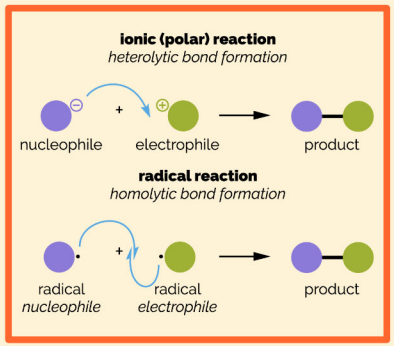
HIGHLIGHTS

- Ionic and radical reactions.
- Curly arrows and curly fishhooks.
- What is a nucleophile and what is an electrophile.
- Guidelines for writing a mechanism.
- Allowable curly reaction arrows
- Common steps within a reaction mechanism.



The order in which bonds are made and broken in a reaction is known as the reaction mechanism and the curly arrow can describe the redistribution of electrons in each of the step or part of the reaction or mechanism. The curly arrow notation is a powerful simplification that rationalizes the movement of electrons to create and break bonds. To be able to accurately draw the curly arrow reaction mechanism, you must identify the bonds that are made and broken. Then you must identify which atoms or bonds are used to create each new bond. These are electron donors or nucleophiles. Nucleophiles attack electron poor atoms, which act as electron acceptors and are called electrophiles. By linking nucleophiles and electrophiles you can start to built a picture of the reaction (and predict what the products might be).

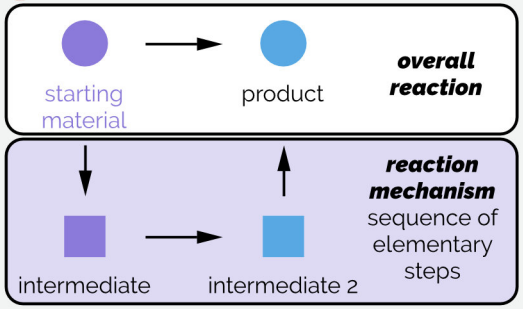
CHEMISTRY CLASSICS

ORGANIC REACTIONS

AN INTRODUCTION TO REACTION MECHANISMS & THE CURLY ARROW

Reactions & the Curly Arrow

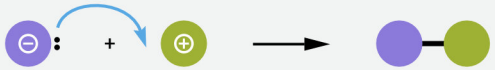
1. Reaction Mechanism



Mechanism describes order bonds made & broken to form product.

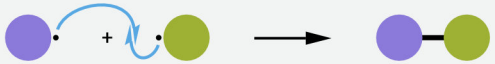
2. Reactions

ionic (polar) reaction - *heterolytic bond formation*



curly arrow - movement of **two electrons**
tail of arrow - where electrons **are**
head of arrow - where electrons **will be**

radical reaction - *homolytic bond formation*

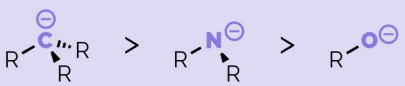


curly fishhook - movement of **one electron**

3. Nucleophiles & Electrophiles

nucleophiles
electron rich - attack electrophiles

charged



nucleophilicity decreases with increasing electronegativity across row

nucleophilicity decreases across row

neutral atoms

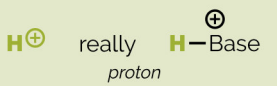
nucleophilicity increases down group

electron donating group increases nucleophilicity

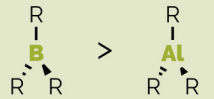
M less electronegative than C
more polarized more nucleophilic

bonds

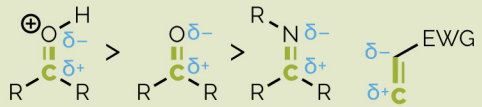
electrophiles
electron poor - attacked by nucleophiles



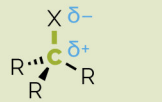
electron donating groups or delocalization reduces electrophilicity



electron withdrawing groups increase electrophilicity



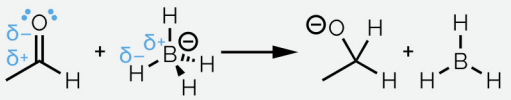
increased polarization = increased electrophilicity



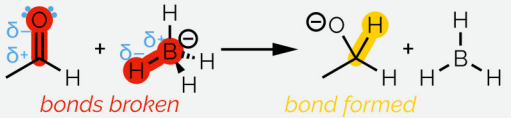
X more electronegative than C
more polarized more electrophilic

4. Writing a mechanism

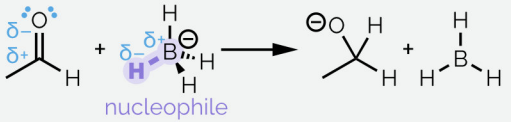
1. **Draw the reactants in full**
include lone pairs & polarization



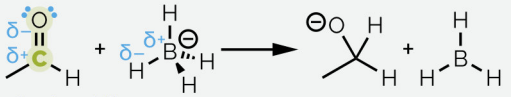
2. **Identify the bonds made & broken**



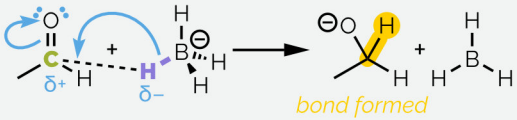
3. **Identify the nucleophile**
molecule then atom/bond - will be part of new bond



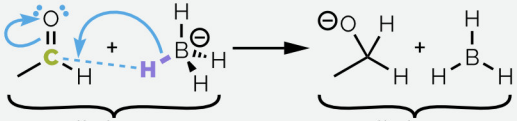
4. **Identify the electrophile**
molecule then atom - will be part of new bond



5. **Curly arrow**
must start from lone pair or bond
must end as bond or on atom

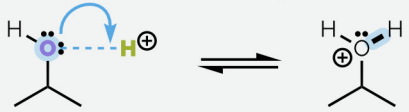


6. **Overall charge will remain constant**

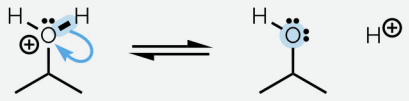


5. Curly arrows

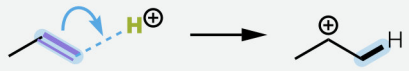
1. **Lone pair to bond curly arrow**



2. **Bond to lone pair curly arrow**

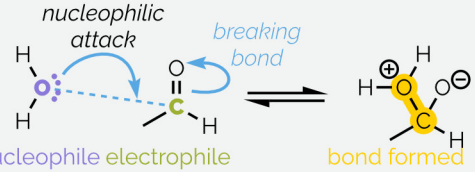


3. **Bond to bond curly arrow**

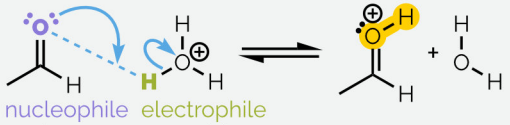


6. Common Patterns

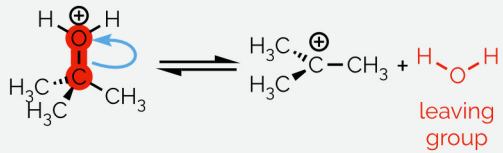
1. **Nucleophilic attack**



2. **Proton transfer**



3. **Loss of a leaving group**



Patterns 1 & 3 combine in substitution