CHM52 Quiz 3b 25 Pts Spring 2018 Name: Key

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1. (4 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?

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

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

	CO	Br_2	$COBr_2$
I	$\frac{0.500\text{ mol}}{L}$	$\frac{0.400\text{ mol}}{L}$	0
C	$-x$	$-x$	$+x$
E	$0.500-x$	$0.400-x$	x

$x = [COBr_2] = 0.233M$

$0.500 - 0.233 = 0.267$ $0.400 - 0.233 = 0.167$

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

$K_c = 5.23$

2. (4 Pts) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ $K_c = 4.8 \times 10^{-31}$

$2NOBr(g) \rightleftharpoons 2NO(g) + Br_2(g)$ $K_c = 0.50$

Given the above a equilibrium constant data at 25 °C, what is the value of K_c at this temperature for the reaction

$2NOBr(g) \rightleftharpoons N_2(g) + O_2(g) + Br_2(g)$?

$2NO(g) \rightleftharpoons N_2(g) + O_2(g)$ $K_{c1} = \frac{1}{4.8\times10^{-31}}$

$2NOBr(g) \rightleftharpoons 2NO(g) + Br_2(g)$ $K_c = 0.50$

$2NOBr(g) \rightleftharpoons N_2(g) + O_2(g) + Br_2(g)$ so: $K_{c3} = K_{c1} \cdot K_c$

$$K_{c3} = \frac{1}{4.8\times10^{-31}} \cdot 0.50 = 1.0\times10^{30}$$

3. (3 Pts) Write the mass-action expression, K_c, for the following chemical reaction.

$$MgO(s) + SO_2(g) + \tfrac{1}{2}O_2(g) \rightleftharpoons MgSO_4(s)$$

$$K_c = \frac{1}{[SO_2][O_2]^{1/2}}$$

More questions on back

Key

4. (4 Pts) The equilibrium constant for the reaction of bromine with chlorine to form bromine monochloride is 58.0 at a certain temperature.

$Br_2(g) + Cl_2(g) \rightleftharpoons 2BrCl(g)$ K_{c_1}

What is the equilibrium constant for the following reaction?

$BrCl(g) \rightleftharpoons \frac{1}{2} Br_2(g) + \frac{1}{2} Cl_2(g)$ $K_{c_2} = \frac{1}{\sqrt{K_{c_1}}}$

$K_{c_2} = 0.131$

5. (3 Pts) Write the mass-action expression, K_c, for the following chemical reaction equation.

$2C_6H_6(g) + 15O_2(g) \rightleftharpoons 12CO_2(g) + 6H_2O(g)$

$$K_c = \frac{[CO_2]^{12}[H_2O]^6}{[C_6H_6]^2[O_2]^{15}}$$

6. (4 Pts) At 450°C, *tert*-butyl alcohol decomposes into water and isobutene.

$(CH_3)_3COH(g) \rightleftharpoons (CH_3)_2CCH_2(g) + H_2O(g)$

A reaction vessel contains these compounds at equilibrium. What will happen if the volume of the container is reduced by 50% at constant temperature?

A) The forward reaction will proceed to reestablish equilibrium.
B) The reverse reaction will proceed to reestablish equilibrium. increased pressure points to less moles of gas.
C) No change occurs.
D) The equilibrium constant will increase.
E) The equilibrium constant will decrease.

7. (3 Pts) The equilibrium constant, K_p, for the reaction

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

is 55.2 at 425°C. A rigid cylinder at that temperature contains 0.127 atm of hydrogen, 0.134 atm of iodine, and 1.055 atm of hydrogen iodide. Is the system at equilibrium?

A) Yes.
B) No, the forward reaction must proceed to establish equilibrium.
C) No, the reverse reaction must proceed to establish equilibrium.
D) Need to know the volume of the container before deciding.
E) Need to know the starting concentrations of all substances before deciding.

$$Q = \frac{[HI]^2}{[H_2][I_2]} = \frac{[1.055]^2}{[0.127][0.134]} = 65.4$$

$65.4 > 55.2$

$Q_c > K_c$