

## Organic Reaction Types

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### Organic reactions can be classified based on:

- Net Result
  - Substitution
  - Addition
  - Elimination
  - Rearrangement
  - Acid-Base
- Mechanism
  - Polar
  - Radical
- Oxidation State Changes
  - Oxidation-Reduction
  - Non-Oxidation-Reduction

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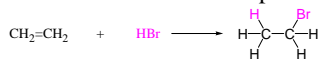
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### Reaction Types by Net Result - I

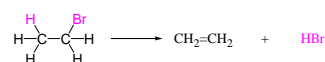
- Substitution: One group replaces another



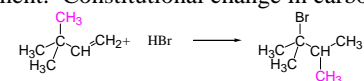
- Addition: A molecule adds across a pi bond



- Elimination: One molecule is lost to give a pi bond



- Rearrangement: Constitutional change in carbon skeleton




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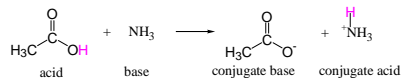
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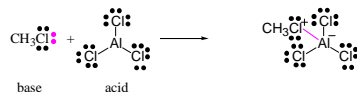
## Reaction Types by Net Result - II

### • Acid-Base Reactions

– Bronsted definition: transfer of  $H^+$  from acid to base



– Lewis definition: transfer of electron pair from base to acid




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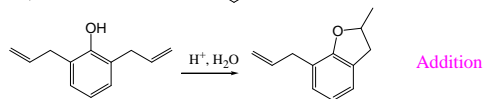
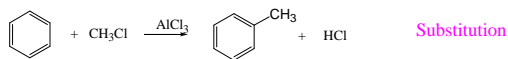
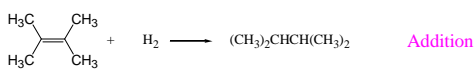
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### Problem: Classify the Following Reactions




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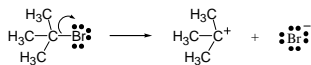
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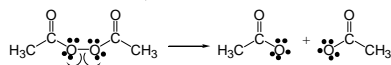
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## Reaction Type by Mechanism

• Polar Reactions: Involve heterolytic bond cleavage (heterolytic – uneven break: all electrons go to one atom)



• Radical Reactions: Involve homolytic bond cleavage (homolytic – even break: one electron goes to each atom)




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## A Note on Reaction Mechanism

- Curved arrows are used to show where **ELECTRONS** go in reactions
- Double-headed arrows show movement of electron pairs
- Single-headed arrows show movement of single electrons

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## Problem

- Use arrows to demonstrate the heterolytic bond cleavage of the polar bond in 2-iodopropane



- Use arrows to demonstrate the homolytic bond cleavage of a bromine molecule



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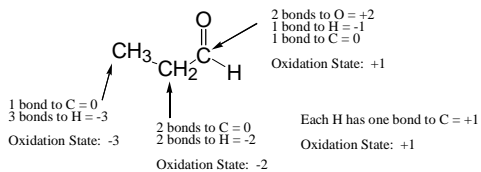
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## Oxidation States

- Carbon oxidation states are assigned on the basis of the electronegativity of attached atoms
  - For each bond to a more electronegative atom give +1
  - For each bond to a less electronegative atom (even H) give -1
  - For each bond to carbon give 0



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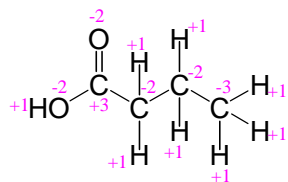
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## Problem

- Assign oxidation states to all atoms in the following structure




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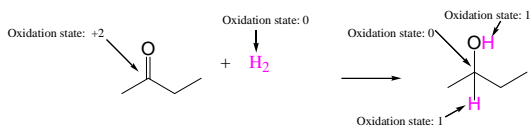
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## Reaction Types Based on Oxidation State

- Oxidation:Reduction reactions involve changes in oxidation state at one or more atoms
  - If the oxidation state increases: oxidation
  - If the oxidation state decreases: reduction




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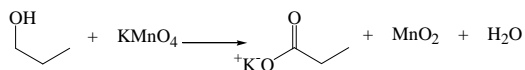
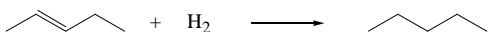
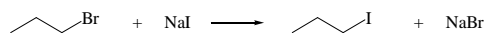
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## Problem

- Identify if the following reactions are oxidation-reduction reactions
- For any that are, identify the atoms that are oxidized and reduced




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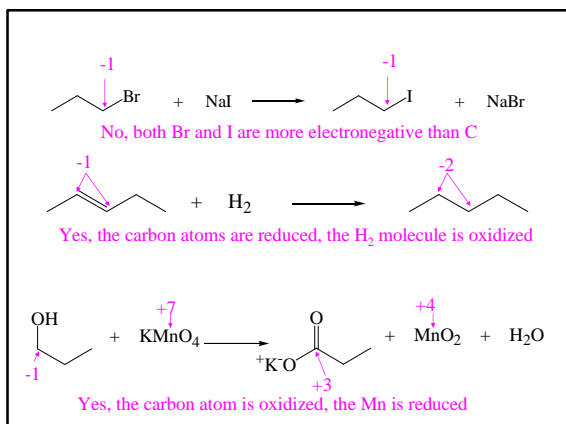
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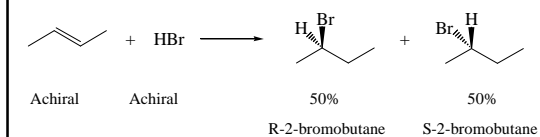
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## Reaction Stereochemistry - I

- Principle 1: If a reaction producing a chiral molecule involves only achiral reactants, all stereoisomers will be produced in equal amounts (racemic mixture is generated)




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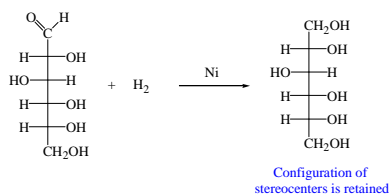
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## Reaction Stereochemistry - II

- Principle 2: If a reaction producing a chiral molecule starts from chiral reactants, some stereoisomers may be formed preferentially




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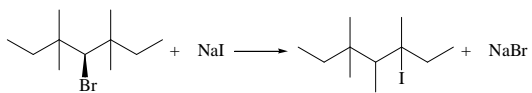
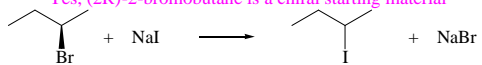
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## Problem

- Is it possible for the following reactions to give optically active products?

Yes, (2R)-2-bromobutane is a chiral starting material



No, 4-bromo-3,3,5,5-tetramethylheptane is achiral

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