Unit 7 Organic Chem

At the end of this unit, you'll be able to…

- ✓ Identify organic compounds versus inorganic compounds based on structure, name, or characteristics of an unknown compound
- ✓ Recognize the characteristics of organic compounds
- ✓ Differentiate between aliphatic, aromatic, saturated, and unsaturated compounds
- ✓ Name organic compounds based on IUPAC rules, with the help of table P and Q
- ✓ Draw organic compounds from a IUPAC name
- ✓ Distinguish between alkynes, alkenes, and alkanes
- ✓ Name and identify isomers
- ✓ Identify various functional groups of organic compounds using Table R:
  - Halide (halocarbon)
  - Alcohol
  - Ether
  - Aldehyde
  - Ketone
  - Organic Acid
  - Ester
  - Amine
  - Amide

- ✓ Categorize various organic reactions properly including addition, substitution,
- ✓ polymerization, esterification, fermentation, saponification, and combustion.

Term	Definition
Addition rxn	a halogen atom (or atoms) replaces a double or triple bond within an unsaturated hydrocarbon
Alcohol	an organic molecule that contains at least one –OH (hydroxyl) group attached to the carbon chain. Ex: CH3OH (methanol), CH3CH2OH (ethanol)
Aldehyde	an organic molecule that contains a carbonyl group attached to a primary/terminal carbon. Ex: HCHO (methanal), CH3CHO (ethanal)
Alkane	a saturated hydrocarbon; a hydrocarbon containing all single bonds; a hydrocarbon with no double or triple bonds
Alkene	an unsaturated hydrocarbon containing at least one double bond
Alkyne	an unsaturated hydrocarbon containing at least one triple bond
Amide	an organic molecule that contains a carbonyl group attached to a nitrogen within the carbon chain. Ex: HCONH2 (methanamide), CH3CONH2 (ethanamide)
Amine	an organic molecule that contains a nitrogen which is attached to only carbon or hydrogen. Ex: CH3NH2 (methylamine), CH3NHCH3 (dimethylamine)
Amino acid	an organic molecule that contains one carboxyl group bonded to a primary/terminal carbon and at least one amine group bonded to either a primary or secondary carbon.
Condensation polymerization	a chemical reaction that involves linking two molecules together by eliminating a molecule of water
Dehydration synthesis	(see condensation polymerization)
Ester	an organic molecule containing a carboxyl group attached to a secondary/interior carbon
Esterification	a dehydration synthesis reaction that joins an organic acid and alcohol; a reaction that involves the removal of water to join an organic acid and an alcohol
Ether	an organic compound consisting of two hydrocarbon chains joined together by a single oxygen atom
Fermentation	a chemical reaction that involves breaking down glucose (sugar) in the absence of oxygen to produce ethanol, carbon dioxide, and water
Functional group	a substructure that determines the chemical properties of a molecule (Ex: carboxylic acid group)
Halide (halocarbon)	an organic molecule containing one or more halogens (F, Cl,Br, I, At)
Hydrocarbon	an organic molecule containing only carbon and hydrogen
Isomer	molecules that have the same molecular formula and different structural formulas
Ketone	an organic molecule with a carbonyl group attached to a secondary/interior carbon

Term	Definition
Monomer	a single molecule or subunit
Organic acid/Carboxylic acid	an organic molecule containing a carboxyl group bonded to a primary/terminal carbon
Organic chemistry	the study of molecules containing carbon AND hydrogen
Polymer	two or more monomers/molecules/subunits chemically combined
Polymerization	the joining together of monomer units by addition reactions or dehydration synthesis to form polymers
Primary	positional description referring to a carbon at the end of a hydrocarbon chain; terminal
Saponification	the process of making soap from the hydrolysis of an ester by a strong base (glycerol is also a byproduct)
Saturated hydrocarbon	an alkane; a hydrocarbon containing all single bonds; a hydrocarbon with no double or triple bonds
Secondary	positional description referring to an interior carbon that is bonded to exactly two other carbons
Substitution rxn	halogen atoms replace hydrogen atoms on an alkane/saturated hydrocarbon
Tertiary	positional description referring to an interior carbon that is bonded to exactly three other carbons
Unsaturated hydrocarbon	alkene or alkyne; an unsaturated hydrocarbon containing at least one double and/or triple bond

Name _____ Date _____

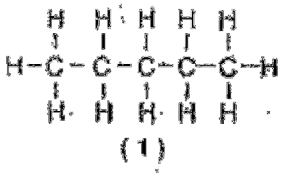
Period _____

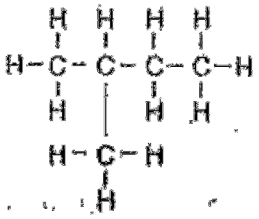
Intro to Organic Chem

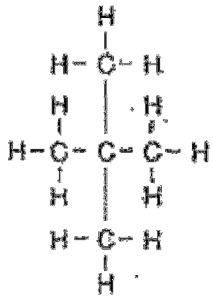
Objective #1: Differentiating between organic and inorganic molecules

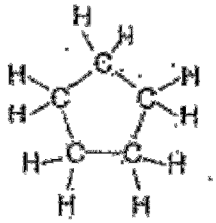
Directions: Examine the molecules below and answer the questions that follow.

Organic Molecules

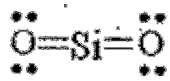

(1)

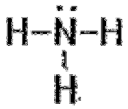

(3)

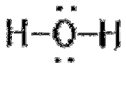

(2)


(4)

Inorganic Molecules


(1)


(3)


(2)


(4)

1. Compare and contrast the organic molecules versus the inorganic molecules.

_____

_____

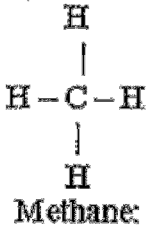
2. What atom must be present in an organic molecule? _____

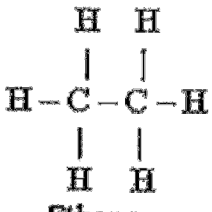
3. How many covalent bonds can a carbon atom form? _____

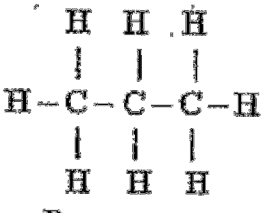
Objective #2: Families of Hydrocarbons

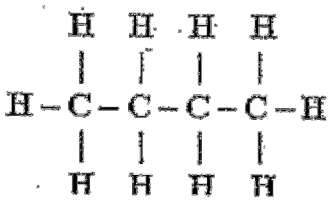
Directions: Examine the molecules below and answer the questions that follow.

Alkane Family:


Methane:


Ethane:

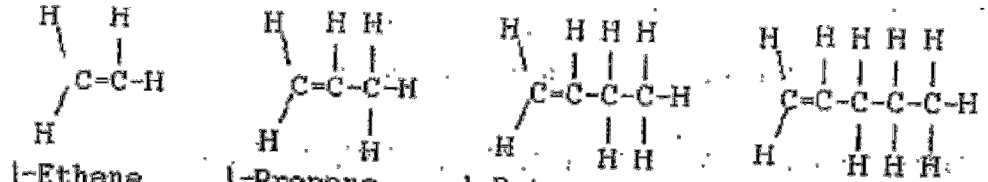

Propane:


Butane:

Name _____ Date _____

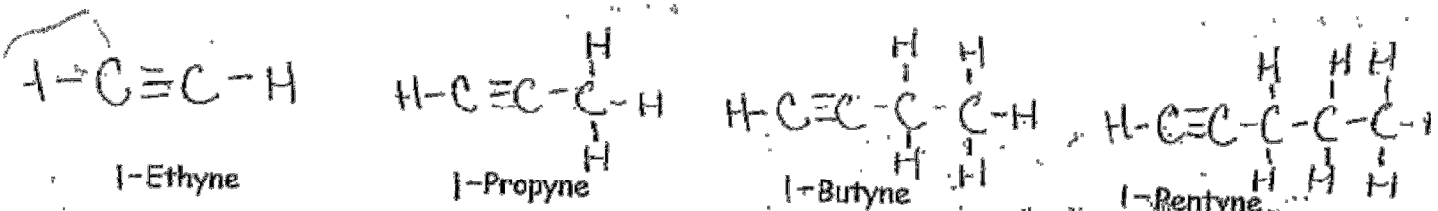
Period _____

Alkene Family:



1-Ethene 1-Propene 1-Butene 1-Pentene

Alkyne Family:



1-Ethyne 1-Propyne 1-Butyne 1-Pentyne

1. The alkane, alkene, and alkyne family are known as hydrocarbons. Define hydrocarbon.

2. How are the alkane, alkene, and alkyne families similar?

3. How are the alkane, alkene, and alkyne families different?

4. What does the "ane" suffix mean in an organic compound name?

5. What does the "ene" suffix mean in an organic compound name?

6. What does the "yne" suffix mean in an organic compound name?

7. Where in your reference tables can you find information on the hydrocarbon families?

8. How are propane, propene, and propyne similar? How are they different?

9. What do you think the prefix in an organic compound name stands for? _____

10. Where in your reference tables can you find information on the prefix for organic molecules? _____

11. Predict what the following compounds will look like

a. Pentane b. Hexane c. Heptyne

Name _____ Date _____

Period _____

Hydrocarbon Review

Hydrocarbon Review Questions:

1. All organic compounds must contain the element
   a. Hydrogen b. nitrogen c. carbon d. oxygen

2. Which element is composed of atoms that can form more than one covalent bond with one another?
   a. Hydrogen b. helium c. carbon d. calcium

3. What is the total number of valence electrons in a carbon atom in the ground state?
   a. 12 b. 2 c. 6 d. 4

4. Which property is generally characteristic of an organic compound?
   a. Low melting point b. high melting point
   c. soluble in polar solvents d. insoluble in non-polar solvents

5. In general, which property do organic compounds share?
   a. High melting points b. high electrical conductivity
   c. readily soluble in water d. slow reaction rate

6. A hydrocarbon molecule containing one triple covalent bond is classified as an
   a. Alkene b. alkane c. alkyne d. alkadiene

7. What is the total number of hydrogen atoms in a molecule of butane?
   a. 10 b. 6 c. 8 d. 4

8. By how many carbon atoms does each member of a homologous series differ from the previous member?
   a. 1 b. 2 c. 3 d. 4

9. Which of the following is a saturated hydrocarbon?
   a. Ethane b. ethyne c. propene d. propane

10. what is the total number of pairs of electrons shared between the two adjacent carbon atoms in an ethyne molecule?
    a. 1 b. 2 c. 3 d. 4

11. Which compound is a member of the same homologous series as C3H6?
    a. C_2H_4 b. C_2H_6 c. C_3H_4 d. C_3H_8

12. Which hydrocarbon is a member of the series with the general formula C_nH_{2n-2}?
    a. Ethyne b. ethane c. butane d. benzene

13. Which compound belongs to the alkene series?
    a. C_2H_2 b. C_2H_4 c. C_6H_6 d. C_6H_{14}

14. Which type of bond occurs in a saturated hydrocarbon molecule?
    a. Single covalent b. double covalent
    c. Triple covalent d. ionic

15. Which type of bonds and solids are characteristic of organic compounds?
    a. Ionic bonds and ionic solids
    b. Ionic bonds and molecular solids
    c. Covelent bonds and ionic solid
    d. covalent bonds and molecular solids

16. The four single bonds of a carbon atom are directed in space toward the corners of a
    a. Regular tetrahedron b. regular octahedron
    c. square plane d. tigonal bipyramidal

17. In which group could the hydrocarbons all belong to the same homologous series?
    a. C_2H_2, C_2H_4, C_2H_6
    b. C_2H_4, C_3H_4, C_4H_8
    c. C_2H_4, C_2H_6, C_3H_6
    d. C_2H_4, C_3H_6, C_4H_8

18. Which formula represents butane?
    a. CH_3CH_3
    b. $CH_3CH_2CH_3$
    c. $CH_3CH_2CH_2CH_3$
    d. $CH_3CH_2CH_2CH_2CH_3$

21. Draw the structural formula for the one structural isomer of butane and name it.

22. Draw structural formulas for two structural isomers of octane that have only one branch. Name the isomers.

23. Draw the structural formula for one structural isomer of pentane and name it.

24. The molecule 2-methylheptane is a structural isomer of which straight-chain alkane?

25. The molecule 2-methylbutane is a structural isomer of which straight-chain alkane?

26. The molecule 3-methyloctane is a structural isomer of which straight-chain alkane?

27. The molecule 3-ethylhexane is a structural isomer of which straight-chain alkane?

28. The molecule 3-methylpentane is a structural isomer of which straight-chain alkane?

29. The molecule 3-propylheptane is a structural isomer of which straight-chain alkane?

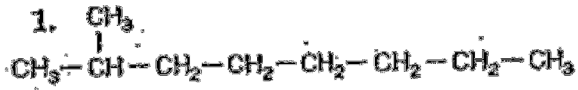
30. The molecule 3-methylhexane is a structural isomer of which straight-chain alkane?

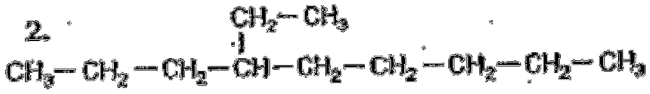
Name _____ Date _____

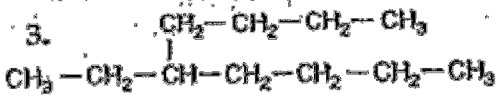
Period _____

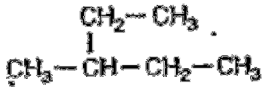
Naming Hydrocarbons

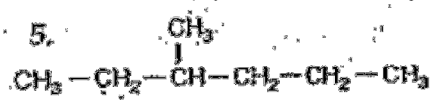
Give the IUPAC name for the following molecules:

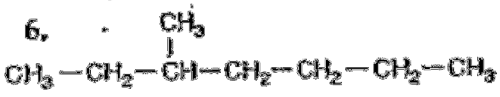
1. 

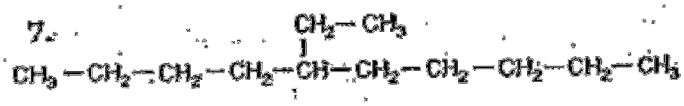
2. 

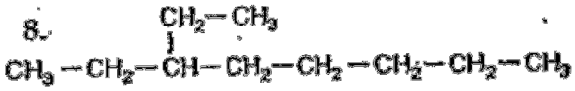
3. 

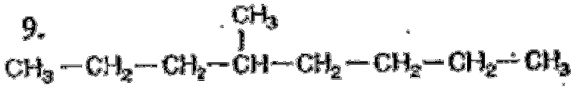
4. 

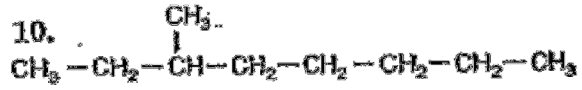
5. 

6. 

7. 

8. 

9. 

10. 

Write condensed structural formulas for the following:

11. 4-methyloctane

12. 4-ethyldecane

13. 3-ethylpentane

14. 3-ethylhexane

15. 5-butyldecane

16. 4-ethylheptane

17. 3-methylnonane

18. 2-methylheptane

19. 4-propylheptane

20. 5-butylnonane

Name _____ Date _____

Period _____

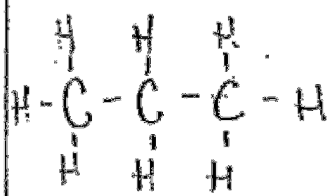
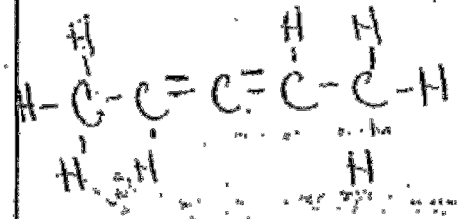
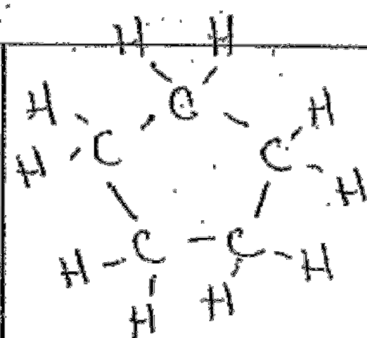
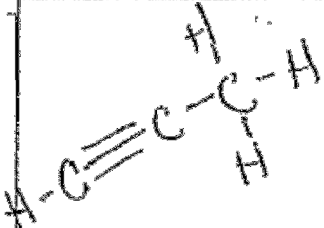
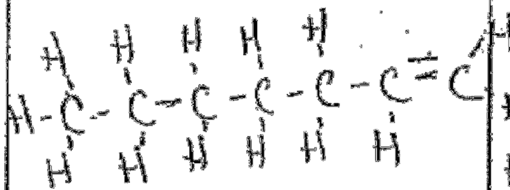
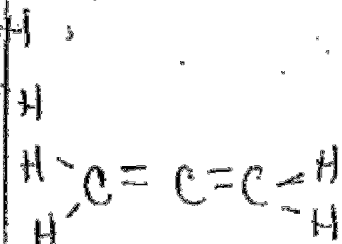
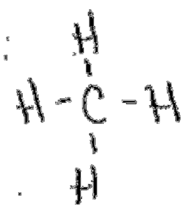
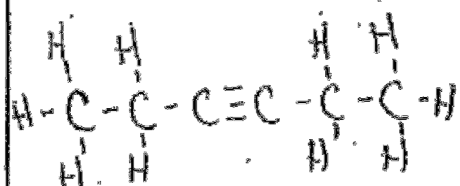
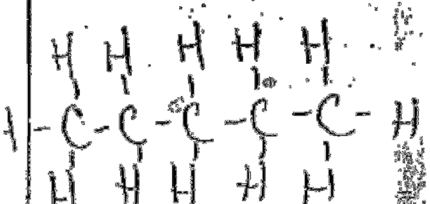
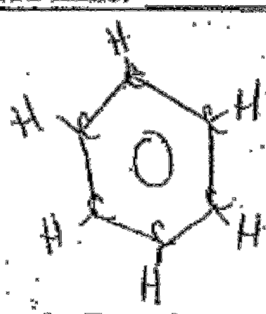
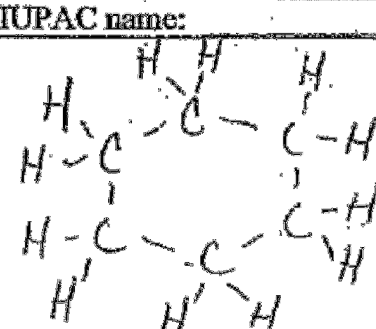
Structural Formulas of Organic Compounds

Directions: Please draw the structural formula for each of the following and determine if it is saturated or unsaturated. Also give the molecular formula for each compound.

Ethane: Molecular Formula: _____ Saturated? _____	Propene: Molecular Formula: _____ Saturated? _____	2,4-Hexene (2,4-Hexadiene) Molecular Formula: _____ Saturated? _____
Heptane Molecular Formula: _____ Saturated? _____	2-Octyne Molecular Formula: _____ Saturated? _____	2-Hexyne Molecular Formula: _____ Saturated? _____
Butane Molecular Formula: _____ Saturated? _____	3,5-Octene Molecular Formula: _____ Saturated? _____	1-Pentene Molecular Formula: _____ Saturated? _____
3-Nonyne Molecular Formula: _____ Saturated? _____	Decane Molecular Formula: _____ Saturated? _____	n-Propyne Molecular Formula: _____ Saturated? _____

Name ______________________________________ Date __________________
Period ______________________________________

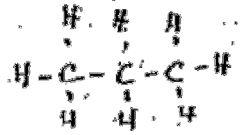
Directions: From the structural formula provided give the molecular formula and the IUPAC name.

 Molecular Formula: ________ IUPAC name:	 Molecular Formula: ________ IUPAC name:	 Molecular Formula: ________ IUPAC name:
 Molecular Formula: ________ IUPAC name:	 Molecular Formula: ________ IUPAC name:	 Molecular Formula: ________ IUPAC name:
 Molecular Formula: ________ IUPAC name:	 Molecular Formula: ________ IUPAC name:	 Molecular Formula: ________ IUPAC name:
 Molecular Formula: ________ IUPAC name:	 Molecular Formula: ________ IUPAC name:	 Molecular Formula: ________ IUPAC name:

Name _____ Date _____

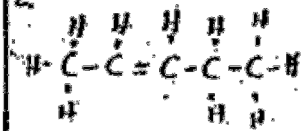
Period _____

Directions: From the structural formula provided give the molecular formula and the IUPAC name.

1. 

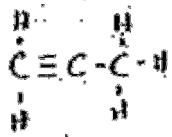
Molecular Formula: _____

Name: _____

2. 

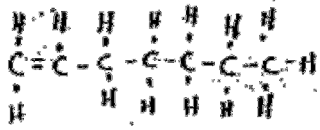
Molecular Formula: _____

Name: _____

3. 

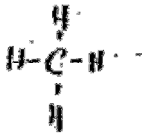
Molecular Formula: _____

Name: _____

4. 

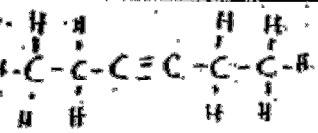
Molecular Formula: _____

Name: _____

5. 

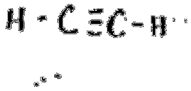
Molecular Formula: _____

Name: _____

6. 

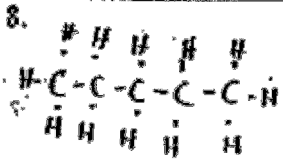
Molecular Formula: _____

Name: _____

7. 

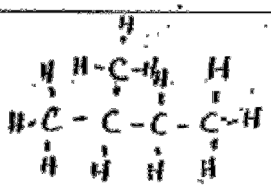
Molecular Formula: _____

Name: _____

8. 

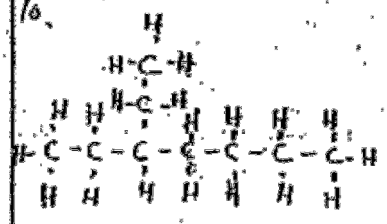
Molecular Formula: _____

Name: _____

9. 

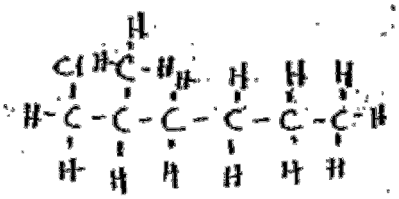
Molecular Formula: _____

Name: _____

10. 

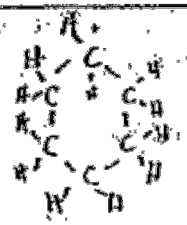
Molecular Formula: _____

Name: _____

11. 

Molecular Formula: _____

Name: _____

12. 

Molecular Formula: _____

Name: _____

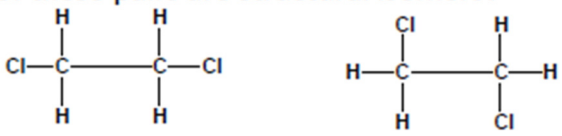
Name _____ Date _____

Period _____

Isomers

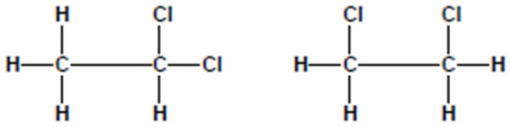
1. Which of these pairs are structural isomers?

a.

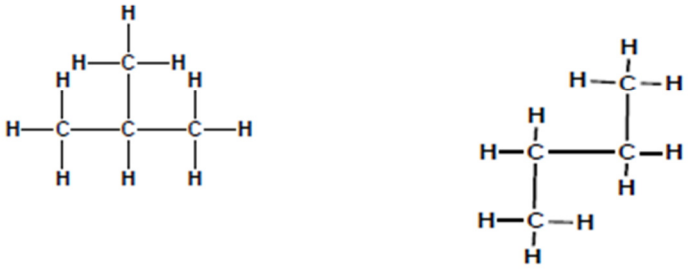


b.

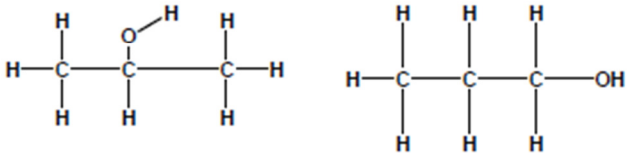
c.



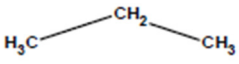
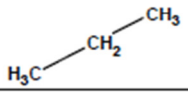
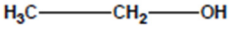
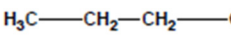
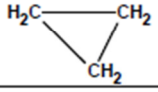
d.



e.

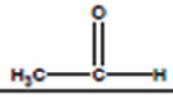
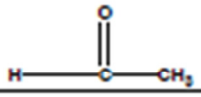
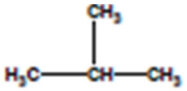
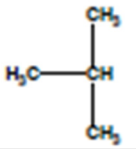
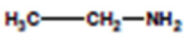
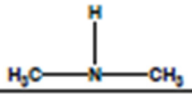
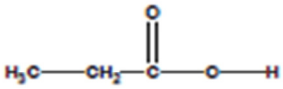
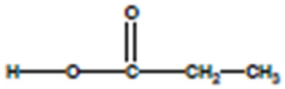
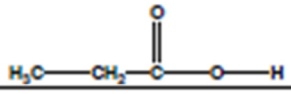
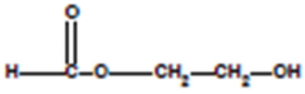
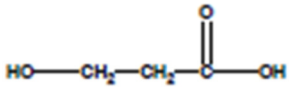
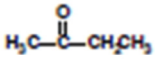
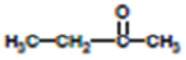
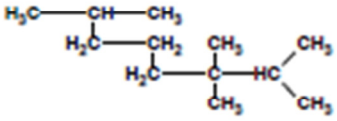
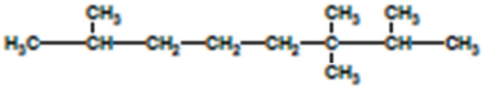
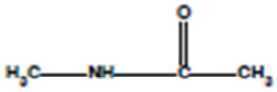
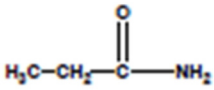
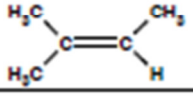
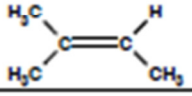
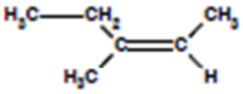
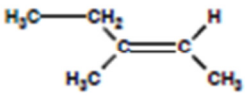


2. Examine each of the following pairs of structures and decide if the two are identical, isomers or different compounds.

	Chemical structure	Chemical structure	Identical/ Isomers/ Different compounds
a.			
b.			
c.			
d.			

Name _____ Date _____

Period _____

e.			
f.			
g.			
h.			
i.			
j.			
k.			
l.			
m.			
n.			
o.			
p.			

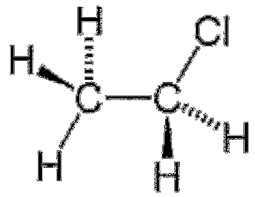
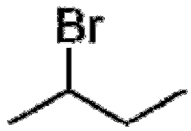
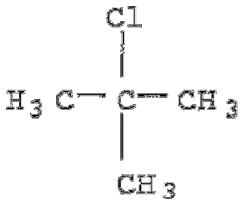
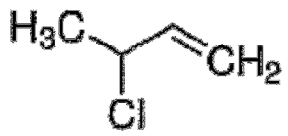
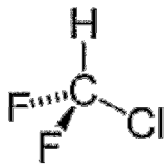
Name _____ Date _____

Period _____

Functional Groups

Halides

Directions: Name the molecules where the structural formula is given, draw the structural formulas where the name is given. Provide the molecular formula and the functional group(s) for all the molecules (using Table R).

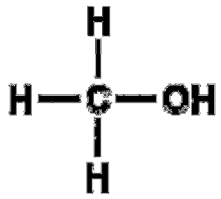
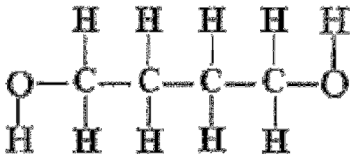
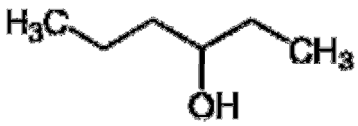
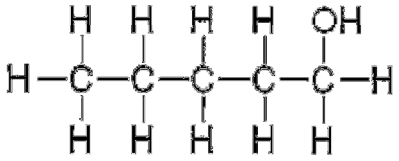
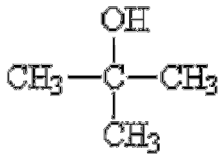
1) _____  Molecular Formula: _____ Functional Group: _____	2) _____  Molecular Formula: _____ Functional Group: _____	3) 1,2,3-trifluoropropane Molecular Formula: _____ Functional Group: _____
4) _____  Molecular Formula: _____ Functional Group: _____	5) 1,6-dichlorohexane Molecular Formula: _____ Functional Group: _____	6) 2-methyl-3-bromopentane Molecular Formula: _____ Functional Group: _____
7) 2,2,3-tribromobutane Molecular Formula: _____ Functional Group: _____	8) 2-methyl-3-fluoropentane Molecular Formula: _____ Functional Group: _____	9) _____  Molecular Formula: _____ Functional Group: _____
10) _____  Molecular Formula: _____ Functional Group: _____	11) 2-fluoro-3-ethyl hexane Molecular Formula: _____ Functional Group: _____	12) 2-methyl-4,4-dibromoheptane Molecular Formula: _____ Functional Group: _____

Name _____ Date _____

Period _____

Alcohols

Directions: Name the molecules where the structural formula is given, draw the structural formulas where the name is given. Provide the molecular formula and the functional group(s) for all the molecules (using Table R).

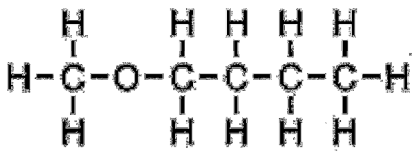
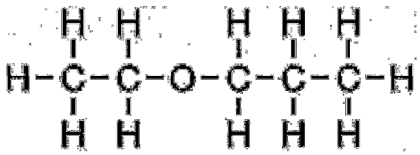
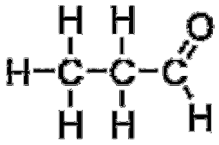
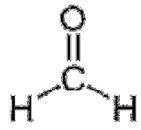
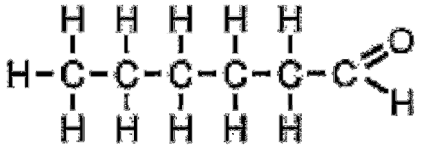
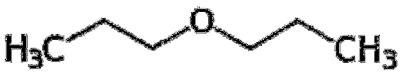
1) _____  Molecular Formula: _____ _____hydroxy	2) _____  Molecular Formula: _____ _____hydroxy	3) 1,1,2-propantriol Molecular Formula: _____ _____hydroxy
4) _____  Molecular Formula: _____ _____hydroxy	5) 1,1,2-butantriol Molecular Formula: _____ _____hydroxy	6) 1,5-pentandiol Molecular Formula: _____ _____hydroxy
7) ethanol Molecular Formula: _____ Primary/Secondary/Tertiary	8) 2-butanol Molecular Formula: _____ Primary/Secondary/Tertiary	9) _____  Molecular Formula: _____ Primary/Secondary/Tertiary
10) _____  Molecular Formula: _____ Primary/Secondary/Tertiary	11) 2-methyl-3-butanol Molecular Formula: _____ Primary/Secondary/Tertiary	12) 2-methyl-2-pentanol Molecular Formula: _____ Primary/Secondary/Tertiary

Name _____ Date _____

Period _____

Ethers and Aldehydes

Directions: Name the molecules where the structural formula is given, draw the structural formulas where the name is given. Provide the molecular formula and the functional group(s) for all the molecules (using Table R).

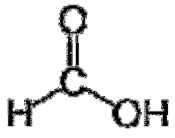
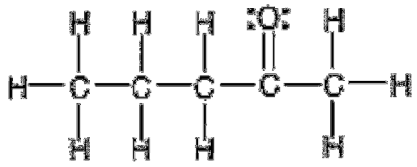
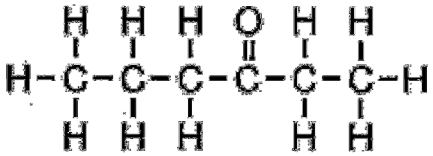
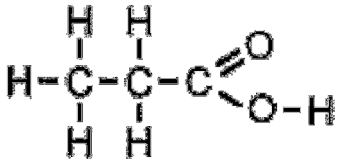
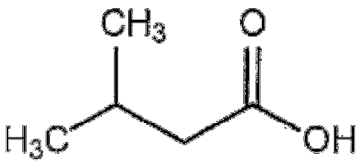
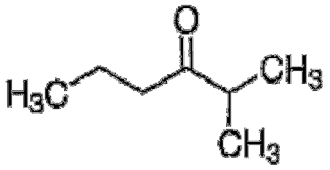
1) methyl ethyl ether Molecular Formula: _____ Functional Group: _____	2) _____  Molecular Formula: _____ Functional Group: _____	3) butanal Molecular Formula: _____ Functional Group: _____
4) ethanal Molecular Formula: _____ Functional Group: _____	5) _____  Molecular Formula: _____ Functional Group: _____	6) _____  Molecular Formula: _____ Functional Group: _____
7) pentanal Molecular Formula: _____ Functional Group: _____	8) _____  Molecular Formula: _____ Functional Group: _____	9) methyl propyl ether Molecular Formula: _____ Functional Group: _____
10) _____  Molecular Formula: _____ Functional Group: _____	11) dimethyl ether Molecular Formula: _____ Functional Group: _____	12) _____  Molecular Formula: _____ Functional Group: _____

Name _____ Date _____

Period _____

Ketones and Organic Acids

Directions: Name the molecules where the structural formula is given, draw the structural formulas where the name is given. Provide the molecular formula and the functional group(s) for all the molecules (using Table R).

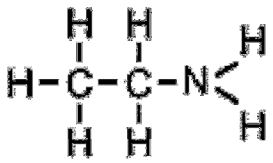
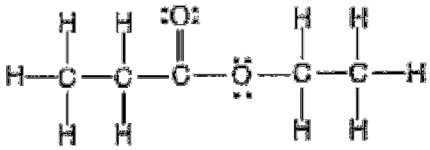
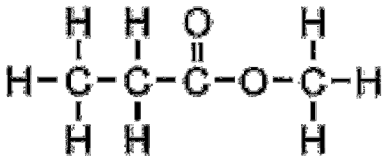
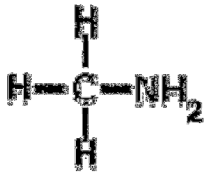
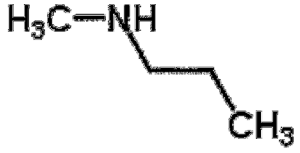
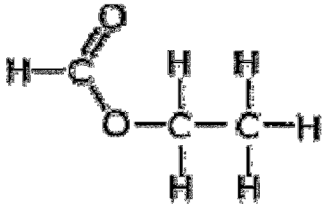
1) propanone Molecular Formula: _____ Functional Group: _____	2) _____  Molecular Formula: _____ Functional Group: _____	3) ethanoic acid Molecular Formula: _____ Functional Group: _____
4) _____  Molecular Formula: _____ Functional Group: _____	5) butanoic acid Molecular Formula: _____ Functional Group: _____	6) _____  Molecular Formula: _____ Functional Group: _____
7) 4-methyl pentanoic acid Molecular Formula: _____ Functional Group: _____	8) _____  Molecular Formula: _____ Functional Group: _____	9) 3-pentanone Molecular Formula: _____ Functional Group: _____
10) _____  Molecular Formula: _____ Functional Group: _____	11) 3-methyl-2-butanone Molecular Formula: _____ Functional Group: _____	12) _____  Molecular Formula: _____ Functional Group: _____

Name _____ Date _____

Period _____

Esters and Amines

Directions: Name the molecules where the structural formula is given, draw the structural formulas where the name is given. Provide the molecular formula and the functional group(s) for all the molecules (using Table R).

1) methyl ethanoate Molecular Formula: _____ Functional Group: _____	2) _____  Molecular Formula: _____ Functional Group: _____	3) 3-pentanamine Molecular Formula: _____ Functional Group: _____
4) _____  Molecular Formula: _____ Functional Group: _____	5) methyl ethylamine Molecular Formula: _____ Functional Group: _____	6) _____  Molecular Formula: _____ Functional Group: _____
7) ethyl propylamine Molecular Formula: _____ Functional Group: _____	8) _____  Molecular Formula: _____ Functional Group: _____	9) ethyl ethanoate Molecular Formula: _____ Functional Group: _____
10) _____  Molecular Formula: _____ Functional Group: _____	11) propyl methanoate Molecular Formula: _____ Functional Group: _____	12) _____  Molecular Formula: _____ Functional Group: _____

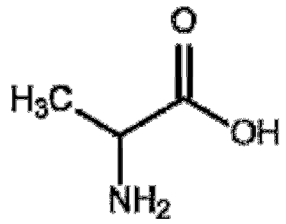
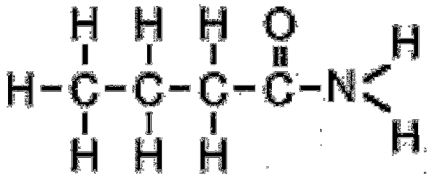
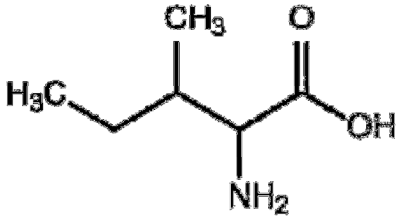
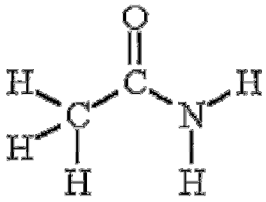
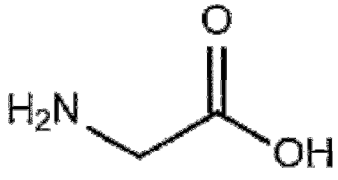
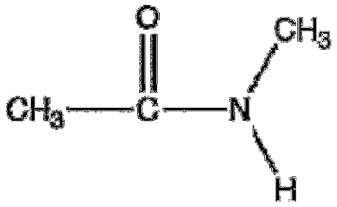
Name _____ Date _____

Period _____

Amides and Amino Acids

Directions: Name the molecules where the structural formula is given, draw the structural formulas where the name is given. Provide the molecular formula and the functional group(s) for all the molecules (using Table R).

*For the amino acids, do not name them, simply write "amino acid" in place of the name

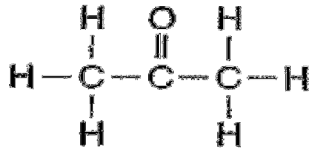
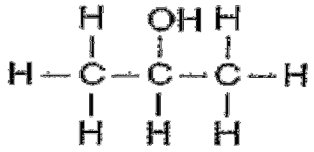
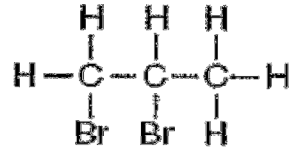
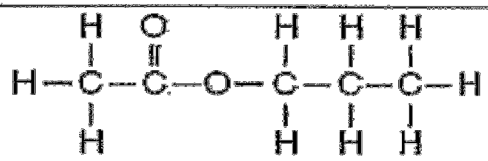
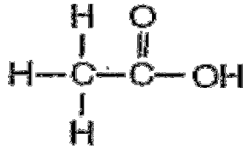
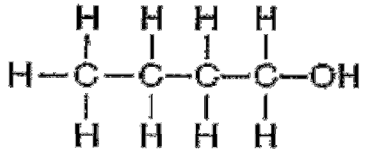
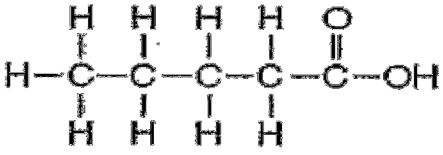
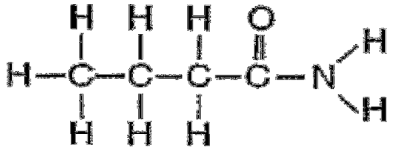
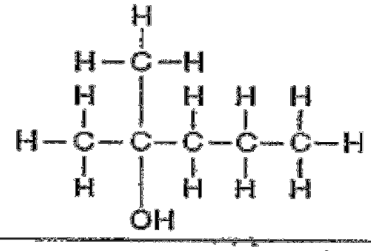
1) methanamide Molecular Formula: _____ Functional Group: _____	2) _____  Molecular Formula: _____ Functional Group: _____	3) ethyl methanamide Molecular Formula: _____ Functional Group: _____
4) _____  Molecular Formula: _____ Functional Group: _____	5) _____  Molecular Formula: _____ Functional Group: _____	6) _____  Molecular Formula: _____ Functional Group: _____
7) _____  Molecular Formula: _____ Functional Group: _____	8) propanamide Molecular Formula: _____ Functional Group: _____	9) _____  Molecular Formula: _____ Functional Group: _____

Name _____ Date _____

Period _____

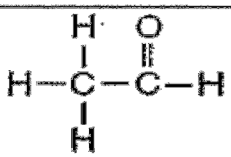
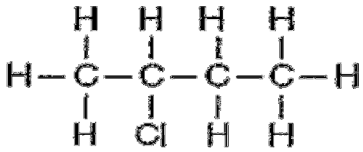
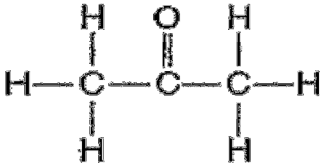
Functional Group Practice

Directions: Fill in the missing information in the table below.

Name	Drawing	Class of Compounds
		
		
		
		
		
		
		
		
		

Name _____ Date _____

Period _____

		
		
		
1-butanamine		
Pentanoic acid		
3-hexanone		
2,2-dibromobutane		
Ethyl pentanoate		
3-heptanol		
butanal		

Name _____ Date _____

Period _____

Organic Reactions

1. What occurs in a substitution reaction? _____

_____

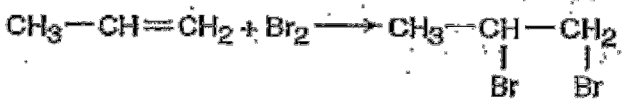
2. Which compound will undergo substitution with chlorine?

a. C_2H_4 b. CH_4 c. C_4H_8 d. C_3H_6

3. How can an unsaturated hydrocarbon become saturated? _____

_____

4. What type of reaction is represented by the equation below?



A) addition B) condensation C) substitution D) polymerization

5. What are the products of fermentation? _____

6. What must be present in order for fermentation to occur? _____

7. When an organic acid reacts with an alcohol what is formed? _____

8. What type of reaction occurs in question #7? _____

9. How is soap formed? _____

_____

10. Compare and contrast addition polymerization and condensation polymerization.

_____

_____

_____

11. Explain the difference between an addition reaction and a replacement reaction.

_____

_____

_____

12. What is a monomer? _____

13. The products of the complete combustion of a hydrocarbon are water and

A) an alcohol B) carbon C) carbon dioxide D) an aldehyde

14. The process of joining many monomers is called

A) saponification B) polymerization C) fermentation D) substitution

15. Condensation polymerization is *best* described as

A) a reduction reaction
B) a cracking reaction
C) a dehydration reaction
D) an oxidation reaction

16. During condensation polymerization, two monomers may be joined by the removal of a molecule of

A) hydrogen B) water C) carbon dioxide D) oxygen

Name _____ Date _____

Period _____

Directions: For each of the following reactions identify what type of reaction is represented and then determine what the products will be.

1. C_4H_{10} + Cl_2 → _____ + _____

Reaction Type: _____

2. C_2H_6 + Cl_2 → _____ + _____

Reaction Type: _____

3. $C_6H_{12}O_6$ + yeast → _____ + _____

Reaction Type: _____

4. C_3H_8 (g) + O_2 → _____ + _____

Reaction Type: _____

5. C_2H_4 + H_2 → _____ + _____

Reaction Type: _____

6. C_3H_8 + Br_2 → _____ + _____

Reaction Type: _____

7. Butane, C_4H_{10}, is used in disposable lighters because it easily undergoes a combustion reaction with O_2(g) in the air.

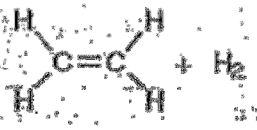
(a) In the box below, draw the structural formula for butane.

(b) To what homologous series of hydrocarbons does butane belong?

(c) On the line below, write the products for the complete combustion of butane.

$C_4H_{10} + O_2$ → _____

8. On the line below, write the product(s) for the reaction of this compound with H_2.



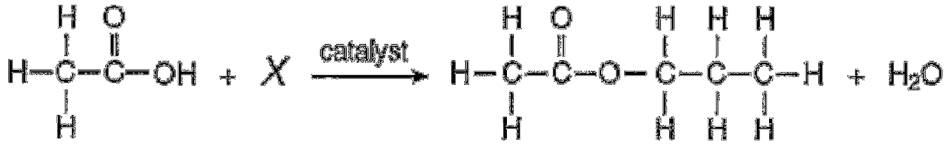
+ H_2 → _____

Name _____ Date _____

Period _____

Base your answers to questions 1 through 4 on the information below.

The incomplete equation below represents an esterification reaction. The alcohol reactant is represented by X.



1. Box the functional group in the organic reactants and products.

2. Circle the atom within the organic acid functional group that will be lost during a chemical reaction (it's also the atom that makes it an "acid").

3. Write an IUPAC name for the reactant represented by its structural formula in this equation.

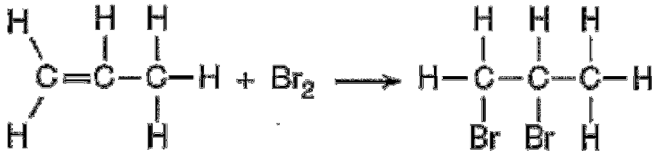
4. In the box below, draw the structural formula for the alcohol represented by X.

5. Given the balanced equation for producing bromomethane:

$$Br_2 + CH_4 \rightarrow CH_3Br + HBr$$

Identify the type of organic reaction shown.

Base your answers to questions 6 through 7 on the equation below, which represents an organic compound reacting with bromine.



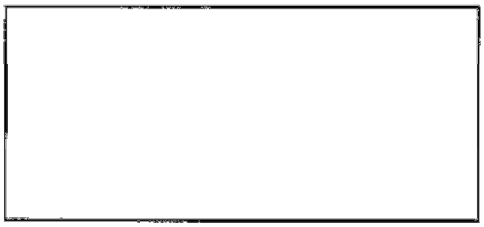
6. What is the IUPAC name for the organic compound that reacts with Br_2?

7. What type of organic reaction is represented by this equation?

Base your answers to questions 8 and 9 on the information below.

Many esters have distinctive odors, which lead to their widespread use as artificial flavorings and fragrances. For example, methyl butanoate has an odor like pineapple and ethyl methanoate has an odor like raspberry.

8. In the box below, draw a structural formula for the ester that has an odor like pineapple.



9. What is a chemical name for the alcohol that reacts with methanoic acid to produce the ester that has an odor like raspberry?

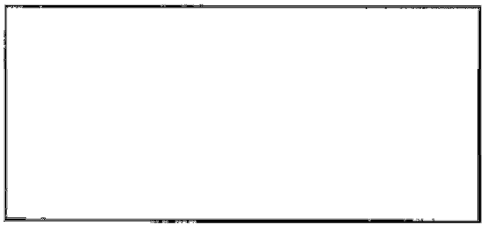
Base your answers to questions 10 through 11 on the information below.

Given the balanced equation for an organic reaction between butane and chlorine that takes place at 300.°C and 101.3 kilopascals:

$$C_4H_{10} + Cl_2 \rightarrow C_4H_9Cl + HCl$$

10. Identify the type of organic reaction shown.

11. Draw a structural formula for the organic product.



12. Given the incomplete equation for the combustion of ethane:

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6 \_\_\_\_$$

What is the formula of the missing product?
(1) CH_3OH (2) $HCOOH$ (3) H_2O (4) H_2O_2

13. Given the balanced equation for an organic reaction:

$$C_2H_2 + 2Cl_2 \rightarrow C_2H_2Cl_4$$

This reaction is best classified as
(1) addition (2) esterification (3) fermentation (4) substitution

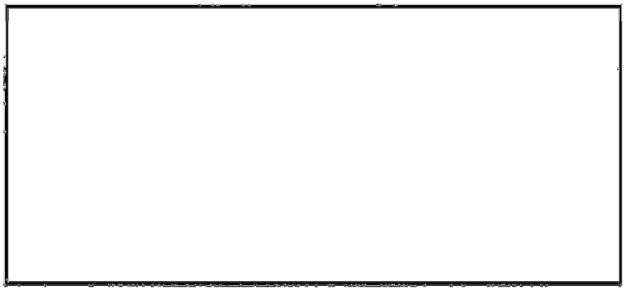
Base your answers to questions 14 and 15 on the information below.

Given the reaction between 1-butene and chlorine gas:

$$C_4H_8 + Cl_2 \rightarrow C_4H_8Cl_2$$

14. Which type of chemical reaction is represented by this equation?

15. Draw the structural formula of the product 1,2-dichlorobutane.



16. Given the incomplete equation representing an organic addition reaction:

$$X(g) + Cl_2(g) \rightarrow XCl_2(g)$$

Which compound could be represented by *X*?
(1) CH_4 (2) C_2H_4 (3) C_3H_8 (4) C_4H_{10}

Name: _____

Section I: For each statement or question, write on the answer blank the letter of the word or expression, of those given, that best completes the statement or answers the question. Some questions may require the use of Reference Tables for Physical Setting/Chemistry.

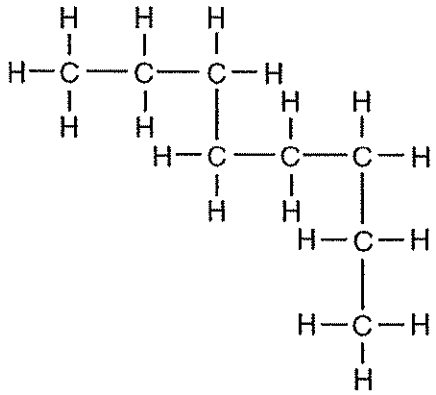
1) Which element must be present in an organic compound?
   A) nitrogen
   B) oxygen
   C) carbon
   D) hydrogen

2) Molecules of 1-bromopropane and 2-bromopropane differ in
   A) structural formula
   B) number of bromine atoms per molecule
   C) molecular formula
   D) number of carbon atoms per molecule

3) Which formula represents an unsaturated hydrocarbon?
   A) C_6H_{14}
   B) C_5H_8
   C) C_3H_8
   D) C_2H_6

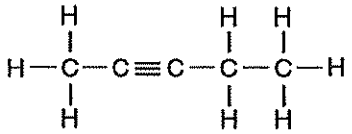
4) Which compound is classified as a hydrocarbon?
   A) ethane
   B) ethanoic acid
   C) chloroethane
   D) ethanol

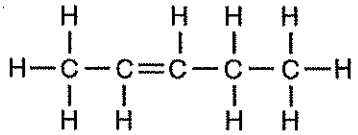
5) What is the correct IUPAC name for the hydrocarbon with the structural formula shown below?

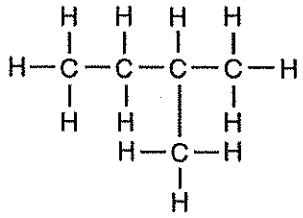


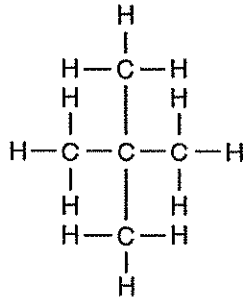
   A) 1-propyl pentane
   B) 1-propyl hexane
   C) *n*-octane
   D) 1-propyl-3-ethyl propane

6) Which structural formula represents 2-pentyne?

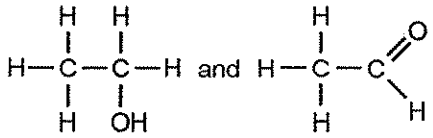
A)


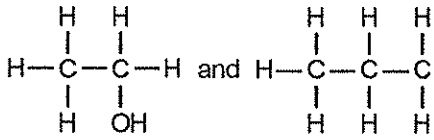
B)


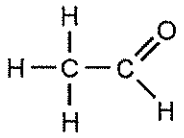
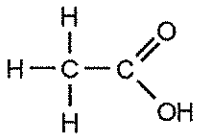
C)


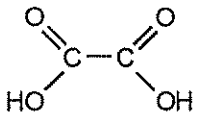
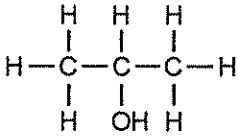
D)


7) Which pair of compounds are alcohols?

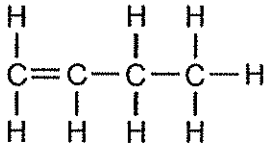
A)  and

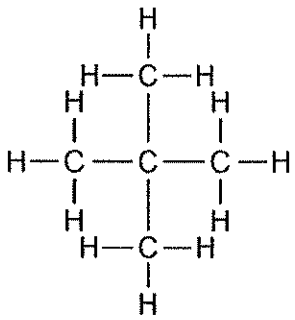
B)  and

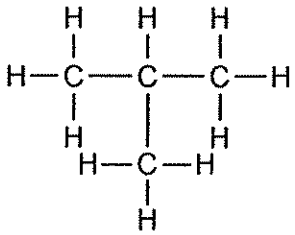
C)  and 

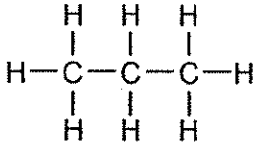
D)  and 

8) Which formula is an isomer of butane?

A) 

B) 

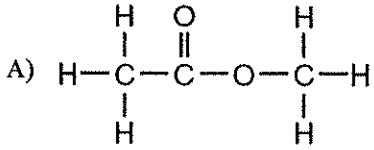
C) 

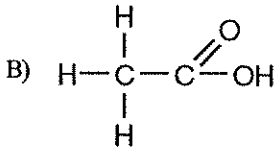
D) 

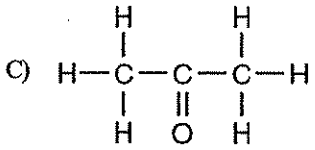
9) Methanal is the IUPAC name for an

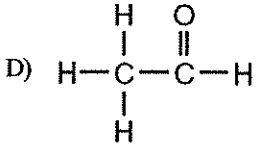
A) alcohol
B) aldehyde
C) ether
D) acid

10) Which structural formula represents a ketone?

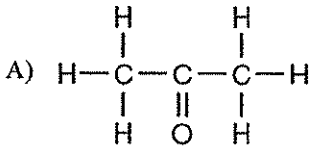
A) 

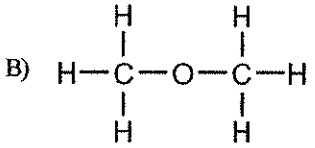
B) 

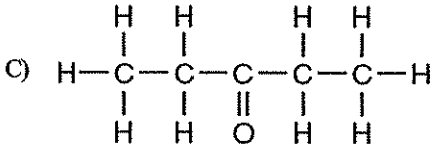
C) 

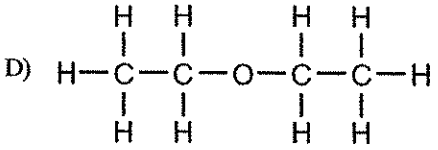
D) 

11) Which of the following is the structural formula for diethyl ether?

A) 

B) 

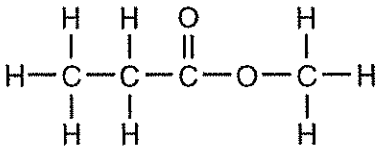
C) 

D) 

12) Which of the following statements is true for a compound whose formula is CH_3CH_2COOH?

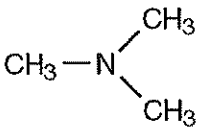
A) Its solution turns phenolphthalein pink.
B) Its solution turns litmus blue.
C) It is an alcohol.
D) It is an acid.

13) What type of compound is represented by the following structural formula?



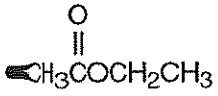
A) an ester
B) an aldehyde
C) an ether
D) a ketone

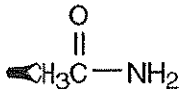
14) To which organic family does the compound with the following structural formula belong?

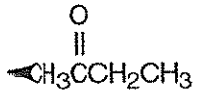


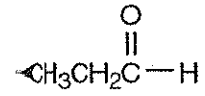
A) ethers
B) ketones
C) esters
D) amines

15) Which structure represents an amide?

A) 

B) 

C) 

D) 

16) Which compound can undergo an addition reaction?

A) C_2H_4
B) C_4H_{10}
C) CH_4
D) C_3H_8

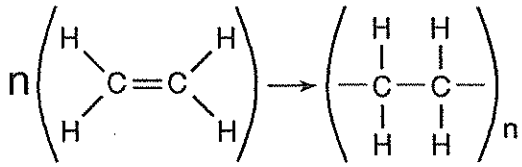
17) Given the equation:

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2$$

The chemical process illustrated by this equation is

A) saponification
B) fermentation
C) polymerization
D) esterification

18) Which type of reaction is represented by the equation below? *[NOTE: n and n are very large numbers equal to about 2,000.]*



A) fermentation
B) polymerization
C) saponification
D) esterification

19) In which reaction is soap a product?

A) addition
B) polymerization
C) saponification
D) substitution

20) The products of the complete combustion of a hydrocarbon are water and

A) carbon
B) an aldehyde
C) carbon dioxide
D) an alcohol

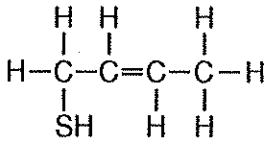
Section II: Record your answers in the spaces provided. Some questions may require the use of Reference Tables for Physical Setting/Chemistry.

21) Draw the structural formula for butanoic acid.

22) In the box below, draw the structural formula for propanone.

Questions 23 and 24 refer to the following:

A thiol is very similar to an alcohol, but a thiol has a sulfur atom instead of an oxygen atom in the functional group. One of the compounds in a skunk's spray is 2-butene-1-thiol. The formula of this compound is shown below.

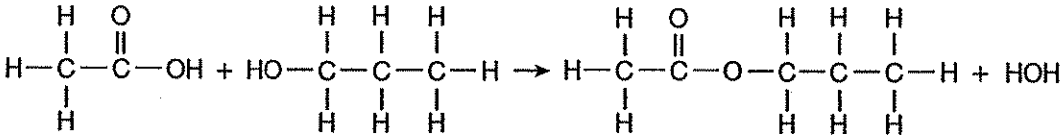


23) Explain, in terms of composition, why the compound described is a thiol.

24) Explain, in terms of electron configuration, why oxygen atoms and sulfur atoms form compounds with similar molecular structures.

Questions 25 through 27 refer to the following:

Many artificial flavorings are prepared using the type of organic reaction shown below.

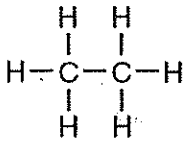


25) What is the name of the organic reaction shown?

26) To what class of organic compounds does reactant 2 in the given diagram belong?

27) In the box below, draw the structural formula of an isomer of reactant 2 in the given diagram.

28) Given the following structural formula:

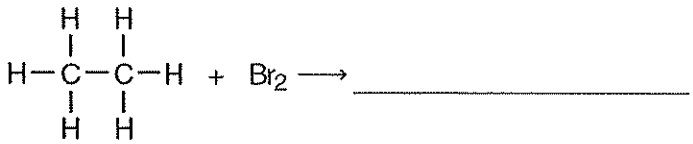


(a) To what series of homologous hydrocarbons does this compound belong?

(b) Write the correct IUPAC name for this compound.

(c) Is this compound saturated or unsaturated? [*Give evidence to support your answer.*]

(d) On the line below, write the product(s) for the reaction of this compound with Br_2.

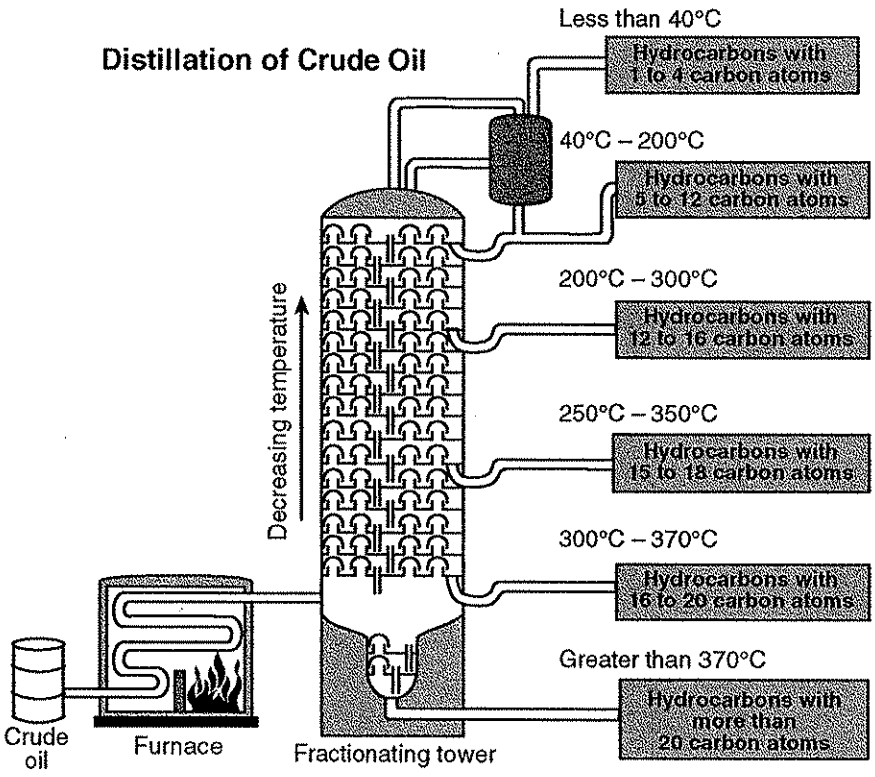


(e) Name the type of organic reaction that occurs between C_2H_6 and Br_2.

Questions 29 through 32 refer to the following:

Crude oil is a mixture of many hydrocarbons that have different numbers of carbon atoms. The use of a fractionating tower allows the separation of this mixture based on the boiling points of the hydrocarbons.

To begin the separation process, the crude oil is heated to about 400° C in a furnace, causing many of the hydrocarbons of the crude oil to vaporize. The vaporized mixture is pumped into a fractionating tower that is usually more than 30 meters tall. The temperature of the tower is highest at the bottom. As vaporized samples of hydrocarbons travel up the tower, they cool and condense. The liquid hydrocarbons are collected on tray sand removed from the tower. The diagram below illustrates the fractional distillation of the crude oil and the temperature ranges in which the different hydrocarbons condense.



29) Based on the information given, state the trend between the boiling point of the hydrocarbons contained in the crude oil and the number of carbon atoms in these molecules.

30) Describe the relationship between the strength of the intermolecular forces and the number of carbon atoms in the different hydrocarbon molecules for the given situation.

31) Write an IUPAC name of *one* saturated hydrocarbon in the situation shown that leaves the fractionating tower at less than 40° C.

32) How many hydrogen atoms are present in one molecule of octane?