Types of Reactions:

1. Substitutions - one group replaces another. (alkanes, alkyl halides, aromatics)

$$CH_3Br + NaOH \rightarrow CH_3OH + NaBr$$

2. Additions - all parts of the incoming reagent appear in the product. (π bonds)

$$CH_2=CH_2 + H_2O \rightarrow CH_3CH_2OH$$

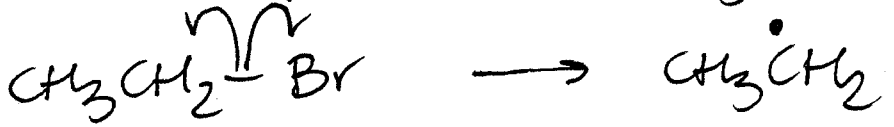
3. Eliminations - the opposite of additions. one molecule loses the elements of a small molecule (HCl, H_2O, N_2) alkyl halides, alcohols

$$CH_3CH_2Br \xrightarrow{KOH} CH_2=CH_2 + HBr$$

4. Rearrangements - a molecule undergoes a reorganization of its constituent parts.

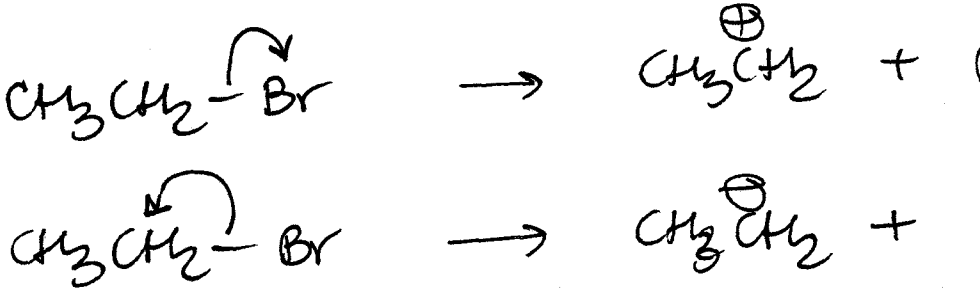
All these reactions involve both making and breaking covalent bonds. This can be done two ways:

1. homolytic cleavage - one e⁻ goes to each atom - produces fragments w/ unpaired e⁻'s.



radicals (fragments w/ unpaired e's) - Ch. 10

2. heterolytic cleavage - one atom gets both e's. - produce charged fragments (ions) - generally need a pretty polar bond.



* e⁻ pair from the bond goes to the more e⁻neg atom.

Start w/ Acid-base rxns.

1. Brønsted-Lowry defs. - rely on H^+
   a. acid: can donate H^+
   b. base: can pick up H^+

ex. $HCl + NaOH \rightarrow H_2O + NaCl$
acid base water salt

2. Lewis defs. (1923) - more general
   a. acid: lone pair acceptor
   b. base: lone pair donor

$AlCl_3$ Lewis acid

carbon w/ ⊕ = carbocation
- e⁻ deficient
- Lewis acid
- electrophile (e⁻ loving)

carbon w/ ⊖ = carbanion
- e⁻ rich
- Lewis bases
- nucleophiles (nucleus loving)

Acid/Base Strengths

$$AH + B \rightarrow A^{\ominus} + {}^{\oplus}BH$$

AH: acid; B: base; $A^{\ominus}$: conjugate base; $^{\oplus}BH$: conjugate acid

the stronger the acid, the weaker the conjugate base (+ vice versa)

Acid strength is defined by its dissociation constant.

$$HA \rightleftharpoons H^+ + A^- \qquad K_a = \frac{[H^+][A^-]}{[HA]}$$

$$pK_a = -\log K_a$$

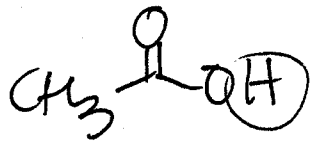
*see table on p. 101

larger pK_a = weaker acid.

($pK_a + pK_b = 14$)

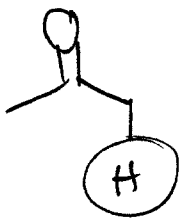
KNOW THESE pKa VALUES:

H_2SO_4 −9

Acetic acid  ~5 (4.75)

H_2O 15.7

Alcohols CH_3CH_2OH 16

Acetone  (the H on the carbon right next to a C=O α-H)

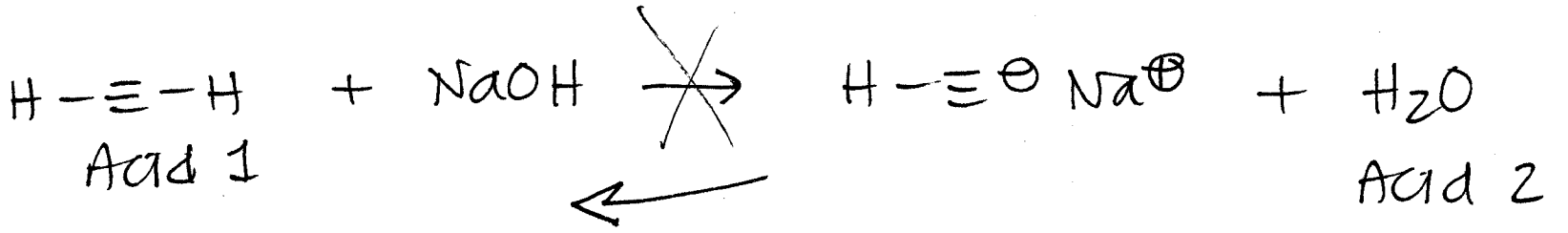
~20

Acetylene $H-\equiv-H$ 25

NH_3 (amines) ~40 (38)

Alkanes CH_3CH_3 ~50

we use these for predicting rxns (among other things).



First, complete the rxn.

Next, identify the two acids.

Then compare the pka values

Acid 1 : pka 25

Acid 2 : pka 15.7

Which is the weaker acid? Acid 1

* Acid - Base equilibria always lie towards the weaker acid + base.