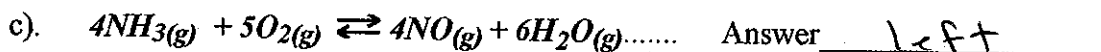
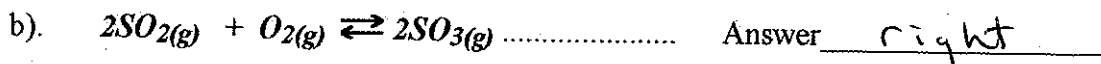
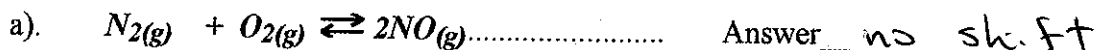


Chemistry 12
Worksheet 2-2
LeChatelier's Principle Name Key

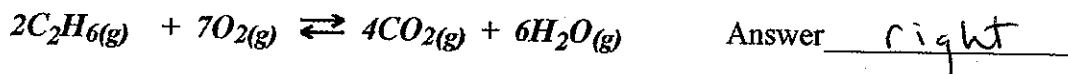
1. In order to decide what effect a *change in total pressure* will have on an equilibrium system with gases, what is the first thing you should do when given the balanced equation?

count # of 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*?



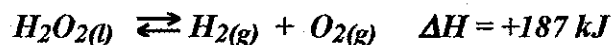
4. Explain why a flask filled with $NO_2(g)$ and $N_2O_4(g)$ will get **darker** when heated. Use the equation: $N_2O_4(g) + \text{heat} \rightleftharpoons 2NO_2(g)$

adding heat shifts the equilibrium to the right. $[NO_2]$ increases. Since NO_2 is darker than N_2O_4 , the solution gets darker

5. State *Le Chatelier's Principle*.

when a system at equilibrium is stressed, it will shift to relieve the stress

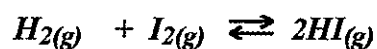
6. *Hydrogen peroxide* is decomposed as follows:



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

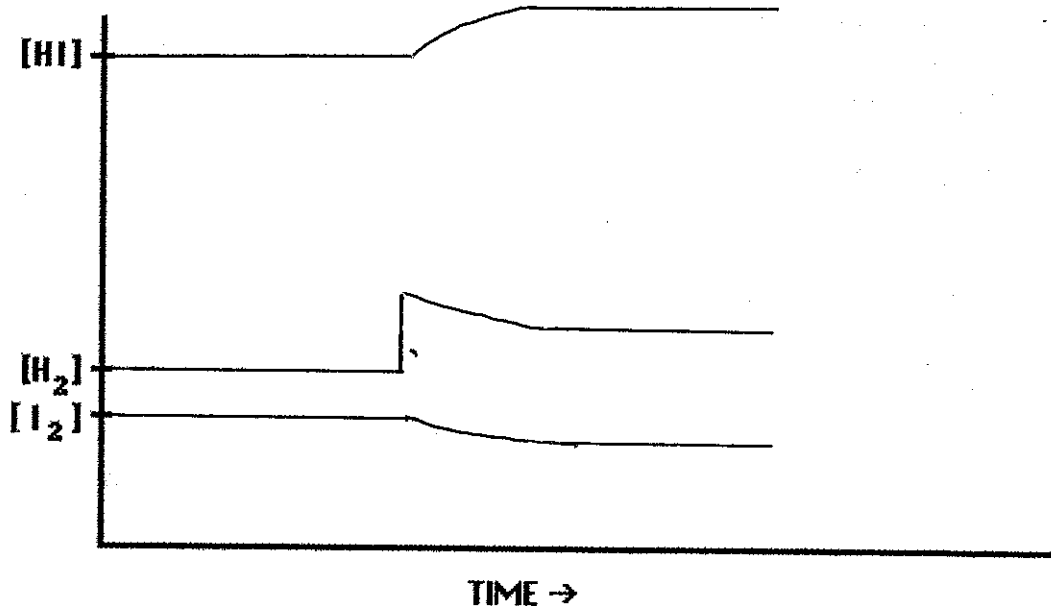
- a) *Increase* the $[\text{H}_2]$ Answer left
- b) *Decrease* the $[\text{O}_2]$ Answer right
- c) *Decrease* the *total pressure* Answer right
- d) *Increase* the *temperature* Answer right
- e) Add MnO_2 as a *catalyst* Answer no shift

7. Consider the following reaction at equilibrium:

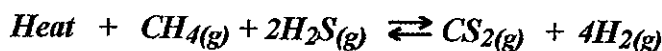


- a) Addition of more H_2 gas to the container will do what to the rate of the forward reaction?
Answer increase
- b) If, for a while, the rate of the *forward* reaction is *greater than* the rate of the *reverse* reaction, what will happen to the $[\text{HI}]$?
Answer increase
- c) As the $[\text{HI}]$ 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 position 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 H_2 & I_2

f) Sketch a graph of the relative concentrations of each species as the process outlined in a-e of this question (on the last page) is carried out.



8. Consider the following equilibrium and state which way (left or right) the equilibrium shifts when each of the changes below are made.

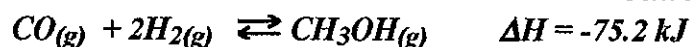


- a) CH₄ gas is added Answer right
- b) CS₂ gas is removed..... Answer right
- c) H₂ gas is added Answer left
- d) The total volume of the container is decreased Answer left
- e) The temperature is increased Answer right
- f) The total pressure is decreased Answer right
- g) Helium gas is added to increase the total pressure.... Answer left

~~9. Using the following equilibrium, state what would happen to the equilibrium partial pressure of CH₃OH gas when each of the following changes are made:~~

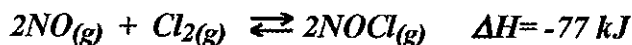


- ~~- a) CO gas is added to the container Answer _____
 - b) The temperature is increased Answer _____
 - c) The total pressure of the system is increased..... Answer _____~~



- d) ~~H₂ gas is removed from the system~~..... Answer _____
- e) ~~A catalyst is added~~..... Answer _____
- f) ~~The total volume of the container is increased~~..... Answer _____

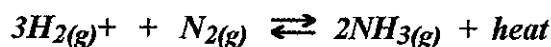
10. For the reaction:



state the optimal pressure and temperature conditions necessary for maximum production of NOCl. (high or low?)

1. high pressure 2. low temperature

11. For the reaction:



state the optimal conditions for a high yield of ammonia (NH₃). (high or low?)

1. high pressure 2. low temperature

12. Given the following equilibrium system, state which way the equilibrium will shift when the changes below are made:



- a) The volume of the container is halved..... Answer left
- b) The temperature is decreased Answer right
- c) CO₂ is added to the container..... Answer left
- d) The total pressure is increased Answer left
- e) O₂ gas is removed from the system Answer left
- f) Neon gas is added to increase the total pressure Answer left
- h) A catalyst is added..... Answer no shift

13. Using the equilibrium: $\text{N}_2\text{(g)} + \text{O}_2\text{(g)} + \text{heat} \rightleftharpoons 2\text{NO(g)}$

Explain why nitric oxide (NO) does *not* generally form in the atmosphere but *is* formed in the internal combustion engine of an automobile or during a lightning storm.

not enough heat present in the atmosphere

14. Explain why a syringe containing NO_2 gas will first get *darker* and *then lighter* in colour when compressed. Use the equilibrium equation:



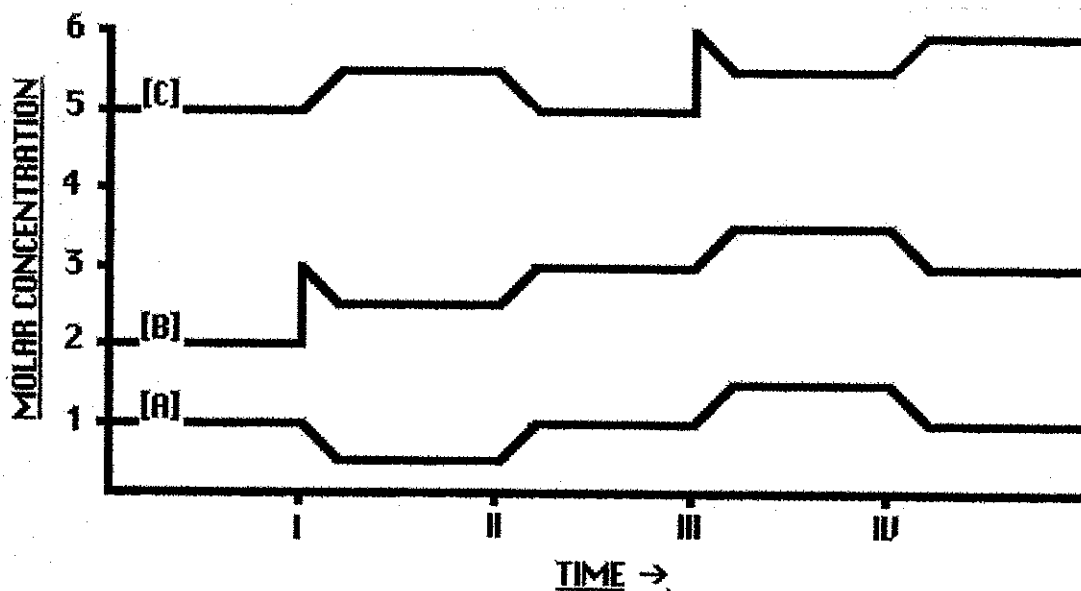
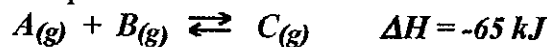
darker as $[\text{NO}_2]$ increases due to compression, then lighter as equilibrium shifts left to relieve pressure

15. Explain why a flask containing NO_2 will get *lighter* in colour when put into ice water. Use the equation:



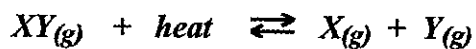
equilibrium shifts left to counteract decrease in temp.

16. Given the following graph showing the concentrations of species A, B and C, state what changes in **temperature** or **concentration** are responsible for each of the shifts shown on the graph. The equilibrium equation is:



- a) At time I, the $[\text{B}]$ increased
- b) At time II, the temperature increased
- c) At time III, the $[\text{C}]$ increased.
- d) At time IV, the temperature decreased.

17. Given the equilibrium equation:



If initially, at equilibrium, the $[XY] = 3.0 \text{ M}$, the $[X] = 5.0 \text{ M}$ and the $[Y] = 6.0 \text{ M}$, draw a graph similar to the one in question 16 showing qualitatively what happens to the concentrations of each species as the following changes are made to the system:

Time I - The temperature is increased.

Time II - Some $X(g)$ is added to the system

Time III - Some $Y(g)$ is removed from the system

Time IV - The temperature is decreased.

