CHM 152/154 Diebolt Spring '05 Quiz 5 KEY

1. Predict whether $\Delta S° > 0$ ($+\Delta S$) or $\Delta S° < 0$ ($-\Delta S$) for each of the following reactions. (6 pt)

a) $P_4O_{10}(s) + 6H_2O(l) \rightarrow 4H_3PO_4(s)$ **$\Delta S° < 0$ (-)**

b) $2CF_4(g) + H_2(g) \rightarrow C_2H_2(g) + 4F_2(g)$ **$\Delta S° > 0$ (+)**

Multiple Choice. (12 pt; 3 pts each)

B 2. Which of these elements does **not** have ΔH_f° **= 0**?:

A. $Br_2(l)$ B. $Cl(g)$ C. $Ar(g)$ D. $Ba(s)$ E. $\Delta H_f^\circ = 0$ for all of these

D 3. Which of the following processes would have a negative value of ΔS?:

A. boiling water to form steam
B. dissolving $KCl(s)$ in water
C. detonating a stick of dynamite
D. Freezing water to form ice

D 4. Select the equation that represents the standard enthalpy of formation, ΔH_f°, for the product:

A. $CO(g) + \frac{1}{2} O_2(g) \rightarrow CO_2(g)$
B. $Al(s) + 3Br(l) \rightarrow AlBr_3(s)$
C. $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$
D. $3Mg(s) + N_2(g) \rightarrow Mg_3N_2(s)$

A 5. Which of these substances should have the **lowest** entropy?

A. $Mg(s)$ B. $C_6H_{12}O_6(s)$ C. $CH_3OH(l)$ D. $Ne(g)$ E. $C_3H_8(g)$

6. For the following reaction, $\Delta H_{rxn}^\circ = -24.8 \frac{kJ}{mol}$ and $\Delta S_{rxn}^\circ = 15.0 \frac{J}{K \cdot mol}$:

$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$

a. **Calculate the value of ΔG_{rxn}°** at 25 °C. (Provided equation: $\Delta G = \Delta H - T\Delta S$) (4 pts)

$$\Delta G = -24.8 \frac{kJ}{mol} - (298\ K)\left(15.0 \frac{J}{K \cdot mol}\right)\left(\frac{1 kJ}{1000\ J}\right) = -24.8 \frac{kJ}{mol} - 4.47 \frac{kJ}{mol} = \mathbf{-29.3} \frac{kJ}{mol}$$

b. Is the reaction **spontaneous or nonspontaneous** at 25 °C? (2 pts)

spontaneous; $-\Delta G$

7. Calculate the **entropy change**, $\Delta S°$, for the following reaction (6 pts):

	$4HCl(g)$	+	$O_2(g)$	$\rightarrow$	$2Cl_2(g)$	+	$2H_2O(g)$
$S° \left(\frac{J}{K \cdot mol}\right)$:	186.8		205.0		223.0		188.7

$$\Delta S_{rxn}^\circ = (2)\left(223.0 \frac{J}{K \cdot mol}\right) + (2)\left(188.7 \frac{J}{K \cdot mol}\right) - (4)\left(186.8 \frac{J}{K \cdot mol}\right) - (1)\left(205.0 \frac{J}{K \cdot mol}\right)$$

$$\mathbf{\Delta S_{rxn}^\circ = -128.8} \frac{J}{K \cdot mol}$$