

Discussion Quiz #4 2017 Take home(10 points)

Your Name: _____

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Discussion /dayTime: _____

Remember: Zero tolerance policy for academic dishonesty.

1. (2 points) The vapor pressure of pure water at 29 °C is 4000. Pa. Calculate the vapor pressure (in Pa) of an aqueous solution prepared by adding 0.755 mol of CaCl₂ to 270. mL of water at 29 °C.

$$p_{\text{solvent}} = \chi_{\text{solvent}} \cdot p^{\circ}_{\text{pure solv}} = 0.8688 \cdot 4000. = 3475 \text{ Pa or } 3480 \text{ Pa}$$

$$\chi_{\text{solvent}} = n_{\text{water}} / (n_{\text{water}} + n_{\text{CaCl}_2}) = 15.0 / (15.0 + 0.755 \cdot 3) = 0.8688$$

$$n_{\text{water}} = 15 \text{ ml}$$

2. (3 points) For each of the quantities below, circle the correct relationship (<, >, or =). If you need more information in order to answer, circle nothing.

$$|\Delta_{\text{latt}}H(\text{Na}_2\text{S})| > |\Delta_{\text{latt}}H(\text{Na}_2\text{SO}_4)| \quad \underline{\mathbf{1 \text{ point each R or W}}}$$

$$|\Delta_{\text{aq}}H(\text{Na}_2\text{S})| > |\Delta_{\text{aq}}H(\text{Na}_2\text{SO}_4)| \quad |\Delta_{\text{sol}}H(\text{Na}_2\text{S})| \text{ can not say } |\Delta_{\text{sol}}H(\text{Na}_2\text{SO}_4)|$$

3. This question concerns the lowering of temperature of the ice-water mixture that results when excess NaCl(s) is added to 325.0 g of ice, initially at 0 °C. You will need the following information:

enthalpy change of solution of NaCl(s) is 3.87 kJ/mol,

solubility of NaCl(s) is 35.65 g per 100.0 g of water,

heat of fusion of water is 333.55 J/g,

heat capacity of water is 4.186 J/(g °C),

heat capacity of ice is 2.050 J/(g °C).

R or W

- a. (1 point) Calculate the enthalpy change ΔH_1 when 325.0 g of ice is melted to water at 0 °C.

$$\Delta H_1 = 108400 \text{ J}$$

$$\Delta H_1 = 325.0 \text{ g} \cdot 333.55 \text{ J/g} = 108403.75 \text{ J} = 108404 \text{ J}$$

- b. (1 point) Calculate the enthalpy change ΔH_2 when enough NaCl(s) dissolves in 325.0 g of water at 0 °C to form a saturated solution.

$$\Delta H_2 = 7673 \text{ J}$$

$$\frac{35.65 \text{ g}(\text{NaCl})}{100.0 \text{ g}(\text{H}_2\text{O})} \cdot 325.0 \text{ g}(\text{H}_2\text{O}) \cdot \frac{1 \text{ mol}}{58.44 \text{ g}} = 1.983 \text{ mol NaCl}$$

$$1.983 \text{ mol NaCl} \cdot 3.87 \frac{\text{kJ}}{\text{mol}} \frac{1000 \text{ J}}{1 \text{ kJ}} = 7670 \text{ J}$$

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- c. (1 point) Write the expression whose value q_1 is the enthalpy change when 325.0 g of water at $T = 0\text{ }^\circ\text{C}$ is cooled to temperature T . $^\circ\text{C}$.

$$q_{\text{water}} = m_{\text{water}} C_{\text{water}} \Delta T = 325.0 \text{g} * 4.186 \text{(J/(gC))} * (T_f - 0) \text{C}$$

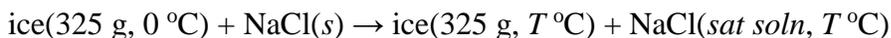
$$q_1 = 1360. * T_f \text{ J}$$

- d. (1points) Write the expression whose value q_2 is the enthalpy change when 325.0 g of ice at $0\text{ }^\circ\text{C}$ is cooled to temperature T . $^\circ\text{C}$.

$$q_{\text{ice}} = m_{\text{ice}} C_{\text{ice}} \Delta T = 325.0 \text{g} * 2.050 \text{(J/(gC))} * (T_f - 0) \text{C}$$

$$q_2 = 666.3 * T_f \text{ J}$$

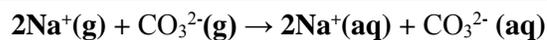
- e. (1 points) The total enthalpy change of the process



is $\Delta H_{\text{total}} = \Delta H_1 + \Delta H_2 + q_1 + q_2$. Based on energy conservation, what must be the numerical value of ΔH_{total} ?

$$\Delta H_{\text{total}} = 0 \text{ J}$$

4. Write the chemical equation whose enthalpy change is the enthalpy change of aqution of sodium carbonate, $\text{Na}_2\text{CO}_3(s)$. To receive credit, you must include the correct state of each species.



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