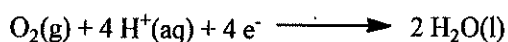
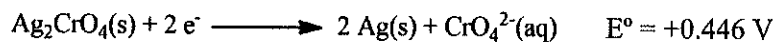


19. An electrolysis cell is operated for 3000 s using a current of 1.50 A. From which 1.0 M solution will the greatest mass of metal be deposited?
- (A) TlNO_3
(B) $\text{Pb}(\text{NO}_3)_2$
(C) ZnCl_2
(D) $\text{In}(\text{NO}_3)_3$
20. The reduction of O_2 to H_2O in acidic solution has a standard reduction potential of +1.23 V. What is the effect on the half-cell potential at 25 °C when the pH of the solution is increased by one unit?



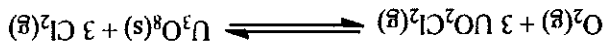
- (A) The half-cell potential decreases by 59 mV.
(B) The half-cell potential increases by 59 mV.
(C) The half-cell potential decreases by 236 mV.
(D) The half-cell potential increases by 236 mV.
21. Given the two standard reduction potentials below, what is the K_{sp} of Ag_2CrO_4 at 25 °C?



- (A) 8.64×10^{11}
(B) 1.08×10^{-6}
(C) 1.16×10^{-12}
(D) 1.11×10^{-39}
22. What is the value of the quantum number l for a $5p$ orbital?
- (A) 1
(B) 2
(C) 3
(D) 4
23. Which electronic transition in atomic hydrogen corresponds to the emission of visible light?
- (A) $n = 5 \rightarrow n = 2$
(B) $n = 1 \rightarrow n = 2$
(C) $n = 3 \rightarrow n = 4$
(D) $n = 3 \rightarrow n = 1$
24. What is the geometry of the chlorate ion, ClO_3^- ?
- (A) trigonal planar
(B) trigonal pyramidal
(C) T-shaped
(D) zigzag

25. In the Lewis structure of ozone, O_3 , what is the formal charge on the central oxygen?
- (A) 2-
(B) 1-
(C) 0
(D) 1+

14. What is the ratio K^o/K_p for the following reaction at 723 °C?



- (A) 0.0122
- (B) 1.00
- (C) 59.4
- (D) 81.8

15. What is $[\text{H}_3\text{O}^+]$ in a solution formed by dissolving 1.00 g NH_4Cl ($M = 53.5$) in 30.0 mL of 3.00 M NH_3 ($K_b = 1.8 \times 10^{-5}$)?

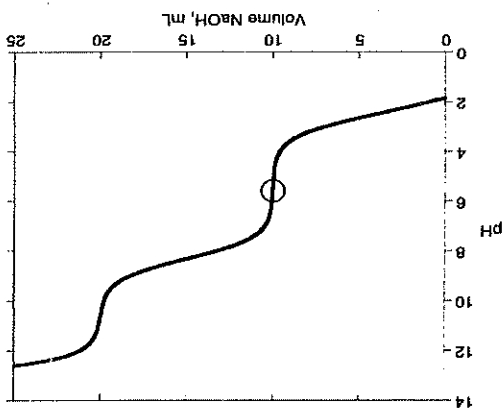
- (A) 2.7×10^{-9} M
- (B) 5.5×10^{-10} M
- (C) 1.2×10^{-10} M
- (D) 1.4×10^{-12} M

16. Copper(II) hydroxide, $\text{Cu}(\text{OH})_2$, has $K_{sp} = 2.2 \times 10^{-20}$. For the reaction below, $K_{eq} = 4.0 \times 10^{-7}$. What is K_f for $\text{Cu}(\text{NH}_3)_4^{2+}$?



- (A) 8.8×10^{-27}
- (B) 5.5×10^{-14}
- (C) 1.8×10^{13}
- (D) 1.1×10^{26}

17. A 0.100 M aqueous solution of H_2SeO_3 is titrated with 1.000 M NaOH solution. At the point marked with a circle on the titration curve, which species represent at least 10% of the total selenium in solution?



- (A) H_2SeO_3 only
- (B) Both H_2SeO_3 and HSeO_3^-
- (C) HSeO_3^- only
- (D) Both HSeO_3^- and SeO_3^{2-}

18. Which two half reactions, when coupled, will make a galvanic cell that will produce the largest voltage under standard conditions?



(A) I and II

(B) I and IV

(C) II and IV

(D) III and IV

8. A 37.5 g piece of gold at 83.0 °C is added to 100. g H₂O at 22.0 °C in a well-insulated cup. What is the temperature after the system comes to equilibrium? (The specific heat capacity of Au is 0.129 J·g⁻¹·K⁻¹)
- (A) 22.7 °C
(B) 23.0 °C
(C) 25.0 °C
(D) 52.5 °C
9. The K_a of phosphoric acid, H₃PO₄, is 7.6×10^{-3} at 25 °C. For the reaction
- $$\text{H}_3\text{PO}_4(\text{aq}) \rightleftharpoons \text{H}_2\text{PO}_4^-(\text{aq}) + \text{H}^+(\text{aq})$$
- $\Delta H^\circ = -14.2 \text{ kJ/mol}$. What is the K_a of H₃PO₄ at 60 °C?
- (A) 4.2×10^{-3}
(B) 6.8×10^{-3}
(C) 8.5×10^{-3}
(D) 1.8×10^{-2}
10. For the reaction
- $$5 \text{O}_2(\text{g}) + 4 \text{NH}_3(\text{g}) \longrightarrow 4 \text{NO}(\text{g}) + 6 \text{H}_2\text{O}(\text{g})$$
- if NH₃ is being consumed at a rate of 0.50 M·s⁻¹, at what rate is H₂O being formed?
- (A) 0.33 M·s⁻¹
(B) 0.50 M·s⁻¹
(C) 0.75 M·s⁻¹
(D) 3.0 M·s⁻¹
11. The rate of decomposition of hydrogen peroxide is first order in H₂O₂. At [H₂O₂] = 0.150 M, the decomposition rate was measured to be $4.83 \times 10^{-6} \text{ M}\cdot\text{s}^{-1}$. What is the rate constant for the reaction?
- (A) $2.15 \times 10^{-4} \text{ s}^{-1}$
(B) $3.22 \times 10^{-5} \text{ s}^{-1}$
(C) $4.83 \times 10^{-6} \text{ s}^{-1}$
(D) $7.25 \times 10^{-7} \text{ s}^{-1}$
12. The half-life of iodine-131 is 8.02 days. How long will it take for 80% of the sample to decay?
- (A) 2.6 days
(B) 13 days
(C) 19 days
(D) 32 days
13. For a reversible exothermic reaction, what is the effect of increasing temperature on the equilibrium constant (K_{eq}) and on the forward rate constant (k_f)?
- (A) K_{eq} and k_f both increase
(B) K_{eq} and k_f both decrease
(C) K_{eq} increases and k_f decreases
(D) K_{eq} decreases and k_f increases

單一選擇題，共 25 題，每題 4 分，總分 100 分，答錯不扣分，請在答案卷上作答，考試時間 90 分鐘

1. Which aqueous solution exhibits the largest freezing point depression?
- (A) 1.0 m KBr
(B) 0.75 m C₆H₁₂O₆
(C) 0.5 m MgCl₂
(D) 0.25 m Ga₂(SO₄)₃

2. Which calcium compound is not appreciably more soluble in 0.1 M hydrochloric acid than it is in pure water?
- (A) Limestone, CaCO₃
(B) Slaked lime, Ca(OH)₂
(C) Gypsum, CaSO₄ · 2H₂O
(D) Hydroxyapatite, Ca₅(OH)(PO₄)₃

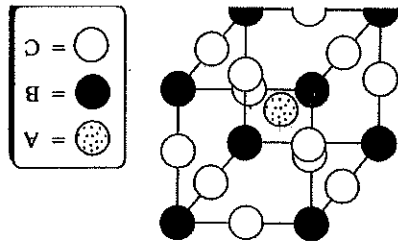
3. Each of the following forms a colored aqueous solution EXCEPT
- (A) Cr(NO₃)₃
(B) Co(NO₃)₂
(C) Cu(NO₃)₂
(D) Zn(NO₃)₂

4. A 2.0 mL sample of a colorless solution, when treated with a few drops of 2 M hydrochloric acid, forms a white precipitate which dissolves when the solution is heated to boiling. The original solution could contain which of the following cations?
- I. 0.1 M Ag⁺
II. 0.1 M Pb²⁺

5. How is the enthalpy of vaporization of a substance related to its enthalpy of fusion?
- (A) I only
(B) II only
(C) Either I or II
(D) Neither I nor II
6. How is the enthalpy of vaporization of a substance related to its enthalpy of fusion?
- (A) The enthalpy of vaporization is greater than the enthalpy of fusion.
(B) The enthalpy of vaporization is equal to the enthalpy of fusion.
(C) The enthalpy of vaporization is less than the enthalpy of fusion.
(D) There is no general relationship between a substance's enthalpy of vaporization and enthalpy of fusion.

7. Which of the following is a mathematical statement of the first law of thermodynamics?
- (A) $\Delta V = (nR/P)\Delta T$
(B) $\Delta E = q + w$
(C) $\Delta H = \Delta E + P\Delta V$
(D) $\Delta G = \Delta H - T\Delta S$

7. The cubic unit cell of a perovskite structure containing atoms of types A, B, and C is illustrated below. What is the empirical formula of this substance?



- (A) ABC
(B) ABC₃
(C) AB₄C₆
(D) AB₈C₁₂