

## Chemistry 12

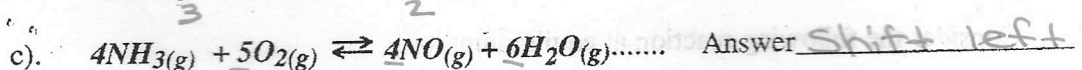
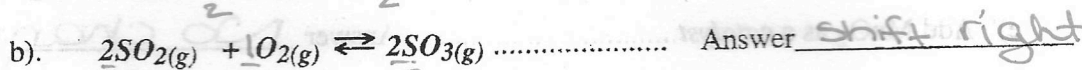
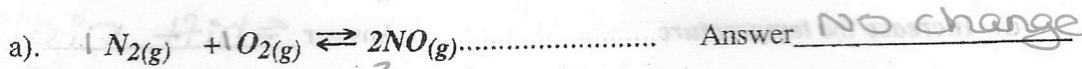
## Worksheet 2-2

LeChatelier's Principle Name \_\_\_\_\_

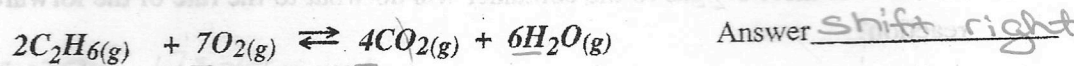
1. In order to decide what effect a **change in total pressure** will have on an equilibrium system with gases, what is the first thing you should do when given the balanced equation?

Find the moles of gas on each side.

2. Predict which way the following equilibrium systems will shift when the **total pressure** is **increased**. (NOTE: Some may have no shift)



3. Which way will the following equilibrium shift if the **total pressure** on the system is **decreased**?



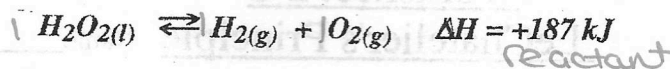
4. Explain why a flask filled with  $\text{NO}_2(\text{g})$  and  $\text{N}_2\text{O}_4(\text{g})$  will get **darker** when heated. Use the equation:  $\text{N}_2\text{O}_4(\text{g}) + \text{heat} \rightleftharpoons 2 \text{ NO}_2(\text{g})$

When heated, the reaction will shift right. The products must be darker.

5. State **Le Chatelier's Principle**.

Any stress applied to a reaction @ equilibrium will cause the reaction to shift and relieve the stress.

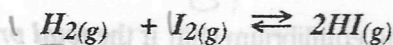
6. Hydrogen peroxide is decomposed as follows:



Predict the *direction of equilibrium shift* by each of the following imposed changes:

- a) *Increase* the  $[\text{H}_2]$  ..... Answer shift left
- b) *Decrease* the  $[\text{O}_2]$  ..... Answer shift right
- c) *Decrease* the *total pressure* ..... Answer shift right
- d) *Increase* the *temperature* ..... Answer shift right
- e) Add  $\text{MnO}_2$  as a *catalyst* ..... Answer No change

7. Consider the following reaction at equilibrium:



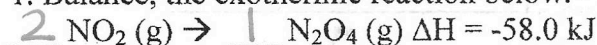
- a) Addition of more  $\text{H}_2$  gas to the container will do what to the rate of the forward reaction?  
Answer Shift forward (increase)
- b) If, for a while, the rate of the *forward* reaction is *greater than* the rate of the *reverse* reaction, what will happen to the  $[\text{HI}]$ ?  
Answer Increase
- c) As the  $[\text{HI}]$  is increased, what will happen to the rate of the *reverse* reaction?  
Answer Increase
- d) When the *rate* of the *reverse* reaction once again becomes *equal* to the rate of the *forward* reaction, a new equilibrium has been reached.
- e) Since the *rate* of the *forward* reaction was, for a while, greater than the rate of the *reverse* reaction, the new equilibrium will have a slightly higher concentration of

HI and a slightly lower concentration of  $\text{H}_2$  &  $\text{I}_2$

1. a, b    2. a, d    3. c, d    4. c, d, e    5. all

Le Chatelier- Stress...Shift...Change in Concentration WS

1. Balance, the exothermic reaction below.



Predict the effect of each of the following changes on this system at equilibrium (drive forward reaction, drive reverse reaction, no effect).

a) add N<sub>2</sub>O<sub>4</sub>      Shift left or drive reverse

b) remove NO<sub>2</sub>      Shift left or drive reverse

\* c) increase the volume      Reverse  
dec Pressure (shift to more moles)

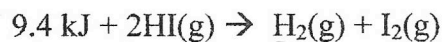
Means decrease Pressure

\* d) decrease the temperature      Forward

where energy is ΔH

Lesson #2

2. Use Le Chatelier's principle to predict how the changes listed will affect the following equilibrium reaction:



a. What is the effect on the concentration of HI if a small amount of H<sub>2</sub> is added?  
2 mol gas      3 mol of gas

If H<sub>2</sub> is added reaction will shift left, so conc. of HI ↑

b. What is the effect on the concentration of HI if the pressure of the system is increased?

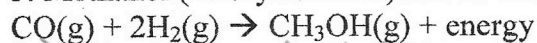
NO effect b/c both sides have same # of mol

\* c. What is the effect on the concentration of HI if the temperature of the system is increased?  
[HI] decreases

d. What is the effect on the concentration of HI if a catalyst is added?

NO EFFECT

3. Methanol (methyl alcohol) can be manufactured using the following equilibrium reaction:



3 mol(g)      1 mol(g)  
Predict the effect of the following changes on the equilibrium concentration of CH<sub>3</sub>OH(g).

\* a. a decrease in temperature      Forward or Shift Right

- \* b. an increase in pressure Shift right
- c. addition of H<sub>2</sub>(g) Shift right
- d. addition of a catalyst No Effect

4. In the equilibrium reaction:  $4\text{HCl}(g) + \text{O}_2(g) \rightarrow 2\text{H}_2\text{O}(g) + 2\text{Cl}_2(g) + 114.4 \text{ kJ}$   
 Predict the direction of equilibrium shift if the following changes occur.

- Lesson #2
- \* a. the pressure is increased Shift forward or right
  - \* b. energy is added Shift reverse or left
  - c. oxygen is added Reaction shifts right
  - d. HCl is removed Reaction shifts left
  - e. a catalyst is added No change

5. Suggest four ways to increase the concentration of SO<sub>3</sub> in the following equilibrium reaction:  
 $2\text{SO}_2(g) + \text{O}_2(g) \rightarrow 2\text{SO}_3(g) + 192.3 \text{ kJ}$

- Decrease SO<sub>3</sub>
- Decrease SO<sub>2</sub>
- Increase O<sub>2</sub>
- Decrease Energy
- Increase Pressure
- Decrease Volume