

Chapter 9 - Lecture Worksheet 1

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



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

C. At equilibrium:

1. $[\text{NO}_2] = [\text{N}_2\text{O}_4]$
2. $[\text{NO}_2]^2 = [\text{N}_2\text{O}_4]$
3. $2[\text{NO}_2] = [\text{N}_2\text{O}_4]$
4. $k_{\text{forward}} = k_{\text{reverse}}$
5. $\text{Rate}_{\text{forward}} = \text{Rate}_{\text{reverse}}$

D. Experimental data. Draw some conclusions:

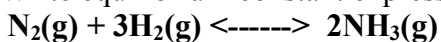
Initial Concs (M)		Final Concs (M)	
$[\text{NO}_2(\text{g})]_0$	$[\text{N}_2\text{O}_4(\text{g})]_0$	$[\text{NO}_2(\text{g})]_{\text{eq}}$	$[\text{N}_2\text{O}_4(\text{g})]_{\text{eq}}$
0.000	0.670	0.0547	0.643
0.0500	0.445	0.0457	0.448
0.0300	0.500	0.0475	0.491
0.0400	0.600	0.0523	0.594
0.200	0.00	0.0204	0.0898

Ratios of Equilibrium Concentrations (25⁰C)

$\frac{[\text{N}_2\text{O}_4(\text{g})]}{[\text{NO}_2(\text{g})]}$	$\frac{[\text{N}_2\text{O}_4(\text{g})]}{[\text{NO}_2(\text{g})]^2}$
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 ($k_{\text{forward}} / k_{\text{reverse}}$)

2. Write equilibrium constant expression for:



For reaction A at 25°C, $K_{\text{eq}} = 3.5 \times 10^8$.

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.

3. Write equilibrium constant expression for:



For reaction B at 25°C, $K_{\text{eq}} = 9.8 \times 10^{-9}$.

We can say that:

1. $\text{CaCO}_3(\text{s})$ is very soluble.
2. $\text{CaCO}_3(\text{s})$ is not very soluble.
3. Cannot tell from the information given.

4. Write the equilibrium constant expression for: $2\text{NH}_3(\text{g}) \rightleftharpoons \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$

How is this related to the expression for K in question 2 above ?

5. Write the equilibrium constant expression for: $\frac{1}{2} \text{N}_2(\text{g}) + \frac{3}{2} \text{H}_2(\text{g}) \rightleftharpoons \text{NH}_3(\text{g})$

How is this related to the expression for K in question 2 above ?

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. $K = (1/K_A)^2$	