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Pre-Lab Questions

1. A student withdraws 3.00 mL of supernate from a saturated solution of $\text{KHC}_8\text{H}_4\text{O}_4$ at room temperature ($\sim 22\text{ }^\circ\text{C}$). This sample was titrated to the phenolphthalein endpoint and 12.85 mL of 0.0997 M NaOH was required.
 - a. Calculate moles of $\text{HC}_8\text{H}_4\text{O}_4^-$ in the 3.00 mL aliquot.
 - b. Calculate the $[\text{HC}_8\text{H}_4\text{O}_4^-]_{\text{equil}}$ (a.k.a. solubility).
 - c. What is the value for $[\text{K}^+]_{\text{equil}}$?
 - d. Calculate K_{sp} at $22\text{ }^\circ\text{C}$.
2. A similar titration as in #1 above was done for a saturated solution of KHP in 0.500 M KCl also at room temperature. The withdrawn supernate was 5.00 mL (instead of 3.00 mL). The volume of titrant (0.0997 M NaOH) used was 8.35 mL.
 - a. Calculate the new solubility in 0.500 M KCl.

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b. Calculate the % decrease in solubility by using equation 5.

3. Two more titrations like the one in #1 above were done at two other temperatures and a plot of $\ln K_{sp}$ vs $1/T$ (in Kelvin) was constructed and yielded the trendline equation below. Calculate ΔH°_{soln} (**kJ/mol**) and ΔS°_{soln} (**kJ/K·mol**).

$$y = -4480x + 13.8$$

$$\Delta H^\circ_{soln} = \underline{\hspace{2cm}} \text{ kJ/mol} \quad \Delta S^\circ_{soln} = \underline{\hspace{2cm}} \text{ kJ/K}\cdot\text{mol}$$

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Data and Calculations**Concentration of standard NaOH: _____ M**

Sample of sat'd KHP	Temperature (Kelvin)	Vol KHP acid (mL)	Vol NaOH base (mL)	$[\text{HC}_8\text{H}_4\text{O}_4^-]_{\text{eq}}$ (<i>solubility</i>) (M)	$[\text{K}^+]_{\text{eq}}$ (M)	K_{sp}
At room temp						
warmer						
colder						
At room temp with 0.50M KCl						

Show sample calculations for $[\text{HC}_8\text{H}_4\text{O}_4^-]_{\text{eq}}$, $[\text{K}^+]_{\text{eq}}$ and K_{sp} below:

Prepare an Excel[®] chart filling in K_{sp} and T values. Have the computer program calculate $\ln(K_{\text{sp}})$ and $1/T$ for the 4 sets of data.

Plot a scatter graph with $y = \ln(K_{\text{sp}})$ values and $x = 1/T$ (Kelvin) and display the linear trendline equation of your plot. Attach your graph.

Write out the linear trendline equation _____

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4. Calculate the % difference in K_{sp} at room temperature, equation 6. Based on a 10% acceptable difference, are your K_{sp} values in water and in KCl the same? If they are not within 10% of each other, propose a specific error that might have caused this significant difference in K_{sp} .

5. Plot $\ln K_{sp}$ vs $1 / T$ (Kelvin) and determine the linear trendline equation of your plot. Attach your graph.

Linear Trendline Equation: _____

6. Calculate the ΔH°_{soln} and ΔS°_{soln} for the dissolution of solid KHP from the trendline equation of your scatter graph; $\ln(K_{sp})$ vs $1 / T$ (Kelvin). R is the gas constant $8.314 \text{ J mol}^{-1} \text{ K}^{-1}$

$\Delta H^{\circ}_{soln} =$ _____ **kJ / mol** $\Delta S^{\circ}_{soln} =$ _____ **kJ / K·mol**