Chapter 9 - Lecture Worksheet 1

1A. LA Smog is composed of nitrogen oxide emissions. Draw Lewis structures:

$2NO_2(g)$ <------> $N_2O_4(g)$

B. This reactions is: **1.** ENDOTHERMIC **2.** EXOTHERMIC **3.** CANNOT TELL

C. At equilibrium:

1. $[NO_2] = [N_2O_4]$
2. $[NO_2]^2 = [N_2O_4]$
3. $2[NO_2] = [N_2O_4]$
4. $k_{forward} = k_{reverse}$
5. $Rate_{forward} = Rate_{reverse}$

D. Experimental data. Draw some conclusions:

Initial Concs (M)		Final Concs (M)	
$[NO_2(g)]_0$	$[N_2O_4(g)]_0$	$[NO_2(g)]_{eq}$	$[N_2O_4(g)]_{eq}$
0.000	0.670	0.0547	0.643
0.0500	0.445	0.0457	0.448
0.0300	0.500	0.0475	0.491
0.0400	0.600	0.0523	0.594
0.200	0.00	0.0204	0.0898

Ratios of Equilibrium Concentrations (25^0C)

$\frac{[N_2O_4(g)]}{[NO_2(g)]}$	$\frac{[N_2O_4(g)]}{[NO_2(g)]^2}$
11.76	215
9.80	215
10.34	218
11.36	217
4.4	216

E. Why does this work ? Assume a 1 step mechanism and find the ratio **($k_{forward}$ / $k_{reverse}$)**

2. Write equilibrium constant expression for:
$N_2(g) + 3H_2(g)$ <------> $2NH_3(g)$

For reaction A at 25^0C, **$K_{eq} = 3.5 \times 10^8$**.
We can say that at equilibrium:
1. There is a lot of NH_3 relative to N_2 and H_2
2. There is a lot of N_2 relative to NH_3 and H_2
3. There is a lot of H_2 relative to NH_3 and N_2
4. There is about the same amount of NH_3 as N_2 and H_2
5. Cannot tell from the information given.

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3. Write equilibrium constant expression for:
$CaCO_3(s)$ <------> $Ca^{2+}(aq) + CO_3^{2-}(aq)$

For reaction B at 25^0C, **$K_{eq} = 9.8 \times 10^{-9}$**.
We can say that:
1. $CaCO_3(s)$ is very soluble.
2. $CaCO_3(s)$ is not very soluble.
3. Cannot tell from the information given.

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4. Write the equilibrium constant expression for: **$2NH_3(g)$ <------> $N_2(g) + 3H_2(g)$**
How is this related to the expression for K in question **2** above ?

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5. Write the equilibrium constant expression for: 1/2 **$N_2(g) + 3/2\ H_2(g)$ <------> $NH_3(g)$**
How is this related to the expression for K in question **2** above ?

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6. Conclusions ?

PRS Answers	
1. $K = K_A$	6. $K = (K_A)^2$
2. $K = (1/K_A)$	7. $K = (1/K_A)^{1/2}$
3. $K = 2\ (1/K_A)$	8. $K = (1/2)(1/K_A)^{1/2}$
4. $K = 2K_A$	9. $K = (K_A)^{1/2}$
5. $K = (1/K_A)^2$	