

Multiple choice questions: (答錯不倒扣)

1. How many types of Bravais lattices do we have? (5%)
(A) 7, (B) 10, (C) 12, (D) 14, (E) 16
2. Select the liquid-liquid solution that reveals a negative deviation from Raoult's law. (5%)
(A) benzene-toluene, (B) ethanol-hexane, (C) acetone-water, (D) heptane-water, (E) heptane-hexane.
3. Which of the following combinations has the same number of electrons? (5%)
(A) Ne & S²⁻, (B) Cu⁺ & K⁺, (C) Mg²⁺ & Be²⁺, (D) Al³⁺ & F⁻, (E) Si & Ca²⁺.
4. For a reversible reaction $A + B \rightleftharpoons C + D$, the enthalpy change and activation energy of the forward reaction are -20.0 kJ/mol and 85.0 kJ/mol, respectively. What is the activation energy of the reverse reaction? (5%)
(A) 65.0 kJ/mol, (B) -105.0 kJ/mol, (C) -65.0 kJ/mol, (D) 105.0 kJ/mol, (E) 130.0 kJ/mol.
5. Which of the following acids and its sodium salt are the best combination for buffering a solution at pH 4.30? (5%)
(A) benzoic acid ($K_a = 6.4 \times 10^{-5}$), (B) propanoic acid ($K_a = 1.3 \times 10^{-5}$), (C) chloroacetic acid ($K_a = 1.35 \times 10^{-3}$), (D) hypochlorous acid ($K_a = 3.5 \times 10^{-8}$), (E) all of the above are similar

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6. Which of the following substances are likely to be soluble in water? (5%)

(A) aluminum nitrate, (B) lead(II) sulfide, (C) nickel(II) hydroxide, (D) silver chloride, (E) barium chromate.

7. For the synthesis of ammonia at 500°C , the equilibrium constant is 6.0×10^{-2} . Determine which system in the following cases will shift toward the product? (5%)

i. $[\text{NH}_3]_0 = 1.0 \times 10^{-3} \text{ M}$; $[\text{N}_2]_0 = 1.0 \times 10^{-5} \text{ M}$; $[\text{H}_2]_0 = 2.0 \times 10^{-3} \text{ M}$

ii. $[\text{NH}_3]_0 = 2.0 \times 10^{-4} \text{ M}$; $[\text{N}_2]_0 = 1.50 \times 10^{-5} \text{ M}$; $[\text{H}_2]_0 = 2.0 \times 10^{-1} \text{ M}$

iii. $[\text{NH}_3]_0 = 1.0 \times 10^{-4} \text{ M}$; $[\text{N}_2]_0 = 5.0 \text{ M}$; $[\text{H}_2]_0 = 1.0 \times 10^{-2} \text{ M}$

(A) only i, (B) only ii, (C) only iii, (D) i & ii, (E) i & iii.

8. Which has the largest ion size? (5%)

(A) Li^+ , (B) F^- , (C) Br^- , (D) Mg^{2+} , (E) Ga^{3+} .

9. Which of the following electrolytes has the biggest difference between its expected and observed values of the van't Hoff factor? Assume the concentrations for all the electrolyte solutions are 0.05 m . (5%)

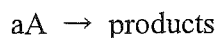
(A) NaCl , (B) MgCl_2 , (C) HCl , (D) MgSO_4 , (E) Glucose.

10. How is the central atom in XeF_4 hybridized? (5%)

(A) sp , (B) sp^2 , (C) sp^3 , (D) dsp^3 , (E) d^2sp^3 .

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11. Select the reaction order of the following reaction for which the half-life of reactant A is independent of its initial concentration. (5%)



(A) zero order, (B) first order, (C) second order, (D) both zero and first orders, (E) both zero and second orders.

12. What kind of orbitals of carbon atoms are used to form π molecular orbitals in a benzene molecule? (5%)

(A) *s* orbitals, (B) *p* orbitals, (C) *sp* orbitals, (D) *sp*² orbitals, (E) *sp*³ orbitals.

13. Calculate the formal charge for the central atom of a sulfate ion with the most stable Lewis structure. (5%)

(A) -2, (B) -1, (C) 0, (D) 1, (E) 2.

14. Determine the pH at the second equivalent point for the titration of a H₃PO₄ solution with NaOH. (5%)

(A) $\text{pH} = \text{p}K_{a1}$, (B) $\text{pH} = \text{p}K_{a2}$, (C) $\text{pH} = \text{p}K_{a3}$, (D) $\text{pH} = (\text{p}K_{a1} + \text{p}K_{a2})/2$, (E) $\text{pH} = (\text{p}K_{a2} + \text{p}K_{a3})/2$.

15. Which of the following sets of quantum numbers is allowed in the hydrogen atom? (5%)

(A) $n = 3, \ell = 2, m_\ell = 2$, (B) $n = 4, \ell = 3, m_\ell = 4$, (C) $n = 0, \ell = 0, m_\ell = 0$, (D) $n = 2, \ell = -1, m_\ell = 1$, (E) $n = 1, \ell = 1, m_\ell = 0$.

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16. What is the bond order for a B_2 molecule? (5%)

(A) 0, (B) 1, (C) 2, (D) 3, (E) 4.

17. The maximum possible useful work obtainable from a process at constant pressure and temperature is equal to the change of which of the following thermodynamic properties? (5%)

(A) internal energy, (B) enthalpy, (C) entropy, (D) free energy, (E) none of the above.

18. As you move from top to bottom on the periodic table, what generally happens to the ionization energy? (5%)

(A) it increases, (B) it remains constant, (C) it cannot be determined, (D) it decreases, (E) it increases then decreases.

19. Which of the following electromagnetic radiations has the largest wavelength? (5%)

(A) X ray, (B) Infrared, (C) γ ray, (D) Visible light, (E) Ultraviolet.

20. Which of the following molecules does not totally obey the octet rule? (5%)

(A) SF_6 , (B) Ne, (C) CO_2 , (D) CCl_4 , (E) N_2 .