

- 說明：
1. 答案一律寫在試卷(答案卷)上，否則不予計分。
 2. 請依序作答、並標明題號。
 3. 本試題隨試卷交回。

一、選擇題：(每題 3 分，共 75 分。答錯不倒扣)

1. What is the bond order of He_2 ?
(A) 0 (B) 0.5 (C) 1 (D) 1.5 (E) 2
2. The molecular orbital electron configuration: $(\sigma 1s)^2(\sigma 1s^*)^2(\sigma 2s)^2(\sigma 2s^*)^2(\pi x)^2(\pi y)^2(\sigma 2p)^2$ applies to which of the following molecules?
(A) F_2 (B) O_2 (C) BC (D) NO (E) CO
3. The boiling points of the halogens increase from F_2 to I_2 . What type of intermolecular forces are responsible for this trend?
(A) permanent dipole (B) hydrogen bonding (C) ion-ion attraction
(D) London dispersion forces (E) ion-dipole attraction
4. Which of the following is paired incorrectly?
(A) crystalline solids — highly regular arrangement of their components
(B) amorphous solids — considerable disorder in their structures
(C) unit cell — the smallest repeating unit of the lattice
(D) gold metal — simple cubic unit cell
(E) glass — amorphous solid
5. A 0.2 molar solution of a solute, X, in benzene, displays an osmotic pressure given by the formula $\pi = (0.1)RT$. Which of the following is most likely to be the case?
(A) X exists in benzene as X.
(B) X exists in benzene as X_2 .
(C) X exists in benzene dissociated into two particles.
(D) This solution strongly deviates from ideal behavior.
(E) None of these is plausible.
6. The catalyzed pathway in a reaction mechanism has a _____ activation energy and thus causes a _____ reaction rate.
(A) higher, lower (B) higher, higher (C) lower, higher (D) lower, steady (E) higher, steady
7. Consider the gaseous reaction $\text{CO}(\text{g}) + \text{Cl}_2(\text{g}) \rightleftharpoons \text{COCl}_2(\text{g})$. 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) $1 / K(RT)$
8. The equilibrium constant for the reaction $\text{A}^- + \text{H}^+ \rightleftharpoons \text{HA}$ is called:
(A) K_a (B) K_b (C) $1 / K_a$ (D) K_w / K_b (E) $K_w K_a$
9. As water is heated, its pH decreases. This means that
(A) the water is no longer neutral.
(B) the K_w value is decreasing.
(C) the water has a lower $[\text{OH}^-]$ than cooler water.
(D) the dissociation of water is an endothermic process.
(E) none of these.

(背面仍有題目,請繼續作答)

10. Which of the following atomic symbols is incorrect?
(A) $^{14}_6\text{C}$ (B) $^{37}_{17}\text{Cl}$ (C) $^{32}_{15}\text{P}$ (D) $^{39}_{19}\text{K}$ (E) $^{14}_8\text{N}$
11. A d^6 ion (Fe^{2+}) is complexed with six strong-field ligands (for example, SCN^-). What is the number of unpaired electrons in this complex?
(A) 0 (B) 1 (C) 2 (D) 3 (E) 4
12. Calculate the ratio of the effusion rates of N_2 and N_2O .
(A) 0.637 (B) 1.57 (C) 1.25 (D) 0.798 (E) 1.61
13. Which of the following statements correctly describes the signs of q and w for the following exothermic process $\text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{H}_2\text{O}(\text{l})$ at $P = 1 \text{ atm}$ and $T = 370 \text{ K}$?
(A) q and w are negative. (B) q is positive, w is negative. (C) q is negative, w is positive.
(D) q and w are both positive. (E) q and w are both zero.
14. Given: $\text{Cu}_2\text{O}(\text{s}) + 1/2 \text{O}_2(\text{g}) \rightarrow 2\text{CuO}(\text{s}) \quad \Delta H^\circ = -144 \text{ kJ}$
 $\text{Cu}_2\text{O}(\text{s}) \rightarrow \text{Cu}(\text{s}) + \text{CuO}(\text{s}) \quad \Delta H^\circ = +11 \text{ kJ}$
Calculate the standard enthalpy of formation of $\text{CuO}(\text{s})$.
(A) -166 kJ (B) -299 kJ (C) $+299 \text{ kJ}$ (D) $+155 \text{ kJ}$ (E) -155 kJ
15. The energy of the light emitted when a hydrogen electron goes from $n = 2$ to $n = 1$ is what fraction of its ground-state ionization energy?
(A) $3/4$ (B) $1/2$ (C) $1/4$ (D) $1/8$ (E) $1/9$
16. How many electrons can be contained in all of the orbitals with $n = 4, l = 3, m_l = 0$?
(A) 2 (B) 8 (C) 10 (D) 18 (E) 32
17. Select the molecule among the following that has a dipole moment.
(A) CO_2 (B) SeO_3 (C) XeF_4 (D) SF_4 (E) BeCl_2
18. What type of structure does the XeOF_2 molecule have?
(A) pyramidal (B) tetrahedral (C) T-shaped (D) trigonal planar (E) octahedral
19. The hybridization of the central nitrogen of N_2O is:
(A) not hybridized (B) sp (C) sp^2 (D) sp^3 (E) dsp^3
20. Which of the following will not produce a buffered solution?
(A) 100 mL of 0.1 M Na_2CO_3 and 50 mL of 0.1 M HCl
(B) 100 mL of 0.1 M NaHCO_3 and 25 mL of 0.2 M HCl
(C) 100 mL of 0.1 M Na_2CO_3 and 75 mL of 0.2 M HCl
(D) 50 mL of 0.2 M Na_2CO_3 and 5 mL of 1.0 M HCl
(E) 100 mL of 0.1 M Na_2CO_3 and 50 mL of 0.1 M NaOH

21. For the following reaction, $\text{CO(g)} + 2\text{H}_2\text{O(g)} = \text{CH}_4\text{(g)} + \text{O}_2\text{(g)}$, $\Delta H^\circ = 803 \text{ kJ}$
which of the following will increase K ?
(A) decrease number of moles of methane
(B) increase volume of system
(C) increase the temperature of system
(D) all of these
(E) none of these
22. A voltaic cell has an E° value of +1.00 V. The reaction
(A) is not spontaneous. (B) has $K = 1$. (C) has $K < 1$. (D) has $\Delta G^\circ = 0$. (E) has a negative ΔG° .
23. The color of a transition metal complex results from:
(A) bending vibrations.
(B) stretching vibrations.
(C) transition of an electron between d orbitals.
(D) transition of an electron between an s and a p orbital.
(E) nuclear magnetic resonance.
24. How many isomers are there with the formula $\text{C}_3\text{H}_5\text{Br}$? Include both structural and geometric isomers.
(A) 2 (B) 3 (C) 4 (D) 5 (E) 6
25. An element E has the electron configuration $[\text{Kr}]4d^{10}5s^25p^2$. The formula for the fluoride of E is most likely
(A) EF_{14} (B) EF_4 (C) EF (D) EF_6 (E) EF_8

二、填充題：(每題 5 分，共 25 分。僅寫出答案即可)

1. A solution of 8.0 M formic acid (HCOOH) is 0.47% ionized. What is the K_a of formic acid?

2. The K_f for the complex ion $\text{Ag}(\text{NH}_3)_2^+$ is 1.7×10^7 . The K_{sp} for AgCl is 1.6×10^{-10} . What is the molar solubility of AgCl in 1.0 M NH_3 ? _____
3. If an electrolysis plant operates its electrolytic cells at a total current of 1.0×10^6 amp, how many hours will it take to produce one metric ton (one million grams) of Mg(s) from seawater containing Mg^{2+} ?
(1 faraday = 96,485 coulombs, $\text{Mg} = 24.31 \text{ g/mol}$) _____
4. The half-life of ^{90}Sr is 28 years. How many years will it take for a given sample of ^{90}Sr to be 90.0% decomposed? _____
5. $\text{CH}_3\text{C}\equiv\text{CCH}_2\text{CH}_2\text{Cl}$ is named: _____.