HONORS CHEMISTRY INTRODUCTION TO RATES AND EQUILIBRIUM

PART 1: COLLISION THEORY

Follow the links below to complete the assignment. Some animations may take a while to load so be patient!

A. Watch: Ted ED "How to get a Date"

http://ed.ted.com/lessons/how-to-speed-up-chemical-reactions-and-get-a-date

- While watching, take 10 bullet points of notes on how to speed up chemical reactions.
- Click "Think" tab and take the quiz. Write the answers here in complete sentences (yes, I mean it this time).

B. **Visit: The Collision Theory of Reaction Rates –** (http://www.chemguide.co.uk/physical/basicrates/introduction.html)

- Read the information describing the collision theory. Answer the questions that follow.

1. It is pretty obvious that if you have a situation involving two reactants they can only react together if they come into contact with each other. They first have to collide, and then they ***may*** react. Why is the term "***may*** react" used?
2. What is activation energy?
3. Describe the significance of the Maxwell – Boltzmann Distribution Curve.

C. **Watch: Orientation of Collisions – see link below (you will have to use Firefox and allow Flash Player)** (http://www.mhhe.com/physsci/chemistry/essentialchemistry/flash/collis11.swf

Explain, in your own words, what "Orientation of Collisions" means.

D. **Watch: ActivationEnergy** (http://www.mhhe.com/physsci/chemistry/essentialchemistry/flash/activa2.swf)

Sketch a potential energy diagram of the two following reaction coordinates (endothermic and exothermic). Label all parts and briefly describe what is happening at each part of the reaction coordinate curve (A, B, C, and D)

An Endothermic reaction

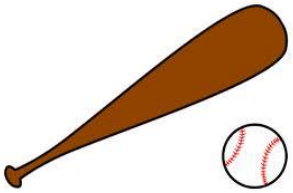
An Exothermic Reaction

E. How does a Catalyst work?

Complete the fill in the blanks at this site: Write the answers only on this paper.
http://www.sciencegeek.net/Chemistry/taters/energydiagram.htm

F. Read the information and four scenarios below. Answer the questions that follow.

In the picture below, the **baseball bat** will represent Reactant A and the **baseball** will represent Reactant B. A reaction will only be successful if the batter hits a homerun. If the batter does not hit a homerun, the reaction will be considered a failure. Now, read the four scenarios below and answer the key questions that follow.



Scenario 1: The pitcher throws a fastball down the middle of the plate. The batter takes a mighty swing and totally misses the ball. The umpire yells, "Strike one!"

Scenario 2: The pitcher throws an off-speed pitch and the batter checks his swing. The batter just barely makes contact with the ball and it dribbles down in front of the batter's feet into foul territory. The umpire yells, "Foul ball; strike two!"

Scenario 3: The pitcher throws a curve ball that looks like it might catch the outside corner of the plate. The batter swings with all his strength, but the bat grazes the underside of the ball and the ball skews off to the right into the crowd. The umpire yells, "Foul ball, still two strikes!"

Scenario 4: The pitcher throws another fastball down the middle of the plate. The batter swings and wallops the ball high into the air and the ball clears the center field wall that reads 410 feet. The ump yells, "Homerun!"

Questions:

1. Did a reaction take place between Reactant A and Reactant B in Scenario 1? Why or why not? Explain your reasoning in terms of the nature of the collision.

2. Did a reaction take place between Reactant A and Reactant B in Scenario 2? Why or why not? Explain your reasoning in terms of the nature of the collision.

3. Did a reaction take place between Reactant A and Reactant B in Scenario 3? Why or why not? Explain your reasoning in terms of the nature of the collision.

4. Did a reaction take place between Reactant A and Reactant B in Scenario 4? Why or why not? Explain your reasoning in terms of the nature of the collision.

G. Write down these notes:

<u>Factors that affect reaction rates</u> (change COLLISIONS per second) – KNOW THESE!!

1. Temperature

** increases KE of particles so possible to meet required Ea (more FORCEFUL collisions)!

** increases velocity so increase FREQUENCY at which they collide

2. Concentration of the Reactants

** more "stuff" = more collisions

3. Surface Area

** more exposure to collide (smaller particles have MORE surface area)

** increase area for orientation to be 'effective'

4. Catalyst

** provide a meeting site / ALTERNATE PATHWAY!

** lower the Ea so more collisions meet sufficient energy required = MORE effective collisions

{remember catalysts are NOT CONSUMED OR USED UP IN RXN!!!}

5. Nature of the Reactants

**refers to their complexity and the number of bonds that must be broken and reformed in the course of reaction.

H. Visit: Ozone Lesson Watch the animation, which demonstrates how ozone is destroyed by chlorofluorocarbons (CFC's). (Note: You can control the speed of the animation by clicking on the buttons to the right of the animation.) Also, please read the information that follows on the webpage. Then, answer the questions that follow.

Questions:

1. What is ozone?

2. What is the importance of the ozone layer?

3. How is ozone destroyed?

4. In reaction $CFCl_3$ + UV Light -> $CFCl_2$ + Cl, there is only one reactant ($CFCl_3$) and no collision. So, why did a reaction take place?

Answer the two questions below regarding two chemical reactions.

1. For the reaction H_2 (g) + Br_2 (g) -> HBr (g), list the type(s)/number of bonds that must be broken and the type(s)/number of bonds that must form for the chemical reaction to take place. (You must first balance the reaction.)

1. For the reaction N_2 (g) + H_2 (g) -> NH_3 (g), list the type(s)/number of bonds that must be broken and the type(s)/number of bonds that must form for the chemical reaction to take place. (You must first balance the reaction.)

Extra Resources – if you need extra help!
https://prezi.com/x-6ofuuic3fv/copy-of-chemical-reactions-and-collision-theory/

PART 2: EQUILIBRIUM

A: What is equilibrium?

Go to https://courses.lumenlearning.com/boundless-chemistry/chapter/equilibrium/

Read and watch the video (at bottom of page) about Chemical Equilibrium.
You may use the following link for more information. http://www.chem1.com/acad/webtext/chemeq/Eq-01.html

Questions:

1. What is equilibrium?
2. Why do reactions go towards equilibrium?
3. What is a reversible reaction?
4. Why must a container or system be closed or equilibrium to be established?
5. A chemical reaction is in equilibrium when there is_____.
6. Compare the 2 graphs (these graphs can be found on the video from Boundless website above).
   What is the same?
   What is different?
   At equilibrium, what is unchanging?
   At equilibrium, what is equal?
7. According to the law of mass action, what must be EQUAL at equilibrium?
8. Why is chemical equilibrium considered dynamic?

B: Le Chatelier's Principle

Go to the sites shown here.
https://ed.ted.com/on/moKExh1B
https://courses.lumenlearning.com/boundless-chemistry/chapter/factors-that-affect-chemical-equilibrium/
I would recommend either watching the video or reading information from the first … also see additional resources below.

Answer the questions based on what you've read.

1. What does LeChatelier's principle mean?
2. What is a stress?
3. If you ADD something (a reactant, product or heat/energy), will the equilibrium shift toward the side of the reaction to make even more of it, or will the equilibrium shift in the direction to use it up? Explain.
4. If you REMOVE a chemical or heat from a system, will the system shift toward the side that replaces what you took out or try to use even more of it?
5. Explain what happens when you increase pressure on a system that was at equilibrium?
6. View this Ted Ed video on an important application of Le Chat's Principle (https://ed.ted.com/on/nLHJykrk). Write down what Haber did to optimize the production of ammonia and how it relates to the Le Chat's principle.

   Additional resources:
   http://www.chem1.com/acad/webtext/chemeq/Eq-02.html
   http://www.chem.ox.ac.uk/vrchemistry/ChemicalEquilibrium/HTML/page29.htm
   http://www.youtube.com/watch?v=4-fEvpVNTlE

C: What is K?

Visit this website (may need to use Flash Player accessible through Firefox):
http://www.mhhe.com/physsci/chemistry/animations/chang_7e_esp/kim2s2_5.swf

1. Watch the animation and write down the K expression.

2. Choose to start with all NO_2. Write down the equilibrium concentrations for both compounds. Use these values in the equilibrium K expression and calculate the value of K. Show all work. Draw a rough graph showing how the reactant and product concentrations change over time as equilibrium is being established.

3. Choose to start with all N_2O_4. Write down the equilibrium concentrations for both compounds. Use these values in the equilibrium K expression and calculate the value of K. Show all work. Draw a rough graph showing how the reactant and product concentrations change over time as equilibrium is being established.

4. Choose to start with a mixture of both compounds. Write down the equilibrium concentrations for both compounds. Use these values in the equilibrium K expression and calculate the value of K. Show all work. Draw a rough graph showing how the reactant and product concentrations change over time as equilibrium is being established.

Refer to http://www.chem.ox.ac.uk/vrchemistry/ChemicalEquilibrium/HTML/page40.htm

5. What is the general formula for equilibrium expressions?
6. What states of matter are included in this expression?
7. What is the difference between the equilibrium constant and the equilibrium expression?
8. What would be the equilibrium expression for $O_2 + N_2 \rightleftharpoons 2NO$ if all chemicals involved are gases?

D: Phase equilibrium

This is a great resource, but you will also have to do some thinking ☺
http://www.youtube.com/watch?v=JsoawKguU6A

1. At what temperature are ice and liquid water in equilibrium with each other?
   a. This temperature is called the _____.
   b. What rates are equal?
   c. What appears constant?

2. At what temperature are steam and liquid water in equilibrium with each other?
   a. This temperature is called the _____.
   b. What rates are equal?
   c. What appears constant?

E: Solution Equilibrium

This is a great resource, but you will also have to do some thinking ☺
http://www.youtube.com/watch?v=Vgw1fYBYW3ghttp://www.youtube.com/watch?v=Vgw1fYBYW3g

1. What type of solution is at equilibrium?
2. What is happening to the solute on a molecular level when it is at equilibrium?
3. What is equal in this type of equilibrium?
4. What is constant during this type of equilibrium?