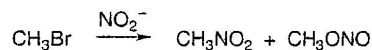


Ambident S_N2 Nucleophiles

Molecules that possess more than one nucleophilic site are referred to as “ambident” nucleophiles. S_N2 reactions involving these nucleophiles may lead to mixtures of products. For example, nucleophilic attack by nitrite on methyl bromide gives both nitromethane and methyl nitrite.



Examine atomic charges and the electrostatic potential map for *nitrite anion*. Which atom(s) is most electron rich? Which product would be obtained if this atom behaved as a nucleophile in its reaction with methyl bromide.

Other possible ambident nucleophiles include *cyanide anion* (CN⁻), *methyl sulfinate anion* (CH₃SO₂⁻), and *acetone enolate* (CH₃COCH₂⁻). Identify the most electron-rich atom(s) in each anion (based on charges alone), and indicate the major product that should result from an S_N2 reaction with methyl bromide at this atom(s).

Another way to assess nucleophilic reactivity is to examine the shape of the nucleophile's electron-donor orbital (this is the highest-occupied molecular orbital or HOMO). Examine the shape of each anion's HOMO. At which atom would an electrophile, like *methyl bromide*, find the best orbital overlap? (Note: This would involve overlap of the the HOMO of the nucleophile and the lowest-unoccupied molecular orbital or LUMO of CH₃Br.) Draw all of the products that might result from an S_N2 reaction with CH₃Br at these atoms.

Can the ambident nucleophilicity of any of these anions be explained solely on electrostatic grounds? Solely on orbital overlap grounds? Explain your reasoning.