Objective 2: Understand organic hydrogenation reactions, oxidation-reduction reactions, and reactions that produce esters and amides.

1. a. An acid reacts with an alcohol to produce an ester and water.



Circle each functional group. Write the name of the functional group next to your circle. Box the bond that breaks in each reactant. Triangle the bond that forms in each reactant. b. An acid reacts with an amine to produce an amide and water.



Circle each functional group. Write the name of the functional group next to your circle. Box the bond that breaks in each reactant. Triangle the bond that forms in each reactant. c. Compare these two reactions. How are these two reactions similar?

- 2. An alcohol is classified as 1°, 2°, or 3°.
- a. Identify each alcohol as 1°, 2°, or 3°.





geosmin - the smell of plowed earth

button mushroom flavor



ОН

cucumber odor from violet leaves

b. A 1<sup>°</sup> alcohol is oxidized to an aldehyde which is further oxidized to an acid. A 2<sup>°</sup> alcohol is oxidized to a ketone. A 3<sup>°</sup> alcohol does not undergo oxidation. Common oxidizing agents are  $H_2O_2$  (hydrogen peroxide), NaClO (bleach), KMnO<sub>4</sub>, and K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>. Each alcohol from part a is treated with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>. Draw the structure of the product of each reaction.

3. An alkene undergoes hydrogenation to form an alkane. For example, propene  $(C_3H_6)$  reacts with H<sub>2</sub> gas in the presence of a Pd catalyst to form propane.

+ H<sub>2</sub>(g)  $\longrightarrow$ 

propene

propane

a. Circle the carbons in propene at which each H in  $H_2$  reacts.

b. Which compounds in Question 2a are alkenes?

c. Which alkenes in Question 2a are trans alkenes?

d. Each alkene compound in Question 2a reacts with  $H_2$  gas in the presence of a Pd catalyst. Draw the structure of the product of each reaction.

e. Fat tastes good. Most people like to spread a solid fat on their toast rather than a liquid fat so the food processing industry will partially hydrogenate a liquid polyunsaturated fat to a solid monounsaturated fat. The reaction below shows a polyunsaturated fat being converted to a monounsaturated fat (see <a href="https://en.wikipedia.org/wiki/Trans\_fat">https://en.wikipedia.org/wiki/Trans\_fat</a>).



How many moles of  $H_2$  are needed in this reaction? Give reasons. Circle the alkene that turned into a trans fat.

4. Draw the structure of the product of each reaction. Which reaction represents two amino acids forming a dipeptide? The last reaction shows how nylon is made.

