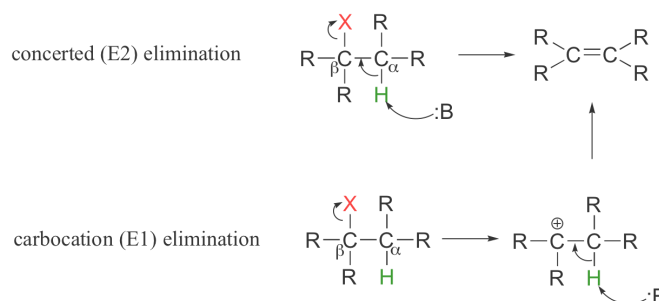


7.18: COMPARISON OF E1 AND E2 REACTIONS

Learning Objective

- distinguish 1st or 2nd order elimination reactions

Elimination reactions of alkyl halides can occur via the bimolecular E2 mechanism or unimolecular E1 mechanism as shown in the diagram below.



COMPARING E1 AND E2 MECHANISMS

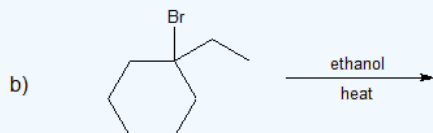
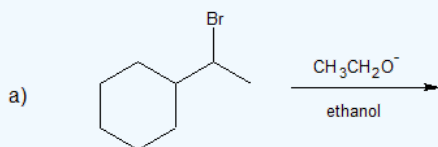
When considering whether an elimination reaction is likely to occur via an E1 or E2 mechanism, we really need to consider three factors:

- The base:** strong bases favor the E2 mechanism, whereas, E1 mechanisms only require a weak base.
- The solvent:** good ionizing solvents (polar protic) favor the E1 mechanism by stabilizing the carbocation intermediate.
- The alkyl halide:** primary alkyl halides have the only structure useful in distinguishing between the E2 and E1 pathways. Since primary carbocations do not form, only the E2 mechanism is possible.

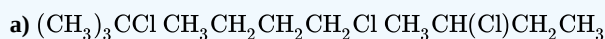
Reaction Parameter	E2	E1
alkyl halide structure	tertiary > secondary > primary	tertiary > secondary >>>> primary
nucleophile	high concentration of a strong base	weak base
mechanism	1-step	2-step
rate limiting step	anti-coplanar bimolecular transition state	carbocation formation
rate law	rate = k[R-X][Base]	rate = k[R-X]
stereochemistry	retained configuration	mixed configuration
solvent	not important	polar protic

Exercises

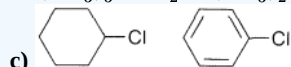
- Predict the dominant elimination mechanism (E1 or E2) for each reaction below. Explain your reasoning.



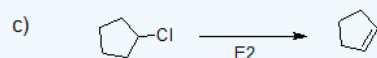
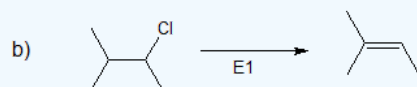
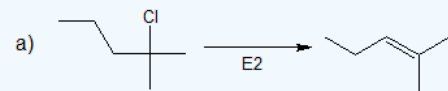
- Which one of the following groups of compounds would eliminate HCl most readily on reaction with potassium hydroxide? Explain your reasoning, draw the bond-line structure and give the IUPAC name of the product.



b) $(\text{CH}_3)_3\text{CCH}_2\text{Cl}$ $(\text{CH}_3)_2\text{CHCH}_2\text{Cl}$

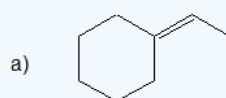


3. Specify the reaction conditions to favor the indicated elimination mechanism.

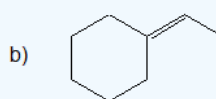


Answer

1.

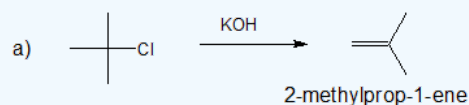


E2 reaction b/c secondary alkyl halide with a strong base.

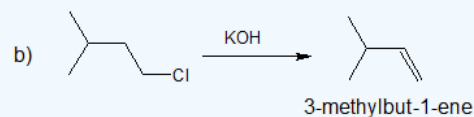


E1 reaction b/c tertiary alkyl halide with a weak base.

2.



t-butyl chloride will react faster b/c it is a tertiary alkyl halide reacting with a strong base via the E2 mechanism.



1-chloro-3-methyl butane will react faster since both reactants are primary alkyl halides and the reaction conditions favor the E2 mechanism, the reactant with less steric hindrance at the beta-hydrogen will react faster.



The alkyl halide b/c aryl halides cannot undergo elimination reactions under these conditions.

3. a) strong base, such as hydroxide, an alkoxide, or equivalent

b) water or alcohol or equivalent weak base with heat

c) strong base, such as hydroxide, an alkoxide, or equivalent

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