CHM152 Q3 25 Pts Fall 2005 *Name:* Key

1. (8 Pts) At a high temperature, the following reaction has an equilibrium constant of 1.0×10^2.

$H_2(g) + F_2(g) \rightleftharpoons 2HF(g)$ $\quad K_c = \dfrac{[HF]^2}{[H_2][F_2]}$

If 1.00 mol of each of H_2 and F_2 are allowed to come to equilibrium in a 10.0 L vessel, calculate the equilibrium amounts of H_2 and HF.

	H_2	+ F_2	$\rightleftharpoons$ 2 HF
I	0.100	0.100	0
C	$-x$	$-x$	$+2x$
E	$0.100-x$	$0.100-x$	$2x$

$K_c = \dfrac{[2x]^2}{[0.100-x]^2}$ "perfect square"

$\sqrt{100} = \dfrac{2x}{0.100-x}$

$1 - 10x = 2x$

$x = \frac{1}{12} = 0.0833$

$0.1 - 0.0833 = 0.0167\ M$

$\frac{10\ L}{L} \left| \frac{0.0167\ mol}{} \right. = 0.17\ mol\ H_2$ & F_2

HF $2x = 0.166\ M$

$\frac{10\ L}{L} \left| \frac{0.166\ mol}{} \right. = 1.67\ mol$

2. (7 Pts) When 0.152 mol of solid PH_3BCl_3 is introduced into a 3.0 L container at a certain temperature, 8.44×10^{-3} mol of PH_3 is present at equilibrium. Calculate K_c at this temperature.

$PH_3BCl_3(s) \rightleftharpoons PH_3(g) + BCl_3(g)$

		0	0
I			
C	N/A	$+x$	$+x$
E		$\frac{8.44\times10^{-3}\ mol}{3.0\ L}$	$\frac{8.44\times10^{-3}\ mol}{3.0\ L}$

$K_c = [PH_3][BCl_3]$

$K_c = \left[\frac{8.44\times10^{-3}}{3.0}\right]^2$

$K_c = 7.91 \times 10^{-6}$

3. (6 Pts) The equilibrium constant for the reaction of bromine with chlorine to form bromine monochloride is 58.0 at a certain temperature.

$Br_2(g) + Cl_2(g) \rightleftharpoons 2BrCl(g)$ $\quad K_{c_1} = 58.0 = \dfrac{[BrCl]^2}{[Br_2][Cl_2]}$

What is the equilibrium constant for the following reaction? SHOW WORK.

$BrCl(g) \rightleftharpoons \frac{1}{2}Br_2(g) + \frac{1}{2}Cl_2(g)$ $\quad K_{c_2} = \dfrac{[Br_2]^{1/2}[Cl_2]^{1/2}}{[BrCl]}$

A. 2.97×10^{-4}
B. 1.72×10^{-2}
C. 3.45×10^{-2}
(D.) 1.31×10^{-1}
E. > 1.00

$K_{c_2} = \sqrt{\dfrac{1}{K_{c_1}}} = \sqrt{\dfrac{1}{58.0}} = 0.131$

4. (4 Pts) Write the expression for K_c and K_p for the reaction

$PH_3BCl_3(s) \rightleftharpoons PH_3(g) + BCl_3(g)$ $\quad K_c = [PH_3][BCl_3]$

↑

$K_p = P_{PH_3} P_{BCl_3}$