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

Quiz Practice problems: Key ideas:

Skills:

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?

d. The ester that forms when iso-amyl alcohol reacts with **acetic** acid smells like banana. Draw the Lewis structure of the ester that forms when iso-amyl alcohol reacts with **salicylic** acid. Will this ester also smell like banana? Give reasons. Answers:







c. These reactions are condensation reactions - water is a product.

These reactions are like a double replacement reaction (AB + CD --> AC + BD) from Chem 1A.

In the 1st reaction, the OH in the acid combines with the H in the alcohol to form water; the rest of the alcohol combines with the rest of the acid to form the ester product.

In the 2nd reaction, the OH in the acid combines with the H in the amine to form water; the rest of the amine combines with the rest of the acid to form the amide product.

d. Alcohol group in iso-amyl alcohol reacts with acid group in salicylic acid to form an ester. This ester will not smell like banana because the structure is different than isoamyl acetate, which smells like banana.



2. An alcohol is classified as 1° , 2° , or 3° . 1° alcohol = 0 or 1 carbon bonded to the C bonded to the O. 2° alcohol = 2 carbons bonded to the C bonded to the O. 3° alcohol = 3 carbons bonded to the C bonded to the O. a. Identify each alcohol as 1° , 2° , or 3° . State the number of carbons bonded to the C bonded to the O.







geosmin - the smell of plowed earth button mushroom flavor

cucumber odor from violet leaves



b. A 1° alcohol is oxidized to an aldehyde which is further oxidized to an acid. A 2° alcohol is oxidized to a ketone. A 3° alcohol does not undergo oxidation. Common oxidizing agents are H_2O_2 (hydrogen peroxide), NaClO (bleach), KMnO₄, and K₂Cr₂O₇. Each alcohol from part a is treated with K₂Cr₂O₇. Draw the structure of the product of each reaction. Answers:

a. geosmin = 3° alcohol, 3 carbons bonded to C bonded to O button mushroom = 2° alcohol, 2 carbons bonded to C bonded to O cucumber odor = 1° alcohol, 1 carbons bonded to C bonded to O cyclohexanol = 2° alcohol, 2 carbons bonded to C bonded to O tert-butanol = 3° alcohol, 3 carbons bonded to C bonded to O b.



3. An alkene undergoes hydrogenation to form an alkane. For example, propene (C_3H_6) reacts with H₂ gas in the presence of a Pd catalyst to form propane.

 \rightarrow + H₂ (g) \rightarrow

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 https://en.wikipedia.org/wiki/Trans_fat).



(i) How many moles of H_2 are needed in this reaction? Give reasons.

(ii) Circle the alkene that turned into a trans fat.

Answers:



b. Button mushroom flavor and cucumber odor are alkenes. See C=C bonds.
c. The C=C bond on the right side of cucumber odor is a trans alkene.
The C=C bond on the left side of cucumber odor is a cis alkene.
d.



e. (i)There are 4 C=C bonds so 4 moles of H_2 are needed. But 3 C=C bonds were converted to saturated C-C bonds and 1 C=C bond switched from the cis isomer to trans isomer.



4. We've looked at 4 types of organic reactions:

Hydrogenation: alkene + H₂ --> alkane

Oxidation: 1° ROH ---> RCHO or RCOOH, 2° ROH ---> RCOR, 3° ROH does not undergo oxidation.

Acid + alcohol ---> ester + water

Acid + amine ---> amide + water

Identify the functional group(s) in each reactant. Then, determine which reaction type occurs.

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.



Answers:

