- The correct name for Fe_2O_3 is
(A) iron oxide (B) iron(II) oxide (C) iron(III) oxide (D) iron monoxide (E) iron(I) oxide

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9. Naturally occurring copper exists in two isotopic forms: ^{63}Cu and ^{65}Cu . The atomic mass of copper is 63.55 amu. What is the approximate natural abundance of ^{63}Cu ?
(A) 63% (B) 90% (C) 70% (D) 50% (E) 30%
10. Which of the following elements, if doped into silicon, would yield an n-type semiconductor?
(A) Ga (B) Al (C) C (D) B (E) As
11. Which compound contains the highest percent by mass of hydrogen?
(A) HCl (B) H_2O (C) H_2SO_4 (D) H_2S (E) HF
12. Which of the following is a strong acid?
(A) HF (B) KOH (C) HClO_4 (D) HClO (E) HBrO
13. Which of the following factor does not affect the solubility?
(A) solute-solvent interactions (B) pressure (C) temperature (D) volume
14. A solution is made by dissolving 13.5 g of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) in 0.100 kg of water. What is the mass percentage of solute in this solution?
(A) 1.00% (B) 10.0% (C) 11.9% (D) 13.5% (E) 15.3%
15. A 2.5-g sample of groundwater was found to contain 2.7 μg of Hg^{2+} . What is the concentration of Hg^{2+} in ppm?
(A) 1.1 (B) 2.2 (C) 11 (D) 22 (E) 0.11
16. A solution is made by dissolving 4.35 g glucose ($\text{C}_6\text{H}_{12}\text{O}_6$; MW=180) in 25.0 mL of water at 25°C . What is the molality of glucose in the solution?
(A) 0.174 m (B) 0.348 m (C) 0.482 m (D) 0.964 m (E) 1.74 m
17. For a certain process at 355 K, $\Delta G = -11.8 \text{ kJ}$ and $\Delta H = -9.2 \text{ kJ}$. Therefore, ΔS for the process is
(A) 0 J/K mol (B) 7.3 J/K mol (C) -7.3 J/K mol (D) -25.9 J/K mol (E) 25.9 J/K mol
18. 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) need to know which salt is in the solution to answer this
(E) need to know the temperature and pressure to answer this
19. Automotive antifreeze consists of ethylene glycol ($\text{C}_2\text{H}_6\text{O}_2$; M.W.= 62.1), a nonvolatile nonelectrolyte. What is the boiling point of a 25.0 mass % solution of ethylene glycol in water? (K_b of water = $0.51^\circ\text{C}/m$)
(A) 2.7°C (B) 97.3°C (C) 101.2°C (D) 102.7°C (E) 105.1°C
20. 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
(E) none of these

作答前請先檢查試題頁數、頁次及考試科目是否正確，如有缺損或印刷不清等，應即舉手請監試人員處理，繳卷時試題須繳回。

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21. A liquid-liquid solution is called an ideal solution if:
- It obeys $PV = nRT$.
 - It obeys Raoult's law.
 - Solute-solute, solvent-solvent, and solute-solvent interactions are very similar.
 - Solute-solute, solvent-solvent, and solute-solvent interactions are quite different.
- (A) I, II, III (B) I, II, IV (C) II, III (D) II, IV (E) I, III, IV
22. Consider the following rate law: $\text{Rate} = k[A]^n[B]^m$
- How are the exponents n and m determined?
- by using the balanced chemical equation
 - by using the subscripts for the chemical formulas
 - by using the coefficients of the chemical formulas
 - by educated guess
 - by experiment
23. Consider the gaseous reaction $\text{CO}(g) + \text{Cl}_2(g) \rightleftharpoons \text{COCl}_2(g)$. What is the expression for K_p in terms of K ?
- (A) $K(RT)$ (B) $K/(RT)$ (C) $K(RT)^2$ (D) $K/(RT)^2$ (E) $1/K(RT)$
24. A crystal was analyzed with x-rays having 1.57 \AA wavelength. A reflection was produced at $\theta = 21.9^\circ$. Assuming $n = 1$, what is the distance between the layers of atoms in the crystal?
- (A) 8.42 \AA (B) 4.21 \AA (C) 0.475 \AA (D) 0.846 \AA (E) 2.10 \AA
25. How many f orbitals have the value $n = 4$?
- (A) 0 (B) 3 (C) 5 (D) 7 (E) 1
26. All alkaline earths have the following number of valence electrons:
- (A) 1 (B) 3 (C) 6 (D) 2 (E) none of these
27. What is the pH of an aqueous solution at 25.0°C in which $[\text{OH}^-]$ is $2.50 \times 10^{-4} \text{ M}$?
- (A) 3.60 (B) -3.60 (C) 10.4 (D) -10.4 (E) 3.25
28. What is the pH of a 0.15 M solution of NH_3 ($K_b = 1.8 \times 10^{-5}$)?
- (A) 0.82 (B) 4.64 (C) 8.2 (D) 11.2 (E) 13.2
29. Consider the reaction $\text{HNO}_2(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{NO}_2^-(aq)$. Which species is a conjugate base?
- (A) $\text{HNO}_2(aq)$ (B) $\text{H}_2\text{O}(l)$ (C) $\text{H}_3\text{O}^+(aq)$ (D) $\text{NO}_2^-(aq)$ (E) two of these
30. K_a for HF is 7.0×10^{-4} . What is the K_b for the fluoride ion?
- (A) 2.0×10^{-14} (B) 1.4×10^{-11} (C) 7.0×10^{-4} (D) 7.0×10^{-9} (E) 1.4×10^{-4}
31. A 16.4-g sample of HF is dissolved in water to give $2.0 \times 10^2 \text{ mL}$ of solution. The concentration of the solution is:
- (A) 0.82 M (B) 0.16 M (C) 0.08 M (D) 4.1 M (E) 8.2 M
32. It is observed that 7.50 mmol of BaF_2 will dissolve in 1.0 L of water. Use these data to calculate the value of K_{sp} for barium fluoride.
- (A) 1.1×10^{-4} (B) 4.2×10^{-7} (C) 1.7×10^{-6} (D) 2.2×10^{-4} (E) 5.6×10^{-5}

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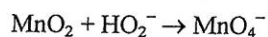
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33. When the equation for the following reaction in basic solution is balanced, what is the sum of the coefficients?



- (A) 11 (B) 31 (C) 14 (D) 9 (E) 18

34. Which of the following should have the lowest boiling point?

- (A) Na_2S (B) HF (C) NH_3 (D) N_2 (E) H_2O

35. Which of the following does not contain at least one pi bond?

- (A) H_2CO (B) CO_2 (C) C_2H_4 (D) C_2H_6 (E) All of the above (A-D) contain at least one pi bond.

II. Calculation :

1. (6 points) A given sample of xenon fluoride contains molecules of a single type XeF_n , where n is some whole number.

Given that 9.03×10^{20} molecules of XeF_n weigh 0.311 g, calculate n .

2. (6 points) A certain oxygen atom has the electron configuration $1s^2 2s^2 2p_x^2 2p_y^2$.

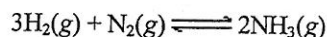
(a) How many unpaired electrons are present?

(b) Is this an excited state of oxygen?

(c) In going from this state to the ground state would energy be released or absorbed?

3. (8 points) A 50.0 g sample of water at 280. K is mixed with 30.0 g of water at 330 K. Calculate the final temperature of the mixture assuming no heat loss to the surroundings. (Hint: Water has a specific heat capacity = $s = 4.18 \text{ J/K}\cdot\text{g}$)

4. (10 points) Initially 2.0 moles of $\text{N}_2(\text{g})$ and 4.0 moles of $\text{H}_2(\text{g})$ were added to a 1.0-liter container and the following reaction then occurred:



The equilibrium concentration of $\text{NH}_3(\text{g}) = 0.55 \text{ moles/liter}$ at $700.^\circ\text{C}$. Calculate the K value for the formation of ammonia at $700.^\circ\text{C}$.