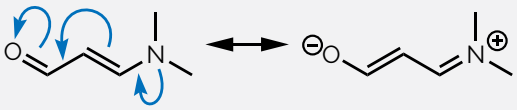
Resonance & the curly arrow

1. Introduction



Resonance structures show different snapshots of the same molecule. They differ by the redistribution of π electrons and lone pairs. The easiest way to predict each resonance structure is by using curly arrows to move⊛ the electrons around the drawings.

2. The curly arrow

A curly arrow shows the movement of two electrons, either a lone pair or a bond. The ***tail*** indicates which electrons will be moved. The ***head*** shows where they will be drawn in the subsequent representation.

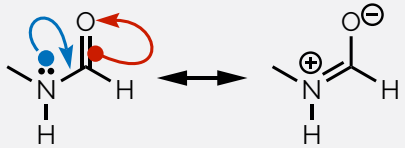
3. Uses

The curly arrow is the organic chemists best friend. In resonance they are used to connect allowable Lewis structures. While we use the term '*moving electrons*', it is misleading as we are just looking at the differences between drawings.

When we discuss ***reactions*** then electrons will be moving. The rules will be very similar but the outcome very different!

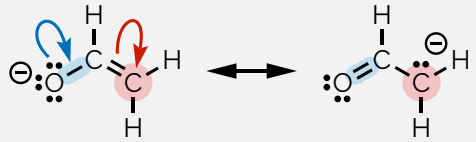
Rules for *resonance* curly arrows

i. A curly arrow must start with two electrons - *either bond or lone pair*



- start from lone pair
- start from π bond

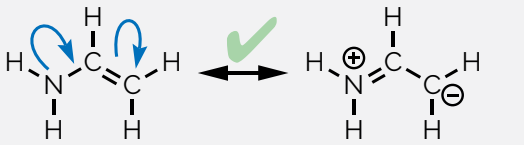
ii. A curly arrow must end on a bond or an atom - *be precise, vague arrows lead to confusion*



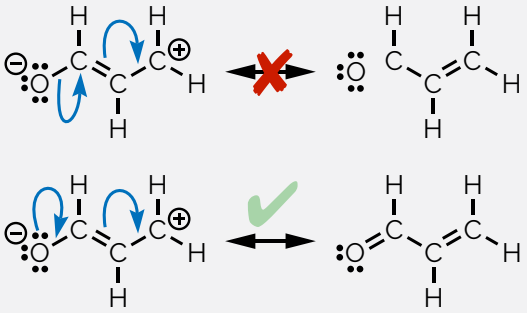
head points to bond
head points to atom

iii. You cannot exceed the octet rule - *atoms can have less but not more*

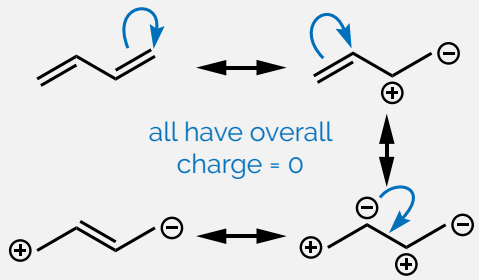
5 bonds
10 valence electrons



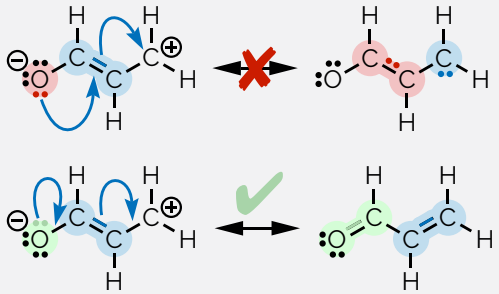
iv. You cannot break σ bonds - *resonance involves π bonds (& lone pairs) only*



v. The charge must remain constant - *all resonance structures must have the same charge as only redistributing electrons*



vi. You cannot skip an atom - *electrons always remain associated with one atom from original drawing*



Allowable curly arrows

Type 1. Bond to lone pair

Type 2. Lone pair to bond

Type 3. Bond to bond

⊛**Electrons are not moving from bond to bond, and we shouldn't use this word! They are delocalised. The real structure is the resonance hybrid. Each resonance structure contributes to the real molecule.**