

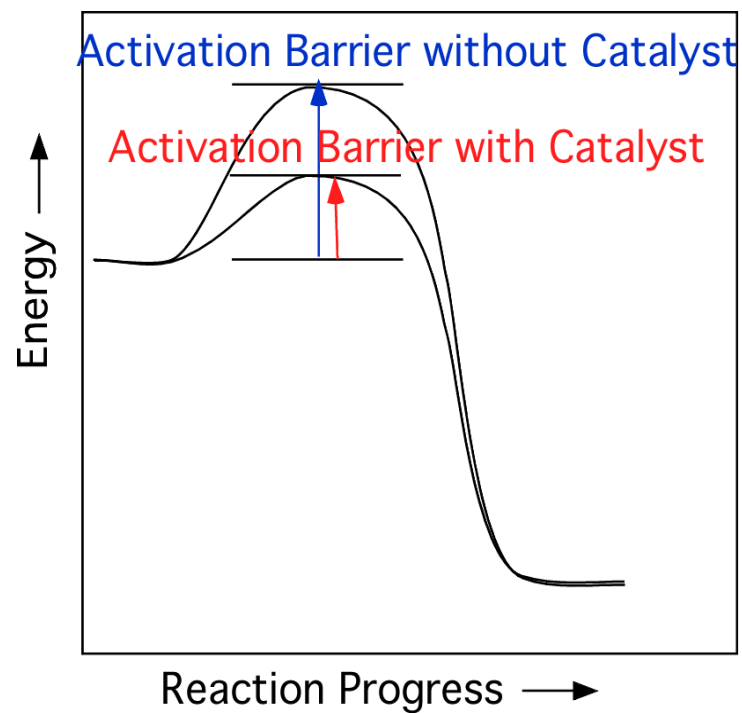
Announcements

To join clicker to class today (Clickers with LCD display joins automatically):

- Turn on the Clicker (the red LED comes on).
- Push “Join” button followed by “20” followed by the “Send” button (switches to flashing green LED if successful).
- Now hiring students to prep for general chemistry next Fall. See Ms. Hauer in HS-449
- Next week in lab you will be checking out and turning in your final experimental section on the Calorimeter lab. Include description of calorimeter, calibration technique and parameters for each reaction.
- We will be starting the last section on acid-base equilibria today. Suggested reading and problems have been e-mailed out and posted on class web site.

Review

- Temperature dependence of the rate constant for reactions is $k(T) = A\exp(-E_a/RT)$
 - Can find E_a from plot of $\ln\{k(T)\}$ vs $1/T$
 - Slope of line = $-E_a/R$.
 - Higher E_a = slower reaction
 - Higher T = faster reaction.
- Catalysts increase the reaction rate by providing an additional reaction path with a smaller E_a



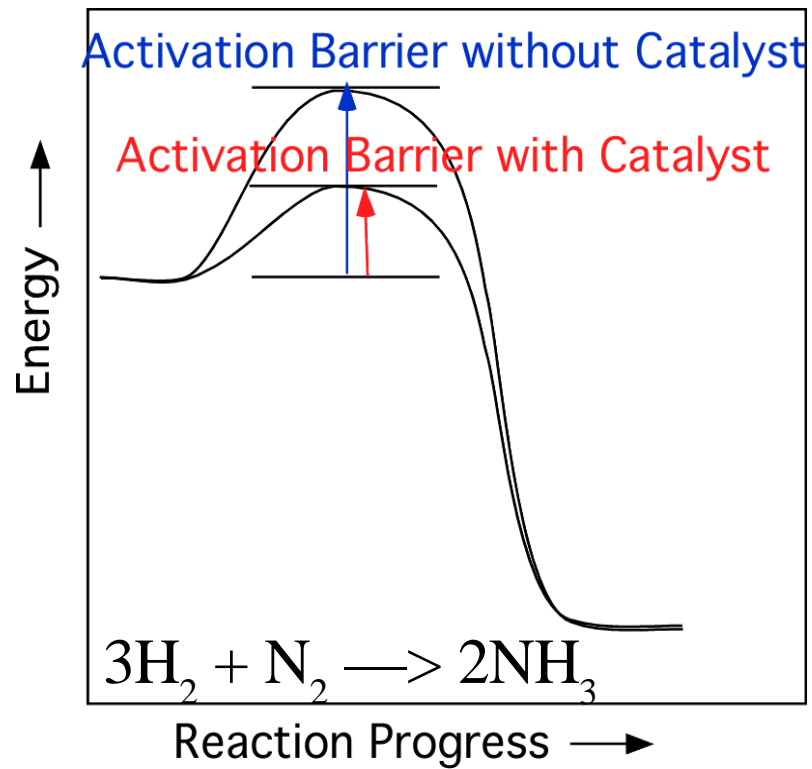
Review

- Writing mass action expressions:
 - $aA + bB \rightleftharpoons cC + dD$
 - Reaction quotient: $Q = [C]^c[D]^d/[A]^a[B]^b$
 - Heterogeneous equilibria: pure solids and solvents do not appear in mass action expression.
 - If all concentrations are at equilibrium this ratio is the equilibrium constant (K).
 - $Q > K \Rightarrow$ reaction will run in reverse.
 - $Q < K \Rightarrow$ reaction will run forward.
- $K_{\text{reverse}} = K^{-1}$

Review

- Le Châtelier's principle:
 - If a system at equilibrium is subjected to a stress, the position of the equilibrium will shift in the direction that will relieve that stress.
 - Changes of concentration starting at equilibrium:
 - Add products, reaction goes backwards
 - Add reactants, reaction goes forwards
 - An increase in pressure favors the side of the reaction with fewer moles of gas.
 - Changes in temperature
 - Exothermic reactions: Higher temperature favors reactants (decreases K_{eq})
 - Endothermic reactions: higher temperature favors products (increases K_{eq})

Equilibrium and Catalysis



Chang Figure 14.18

Acid/Base Equilibria

(Parts of Chapters 16 and 17)

- Brønsted-Lowry vs Lewis acids and Bases
- Conjugate pairs
- Autoionization of water (K_w)
- pH, pOH, pK_w
- “Strength” of Acids and Bases
- Equilibria of "weak" Acids and Bases (pK_a)
- How Buffers work
- titration of strong acids and bases

Brønsted-Lowry Model

- acid = a proton donor • base = a proton acceptor
- $\text{HNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{aq}) \rightleftharpoons \text{NO}_3^-(\text{aq}) + \text{H}_3\text{O}^+(\text{aq})$
acid base
- $\text{Na}^+(\text{aq}) + \text{OH}^-(\text{aq}) + \text{H}_2\text{O}(\text{aq}) \rightleftharpoons \text{Na}^+(\text{aq}) + \text{H}_2\text{O}(\text{aq}) + \text{OH}^-(\text{aq})$
base acid

Lewis Model (does not require water)

- acid = electron pair acceptor • base = electron pair donor
- $\text{H}_3\text{P:} + \text{Cu}^{2+} \rightleftharpoons \text{H}_3\text{P—Cu}^{2+}$
base acid coordinate covalent bond
- $\text{H}_3\text{N:} + \text{H—O—H} \rightleftharpoons \text{H}_3\text{N--H}^+ + \text{OH}^-$
base acid

Conjugate Acid-Base Pairs

- Acids and bases which interconvert during an acid base reaction.

