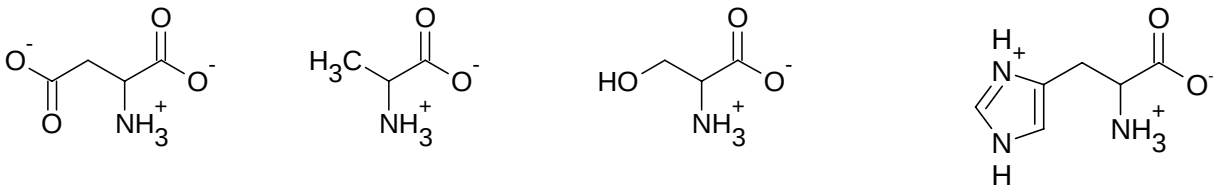
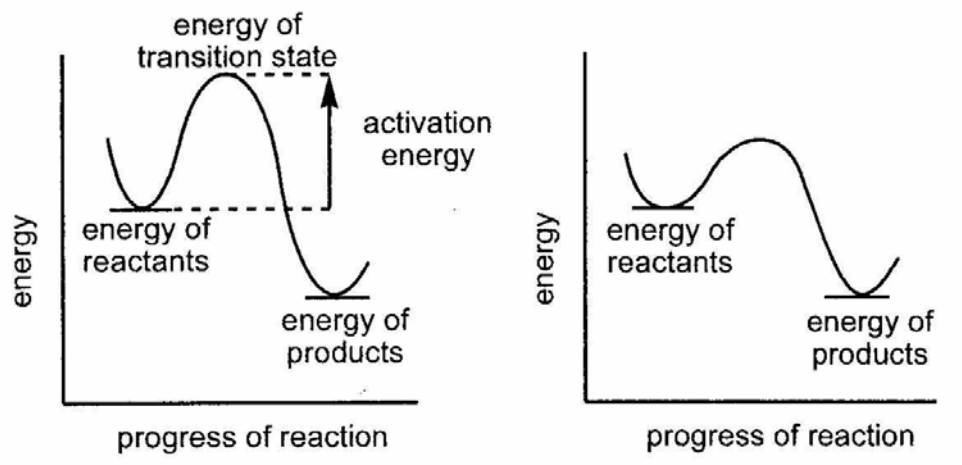
Enzymes Introduction – Lecture Handout
Chem 306

1. Classify the side chains as hydrophobic, polar, acidic or basic.



If the first amino acid is part of a substrate, hypothesize which of the other three amino acid residues might be present in the active site of an enzyme.

2. Review - Energy diagrams – comparing uncatalyzed and catalyzed reactions



Are these reactions endergonic or exergonic?

Identify which reaction is catalyzed. How could you tell?

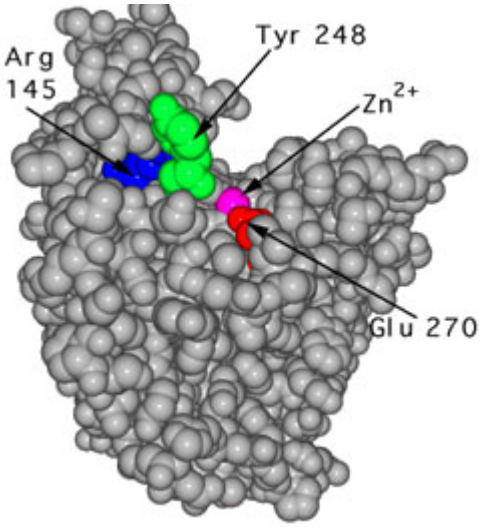
Draw in a vertical arrow to represent the magnitude of the Ea in the catalyzed reaction.

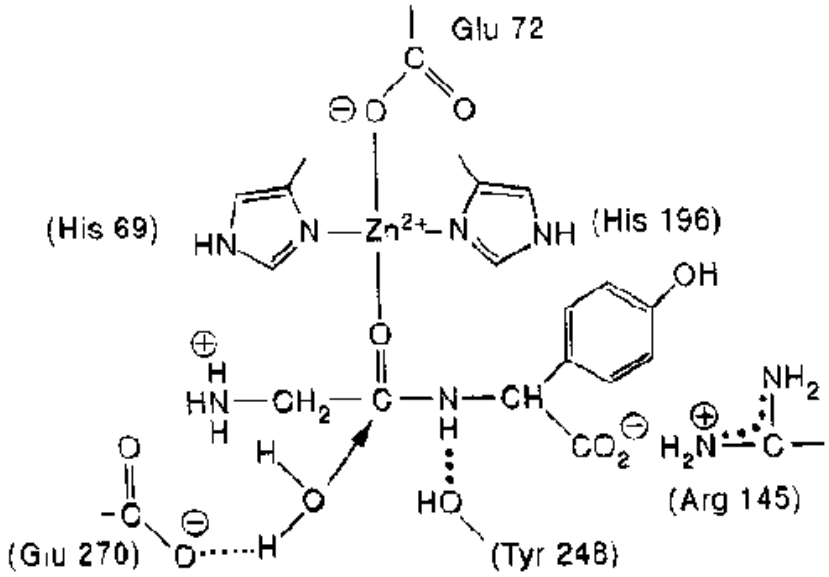
Does the enzyme change the energies of the reactants or products?

Does an enzyme change the equilibrium amounts of reactants and products? Explain.

3. Example of a metal ion cofactor - Zn^{2+}

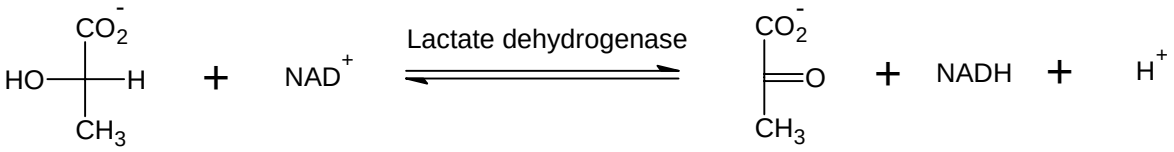
Carboxypetptidase is an enzyme that requires a Zn^{2+} ion as a cofactor. This enzyme hydrolyzes the first amide bond at the C-terminal end of peptides. Carboxypeptidase is synthesized in the pancreas and secreted in the small intestine.



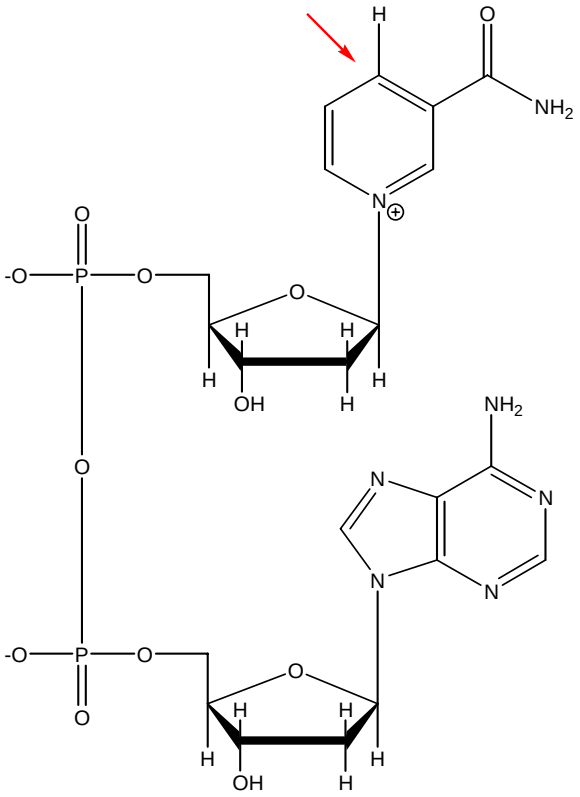


4. Example of a coenzyme – NAD^+

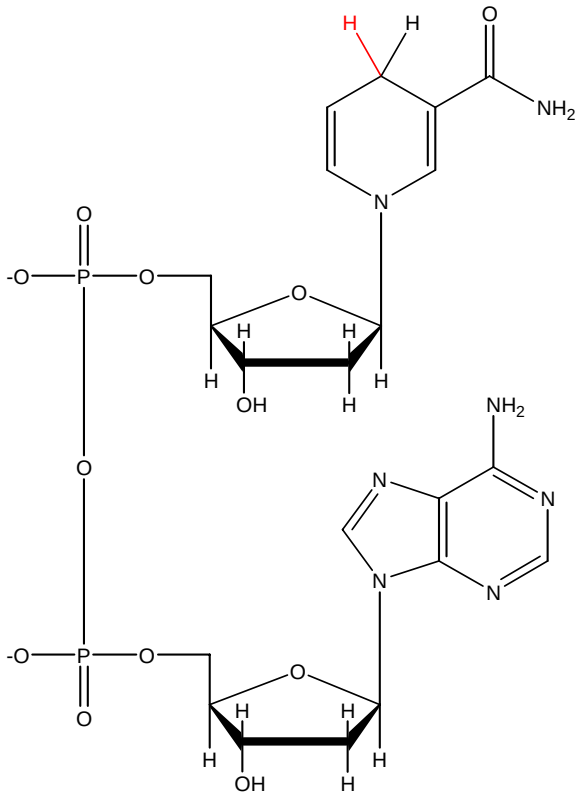
Lactate dehydrogenase is an enzyme that requires the coenzyme NAD^+ /NADH for enzymatic function. Which species has been reduced? Which species has been oxidized?



Structure of NAD+ and NADH



NAD+
Nicotinamide adenine dinucleotide



NADH
Nicotinamide adenine dinucleotide

Identify any functional groups and/or structures discussed this semester.

5. There are into six main types of reactions catalyzed by enzymes which translates into six main classes of enzymes

    1. Oxidoreductase: redox reactions

    2. Transferase: transfer functional groups

    3. Hydrolase: hydrolysis reactions

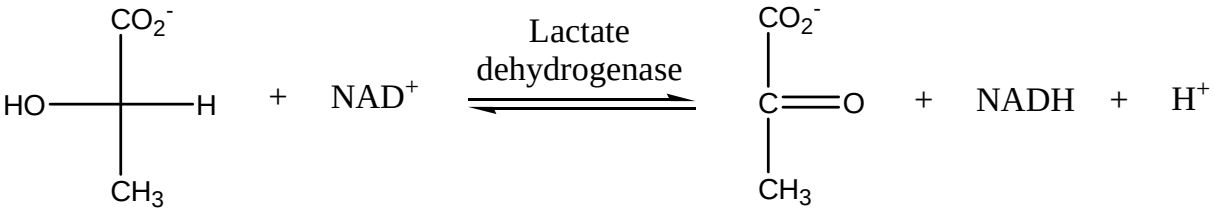
    4. Lyase: addition and elimination reactions

    5. Isomerase: isomerization reaction

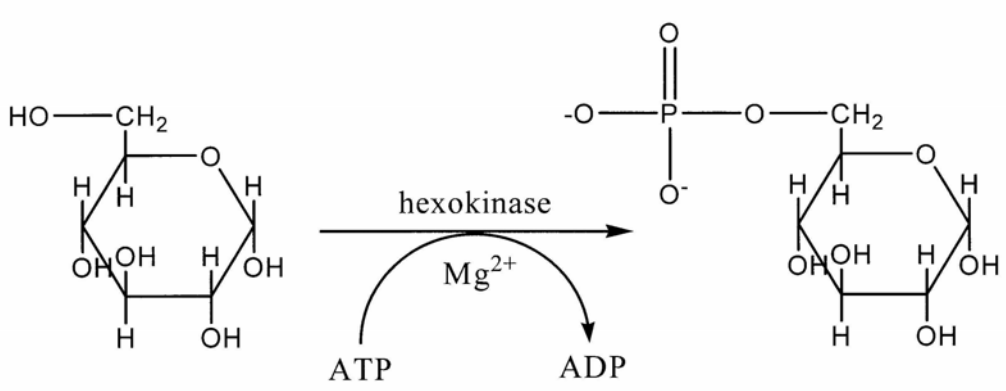
    6. Ligase: bond formation coupled with ATP

A. 6 Main Classes of Enzymes – A closer look

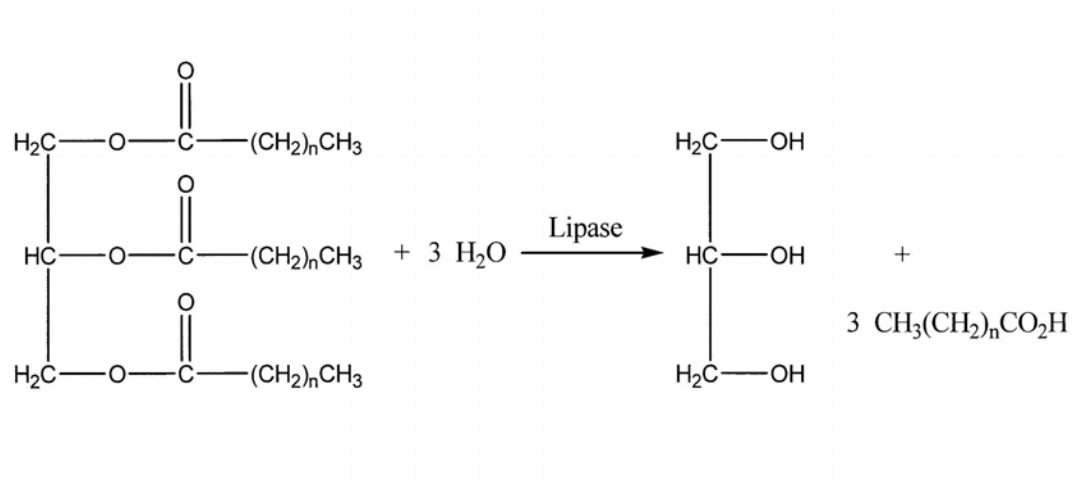
1. Oxidoreductases – require coenzyme



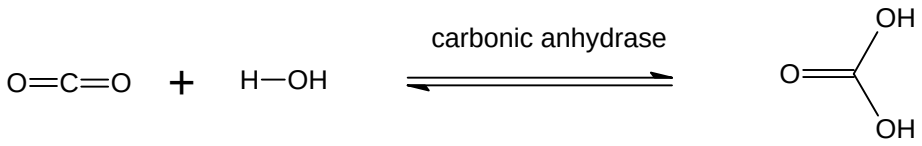
2. Transferases – kinase applies to enzymes that transfer terminal phosphate group



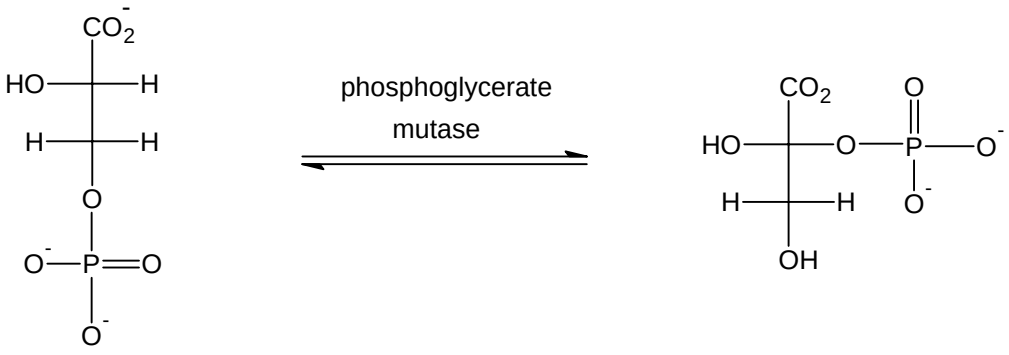
3. Hydrolyases – important in the digestive process



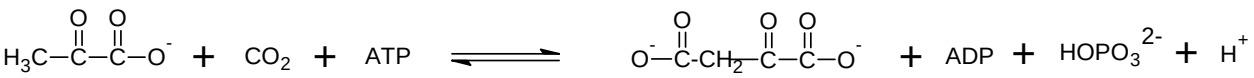
4. Lyases – catalyze the addition of groups such as H_2O, CO_2, or NH_3 to a double bond or reverse reaction in which the group is eliminated to create a double bond



5. Isomerases – rearranges functional groups within a molecule



6. Ligases – requires ATP-ADP conversion to supply energy



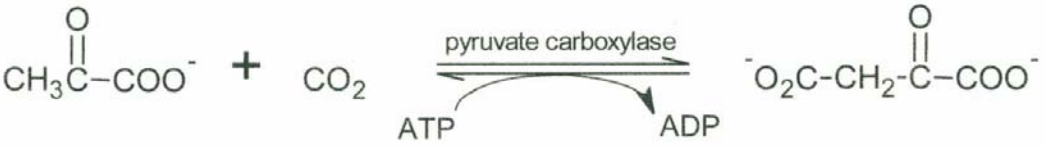
Which of the six classes of enzymes catalyze each of the following reactions?

a.

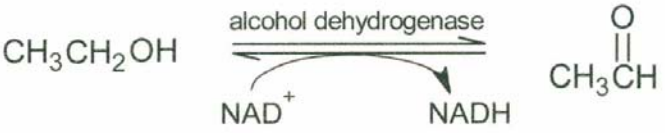
b.

c.

d.



e.



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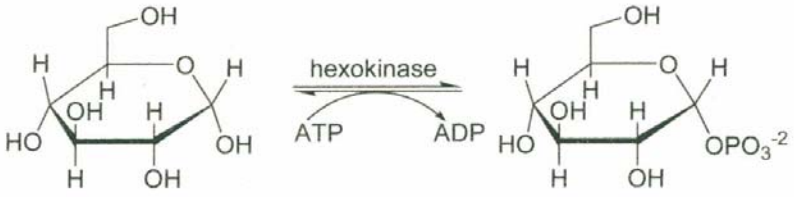


7. Subclasses & Types of Reactions

Oxidoreductases

- **Oxidase** Oxidation of a substrate
- **Reductase** Reduction of a substrate
- **Dehydrogenase:** Introduction of a double bond (C-C or C-O

Transferases

- **Transaminase** Transfer amino groups
- **Kinase** Transfers a phosphate group

Hydrolyases

- **Lipase** Hydrolyzes ester groups of lipids
- **Protease** Hydrolyzes amide bonds of proteins
- **Nuclease** Hydrolyzes phosphate esters in nucleic acids

Lyases

- **Dehydrase** Loss of water from a substrate
- **Decarboxylase** Loss of carbon dioxide from a substrate

Isomerases

- **Epimerase** Isomerization of a chiral carboncenter

Ligases

- **Synthetase** Formation of a new C-C bond from two substrates
- **Carboxylase** Formation of a new C-C bond w/ carbon dioxide.

8. Naming Enzymes

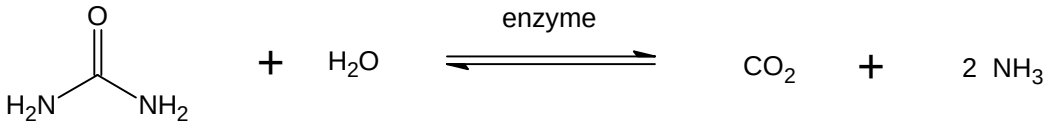
A. Common Names

- derived from the name of the substrate
- derived from the reactions they catalyze
- historical names

B. Systematic Names

- unambiguous – often very long
- specifies substrate, functional group & type of reaction
- names end in -ase

Example:



Name the missing enzymes.