1. loss of two groups
   1.  - on same atom, 1,1- less common
   2.  - on adjacent atoms, 1,2
2. HX 1,2 elimination most common
   1. Three limiting mechanisms
   2. varies with timing of H and X loss
   3. **E1**, X leaves first in RDS, cation forms



* 1. **E2** bimolecular elimination, concerted, H and X leave simultaneously as  bond forms



* 1. **E1cB**, H leaves first in RDS, anion forms



1. **E1** mechanism
   1. first order in substrate, Rate = k[RX]
   2. Favored by weak base and good leaving group, high substitution at leaving group
   3. Follows Zaitsev's (Saytzeff) rule, form most substituted double bond



* 1. Cation is common intermediate – SN1 competes, limits use synthetically
  2. E1 favored over substitution SN1: better base and sterically hindered cation
  3. E1 favored over E2: weak base, polar protic solvents, higher substitution (stable cations)
  4. Rearrangements will also occur

1. **E1cb mechanism**
   1. second-order kinetics, first order in base and in substrate, rate =k[RX][base]
   2. Loss of leaving group is RDS
   3. carbanion prefers stabilizing groups: RCO, CN, NO2, SO2R
   4. poor leaving group also favors E1cb
   5. anti-Zaitsev (Hoffman) elimination without electron withdrawing groups



* 1. elimination of cyanohydrins- microscopic reversibility



1. **E2** elimination
   1. Bimolecular, rate = k[RX][base], SN2 competes
   2. hydrogen isotope effect is 3-8 indicating loss of H in RDS
   3. Strong base and high substitution favors E2 versus SN2
   4. Good leaving group good for E2 and E1.



* 1. Aprotic solvent favors E2 versus E1, why?
  2. Zaitsev elimination- most substituted double bond in transition state



* 1. Conformational preference
     1. anti or syn periplanar maximized orbital overall
     2. Usually from most stable conformation
     3. gauche or eclipsing interactions are minimized
     4. Anti has least steric repulsion, syn occurs if anti is not available





* 1. periplanar elimination allows maximum overlap of newly formed orbitals
  2. in cyclic systems such as cyclohexane, only diaxial substituents are periplanar



* 1. some rings have syn preference, since anti not available (bridgehead?)



* 1. ion pairing can favor syn elimination



1. E2 is often asymmetric, can have E1 or E1cb character
   1. E1 has carbon cation character
      1. follow Zaitsev's rule (most substituted double bond formed) if leaving group is negatively charged
      2. favors stable double bond/carbon cation, leaving group leaves early



* 1. Hofmann's rule if neutral (NR3+ or SR2+) (least substituted double bond formed)
     1. Cation-charge interaction favors carbanion character
     2. Negative charge favored on least substituted carbon, proton leaves early

1. Selective elimination
   1. strong base favors carbanion formation **Elcb**
   2. positive leaving group or very electron-withdrawing groups favor **Elcb**
   3. weak base favors **E1,** strong base **E2** or **E1cb**
   4. ionizing solvents favor **E1** and **E1cb**
2. pyrolytic eliminations
   1. high temperature >200 C yields syn elimination



* 1. unimolecular, appear to be concerted, probably intimate ion chemistry
  2. decarboxylation – why doesn’t a conjugated product form?

1. concerted elimination of HX violates symmetry conservation rules?