

Take notes while watching the following video tutorials to prepare for the "Reactions of Functional Groups Part 1 Activity".

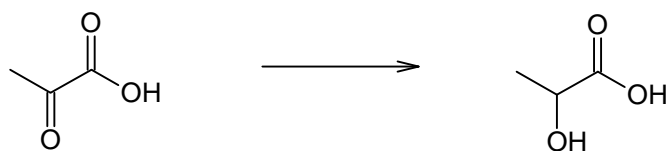
## Reactions of Organic Functional Groups Part 1: Intro & Acid-Base Review

Each functional group has unique chemical reactivity.

Biological molecules can become very large – remember to focus on the functional groups.

Most reactions only affect one functional group of a reactant at a time.  
Recognize the functional groups and look for changes to understand chemical reactivity.

Circle the functional group that changes in the reaction below.



Almost ALL biochemical reactions are catalyzed by enzymes.

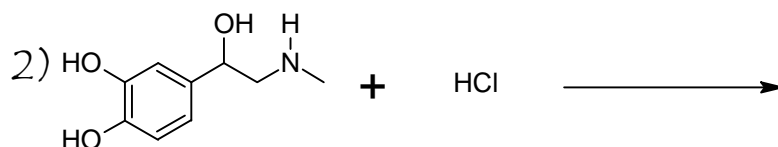
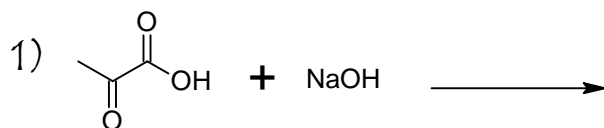
What are catalysts?

Why do our bodies need enzymes?

Draw the Reaction Energy Diagram for a 1-step, exothermic rxn with a large activation energy. Overlay another curve showing the rxn with a catalyst.

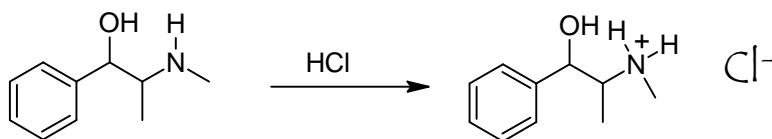
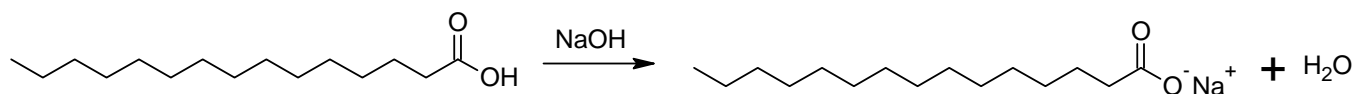
Acid-Base reactions are the most fundamental & frequent biochemical rxn.

Complete the acid-base reactions below.



Solubility and Acid-Base Chemistry

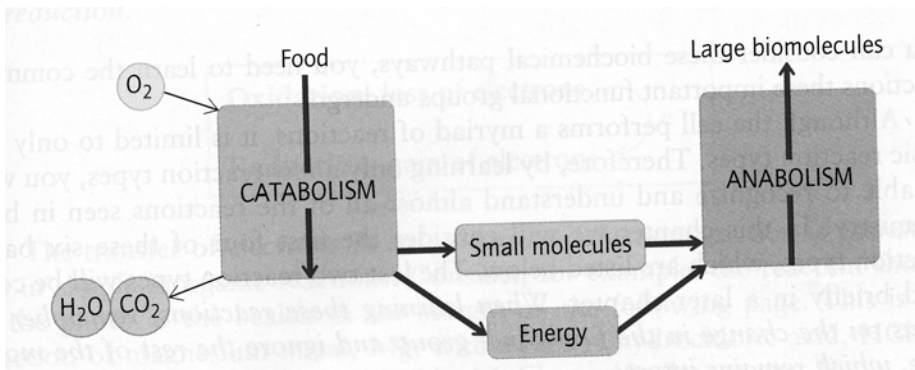
Classify each functional group and predict water solubility for the reactants and products below.



Acid Base Reactions have very low activation energies.

Other Biochemical Reactions have larger activation energies.

Metabolism:



We will study 4 of the biochemical reactions that require catalysts:

- 1) oxidation-reduction
- 2) hydration-dehydration
- 3) acyl group transfer
- 4) phosphoryl group transfer

## Reactions of Organic Functional Groups Part 2: Redox Introduction

(Oxidation & Reduction)

### Oxidation & Reduction Reactions of Inorganic Molecules

#### Guidelines for Assigning Oxidation Numbers

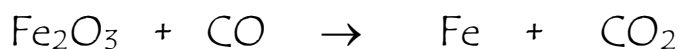
Oxidation numbers are a way to keep track of electron flow in reactions.

The oxidation number is the charge an atom in a compound would have if the electron pairs in each covalent bond "belonged" to the more electronegative atom.

|                          | Oxidation Number                             | Examples  | Exceptions                         |
|--------------------------|--|---|------------------------------------|
| Pure elements            | 0  | The oxidation numbers for each atom in Fe(s) or O <sub>2</sub> is zero. | none                               |
| Fixed charge metals      | The oxidation number is equal to its charge. | Alkali metals → +1<br>Alkaline earth metals → +2<br>Aluminum → +3       | none                               |
| F in compounds           | -1   | F in CaF <sub>2</sub> is -1.<br>F in CF <sub>4</sub> is -1.             | none                               |
| Cl, Br, & I in compounds | -1 if bonded to a less electronegative atom  | Cl is +1 when bonded with F.<br>Cl is -1 when bonded with Br.           | none                               |
| O in compounds           | -2   | O in MgO is -2.<br>O in H <sub>2</sub> O is -2.                         | O is -1 in peroxides.              |
| H in compounds           | +1   | H in H <sub>2</sub> O is +1.  | H is -1 when combined with metals. |

## Practice recognizing Redox Rxns

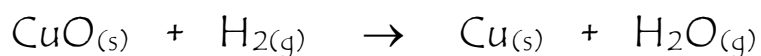
Balance the following reaction & assign oxidation numbers to each atom.



a) Which element is oxidized?

b) Which element is reduced?

Assign oxidation numbers to each atom in the following reaction.



Writing the Oxidation  $\frac{1}{2}$  rxn

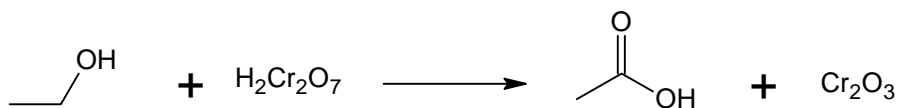
Writing the Reduction  $\frac{1}{2}$  rxn

## Oxidation & Reduction of Organic Molecules

Oxidation: Gain bonds to Oxygen  
Lose bonds to Hydrogen

Reduction: Lose bonds to Oxygen  
Gain bonds to Hydrogen

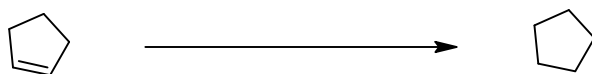
Example – Breathalyzer Test (Organic and Inorganic Redox Combined)



Treatment of  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$  with a reducing agent will produce

- A) an aldehyde.
- B) a carboxylic acid.
- C) an alcohol.
- D) an alkene.
- E) a ketone.

Classify the following reactions as oxidation or reduction.

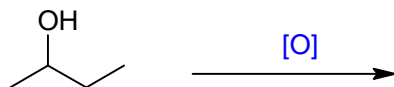
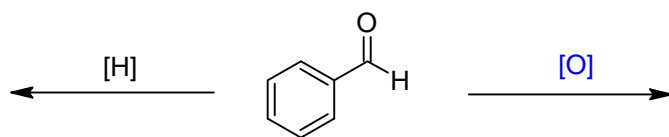


For the reactions below,

a) Predict the products for the reactions below.

Remember: benzene rings are very stable so they will not react.

b) Classify each function group. For alcohols, remember to indicate 1°, 2°, or 3°.

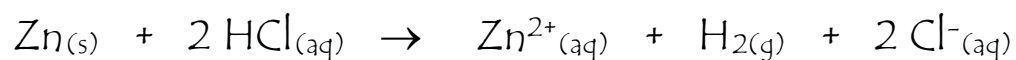




Oxidizing Agents: reactant that gets reduced

Reducing Agents: reactant that gets oxidized

For the following reaction



a) Write the oxidation half reaction.

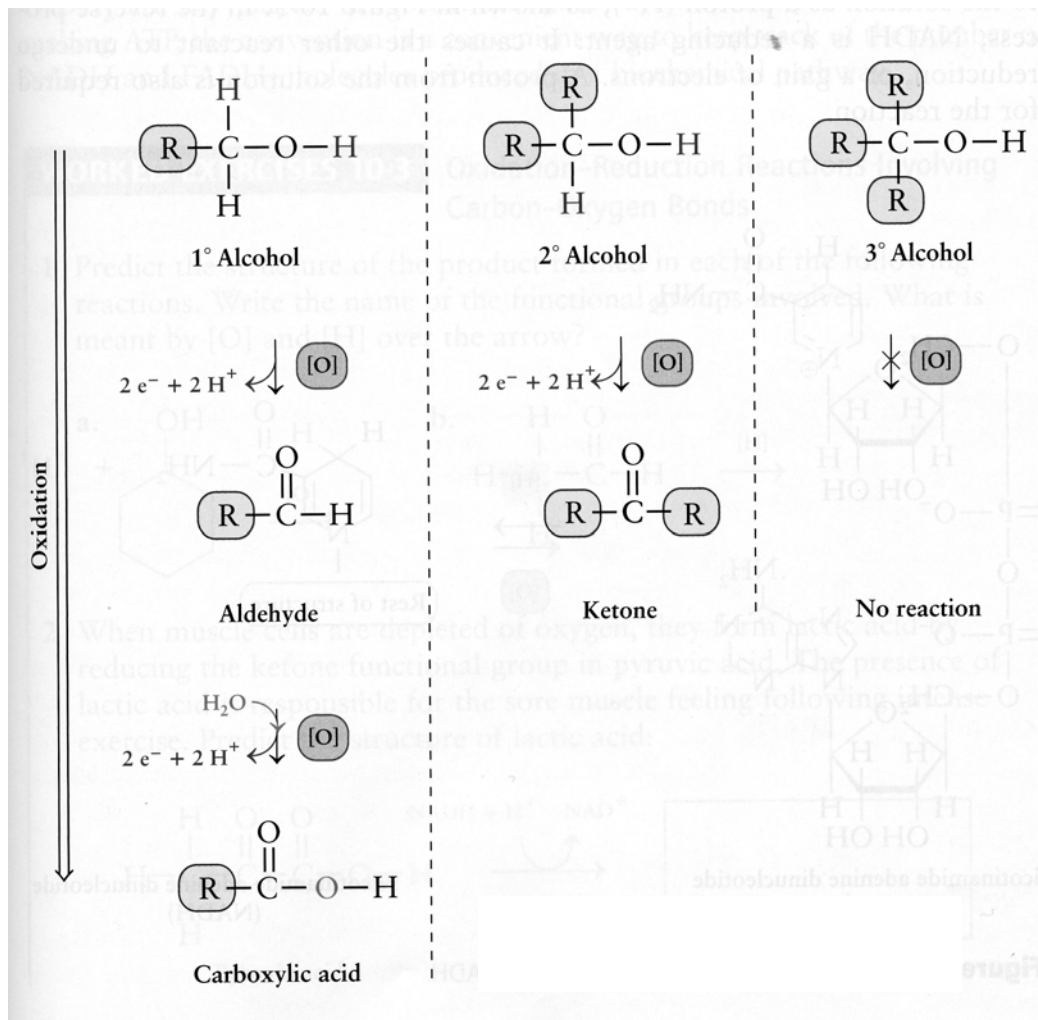
b) Write the reduction half reaction.

c) Which reactant is the oxidizing agent?

d) Which reactant is the reducing agent?

## Reactions of Organic Functional Groups Part 3: Redox of ROH & Carbonyls

### Oxidation of Alcohols

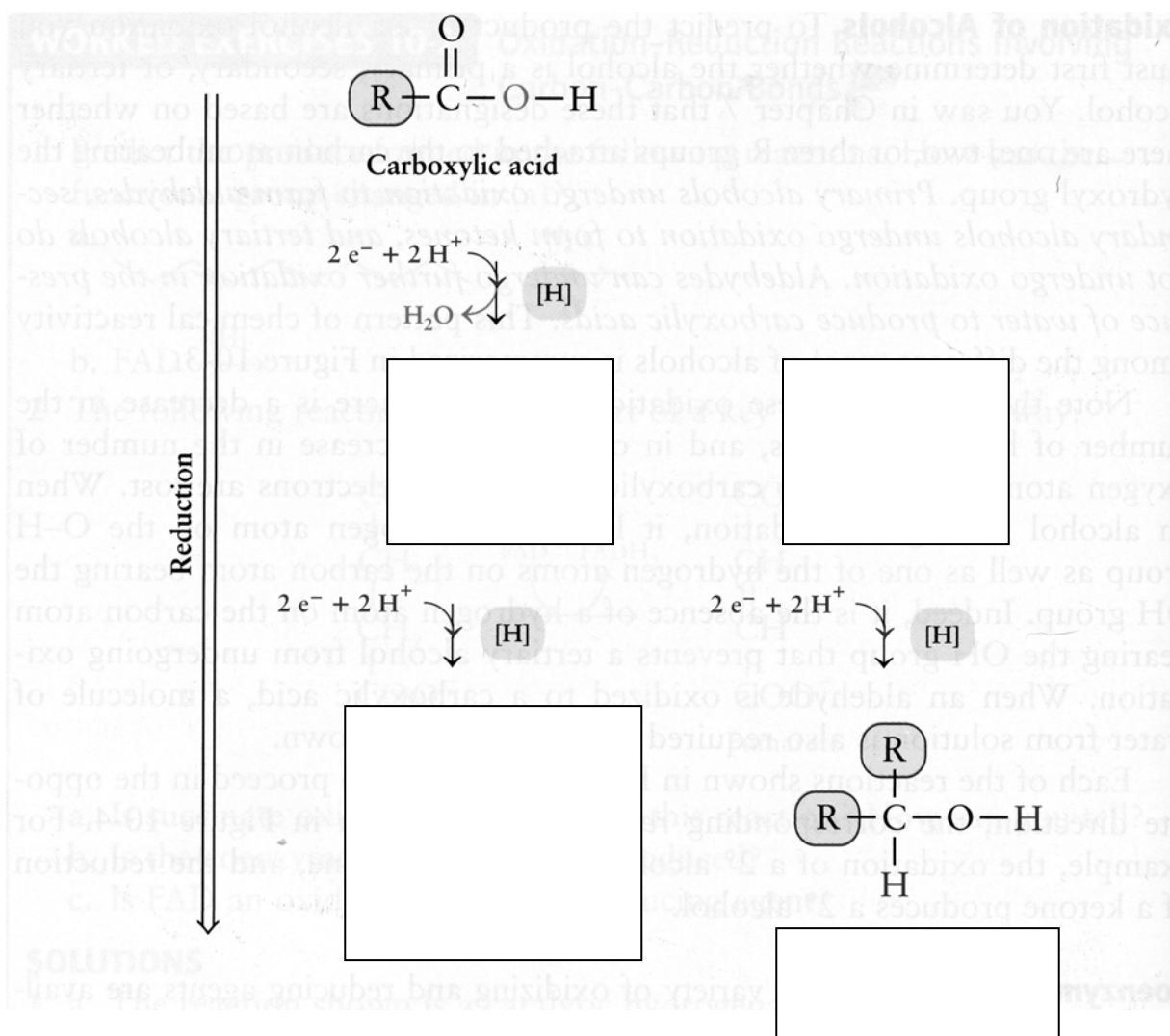


Ethanol Metabolism – The oxidation of a 1° alcohol

## Reduction of Carbonyl Groups

Use your knowledge of oxidation reactions to complete the reduction pathways in the following diagram.

Classify the functional groups (aldehydes, ketones or alcohols) – for the alcohols indicate whether they are 1°, 2°, 3°.



In biochemical reactions, reduction of carbonyl groups is carried out by  $NAD^+$  or  $NADH$ ?

Antioxidants

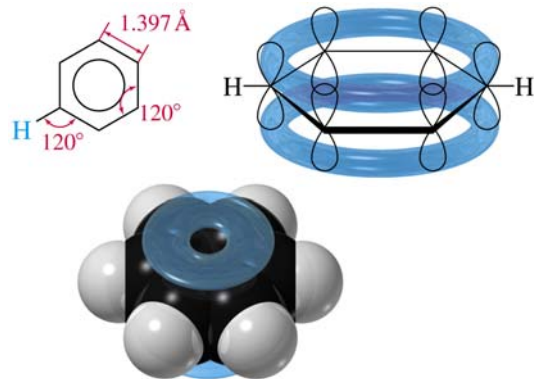
Not ALL Oxidation is Beneficial.

Oxidation reactions form Free Radicals.

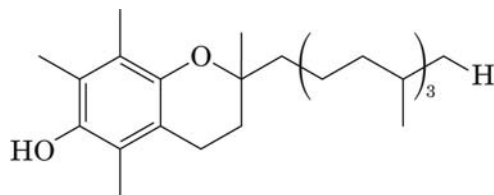
Antioxidants are substances that trap the odd valence electron to prevent it from causing damage to our biomolecules.

Oxidation from Free Radicals is linked with biological aging.

Many antioxidants trap the unpaired electron in an aromatic benzene ring.



Vitamin E is an antioxidant.



Vitamin E

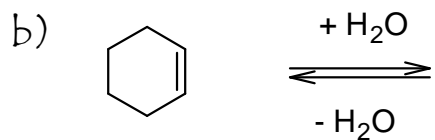
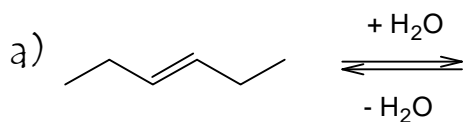
# Reactions of Organic Functional Groups Part 4: Hydration-Dehydration

## Hydration-Dehydration Reactions

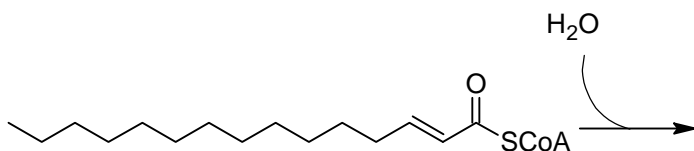
Hydration of Alkenes Produces Alcohols

Dehydration of Alcohols Produces Alkenes

Practice reactions.



c) step 2 in the break down of fatty acids



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