

- Give the formula of each of the following compounds: (8%)
 - ferric hydroxide
 - barium thiosulfate
 - aminoethane
 - potassium hexacyanomanganate(III).
- Predict the number of unpaired electrons in the following species: (10%)
 - Cr
 - Cu^{2+}
 - NO^-
 - CoCl_4^{2-}
 - $\text{Co}(\text{NH}_3)_6^{3+}$
- The hydroiodic acid solution has a density of 1.50 g/ml and is 49.3% HI (F.W. = 128) by weight. Calculate the formality, and mole fraction of HI in this solution. (6%)
- Calculate the Cu^{2+} ion concentration at equilibrium in a solution that is initially 0.10 M in Cu^{2+} and 1.0 M in NH_3 . ($\text{Cu}(\text{NH}_3)_4^{2+}$: $K_f = 2.1 \times 10^{13}$) (6%)
 - Use the results of the preceding question, 4(a), to explain why $\text{Cu}(\text{OH})_2$ dissolves in excess ammonia. ($\text{Cu}(\text{OH})_2$: $K_{sp} = 2.2 \times 10^{-20}$; NH_3 : $K_b = 1.8 \times 10^{-5}$) (6%)
- On the basis of inductive effect, the Lewis acidity of the boron halides is expected to be $\text{BF}_3 > \text{BCl}_3 > \text{BBr}_3$. Experimentally, the opposite is observed. Explain these apparent anomaly. (8%)
- Explain each of the following: (30%)
 - The electron affinity (EA) of F atom is less than that of Cl atom.
 - The bond dissociation energy of C_2 decreases slightly on forming C_2^+ , and increases greatly on forming C_2^- .
 - B_2H_6 is more chemically reactive than does C_2H_6 .

(d). K_a for $\text{Cr}^{3+}(\text{aq})$ is larger than K_a for $\text{Cu}^{2+}(\text{aq})$.

(e). Solutions of $\text{Fe}(\text{H}_2\text{O})_6^{2+}$ are green, while solutions of $\text{Fe}(\text{CN})_6^{4-}$ are yellow.

7. An ideal gas undergoes a reversible isothermal expansion from an initial volume of V_1 to a final volume of $10V_1$ and thereby does 10.0 kJ of work. The initial pressure was 100 atm, calculate the initial volume V_1 . ($1 \cdot \text{l} \cdot \text{atm} = 101.3 \text{ J}$) (8%)

8. Write equations for the half-reactions for the oxidation and reduction of water. (4%)

9. Given: $\text{Ag}^+(\text{aq}) + e^- \rightarrow \text{Ag}(\text{s}) \quad E^\circ_{\text{red}} = +0.799 \text{ V}$
 $\text{AgBr}(\text{s}) + e^- \rightarrow \text{Ag}(\text{s}) + \text{Br}^-(\text{aq}) \quad E^\circ_{\text{red}} = +0.0713 \text{ V}$

Calculate the K_{sp} of $\text{AgBr}(\text{s})$ (6%)

10. For the reaction, $2\text{H}_2(\text{g}) + 2\text{NO}(\text{g}) \rightarrow \text{N}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$, the observed rate expression is

$$\text{Rate} = k[\text{NO}]^2[\text{H}_2]$$

propose a mechanism in agreement with experimental observation. (8%)