If you are a student that **HAS** access to technology, this is not the packet for you. This packet is for students who pick up and drop off their work at the front office every week. If you have access to technology, please go back to your teacher's website and complete the correct assignment.

Name: _____ Period: _____ Teacher: _____

Assignment 5.1 – Equilibrium

Part I. → Fill in the blanks (word bank: equilibrium, reversible, stress)

Chemical Equilibrium

Many chemical reactions are _____, that is the products can react to form the reactants. Example… $2\ HgO\ (s) \Leftrightarrow 2\ Hg\ (l) + O_2\ (g)$

- Do you see the double sided arrow? That means the reaction can go forwards OR backwards!! 😊

Consider …a 'mood ring'…

Chemical _____ – a system that can goes forward and backwards at the same rate…back and forth…back and forth!
Example… a mood ring (when it gets hot, the thermotropic crystals in the stone turn red; when it gets cold, the stone turns blue) it can change colors but, all in all, the crystal chemicals stay the same. Heat (or lack of it) is the stress that causes it to shift color back and forth.

Le Chatlier's Principle – if a _____ is applied to a system at equilibrium (like a mood ring) the system will shift in response to the stress. *There are many stresses that can shift a reaction besides temperature as you will learn below.*

Part II. Types of Stresses that shift reactions….Fill in the Blanks!!

1. *Change in Pressure*

Pressure = # collisions GAS particles hitting each other & the walls of a container. Example imagine kids in a jumpy house hitting each other and the sides of the container…that's similar to gas pressure! Lol. 😊

- Let's say you INCREASE the Pressure by making the jumpy house smaller. What will happen to the number of collisions? _____

In terms of kids, how do you get back to the same # of collisions you had before you made it smaller…take kids out OR add kids? _____

- What if you DECREASE the Pressure by making the jumpy house bigger…
  More or less collisions? _____
  Add or remove kids to get the original pressure back? _____
- If the kids bouncing around were 'molecules' we would refer to them in MOLES of molecules.

Example…imagine our 'jumpy house' is the following reaction:

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

4moles on left (1 N_2 + 3 H_2) 2 moles on right (2 NH_3)

- ➢ If you were to ↑ Pressure (make the container smaller), wouldn't you need less pieces to maintain the original pressure? Do you see the RIGHT has only 2 gas pieces (which is less than 4 gas pieces on the left)?
  SO…↑ PRESSURE = Make the rxn. Shift to make ↓ MOLES.
  (it's an opposite relationship!! 😊*)*
- ➢ If you ↓ Pressure (make the container larger), do you need MORE or LESS moles? _____

2. Change in Concentration

- Increasing the Concentration (adding more kids to the jumpy house) causes an increase in collisions; so, to get back to the original # of collisions, the reaction must **shift to the opposite side** (the side with less gas pieces OR moles)
  SO…↑H_2 makes more collisions on left so shift to decrease # pieces colliding to Right
  - ➢ If you ↑ NH_3 would you shift to the left/right side of the equation?
    _____
- Decreasing the Concentration causes a decrease in collision frequency and decreases the reaction rate; so, to maintain the original # of collisions, the reaction must **shift to the same side**.
  - ➢ If you ↓ N_2 would you shift to the left/right side of the equation?_____
- Note: adding an inert noble gas (last column) will not change the reaction rate so you write **NO SHIFT**. It just sits there (like a rock) and doesn't react or shift anything!!
  - ➢ If you add He to the reaction, which way will it shift?
    _____
- Note: adding a catalyst will speed up the reaction rate but won't cause the reaction to shift….**NO SHIFT**.
  - ➢ If you add a catalyst to the reaction, which way will it shift?
    _____

3. Change in Temperature

Example…

Energy + $N_2\ (g) + 3\ H_2\ (g) \Leftrightarrow 2\ NH_3\ (g)$

- Can you see the reaction is endothermic forward & exothermic reverse?
- A rise in temperature (indicated by heat energy) increases the rate of collisions so **shift to the opposite side** to decrease collisions;
- a decrease in temperature would decrease the rate of collisions so **shift toward the side** with the temperature to increase collisions.

(*treat energy as a reactant or product in a reaction …just like with concentration* 😊).

- If you increase the temperature (Energy) it will shift away from the temperature to the opposite side so…shifts RIGHT.
- If you decrease the temperature, which way will it shift?

  _____

Assignment 5.2 – Equilibrium Shifting Quiz

For the following gaseous equilibrium reactions, indicate what happens to the equilibrium position (shift left/right or no shift) when the indicated disturbance or condition change occurs.

1. $N_2 + 3\ H_2 \leftrightarrow 2\ NH_3 + energy$ If NH_3 is removed, which way will the reaction shift?

- Left
- Right
- No shift

2. $N_2 + 3\ H_2 \leftrightarrow 2\ NH_3 + energy$ If the temperature is decreased, which way will the reaction shift?

- Left
- Right
- No Shift

3. $CO_2 + H_2 + energy \leftrightarrow CO + H_2O$ If the temperature is decreased, which way will the reaction shift?

- Left
- Right
- No Shift

4. $CO_2 + H_2 + energy \leftrightarrow CO + H_2O$ If CO_2 is increased, which way will the reaction shift?

- Left
- Right
- No shift

5. $N_2O_4 + energy \leftrightarrow 2\ NO_2$ If the pressure of the system is decreased, which way will the reaction shift?

- left
- right
- no shift

6. $N_2O_4 + energy \leftrightarrow 2\ NO_2$ If N_2O_4 is removed, which way will the reaction shift?

- left
- right
- no shift

7. $N_2 + O_2 + energy \leftrightarrow 2\ NO$ If the O_2 concentration is decreased, which way will the reaction shift?

- left
- right

- no shift

8. N2 + O2 + energy ↔ 2 NO If Argon is added, which way will the reaction shift?

- left
- right
- no shift

9. H2 + Cl2 ↔ 2 HCl + energy If the pressure is increased, which way will the reaction shift?

- left
- right
- no shift

10. H2 + Cl2 ↔ 2 HCl + energy If a catalyst is added, which way will the reaction shift?

- left
- right
- no shift

5.3 Carbon Feedback Loops Assignment

These past weeks, you've learned about how carbon can cause climate change in various ways. Carbon is continually shifting in and out of our atmosphere warming and cooling by various equilibrium changes. As carbon shifts in and out of our atmosphere the temperature change it causes is called a feedback loop. A positive feedback loop has a warming effect and a negative feedback loop has a cooling effect. Today, you get to predict whether the following carbon cycling events will cause a positive feedback loop (warming) or a negative feedback loop (cooling) effects.

1.Cloudy skies reflect incoming solar radiation.

- Positive Feedback Loop (warming)
- Negative Feedback Loop (cooling)

2.Sea Levels rise as the glaciers melt.

- Positive Feedback Loop (warming)
- Negative Feedback Loop (cooling)

3.Plants get very dried out which makes them fuel for Forest Fires

- Positive Feedback Loop (warming)
- Negative Feedback Loop (cooling)

4.More water in the atmosphere leads to more Rainfall.

- Positive Feedback Loop (warming)
- Negative Feedback Loop (cooling)

5.More CO2 in the atmosphere leads to an increase in Plant Growth.

- Positive Feedback Loop (warming)
- Negative Feedback Loop (cooling)

6.Arctic Permafrost (ice in the ground) melts releasing more methane (CH4) into the atmosphere.

- Positive Feedback Loop (warming)
- Negative Feedback Loop (cooling)

7.As more ice melts globally, there is less Albedo (solar reflection).

- Positive Feedback Loop (warming)
- Negative Feedback Loop (cooling)

8.The ocean absorbs carbon dioxide from the atmosphere.

- Positive Feedback Loop (warming)
- Negative Feedback Loop (cooling)

9.CO2 in the air can join with H20 in the air to make acid rain.

- Positive Feedback Loop (warming)
- Negative Feedback Loop (cooling)

10.As ice sheets melt, they add freshwater in the ocean changing ocean circulation patterns.

- Positive Feedback Loop (warming)
- Negative Feedback Loop (cooling)