

Concept Review

Chapter 12

Summary of Terms

Addition polymer A polymer formed by the joining together of monomer units with no atoms being lost as the polymer forms.

Alcohol An organic molecule that contains a hydroxyl group bonded to a saturated carbon.

Aldehyde An organic molecule containing a carbonyl group, the carbon of which is bonded either to one carbon atom and one hydrogen atom or to two hydrogen atoms.

Alkane A generic word for a saturated hydrocarbon.

Alkene An unsaturated hydrocarbon containing one or more double bonds.

Alkyne An unsaturated hydrocarbons containing a triple bond.

Amide An organic molecule containing a carbonyl group, the carbon of which is bonded to a nitrogen atom.

Amine An organic molecule containing a nitrogen atom bonded to one or more saturated carbon atoms.

Aromatic Said of any organic molecule containing a benzene ring.

Carbonyl group A carbon atom double-bonded to an oxygen atom; found in ketones, aldehydes, amides, carboxylic acids, and esters.

Carboxylic acid An organic molecule containing a carbonyl group, the carbon of which is bonded to a hydroxyl group.

Condensation polymer A polymer formed by the joining together of monomer units accompanied by the loss of small molecules, such as water.

Configuration A term used to describe how the atoms within a molecule are connected. For example, two structural isomers will consist of the same number and same kinds of atoms, but in different configurations.

Conformation One of a wide range of possible spatial orientations of a particular configuration.

Ester An organic molecule containing a carbonyl group, the carbon of which is bonded to one carbon atom and one oxygen atom bonded to another carbon atom.

Ether An organic molecule containing an oxygen atom bonded to two carbon atoms.

Functional group A specific combination of atoms that behaves as a unit in an organic molecule.

Heteroatom Any atom other than carbon or hydrogen in an organic molecule.

Hydrocarbon An organic compound containing only carbon and hydrogen atoms.

Ketone An organic molecule containing a carbonyl group, the carbon of which is bonded to two carbon atoms.

Monomers The small molecular units from which a polymer is formed.

Organic chemistry The study of carbon-containing compounds.

Phenol An organic molecule in which a hydroxyl group is bonded to a benzene ring.

Polymer A long organic molecule made of many repeating units.

Saturated hydrocarbon A hydrocarbon containing no multiple covalent bonds, with each carbon atom bonded to four other atoms.

Structural isomers Molecules that have the same chemical formula but different chemical structures.

Unsaturated hydrocarbon A hydrocarbon containing at least one multiple covalent bond.

Review Questions

12.1 Hydrocarbons

- How do two structural isomers differ from each other?
- How are two structural isomers similar to each other?
- What physical property of hydrocarbons is used in fractional distillation?
- What types of hydrocarbons are more abundant in higher-octane gasoline?

12.2 Unsaturated Hydrocarbons

- What is the difference between a saturated hydrocarbon and an unsaturated hydrocarbon?
- How many multiple bonds must a hydrocarbon have in order to be classified as unsaturated?
- Aromatic compounds contain what kind of ring?

12.3 Functional Groups

- What is a heteroatom?
- Why do heteroatoms make such a difference in the physical and chemical properties of an organic molecule?

12.4 Alcohols, Phenols, and Ethers

- Why are low-formula-mass alcohols soluble in water?
- What distinguishes an alcohol from a phenol?
- What distinguishes an alcohol from an ether?

12.5 Amines and Alkaloids

- Which heteroatom is characteristic of an amine?
- Do amines tend to be acidic, neutral, or basic?
- Are alkaloids found in nature?

12.6 Carbonyl Compounds

- Which elements make up the carbonyl group?
- How are ketones and aldehydes related to each other? How are they different from each other?
- How are amides and carboxylic acids related to each other? How are they different from each other?

12.7 Organic Synthesis

- Why might an organic chemist want to synthesize a molecule that already occurs in nature?
- What is a retrosynthesis analysis?

12.8 Polymer Chemistry

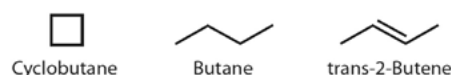
- What happens to the double bond of a monomer participating in the formation of an addition polymer?
- What is released in the formation of a condensation polymer?
- Why is plastic wrap made of polyvinylidene chloride stickier than plastic wrap made of polyethylene?

12.9 A Brief History of Plastics

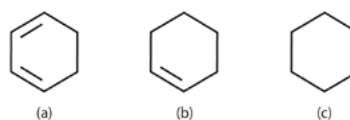
- What is one of the major drawbacks of celluloid?
- What role did Teflon play in World War II?

Quantitative Questions

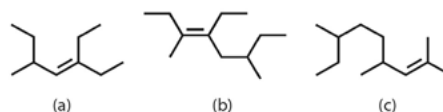
- Rank the following hydrocarbons in order of increasing number of hydrogen atoms:



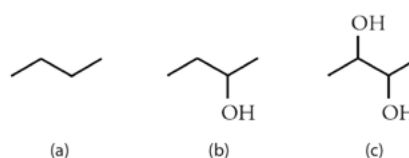
- Rank the following hydrocarbons in order of increasing number of hydrogen atoms:



- Rank the following hydrocarbons in order of smallest to largest carbon chain:



- Rank the following organic molecules in order of increasing solubility in water:





Solutions (Odd-Numbered)

1. Structural isomers have different arrangements of their carbon atoms, but the number of carbon atoms they each have is the same.
3. Boiling points of hydrocarbons are used for fractional distillation.
5. Saturated hydrocarbons have only single bonds. Unsaturated hydrocarbons have multiple bonds.
7. Aromatic compounds contain a 6-membered ring system called a benzene ring.
9. Heteroatoms give an organic molecule its “character”. They are typically electronegative and affect the physical and electrical properties of the molecule.
11. An alcohol simply contains a hydroxyl functional group, but a phenol has a hydroxyl group attached to a benzene ring.
13. Nitrogen is found in all amines.
15. Alkaloids are alkaline amines found in nature, though they can also be synthesized in the laboratory.
17. Both contain carbonyl groups. Ketones have the carbonyl carbon bonded to two adjacent carbon atoms, but aldehydes have the carbonyl carbon bonded to either one hydrogen and one carbon or to two hydrogens.
19. The quantities of the molecule available in nature may be insufficient to allow for its use by many people.
21. One of the bonds in the multiple bond of a monomer opens to form a new bond with a neighboring monomer molecule.
23. The chlorine atoms of the polyvinylidene chloride are good at forming induced dipole-induced dipole molecular interactions as was discussed in Section 7.1.
25. Teflon was used to line the valves and ducts of an apparatus they were building to make nuclear weapons.
27. Compound c, C_6H_{12} , has more hydrogens than compound b, C_6H_{10} , which has more hydrogens than compound a, C_6H_8 .
29. Recall that the hydroxyl group, $-OH$, is very polar. The more hydroxyl groups a compound has, the greater its polarity, which means the greater its solubility in water. Compound a is non-polar and insoluble in water. Compound b has a single hydroxyl group, which makes this compound somewhat soluble in water. Compound c has two hydroxyl groups, which makes it very soluble in water.

