CHM152 Quiz3a 25 Pts Fall 2013 Name: Key

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1. (4 Pts) The equilibrium constant for the reaction $Ni(s) + 4CO(g) \rightleftharpoons Ni(CO)_4(g)$ is 5.0×10^4 at 25°C. What is the equilibrium constant for the reaction $Ni(CO)_4(g) \rightleftharpoons Ni(s) + 4CO(g)$?

$$\frac{[Ni(CO)_4]}{[CO]^4} = 5.0 \times 10^4 \quad \text{so:} \quad \frac{[CO]^4}{[Ni(CO)_4]} = \frac{1}{5.0 \times 10^4} = 2.0 \times 10^{-5}$$

2. (3 Pts) The equilibrium constant expression for the reaction $2BrF_5(g) \rightleftharpoons Br_2(g) + 5F_2(g)$ is

$$K_c = \frac{[Br_2][F_2]^5}{[BrF_5]^2}$$

3. (7 Pts) On analysis, an equilibrium mixture for the reaction $2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$ was found to contain 1.0 mol H_2S, 4.0 mol H_2, and 0.80 mol S_2 in a 4.0 L vessel. Calculate the equilibrium constant, K_c, for this reaction.

$$K_c = \frac{[H_2]^2[S_2]}{[H_2S]^2} = \frac{\left[\frac{4.0}{4.0}\right]^2\left[\frac{0.80}{4.0}\right]}{\left[\frac{1.0}{4.0}\right]^2} = 3.2$$

4. (7 Pts) 2.50 mol NOCl was placed in a 2.50 L reaction vessel at 400°C. After equilibrium was established, it was found that 28% of the NOCl had dissociated according to the equation

$2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$.

Calculate the equilibrium constant, K_c, for the reaction.

	$2NOCl(g)$	$\rightleftharpoons 2NO(g)$	$+ Cl_2(g)$
I	1.00	0	0
C	$-2x$	$2x$	x
E	$1.00-2x$	$2x$	x

$1.00 - 2x = 0.72$ (72% left)

$x = 0.14$

$$K_c = \frac{[2(0.14)]^2[0.14]}{[0.72]^2}$$

$K_c = 0.021$

5. (4 Pts) Carbon tetrachloride reacts at high temperatures with oxygen to produce two toxic gases, phosgene and chlorine.

$CCl_4(g) + {}^1/_2O_2(g) \rightleftharpoons COCl_2(g) + Cl_2(g)$, $K_c = 4.4 \times 10^9$ at 1,000 K

Calculate K_c for the reaction $2CCl_4(g) + O_2(g) \rightleftharpoons 2COCl_2(g) + 2Cl_2(g)$.

$$\frac{[COCl_2][Cl_2]}{[CCl_4][O_2]^{1/2}} = 4.4 \times 10^9 \quad \text{so:} \quad \frac{[COCl_2]^2[Cl_2]^2}{[CCl_4]^2[O_2]} = (4.4 \times 10^9)^2$$

$= 1.9 \times 10^{19}$