CHM152 Quiz 2 25 Pts Fall 2019 Name: Key

Show all work to receive credit. R= 8.314 J/(mol K) $K_p = K_c(RT)^{\Delta n}$ $E=mc^2$

R = 0.0821 L·atm / mol·K

1. (3 Pts) Write the equilibrium expression, K_c, for the following chemical reaction.
$Sn^{2+}(aq) + \frac{1}{2} O_2(g) + 3H_2O(l) \rightleftharpoons SnO_2(s) + 2H_3O^+(aq)$

$$K_c = \frac{[H_3O^+]^2}{[Sn^{2+}][O_2]^{1/2}}$$

2. (5 Pts) Carbon tetrachloride reacts at high temperatures with oxygen to produce two toxic gases, phosgene and chlorine.
$CCl_4(g) + (1/2)O_2(g) \leftrightharpoons COCl_2(g) + Cl_2(g)$, $K_c = 4.4 \times 10^9$ at 1,000 K
Calculate K_c for the reaction $2CCl_4(g) + O_2(g) \leftrightharpoons 2COCl_2(g) + 2Cl_2(g)$.

note 2nd reaction is doubled, so K is squared

$(4.4 \times 10^9)^2 = 1.9 \times 10^{19}$

3. (4 Pts) What is the value of the equilibrium constant, K_c, for the reaction:
$2BrCl_3(g) \leftrightharpoons Br_2(g) + 3Cl_2(g)$ If an equilibrium mixture was found to contain 1.0 mol $BrCl_3$, 2.0 mol Br_2 and 6.0 mol Cl_2 in a 6.0 L vessel.

E $2BrCl_3(g) \rightleftharpoons Br_2(g) + 3Cl_2(g)$

$\frac{1.0}{6.0}$ $\frac{2.0}{6.0}$ $\frac{6.0}{6.0}$

$$K_c = \frac{\left[\frac{2.0}{6.0}\right]\left[\frac{6.0}{6.0}\right]^3}{\left[\frac{1.0}{6.0}\right]^2}$$

$K_c = 12$

4. (3 Pts) Phosgene, $COCl_2$, a poisonous gas, decomposes according to the equation
$COCl_2(g) \leftrightharpoons CO(g) + Cl_2(g)$. Calculate K_p for this reaction if $K_c = 0.083$ at 900°C.

$K_p = K_c(RT)^{\Delta n}$ ← $\Delta n = 1$

$= 0.083(0.0821 \cdot 1173)^1$

$= 8.0$

More questions on back.

Key

5. (5 Pts) A mixture 0.500 mole of carbon monoxide and 0.400 mole of bromine was placed into a rigid 1.00-L container and the system was allowed to come to equilibrium. The equilibrium concentration of $COBr_2$ was 0.233 *M*. What is the value of K_c for this reaction?

$$CO(g) + Br_2(g) \rightleftharpoons COBr_2(g)$$

	CO	Br_2	$COBr_2$
I	0.500	0.400	0
C	−x	−x	+x
E	0.500 − x	0.400 − x	0.233

Since $x = 0.233$

$0.500 - 0.233 = 0.267$

$0.400 - 0.233 = 0.167$

$$K_c = \frac{[COBr_2]}{[CO][Br_2]}$$

$$K_c = \frac{[0.233]}{[0.267][0.167]}$$

$$K_c = 5.23$$

6. (5 Pts) For the nitrogen fixation reaction $3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g)$, $K_c = 6.0 \times 10^{-2}$ at 500°C. If 0.250 M H_2 and 0.050 M NH_3 are present at equilibrium, what is the equilibrium concentration of N_2?

$$3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g)$$

	H_2	N_2	NH_3
I			0.050
C			
E	0.250	?	

$$K_c = \frac{[NH_3]^2}{[H_2]^3[N_2]}$$

$$6.0 \times 10^{-2} = \frac{[0.050]^2}{[0.250]^3[N_2]}$$

$$[N_2] = 2.7$$