Discussion Quiz #4 2017 Take home(10 points)

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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 $CaCl_2$ to 270. mL of water at 29 °C.

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

$\chi_{solvent} = n_{water}/(n_{water}+n_{cacl2}) = 15.0/(15.0+0.755*3) = 0.8688$

$n_{water} = 15ml$

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.

$\Delta_{latt}H(Na_2S)| > |\Delta_{latt}H(Na_2SO_4)|$ **1 point each R or W**

$|\Delta_{aq}H(Na_2S)| > |\Delta_{aq}H(Na_2SO_4)|$ $|\Delta_{sol}H(Na_2S)|$ can not say $|\Delta_{sol}H(Na_2SO_4)|$

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, **R or W**
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).

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

$\Delta H_1 = 108400J$

$\Delta H_1 = 325.0g * 333.55J/g = 108403.75J = 108404J$

b. (1point) 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.

$\Delta H_2 = 7673$ J

$$\frac{35.65g(NaCl)}{100.0g(H2O)} \cdot 325.0g(H_2O) \cdot \frac{1mol}{58.44g} = 1.983molNaCl$$

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

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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 °C is cooled to temperature T. °C.

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

$q_1 = 1360.*T_f$ J

d. (1points) Write the expression whose value q_2 is the enthalpy change when 325.0 g of ice at 0 °C is cooled to temperature T. °C.

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

$q_2 = 666.3*T_f$J

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

ice(325 g, 0 °C) + NaCl(*s*) → ice(325 g, *T* °C) + NaCl(*sat soln*, *T* °C)

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

$\Delta H_{total} = 0$ J

4. Write the chemical equation whose enthalpy change is the enthalpy change of aquation of sodium carbonate, $Na_2CO_3(s)$. To receive credit, you must include the correct state of each species.

$2Na^+(g)$ + $CO_3^{2-}(g)$ → $2Na^+(aq)$ + CO_3^{2-} (aq)

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