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Chemistry 142
Final Exam, May 2000

Problems (Please show your work for full credit, ANSWER 8 OF 10!!!)

1. It took 143 s for 50.0% of a substance to decompose. If the initial concentration was 0.0600 M and the decomposition follows second-order kinetics, what is the value of the rate constant?

2. $K = 2.1 \times 10^3$ for the reaction: $\text{H}_2(\text{g}) + \text{F}_2(\text{g}) \rightleftharpoons 2\text{HF}(\text{g})$.

When the system is analyzed at equilibrium, the concentrations of $\text{H}_2(\text{g})$ and $\text{F}_2(\text{g})$ are both found to be 0.0021 M. What is the concentration of $\text{HF}(\text{g})$ at equilibrium?

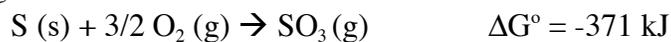
3. A solution is prepared by mixing 90.0 mL of 5.00 M HCl to 150.0 mL of 8.00 M HNO_3 . Water is then added until the final volume is 1.00 L. Calculate $[\text{H}^+]$, $[\text{OH}^-]$, and pH.

4. Will a precipitate form when 75.0 mL of 0.020 M BaCl_2 and 125 mL of 0.040 M Na_2SO_4 are mixed together? (K_{sp} for $\text{BaSO}_4 = 1.5 \times 10^{-9}$)

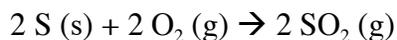
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5. Calculate the pH after 0.020 mole HCl is added to 1 L of a solution that is 0.1 M in both propanoic acid ($\text{HC}_3\text{H}_5\text{O}_2$; $K_a = 1.3 \times 10^{-5}$) and sodium propanoate ($\text{NaC}_3\text{H}_5\text{O}_2$).

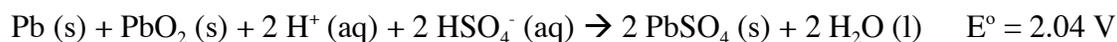
6. Given the following data:



calculate ΔG° for the following reaction:



7. The overall reaction in a lead storage battery is



Calculate E at 25°C for this battery when $[\text{H}_2\text{SO}_4] = 4.5 \text{ M}$.

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8. The compound $\text{Ni}(\text{H}_2\text{O})_6\text{Cl}$ is green due to the absorption red light (650 nm), while $\text{Ni}(\text{NH}_3)_6\text{Cl}$ is purple due to the absorption of yellow light (570 nm).

a) Calculate the energy of the light absorbed by each compound. ($c = 3.00 \times 10^8 \text{ M/s}$,
 $h = 6.63 \times 10^{-34} \text{ J sec}$)

b) In which compound is Δ greater? Explain.

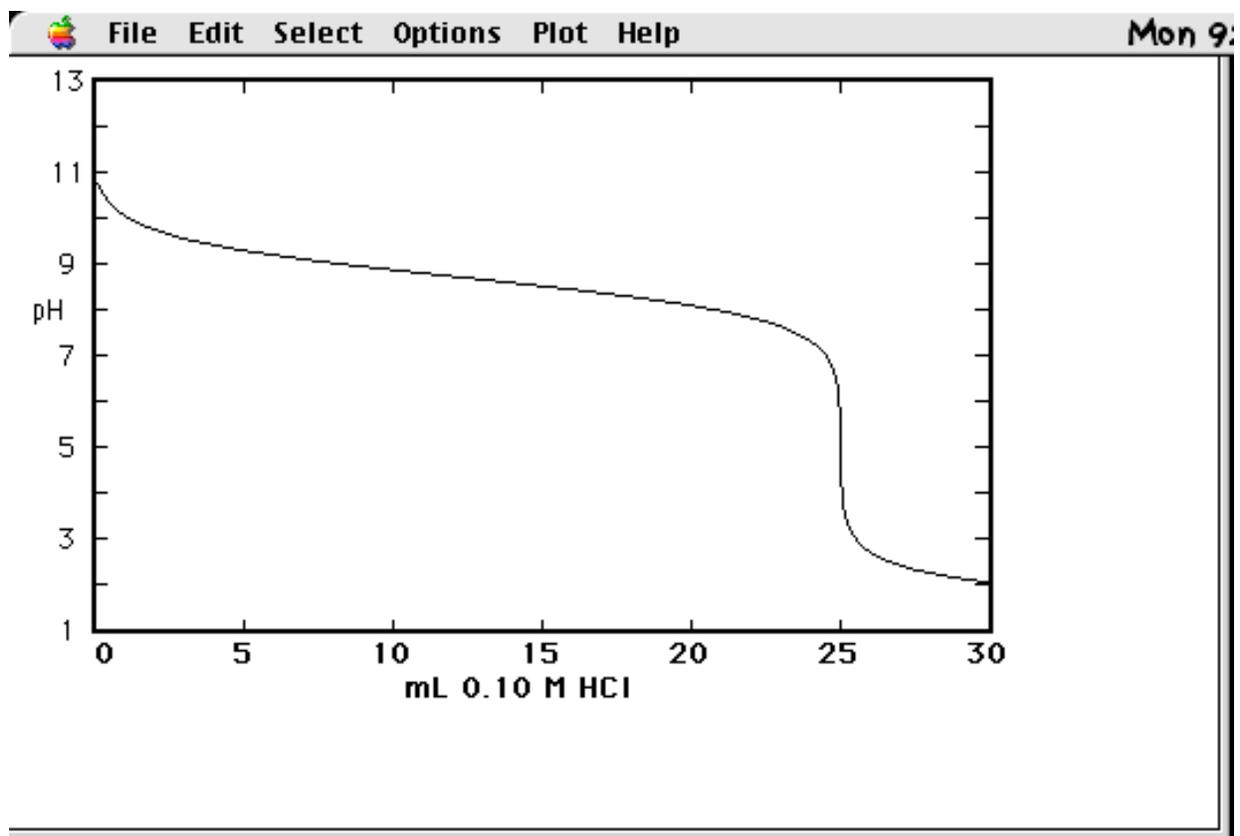
b) Is H_2O or NH_3 a stronger field ligand? Explain.

9. Elemental sulfur can exist in two forms, rhombic and monoclinic. Calculate the temperature for the conversion of the monoclinic sulfur to rhombic sulfur given the following data:

	ΔH_f° (kJ/mol)	ΔS° (J/K mol)
S (rhombic)	0	31.73
S (monoclinic)	0.30	32.55

9. Given the titration curve of 25 ml of NaBrO being titrated with HCl :

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- A. Calculate the NaBrO concentration.
- B. Estimate the pKa of the weak acid HBrO.
- C. Calculate the ΔG for the dissociation of the weak acid.