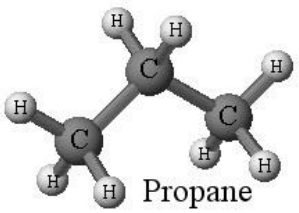
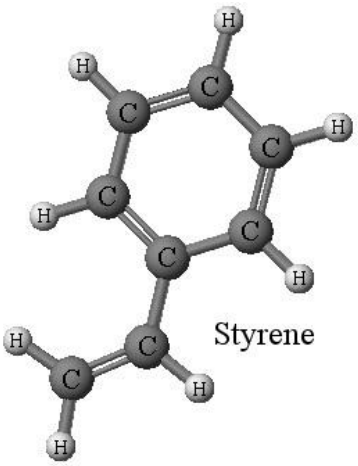
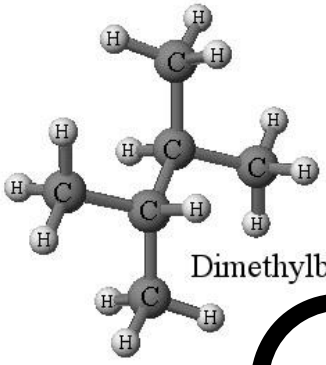
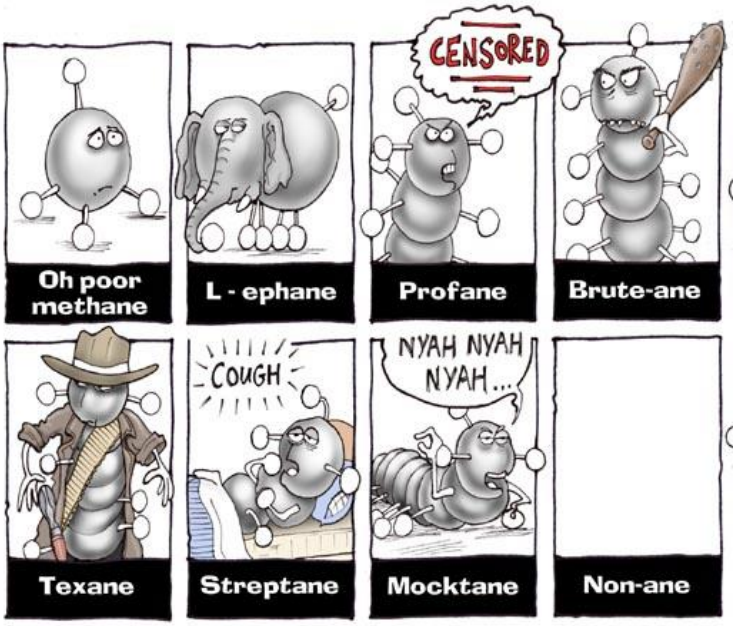






Organic Chemistry



What is Organic Chemistry?

- Organic chemistry is the study of _____ containing compounds.
- Because carbon has _____ valence electrons, carbon forms four covalent bonds.
- Carbon is able to form 4 single bonds, 1 double & 2 single bonds, _____, or a _____.

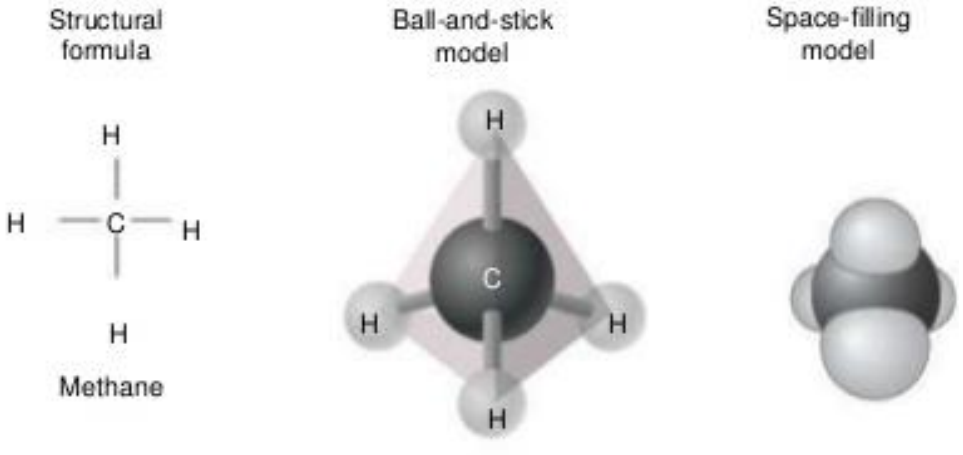
Hydrocarbons:

- An organic compound containing _____ and _____ is called a hydrocarbon.
- Hydrocarbons are the _____ organic compounds
- Hydrocarbons are _____ because the carbon and hydrogen electronegativities are very similar.
- The attraction between hydrocarbons are _____ forces.
- Hydrocarbons with _____ molar masses tend to be gases or liquids that boil at low temeratures (molecular).
- The general rule is "_____". This means if we mix two nonpolar compounds a solution will form, however if you mix a nonpolar compound (like a hydrocarbon oil) and a polar compound (like water) will not mix.
- _____ is the simplest hydrocarbon, containing one carbon and four hydrogens

How to represent organic molecules

There are different ways you can represent hydrocarbons;

- _____ formula: Convenient way to show the arrangement of atoms in a molecule but, being 2D, it does not show how the atoms and molecule are arranged in space.
- _____model; this model shows how the atoms are arranges about one another, but since bonds are not sticks holding atoms together it is not an accurate representation of the location of the electrons.
- _____model; this model shows how the atoms are arranged in space and better represents how the atoms bond/electron clouds, but it can be difficult to distinguish between atoms.



The 4 single bonds of carbon point to the corners of a tetrahedron.

Types of Hydrocarbons

1. Alkanes:

- An alkane is a hydrocarbon where all the carbon-carbon bonds are _____ bonds.
- An alkane can be a _____ chain or a _____ chain
- Straight chain alkanes are an example of a homologous series. A homologous series is a group of compounds where there is a consistent increment of change in molecular structure from one compounds to another.

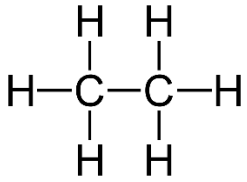
Length of carbon chain	Uses
1–4	Fuels such as natural gas for heating and cooking, propane for barbecues and soldering torches (**Figure 10**), and butane for lighters
5–12	Fuels such as gasoline
12–18	Fuels such as jet fuel
18–20	Fuels such as home heating oil
20–30	Lubricating oils such as engine oil
30–40	Fuel oils such as ship fuel
40–50	Waxes and thick oils such as paraffin wax and petroleum jelly
More than 50	Tars used in road surfacing

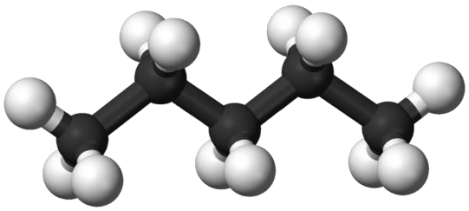
Naming Alkanes:

- **The international Union of Pure and Applied Chemistry established a system for naming organic compounds.**
- All alkanes end in the suffix "_____"
- The prefix of the alkane name corresponds to the number of carbons in the chain.

# of Carbons	1	2	3	4	5	6	7	8	9	10
Prefix										

Ex. Name the following Alkanes:





Drawing Alkanes:

- Start by drawing the carbons in the straight chain, connecting them with single bonds.
- Fill all of the carbons with the correct number of hydrogens so that each carbon has four covalent bonds.

Ex. Draw the structural formula for hexane:

- Hydrocarbons can also be represented using a condensed structural formula

Ex.

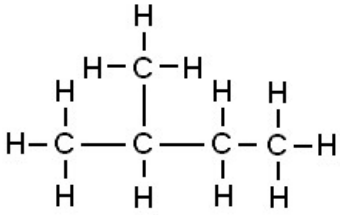
- Hydrocarbons can also be represented using line drawings. A line drawing is created in such a way that each end of a line represents a carbon atom. It is assumed that each carbon is bonded with the proper number of hydrogens.

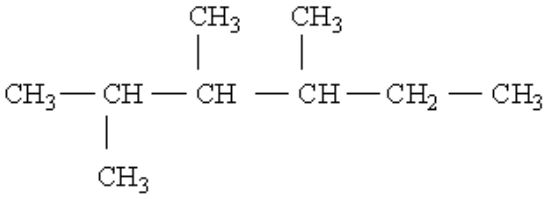
Ex.

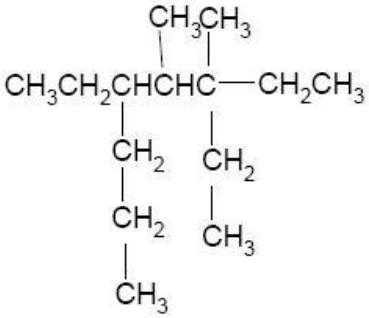
Why is it drawn as a zig zag? (model kits)

Branched Alkanes:

- Hydrocarbons are not always _____ chains.
- Carbon is stable when it forms four covalent bonds. This means it could bond with anywhere between 1-4 carbon atoms, resulting in branched chains.
- An atom or group of atoms that can take the place of a hydrogen atom on a parent hydrocarbon are called _____. The longest continuous chain is the parent chain and does not necessarily need to be written in a straight line.
- Example: Circle the substituents in the following hydrocarbons.



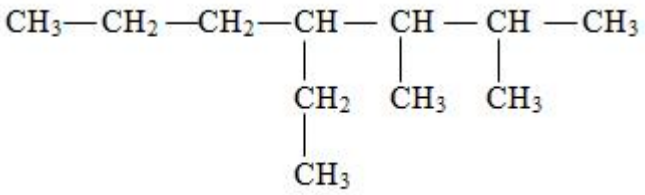




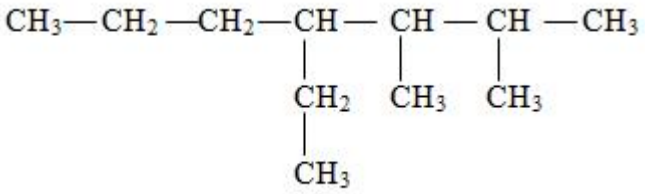
- A hydrocarbon substituent derived from an alkane is called an _____ group
- An alkyl group is essentially just an alkane with one of the _____ atoms removed.
- Alkyl groups are named with the same prefixes as alkanes, but with the suffix "_____" (ex. – CH_2CH_3 is an ethyl group)
- An alkane with one or more alkyl groups is called a _____ chain alkane.

Steps for Naming Branched Chain Alkanes:

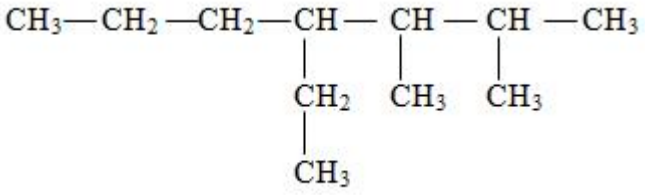
Ex. Determine the name for the following branched chain alkyl group:



1. First identify the longest carbon chain. This chain is considered the parent chain.



2. Number the carbons from one end of the parent chain to the other in such a way that the substituent groups will get the lowest possible numbers



3. Add the numbers to the names of the substituent groups to identify their location about the parent chain (use dashes to separate numbers and words).

4. Use prefixes to indicate the appearance of the same group more than once. (di, tri, tetra)

5. List the names of the alkyl substituents in alphabetical order (ignoring prefixes di- tri- etc).

6. Add the name of the parent chain onto the end. Combine all parts of the name using proper punctuation. Write the entire name without any spaces. Use commas to separate number. Use hyphens to separate numbers and words.

Drawing structural formulas for branched chain alkanes:

Use the parent chain name to draw out the parent chain. Attach the alkyl groups according to their location. Fill all carbons with the appropriate number of hydrogens so each carbon will have four covalent bonds.

Ex. Draw the structural formula for 5-ethyl-4,5-dimethyl-3-propylheptane

Is this the proper name?

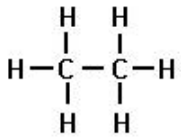
Draw the line formula for this hydrocarbon.

Summary: *http://tiny.cc/crashcoursehydrocarbon*

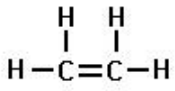
Unsaturated Hydrocarbons

- A saturated hydrocarbon is one in which the _____ number of hydrogen atoms per carbon atom.
- An unsaturated compound is one in which contains a _____ carbon-carbon bond. The ratio of carbon to hydrogen atoms is lower than that of a saturated hydrocarbon.

EX.



Saturated



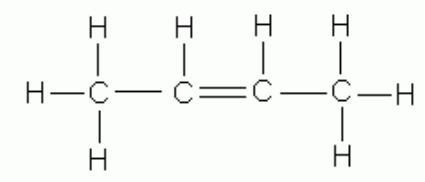
Unsaturated

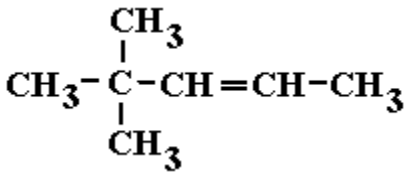
2. Alkenes:

- An alkene is a hydrocarbon that contains one or more carbon-carbon _____ bonds.
- An alkene can have only one carbon-carbon double bond. It is still considered an alkene.

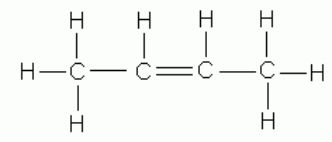
Naming Alkenes:

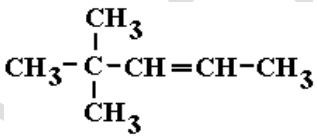
Ex. Name the following alkenes:



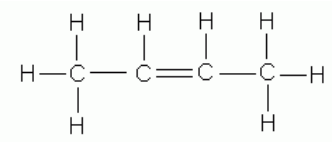


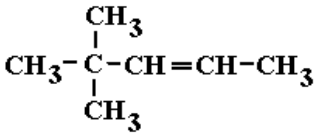
1. Identify the longest carbon chain containing the double bond. This is the parent chain and will be named with the suffix "ene".



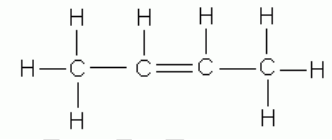


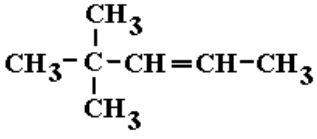
2. Number the carbons so that the carbons containing the double bond has the lowest possible number.



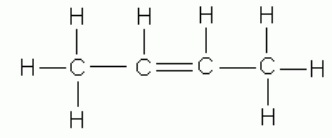


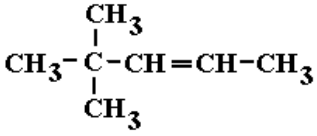
3. Substituents of the chain are named and numbered.





4. Put it all together with proper punctuation.



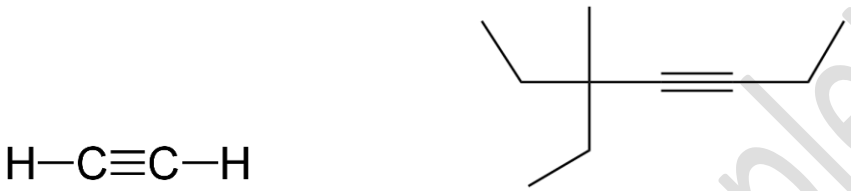


3. Alkynes:

- An alkyne is a hydrocarbon that contains one or more carbon-carbon _____ bond.
- An alkyne can have only one carbon-carbon triple bond. It is still considered an alkyne.

Naming Alkenes:

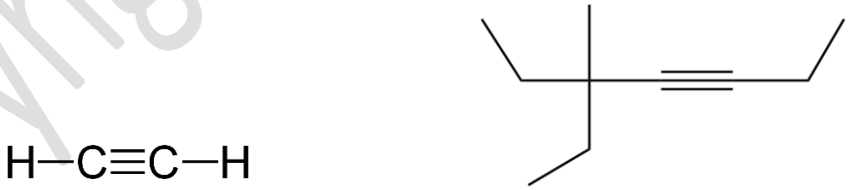
Ex. Name the following alkynes:



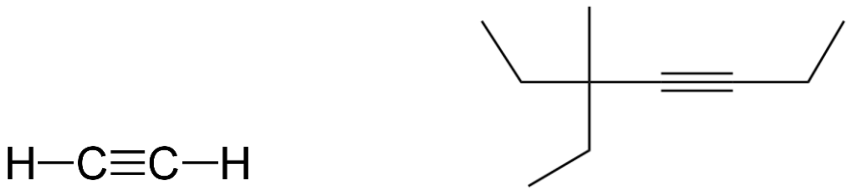
1. Identify the longest carbon chain containing the triple bond. This is the parent chain and will be named with the suffix "ene".

2. Number the carbons so that the carbons containing the triple bond et the lowest possible number.

3. Substituents of the chain are named and numbered.



4. Put it all together with proper punctuation.



Isomers:

Constitutional Isomers:

Draw the structural formula for butane: Draw the structural formula for 2-methylpropane:

Chemical formula: Chemical formula:

- Compounds with the same chemical formula but different molecular structure are called _____ isomers.
- Constitutional isomers _____ in physical properties such as boiling point and melting point.
- Constitutional isomers have _____ chemical reactivates.
- Generally, the more _____ a hydrocarbon has, the lower its boiling point will be, compared with less branched isomers.

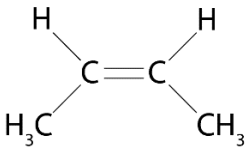
Stereoisomers

- Stereoisomers are molecules in which the atoms are joined in the _____ order but the _____ of the atoms in space are different.
- There are 2 types of stereoisomers: Geometric Isomers and Asymmetric Isomers

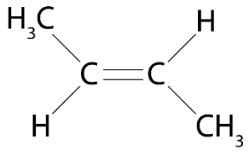
1. **Geometric Isomers**

- Two types of stereoisomers are _____isomers.
- Cis-Trans isomers (geometric isomers) can occur when a _____exists in a molecule. The double bond prevents rotation about the bond leading to different special arrangements on either side of the double bond.
- Cis-Trans isomers have difference physical and chemical properties.

Ex. 2-butene



Cis-2-butene



Trans-2-butene

In the cis configuration, similar groups are on the _____ side of the double bond.

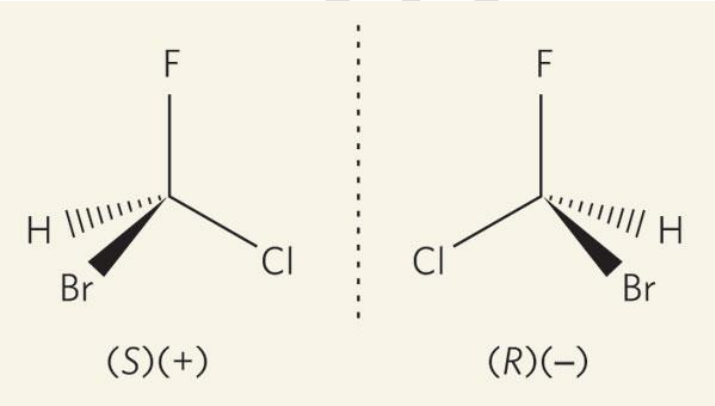
In the trans configuration, similar groups are on _____ sides of the double bond.

Ex. Write the structural formula for both the cis and trans isomers of 2-pentene:

2. Enatiomers

- This category of isomers occur when an atom (usually carbon) has four _____ atoms or groups attached.
- A carbons with four different atoms or groups attached is an _____ carbon.

Ex. CHGClBr:



- An atom that is symmetrical would not have an enantiomer since it cannot have a _____ image.
    - If an object is symmetric, like a ball, it's mirror image can be superimposed (the ball and it's reflection are the same). An object that is not symmetrical is distinguishable even though they have the same parts (like a pair of hands).

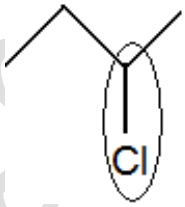
- Enantiomers are also called _____ isomers (they filter light differently).
- Enantiomers have the _____ physical properties (boiling point and melting point) but they interact with molecules differently. Because of this, many of the asymmetric molecules in our bodies can have different effects on our bodies.
- The relationship between these two carbons is similar is left and right hands. They are mirror images of one another.

Functional Groups

- A functional group is a specific arrangement of atoms in an organic compound that is capable of characteristic chemical reactions.

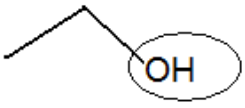
Halides: -X

- Where X represents: _____
- Halocarbons are not usually found in nature, but they are created and used for things such as solvents, ingredients in stretchable polymers, or hydrofluorocarbons used as refrigerants,
- Halocarbons contain Van Der Waals forces which can affect their properties.
- Ex. 2-chlorobutane



Alcohols: -OH

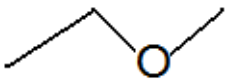
- Alchohols are organic molecules with a _____ group (-OH) attached.
- Alcohols are found in products like mouthwash, perfume, antiseptics, alcoholic beverages and hairspray.
- Ex. Ethanol



- Alcohols are able to create hydrogen bonds. Because of this they boil at higher temperatures than alkanes and halocarbons
- Since hydroxyl groups are derivatives of water, alcohols are slightly soluble in water.

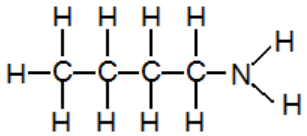
Ether: -O-

- An ether is an organic compound that contains an _____ bonded in between two carbons.
- Ethers usually have lower boiling points than alcohols with similar molecular weights.
- Ethers are not able to form hydrogen bonds
- Ex. Ethyl methyl ether

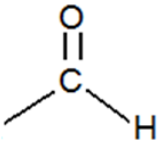


Amines: -NH_2

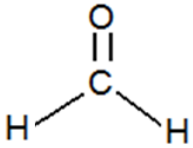
- An amine is an organic molecule with _____ bonded to a carbon.
- Amines can come in the form of RNH_2, R_2NH or R_3N, where R represents a carbon or group of carbons.
- Amines are able to produce hydrogen bonds, similar to alcohols. They are also lightly soluble in water, depending on the number of carbons.
- Ex. butanamine



Aldehydes:

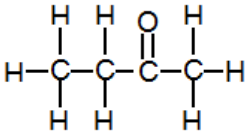


- Aldehydes are organic compounds with a _____ group (double bonded oxygen) attached to carbon at the _____of a chain (the carbon is bonded to at least one oxygen).
- Many aldehydes with large numbers of carbons are aromatic and are used as flavouring agents.
- Ex. methanal (formaldehyde)

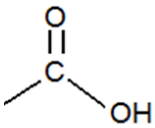


Ketones:

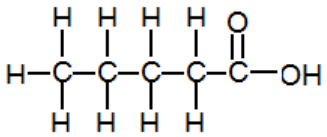
- A keytone is an organic compound with a _____group (double bonded oxygen) attached to a carbon in the _____ of a chain.
- Ex. Butanone

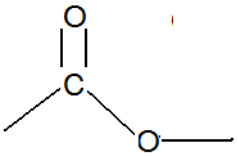


Carboxylic Acid:



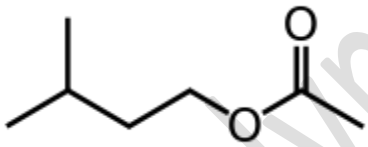
- A carboxylic acid is an organic molecule containing a _____group. A carboxyl group is a functional group that consists of a carbonyl group attached to a hydroxyl group.
- Carboxylic acids are weak acids.
- Citric acid is an example of a carboxylic acid.
- Ex. Pentanoic acid





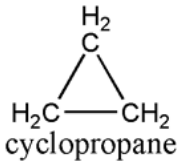
Ester:

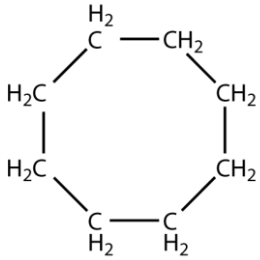
- Many esters have a pleasant fruity odour. Esters are what gives many fruit its characteristic aroma.
- An ester is similar to a _____ where the H on the hydroxyl group (OH) has been removed and another carbon chain attached (ie. It occurs in the middle of a carbon chain).
- Ex. Isopentyl acetate



Cyclic Hydrocarbons:

- A cyclic hydrocarbon is one that contains a hydrocarbon _____.
- Rings with _____carbons are the most abundant
- To name a cycloalkane (cyclic hydrocarbon where all carbons are single bonded) just add "cyclo" as a prefix to the corresponding alkane name



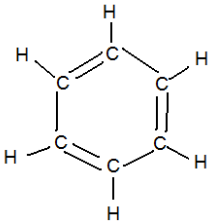


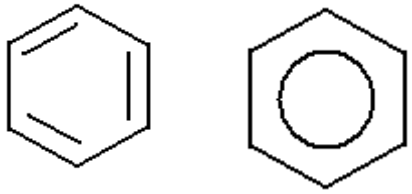
Aromatic compounds

- Contain _____ rings (or similar)
  - Benzene Ring: C_6H_6 in a ring like structure
- Many have a _____ scent (Aroma), hence the name aromatics
- Any Organic compound that is not considered an aromatic compound is an _____ compound.

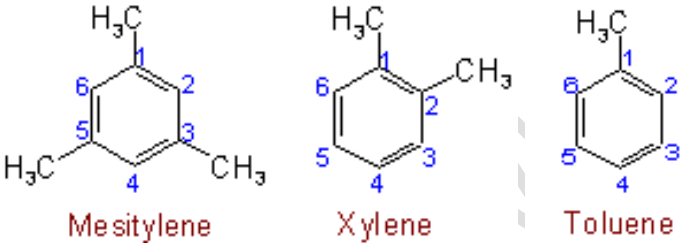
Benzene ring

- The benzene molecule is a _____ carbon ring, each carbon bonded to one hydrogen leaving one electron from each carbon free to participate in a _____ bond.
- Structural diagram Line Drawing





- In benzene the electrons are actually shared evenly thoughout the ring, so each bond is actually a _____ of a single and double bond.
- Benzene is the _____aromatic compound
- Many benzene ring compounds will have alkyl groups replacing the hydrogens.



Polymers

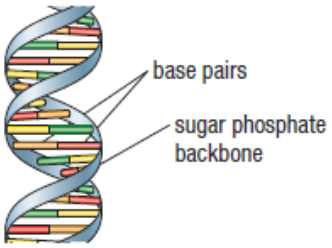


Figure 5 DNA is a polymer. The monomers, called nucleotides, are each made up of a base, phosphate, and a sugar. There are billions of unique strands of DNA.

- Organic molecules can bond together to form _____of atoms.
- A polymer is a large molecule formed by the covalent bonding of _____ smaller molecules.
- The small molecules that combine to form a polymer is called a _____.
- _____ are made up of polymers.
- _____ is a common polymer used to make plastic bottles, containers and toys. Polyethylene is made from several ethane molecules combining together to form a long chain.

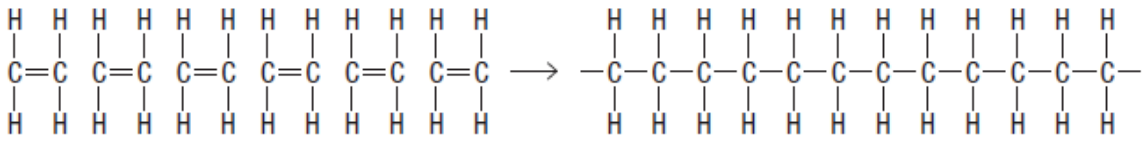
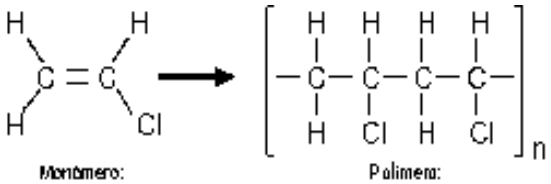


Figure 2 Polymerization of ethene molecules produces polyethene (polyethylene).

- _____ (polyvinyl chloride) is also a polymer used to make pipes and vinyl fabrics. It is made by chloroethene molecules bonding together.



A short history of synthetic polymers:

1839: Vulcanized rubber was developed by American Charles Goodyear to make natural rubber stronger. Natural rubber is a polymer produced from the liquid sap of rubber trees. Natural rubber tends to be brittle when cold and soft when warm. Heating natural rubber with sulfur—vulcanizing—made the product harder and raised its melting point. Vulcanized rubber was used for battery boxes, pumps, dental plates, fountain pens, and, eventually, automobile tires.

1909: Bakelite, invented by Leo Hendrik Baekeland, was the first fully synthetic polymer. It was widely used to replace wood, ivory, and ebony (thereby reducing the pressure on some endangered species). A lightweight plastic, it was non-conductive, heat and moisture resistant, chemically unreactive, and could be coloured. It revolutionized the design of consumer and industrial products. Many things made of Bakelite, such as jewellery, dishes, telephones, and toys, are collectables today.

1929: Vinyl (PVC), invented by Waldo Semon, came to be used worldwide in products such as flooring, shower curtains, and plumbing pipes. It was the first durable material that was used to record and play back music.

1935: Nylon, invented by Wallace Carothers to replace silk in parachutes and stockings, became widely used in many consumer goods.

1830 1840 1850 1860 1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

1868: Celluloid was invented to replace ivory in billiard balls. In the form of celluloid film, this polymer played a central role in the development of the movie industry

1910: Formica was invented for use as an electrical insulator. The polymer was modified during the 1930s to make it more durable. Formica is widely used as a laminate on household surfaces, such as kitchen or bathroom counters.

1933: Saran was invented by Ralph Whiley. It was originally used as a coating: sprayed onto fighter planes to protect the surfaces against corrosion from sea salt. It was eventually approved for use in food packaging.

1997/1998: The existence of the Great Pacific Garbage Patch was predicted and confirmed. In an attempt to reduce the quantity of discarded plastics, polymer chemists worked to develop better biodegradable plastics.

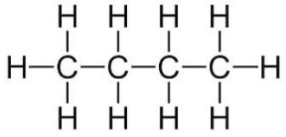
Name: _____

Organic Chemistry & Alkanes

1. Describe in your own words why there is such a diverse arrangement of organic compounds

2. Name the following Alkanes using the IUPAC nomenclature rules

a.



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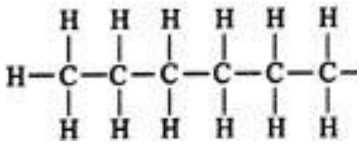

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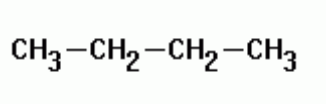

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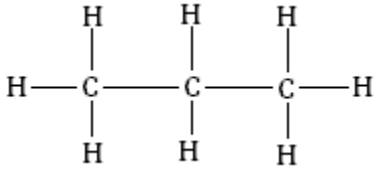
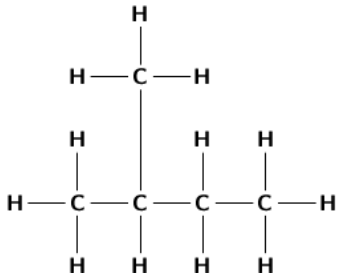


e. 

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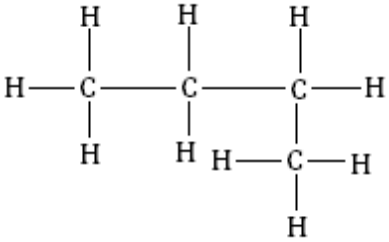
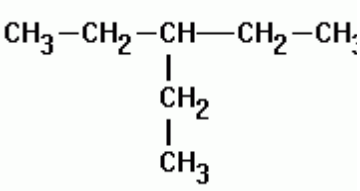
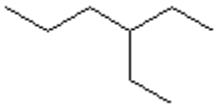
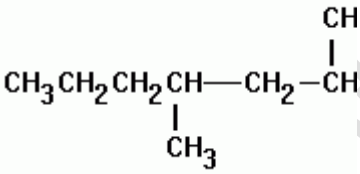
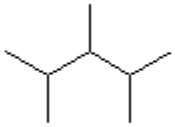
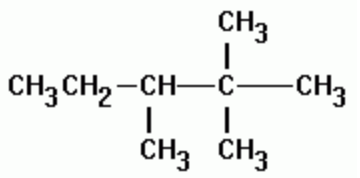
g. 

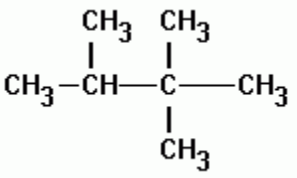
h. 

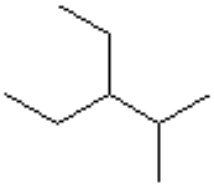
i. 

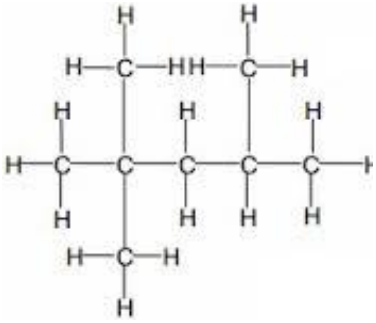
j. 

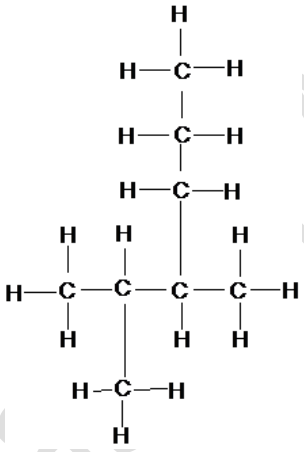
k. 

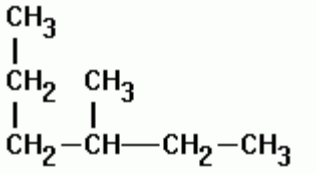
l. 

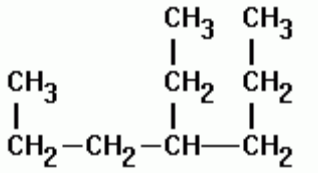
m. 

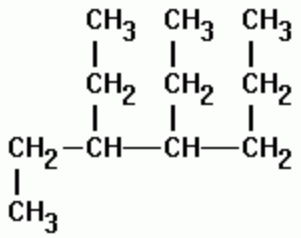
n. 

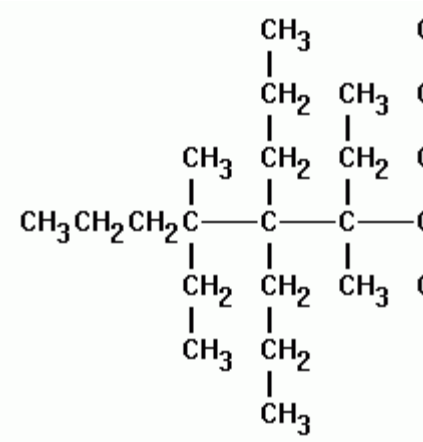
o. 

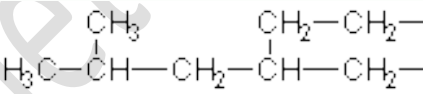
p. 

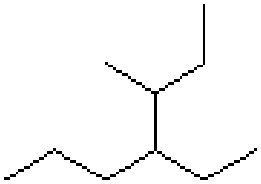
q. 

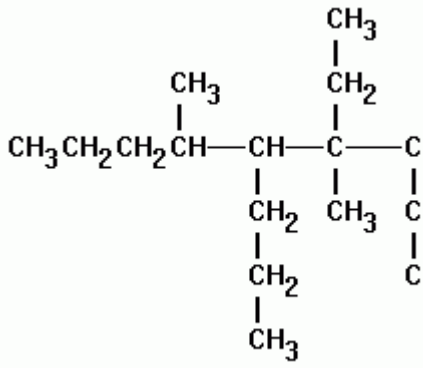
r. 

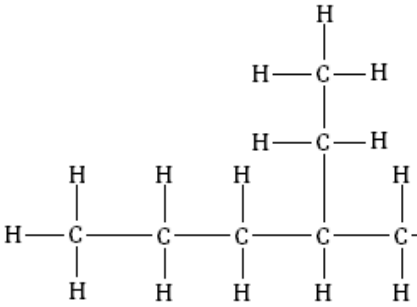
s. 

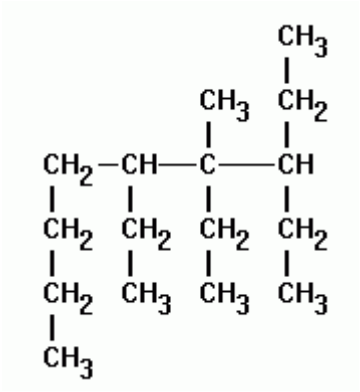
t. 

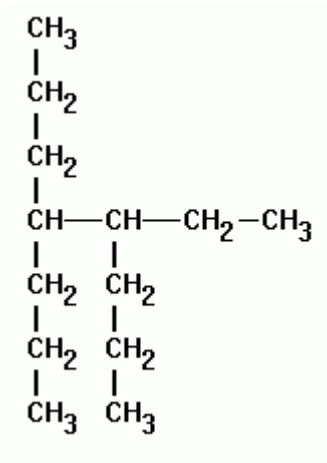
u. 

v. 

w. 

x. 

y. 

z. 

3. For the following compounds, draw the structural formula, the line drawing, the chemical formula and give the proper name if needed.
   a. Ethane

   b. 3, 3-dimethylpentane

   c. 1,3,5-trimethylpentane

d. 3,4-diethyl-2-propylpentane

e. 3-ethyl-2,3-dimetyl-1,4-dipropylpentane

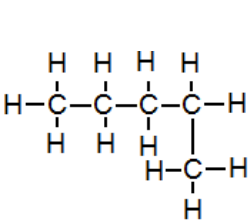
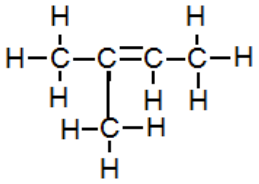
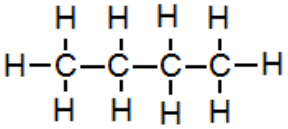
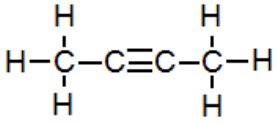
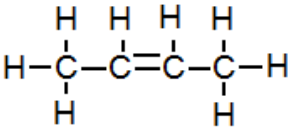
f. 3,4-diethyl-1-methyl--1,4-dipropylbutane

g. 3,5-diethyl-2-methyl-2, 3, 4, 5-tetrapropylhexane

Name:_____

Alkenes & Alkynes Assignment

1. Determine whether the following compounds are saturated or unsaturated.

2. Classify each of the following compounds as an alkane, an alkene, or an alkyne. Explain your reasoning. K/U

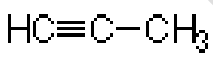
(a) $CH_3CH_2CHCHCH_3$

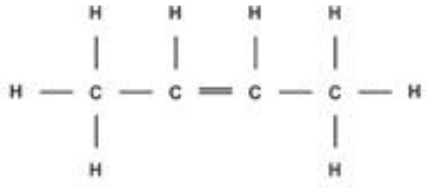
(b) $CH_2CHCH_2CH_3$

(c) $CHCCH_2CCH$

3. Name the following alkenes and alkynes.

a. 

b. 

c. 

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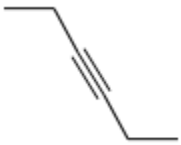
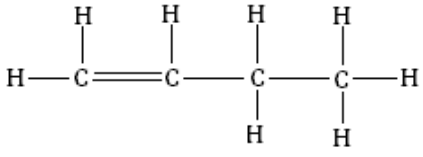
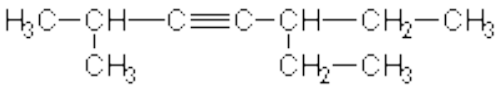
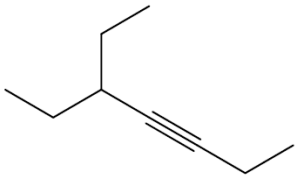
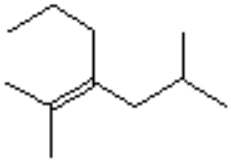
e. 

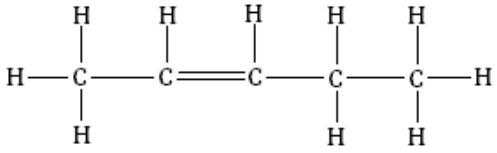
f. 

g. 

h. 

i. 

k. 

j. 

For questions 4-8, correctly identify the following organic compounds from their names:

4. Which is **ethene**?

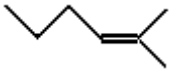
a. 

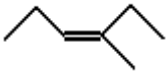
b. 

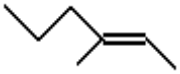
c. 

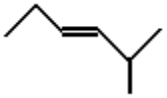
d. =

5. Which is **3-methylhex-3-ene**?

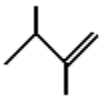
a. 

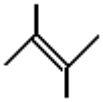
b. 

c. 

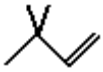
d. 

6. Which is **2,3,3-trimethylbut-1-ene**

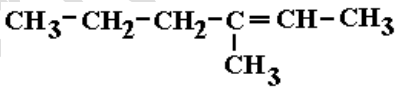
a. 

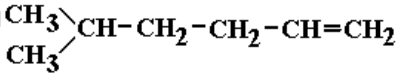
b. 

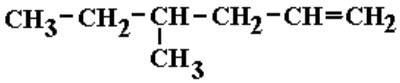
c. 

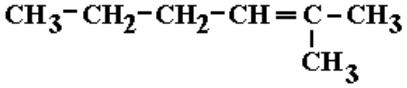
d. 

7. Which is **3-methylhex-2-ene**?

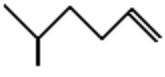
a. 

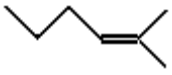
b. 

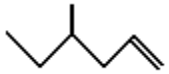
c. 

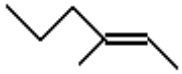
d. 

8. Which is **2-methylhex-2-ene**?

a. 

b. 

c. 

d. 

9. For the following compounds, draw the structural formula and the line drawing. Write the proper name if the one given is not correct.

a. 3-pentene

b. 2-octyne

c. Ethyne

d. 2-butene

e. 1-butyne

f. 2,3-dimethylpenta-2-ene

g. 4,4-dimethyl-2-pentyne

h. 1-ethyl-3,7-dimethyl-5-nonyne

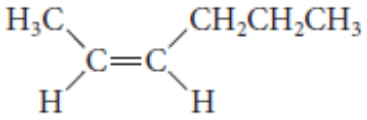
Name:_____

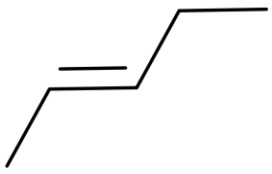
Isomers

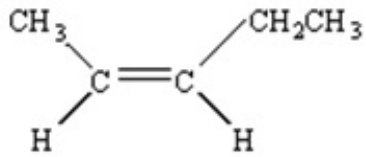
1. Draw and name the 9 constitutional isomers of C_7H_{16}:

2. Multiple choice: Gasoline contains many structural isomers of octane. Which of the following is NOT a structural isomer of octane?
   a. 3-methylheptane
   b. 4-ethylheptane
   c. 2,2,4-trimethylpentane
   d. 2,2,3,3-tetramethylbutane

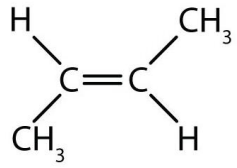
3. Name each of the following using cis-trans conventions:

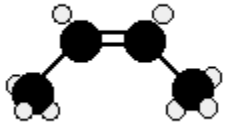
a. 

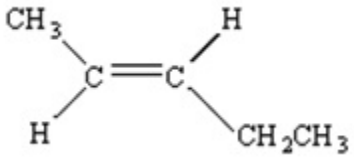
b. 

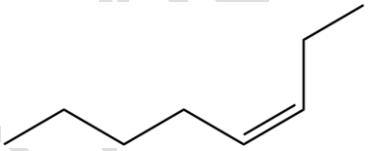
c. 

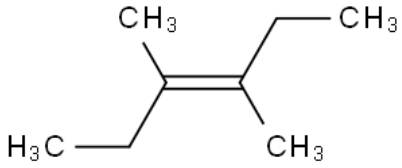
d. 

e. 

f. 

g. 

h. 

i. 

4. Explain the similarities between constitutional isomers and stereoisomers. How are they different?

5. Think of an analogy to describe the relationship between two molecules that are enantiomers.

6. Draw the structural formulas for the following alkenes. If the compound has cis-trans isomers, draw both the cis and trans forms.
    a. 1-pentene

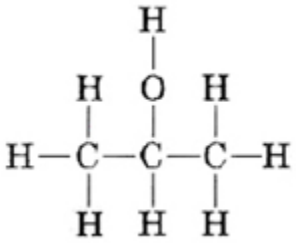
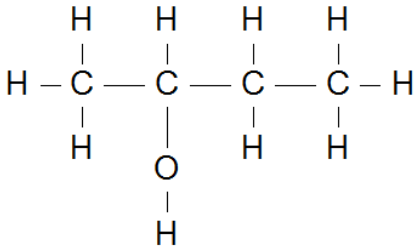
    b. 3-octene

    c. 2-methyl-1-butene

    d. 2,5-dimethyl-3-hexene

7. Draw a concept map to show how the following vocabulary words are related: isomers, constitutional isomers, geometric isomers, stereoisomers, cis-trans isomers and enantiomers.

8. Which compound has an asymmetric carbon atom? Circle the asymmetric carbon(s) (draw the molecule if not provided)

a.  *or* 

b. CH_3CHCHO (Cl) *or* CH_3CHOH (CH_3)

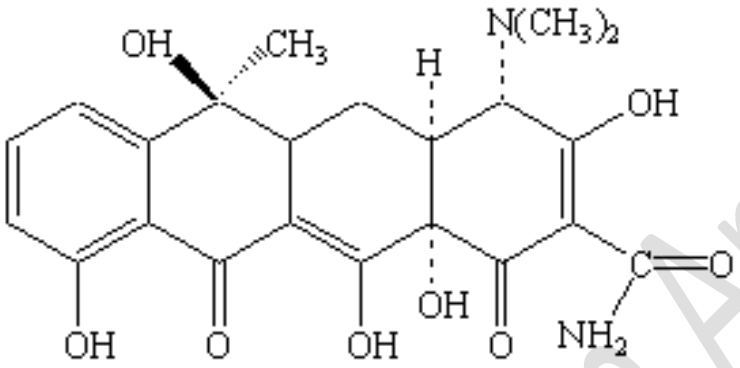
c. 3-methylhexane *or* 3-methylpentane

d. 2,2-dimethylpentane *or* 2,3,4,-trimethylhexane

Name:_____

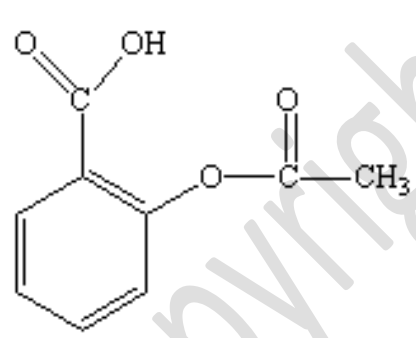
Functional groups

1. The discovery of penicillin in 1928 marked the beginning of what has been called the "golden age of chemotherapy," in which previously life-threatening bacterial infections were transformed into little more than a source of discomfort. For those who are allergic to penicillin, a variety of antibiotics, including tetracycline, are available. Identify the numerous functional groups in the tetracycline molecule.

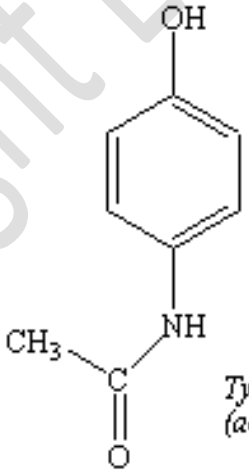


Tetracycline

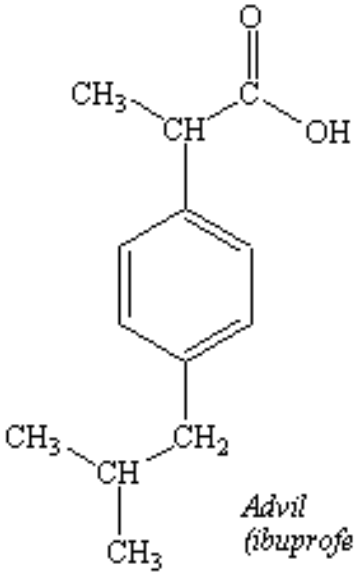
2. The following compounds are the active ingredients in over-the-counter drugs used as analgesics (to relieve pain without decreasing sensibility or consciousness), antipyretics (to reduce the body temperature when it is elevated), and/or anti-inflammatory agents (to counteract swelling or inflammation of the joints, skin, and eyes). Identify the functional groups in each molecule.



Aspirin
(acetylsalicylic acid)



Tylenol
(acetaminophen)

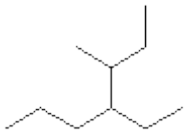


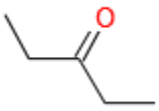
Advil
(ibuprofen)

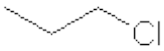
Name:_____

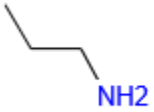
Identify Functional Groups

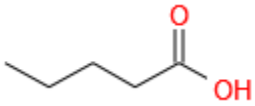
Determine what functional groups are in the following organic compounds and name them.

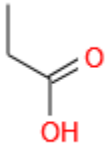


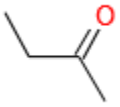


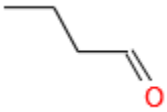


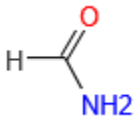


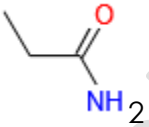


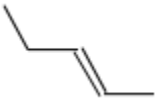


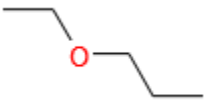


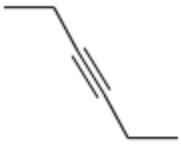


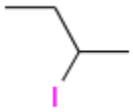


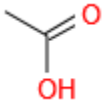


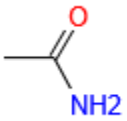


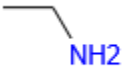


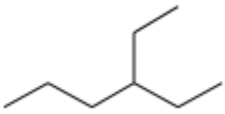


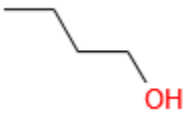


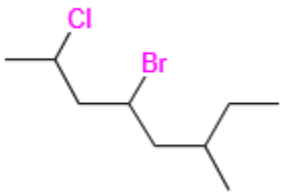


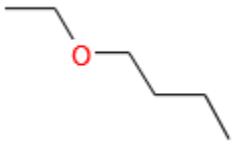












Name:_____

Organic Chemistry, Nelson Chemistry 12 textbook questions

Multiple Choice:

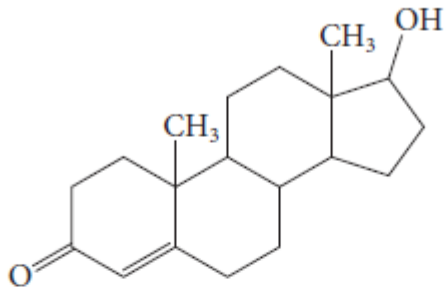
Which of the following statements best describes an aromatic organic compound? (1.3) K/U

(a) an aldehyde or a ketone with a distinctive odour
(b) an unsaturated compound containing a 6-carbon ring with 6 identical bonds
(c) a compound containing a cyclic structure
(d) a compound containing a cyclic structure with a double bond

Short answer:

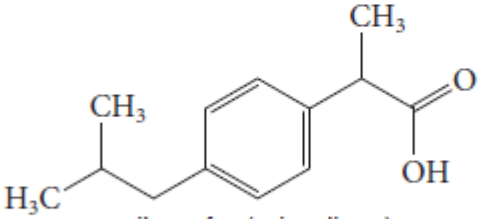
List the non-alkyl functional groups in each of the compounds represented below. (1.1, 1.2, 1.3, 1.7) K/U

(a)



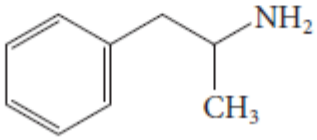
testosterone (hormone)

(b)



ibuprofen (pain reliever)

(c)



amphetamine (stimulant)

Which of the following compounds is an ether? (1.4) K/U

(a) $CH_3\overset{\overset{O}{\|}}{C}CH_2CH_3$

(b) $CH_3CH_2CH_2\overset{\overset{O}{\|}}{C}H$

(c) $CH_3\overset{\overset{OH}{|}}{C}HCH_3$

(d) $CH_3CH_2CH_2OCH_3$

Organic compounds are classified by their functional groups. For each of the compounds listed below, identify the functional group(s), determine the type of compound, and write the correct IUPAC name. (1.4, 1.5, 1.6, 1.7) K/U C

(a) $CH_3CH_2CH_2OH$
(b) CH_3CH_2COOH
(c) $CH_3CH_2CH_2CH_2CH_2CHO$
(d) $CH_3CH_2OCH_2CH_2CH_3$
(e) CH_3NH_2
(f) $CH_3COCH_2CH_2CH_3$
(g) $CH_3\overset{\overset{O}{\|}}{C}OCH_2CH_2CH_3$
(h) $CH_3CH_2CONHCH_3$
(i) $CH_3CH\overset{\overset{O}{\|}}{C}CH_2CH_3$
(j) $H-\overset{\overset{O}{\|}}{\underset{\underset{OH}{|}}{C}}-O$

Draw structural formulas (or line diagrams) and write names for the following isomers:

Name:_____

Cyclic Hydrocarbons

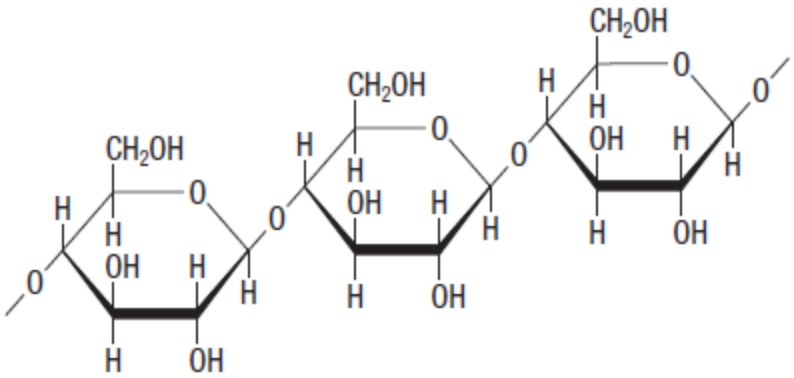
1. Draw the structural formula, line drawing and write the names of the first 5 cyclic alkanes:

Name:_____

Polymers

1. Explain the difference between monomers and polymers.

2. The diagram below shows the structure of a polymer called cellulose. Draw a diagram of the monomer that makes up this polymer.



3. Give two examples of polymers; one natural and one synthetic.

Name:_____

Quick Review

True or False (explain):

1. Alkanes are unsaturated hydrocarbons
2. The names of alkenes include numbers to specify the location of the triple bond
3. Aldehydes ad ketones each have a carbonyl group but difference chemical properties
4. Amine compounds always include a nitrogen atom
5. Unsaturated hydrocarbons have at least one carbon-carbon double or triple bond
6. But-1-ene and but-2-ene are geometric isomers of one another
7. Carboxylic acid molecules are much less polar than the corresponding alkane molecule.
8. Polymers tend to be very strong because they are held together by ionic bonds.
9. All plastics are polymers but not all polymers are plastics.
10. Ethane is the simplest alkane
11. Cycloalkanes are named by adding cyclo- as a prefix to the name of the alkane.
12. A cis- isomer has both groups of interest on the same same of the double bond.
13. The formula for benzene is C_6H_{12}.
14. The structure of an aromatic hydrocarbon is based on a 6 carbon ring with 3 double bonds
15. A keytone contains an oxygen atom bonded to two alkane groups.

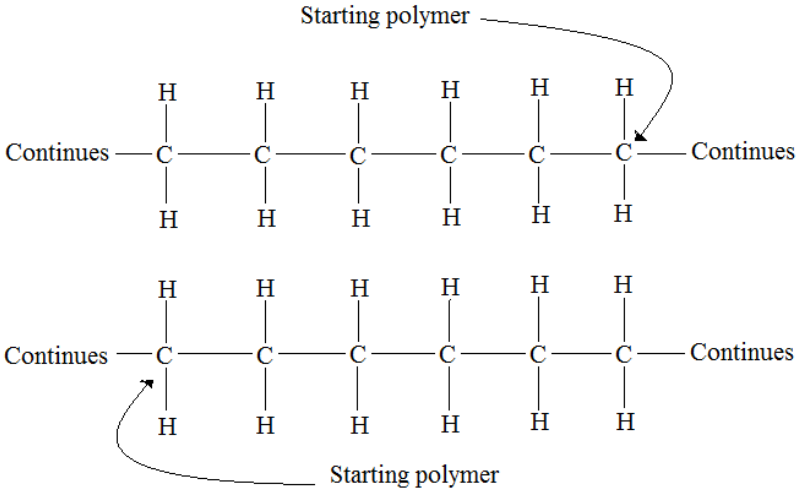
16. Polymers are large molecules that are built from smaller units called alkanes.

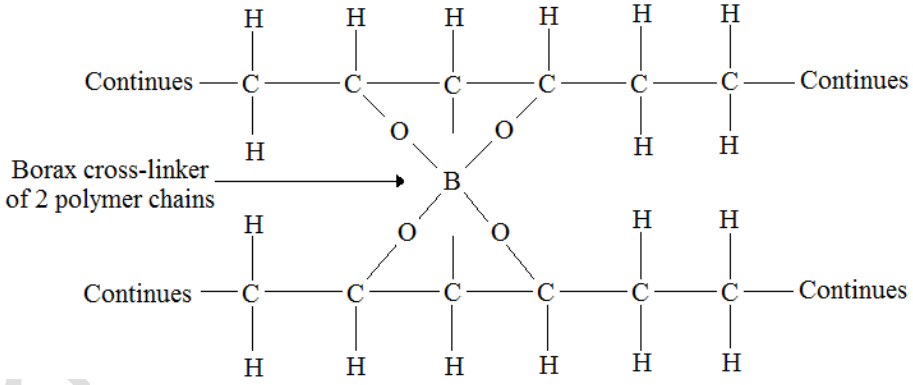
Investigation into Polymers Lab

Background information:

Polymers are long chains of atoms bonded together covalently. These long chains are made up of repeating structural units (same order of atoms over and over). Since polymers are long chains, they can get twisted and tangled together. If a substance can be twisted, pulled, or compressed and it resumes back to its original form, it is usually a type of polymer called an elastomer. Elastomers have elastic properties. That is they can by pushed or pulled and they still go back to their original form. An example of an elastomer is a rubber band or a car tire.

The covalent bonds along the chain are strong, but the bonds between chains are normally weak. However, additives such as borax allow the formation of strong "cross-links" between chains. As the number of cross-links increases, the material becomes more rigid and strong.





The liquid latex, or glue, which we will use in this experiment, contains small globules of hydrocarbons (hydrogen and carbons bonded together) suspended in water. These globules are polymers and are called polyvinyl acetate. The polymer putty is formed by joining the globules using a cross linker sodium tetraborate (found in borax). Sodium borate acts as a cross-linker to the original hydrocarbon polymers. The cross-linker can be thought of as rungs joining two sides of a ladder. The putty is held together by very weak intermolecular bonds that provide flexibility around the bond and rotation about the chain of the cross-linked polymer.

Purpose: The objective of this experiment is to cross-link a polymer and observe the changes in the physical properties as a result of this cross-linking.

Materials:

Plastic bag

White liquid glue

Borax

Water

Food colouring.

General Safety Guidelines:

- Since borax solid (a bleaching agent) and solution will burn the eyes, goggles should be worn.
- Hands should always be washed after kneading the polymers and finishing the experiment.

Procedure:

1. Obtain a plastic bag.
2. Obtain your sample of white glue in the plastic bag. Be sure to make your observations.
3. Place one drop of food colouring in the plastic bag. Close the back and mix (Observations)- Do not use more than 2 drops of food colouring or that will ruin your experiment.
4. Obtain 4-5mL of 4% Borax solution. Slowly add this to your glue mixture while continually stirring. (Observations, Observations, Observations!)
5. Make observations about what you have created. The Polymer is safe to touch, but not to eat or taste because it is toxic if ingested. Get creative with your observations (Dropping it, stretching slowly/quickly, compare your polymers with others in the class, etc.)
6. Place your polymer in the plastic zipper seal bag and seal it with the least amount of air possible.
7. Clean up. Your polymer should go in the plastic bag and the bag should be sealed whenever you are not observing.
8. Take your polymer home and place it in the fridge for about 15 minutes. Make observations about your polymer when the temperature is decreased.

Analysis Questions:

1. In your own words, describe what a polymer is.
2. What would be the effect (your thoughts) of adding more sodium borate solution?
3. Where does all of the water go? Remember that you stated with a solution made up of 96% water.
4. How do the physical properties of the glue change as a result of adding the sodium borate?
5. Why does a car tire appear to be flat in the summer even though the gas inside is hotter than in the winter.

6. Explain how cross linking occurs and its effect on polymers.