HW- Phet Simulation
Reversible Reactions Simulation

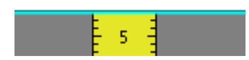
Name Answer Key
Period __________

- Go to the website, "phet.colorado.edu." Click on "Play with Sims"
- Find the "Reversible Reactions" Simulation. Click "Run Now" (on a Mac right-click the app)
- Play with the program for a little while to get to know what it does.
  Note: The gray bars move up and down and so does the ruler. This program simulates a reaction where a reactant (A) reacts to form a product (B). The reverse reaction (B→A) can also occur. You can start with however many molecules of A or B that you wish and then hit Start to see what happens. Hit "Reset" whenever you want to start over again.
- Now, do the following scenarios with the program and answer the questions.

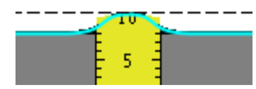
Part A: Reactants and Products set at equal energy.

- *Set both the reactant energy platform and the product energy platform as low as they will go.*

1) Set the ruler as low as it will go. Put in 100 molecules of A and hit start. What are the approximate numbers of molecules of A and of B when the reaction reaches equilibrium?
   A = ~50 B = ~50



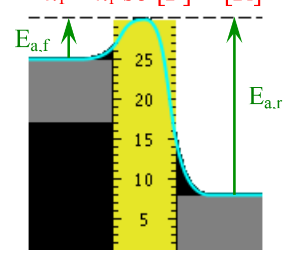
2) Set the ruler a little higher—around 10. Reset, put in 100 molecules of A and hit start.
   a) What are the approximate numbers of molecules of A and of B when the reaction reaches equilibrium? A= ~50 B= ~50
   b) How did raising the "ruler" affect the process? It raised E_a, slowed reaction
   c) What does the "ruler" represent about reactions? E_a



Part B: Reactants set at a higher energy level than products

$R_{for} = k_f [R] = R_{rev} = k_r [P]$

$k_f > k_r$ so $[P] > [R]$



$E_{a.f} < E_{a.r}$

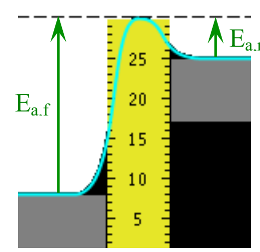
- *Raise the ruler up to 30. Raise the reactant energy platform up to 25. Keep the product energy platform as low as it will go.*

3) Reset, put in 100 molecules of A and hit start. **Add heat until the thermometer is almost fully red**. What are the approximate numbers of molecules of A and of B when the reaction reaches equilibrium? A = 30-40 B = 60-70
4) Compared to part A, how did raising the reactant energy platform above the product platform affect the equilibrium amounts of A and B? Explain why.
   - At equilibrium, fewer reactants, more products
   - To make rates equal, need fewer reactants w/lower E_a (higher k_f) to match more products with higher E_a (lower k_r)

Part C: Products set at a higher energy level than reactants.

$R_{for} = k_f [R] = R_{rev} = k_r [P]$

$k_f < k_r$ so $[R] > [P]$



$E_{a.f} > E_{a.r}$

- *Keep the ruler at 30. Lower the reactant energy platform as low as it will go. Raise the product energy platform up to 25.*

6) Reset, put in 100 molecules of A and hit start. **Add heat until thermometer is almost fully red**. What are the approximate numbers of molecules of A and of B when the reaction reaches equilibrium? A = 60-70 B = 30-40
7) How did raising the product energy platform above the reactant energy platform affect the equilibrium amounts of A and B? Explain why.
   - At equilibrium, more reactants and fewer products
   - With higher E_a (lower k), need more [R] to match lower E_a (higher k) of products

8) Reset, put in 200 molecules of A and hit start. **Add heat until thermometer is almost fully red.** What are the approximate numbers of molecules of A and of B when the reaction reaches equilibrium? A= 120-140 B= 60-80
9) What stayed the same when one compares the situation when you started with 100 molecules of A to the situation when you started with 200 molecules of A?

   Ratio of [P] to [R]: ratio $= \frac{[P]}{[R]} =$ ***constant***

Summary question:

10) Which part of this activity (A, B, or C) would best represent the straw equilibrium situation in which the fatter straw was the forward rate and the thinner straw was the reverse rate? Part B (exothermic, higher k_f)