There are 2 versions

CHM152 QUIZ #9 25 Pts Spring 2005 NAME: Key

Formulas: $\Delta G = \Delta H - T\Delta S$ $\Delta E = q + w$ $\Delta S^o = \sum n\Delta S_f^o(products) - \sum n\Delta S_f^o(reactants)$

$\Delta H_{rxn}^o = \sum n\Delta H_f^o(products) - \sum n\Delta H_f^o(reactants)$

$\Delta G^o = \sum n\Delta G_f^o(products) - \sum n\Delta G_f^o(reactants)$ $\Delta G = \Delta G^o + RT\ln Q$

1. Which of the following substances is likely to have the highest standard entropy in the liquid state? **BE SURE TO EXPLAIN YOUR REASONING.**

   a. CH_2Cl_2
   b. CCl_4
   c. CH_3OH
   d. C_5H_{12}
   e. C_5H_{18}

   Largest structure has most possible disorder (stretching, vibrations, etc.)

2. Of the following product-favored processes, which are endothermic?

   1. the combustion of methane to produce water and carbon dioxide
   2. the expansion of an ideal gas
   3. the melting of ice at temperatures greater than 0°C.

3. Calculate the standard molar entropy change for the combustion of methane.

   $CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(g)$

Species	S° (J/K·mol)
$CH_4(g)$	186.3
$O_2(g)$	205.1
$CO_2(g)$	213.7
$H_2O(g)$	188.8

$\Delta S^\circ = \sum n S^\circ_{prod} - \sum n S^\circ_{react}$

$\Delta S^\circ = -5.2 \frac{J}{K \cdot mol}$

4. ~~Predict the signs of~~ ΔH and ΔS for the evaporation of water at 35°C.

   a. $\Delta H > 0$ and $\Delta S > 0$
   b. $\Delta H > 0$ and $\Delta S < 0$
   c. $\Delta H < 0$ and $\Delta S > 0$
   d. $\Delta H < 0$ and $\Delta S < 0$
   e. Not enough information is provided to answer this question.

ΔH (+) endothermic ΔS (+) more disorder

******* More questions on back*******

Key

5. The dissolution of ammonium nitrate occurs spontaneously in water. As NH_4NO_3 dissolves, the temperature of the water decreases. What are the signs of *H*, *S*, and *G* for this process?
   a. $\Delta H < 0, \Delta S < 0, \Delta G < 0$
   b. $\Delta H < 0, \Delta S > 0, \Delta G < 0$
   c. $\Delta H < 0, \Delta S > 0, \Delta G < 0$
   d. $\Delta H > 0, \Delta S > 0, \Delta G < 0$
   e. $\Delta H > 0, \Delta S < 0, \Delta G > 0$

Endothermic $\Delta H = (+)$
Spon $\Delta G = (-)$
$\Delta S = (+)$

6. Calculate ΔG°_{rxn} for the reaction below at 25.0°C

$2\ H_2S(g) + O_2(g) \rightarrow 2\ H_2O(g) + S(s)$

given $\Delta H^\circ_{rxn} = -442.4$ kJ, and $\Delta S^\circ_{rxn} = -175.4$ J/K.

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$
$= -442.4\,kJ - 298K\left(-0.1754\frac{kJ}{K}\right) = -390\,kJ$

7. Calculate ΔG°_{rxn} for the reaction below at 25.0°C

$2\ H_2O_2(\ell) \rightarrow 2\ H_2O(\ell) + O_2(g)$

given $\Delta G^\circ_f[H_2O_2(\ell)] = -120.35$ kJ/mol, $\Delta G^\circ_f[H_2O(\ell)] = -237.13$ kJ/mol, $\Delta G^\circ_f[O_2(g)] = 0$ kJ/mol.

$\Delta G = \sum n G^\circ_{prod} - \sum n G^\circ_{react}$
$\Delta G^\circ_{rxn} = [2(-237.13) + 0] - [2(-120.35)] = -233.56\,kJ$

8. Calculate ΔG° for the reaction below at 25.0°C.

$4\ Fe(s) + 3\ O_2(g) \rightarrow 2\ Fe_2O_3(s)$

Species	ΔH°_f(kJ/mol)	S°_f(J/K·mol)
Fe(s)	0	27.78
$O_2(g)$	0	205.14
$Fe_2O_3(s)$	-824.2	87.40

$\Delta H^\circ = (2(-824.2)) - 0 = -1648.4\,kJ$
$\Delta S^\circ = (2(87.4)) - (4(27.78) + 3(205.14)) = -551.74\,J$
$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$
$= -1648.4\,kJ - 298(-0.55174)\,kJ$
$\Delta G^\circ = -1484\ kJ$