CHM152 Quiz 4b 25 Pts Fall 2011 Name: Key

1. Consider this reaction. $NO(g) + CO(g) \rightleftarrows \frac{1}{2}N_2(g) + CO_2(g)$ $\Delta H = -374$ kJ

What conditions of temperature and pressure favor the formation of CO_2?

Lower temperature (exothermic); higher pressure (→ Less moles of gas)

2. The equilibrium constant for the gaseous reaction **C + D ⇄ E + 2F**

is 3.0 at 50 °C. In a 2.0 L flask at 50 °C are placed 1.0 mol of **C**, 1.0 mol of **D**, 1.0 mol of **E**, and 3.0 mol of **F**. Initially, the reaction will (SHOW CALCULATIONS TO JUSTIFY YOUR ANSWER)

$$Q = \frac{[E][F]^2}{[C][D]} = \frac{\left[\frac{1.0}{2.0}\right]\left[\frac{3.0}{2.0}\right]^2}{\left[\frac{1.0}{2.0}\right]\left[\frac{1.0}{2.0}\right]} = 4.5$$

(A) proceed at equal rates in both directions.

(B) proceed more rapidly to form **C** and **D**.

(C) proceed more rapidly to form **E** and **F**.

(D) not occur in either direction.

Q > K; so to make Q smaller reaction must shift ← to give Less product + more react.

3. Consider the interrelated equilibria:

1. $Cu^{2+}(aq) + 4NH_3(aq) \rightleftarrows Cu(NH_3)_4^{2+}(aq)$
2. $NH_3(aq) + H_2O \rightleftarrows NH_4^+(aq) + OH^-(aq)$
3. $3OH^-(aq) + Fe^{3+}(aq) \rightleftarrows Fe(OH)_3(s)$

Addition of more Fe^{3+} will

(A) increase the amount of Cu^{2+}

(B) increase the amount of $Cu(NH_3)_4^{2+}$

(C) decrease the amount of Cu^{2+}

(D) decrease the amount of NH_4^+

Adding Fe^{3+} send RXN#3 →; Lowering the $[OH^-]$. This causes RXN #2 to →; Lowering the $[NH_3]$. So RXN # 1 shifts ← since some NH_3 has been removed.

4. Given the reaction $2\mathbf{X}(g) + \mathbf{Y}(g) \rightleftarrows 2\mathbf{Z}(g)$ $\Delta H = -335$ kJ

Which combination of pressure and temperature gives the highest yield of **Z** at equilibrium?

(A) 1000 atm and 500 °C

(B) 500 atm and 500 °C

(C) 1000 atm and 100 °C

(D) 500 atm and 100 °C

(E) catalyst, 500 atm and 100 °C

Key

5. The equilibrium constant K_p for the conversion butane$(g) \rightleftarrows$ isobutane(g) is 2.54 at 25 °C. If butane at 1.00 atm is allowed to come to equilibrium, the partial pressure of isobutane in the equilibrium mixture will be (SHOW WORK TO RECEIVE CREDIT)

(A) 0.390 atm
(B) 0.720 atm
(C) 1.65 atm
(D) 2.54 atm

	butane	$\rightleftarrows$ isobutane
I	1.00 atm	0
C	$-x$	$+x$
E	$1.00 - x$	x

$$K_p = 2.54 = \frac{x}{1.00 - x}$$

$$x = 0.7175 \text{ atm}$$

6. A 1.20-L flask contains an equilibrium mixture of 0.0168 mol of N_2, 0.2064 mol of H_2, and 0.0143 mol of NH_3. Calculate the equilibrium constant, K_c for the reaction (SHOW WORK)

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

$$K_c = \frac{\left[\frac{0.0143}{1.20}\right]^2}{\left[\frac{0.0168}{1.20}\right]\left[\frac{0.2064}{1.20}\right]^3}$$

$$K_c = 1.99$$

7. Consider this reversible reaction, which is endothermic to the right. All substances are gases and are in an insulated closed chamber with a constant volume and are at equilibrium.

$$2H_2O + 2Cl_2 \rightleftarrows 4HCl + O_2 \qquad \Delta H = +113 \text{ kJ}$$

What will be the effect of introducing additional chlorine gas equal to the volume of the reaction chamber and allowing the entire mixture to come to equilibrium again at the original temperature?

(A) The concentration of Cl_2 now will actually be less than in the original mixture.

(B) There is more of both H_2O and HCl than in the original mixture.

(C) There is less oxygen than in the original mixture.

(D) There is less H_2O and more HCl than in the original mixture. shift from $Q \rightarrow K$ $\rightarrow$

(E) The temperature rises sharply.

8. At a certain temperature, 0.500 mol of PCl_5 was placed into a 0.250 L vessel and permitted to react as shown. At equilibrium, the container held 0.100 mol of PCl_5. What is the value of K_c? (SHOW WORK.)

	$PCl_5(g)$	$\rightleftarrows PCl_3(g)$	$+ Cl_2(g)$
I	0.500 mol	0	0
C	$-x$	$+x$	$+x$
E	$0.500 - x$	x	x

from Eq:
$0.500 - x = 0.100$
$x = 0.400$

$$K_c = \frac{\left(\frac{0.400}{0.250}\right)\left(\frac{0.400}{0.250}\right)}{\left(\frac{0.100}{0.250}\right)}$$

$$K_c = 6.40$$