

#11-3

Equilibrium: Le Chatelier's principle

1. (brown580) Consider the following equilibrium  $N_2O_4(g) \leftrightarrow 2NO_2(g)$   $\Delta H = 58.0 \text{ kJ/mol}$ . In what direction will the equilibrium shift when each of the following changes is made to a system at equilibrium

- a. add  $N_2O_4$   $\rightarrow$
- b. remove  $NO_2$   $\rightarrow$
- c. increase the total pressure by adding  $N_2$  X
- d. increase the volume  $\downarrow$  Pressure need to increase pressure
- e. decrease the temperature.  $\leftarrow$

2. (Brady640) The air pollutant sulfur dioxide can be removed from a gas mixture by passing the gases over calcium oxide. The equation is  $CaO(s) + SO_2(g) \leftrightarrow CaSO_3(s)$

Solids will Not cause changes

3. (brady645) Consider the equilibrium  $PCl_3(g) + Cl_2(g) \leftrightarrow PCl_5(g) + \text{energy}$ , for which  $\Delta H^\circ = -88 \text{ kJ}$ . How will the amount of  $Cl_2$  at equilibrium be affected by a) adding  $PCl_3$  b) adding  $PCl_5$  c) raising the temperature, and d) decreasing the volume of the container? E. How will all of these changes affect  $K_p$ .

- a)  $\rightarrow$  down
- b)  $\leftarrow$  up
- c)  $\leftarrow$  up
- d)  $\rightarrow$  down
- E) only C  $\leftarrow \frac{P}{R} \downarrow$  down

4. (brown573) At  $448^\circ\text{C}$  the equilibrium constant,  $K_c$ , for the reaction  $H_2(g) + I_2(g) \leftrightarrow 2HI(g)$  is 51. Predict how the reaction will proceed to equilibrium at  $448^\circ\text{C}$  if we start with  $2.0 \times 10^{-2} \text{ mol}$  of HI,  $1.00 \times 10^{-2} \text{ mol}$   $H_2$  and  $3.0 \times 10^{-2} \text{ mol}$  of  $I_2$  in a 2.0L container. In other words, which way will it shift, products or reactants.

Review Qus. K

$$Q = \frac{[HI]^2}{[H_2][I_2]} = \frac{(1.0 \times 10^{-2} \text{ M})^2}{(.5 \times 10^{-2})(1.5 \times 10^{-2})} = 1.3 = Q$$

$Q < K$   
So  $Q \uparrow$

Shift  $\rightarrow$   
 $\frac{P}{R} \uparrow$