

Name.....

Period.....

Unit 12: Organic Chemistry

Skills:

1. Review Properties of Polar/Non Polar Covalent Molecules
2. Identify Properties of Organic Compounds
3. Naming and Drawing Hydrocarbons
4. Saturated and Unsaturated Hydrocarbons
5. Identifying and Drawing Isomers
6. Identifying Functional Groups (Table R)
7. Identifying + Completing Organic Reactions

Unit 12: Vocabulary:**Complete throughout unit. Due on test day!**

<u>Word</u>	<u>Definition</u>
<u>Polar Bonds</u>	
<u>Alkane</u>	
<u>Alkene</u>	
<u>Alkyne</u>	
<u>Hydrocarbon</u>	
<u>Saturated Hydrocarbon</u>	
<u>Isomer</u>	
<u>Functional Group</u>	
<u>Ether</u>	
<u>Ester</u>	
<u>Alcohol</u>	
<u>Amine</u>	
<u>Polymerization</u>	
<u>Fermentation</u>	
<u>Saponification</u>	

Skill 1: Review of Polar and Nonpolar Covalent Bonds and Molecules

What is the difference between polar and nonpolar covalent **bonds**?

- **Polar Bonds:** _____ (generally consist of: _____)

- **Nonpolar Bonds:** _____ (generally consist of: _____)

Bond	END Polar or non Polar	If polar, label the ends + or -
H-C		
C-C		
C-Cl		

What is the difference between polar and nonpolar **molecules**?

- Polar Molecules: _____

- Nonpolar Molecules: _____

Formula	Dot Diagram for	Dot Diagram For	Dot Diagram of Molecule	Polar or Non Polar Molecule
CH₄				
CH₃Cl				
H₂O				

Review of Carbon

- Has _____ unpaired valence electrons

- Forms _____ bonds with other nonmetals

- Forms _____ (Two or more different structural forms giving it different properties)

Lewis Structure:

C

Skill 2: Identify Properties of Organic Compounds:

Organic Chemistry: The study of _____ containing compounds. They occur extensively in nature because all living things are made of _____ containing compounds.

- Contain _____ and Hydrogen
 - May also have _____, _____ or _____ (group 17: F, Cl, Br, I)

Type of carbon-carbon bond	1. Single Bond	2. Double Bond	3. Triple Bond
Structural Formula (Each line represents _____ shared electrons)			
# of shared PAIRS or electrons between C atoms			
# of shared electrons between C atoms			

Possible structures for carbon-containing compounds:

Chains	Rings	Networks

Properties of Organic Compounds

1. Generally _____ molecules (held together by London Dispersion/Van der Waals forces – which are _____ intermolecular forces (IMF))
2. _____ melting and boiling points
3. Non-electrolytes – do not _____
4. _____ in water (because NONPOLAR molecules do NOT dissolve in POLAR solvents –REMEMBER “Likes dissolves likes)
5. _____ – making them a primary source of energy

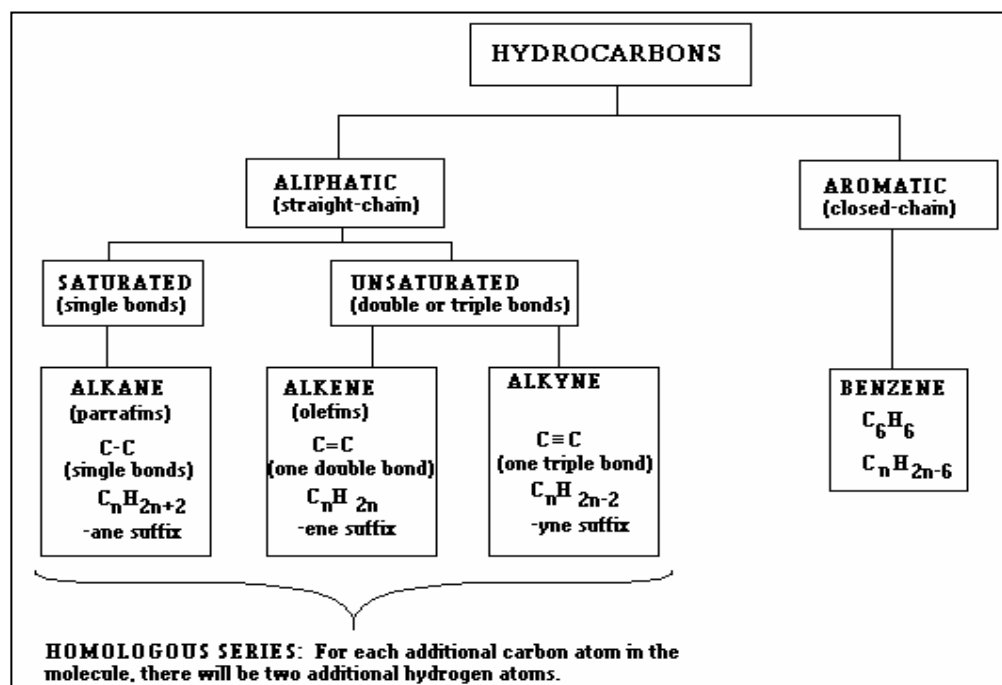
Ways to Represent Organic Compound:

Molecular Formula	Structural Formula	Condensed Formula
<ul style="list-style-type: none"> Shows how many and kind of atoms in molecule Ex:	<ul style="list-style-type: none"> Shows types of bond Shows shape of molecule Ex:	<ul style="list-style-type: none"> Shows Order of molecule Ex:

Practice:

- Which type of bonds and solids are character of organic compounds?
 - ionic bonds and ionic solids
 - ionic bonds and molecular solids
 - covalent bonds and ionic solids
 - covalent bonds and molecular solids
- In general, which property do organic compounds share?
 - high melting points
 - high electrical conductivity
 - high solubility in water
 - slow reaction rate
- A carbon atom in any organic compound can form a total of
 - 1 covalent bond
 - 2 covalent bonds
 - 3 covalent bonds
 - 4 covalent bonds
- Which best explains why there are more organic compounds than inorganic compounds?
 - the carbon atom readily forms covalent bonds with other carbon atoms
 - the carbon atom readily forms ionic bonds with other carbon atoms
 - the carbon atom readily combines with oxygen
 - the carbon atom readily dissolves in water
- Atoms of which element can bond to each other to form chains, rings, and networks?
 - carbon
 - fluorine
 - hydrogen
 - oxygen
- Which element must be present in an organic compound?
 - hydrogen
 - oxygen
 - carbon
 - nitrogen

Skill 2: Naming and Drawing Hydrocarbons



HOMOLOGOUS SERIES: For each additional carbon atom in the molecule, there will be two additional hydrogen atoms.

Hydrocarbons:

Organic compounds consisting of ONLY _____ and _____

(See Tables _____ and _____)

Alkanes Name ends in -ane C_nH_{2n+2}	Alkenes Name ends in -ene C_nH_{2n}	Alkynes Name ends in -yne C_nH_{2n-2}
CH ₄ _____	C ₂ H ₄ _____	C ₂ H ₂ _____
C ₂ H ₆ _____	C ₃ H ₆ _____	C ₃ H ₄ _____
C ₄ H ₁₀ _____	C ₄ H ₈ _____	C ₄ H ₆ _____

Structural Formulas of Alkanes

NOTE: Structural formulas can be written without the hydrogens bonded to the carbon. You just have lines coming off the carbon to indicate that hydrogen is bonded to it.

Methane (natural gas) _____	Propane (gas in grills) _____	Octane (gasoline) _____
Condensed Structural Formula _____	Condensed Structural Formula _____	Condensed Structural Formula _____

Structural Formulas of Alkenes

NOTE: If there is a double or triple bond, we want to know where it is in the chain of carbons, so we put a number to indicate which carbon the double or triple bond is on **(USE THE LOWEST NUMBER POSSIBLE)**

Ethene _____	Propene _____	Butene _____
Condensed Structural Formula _____	Condensed Structural Formula _____	1-butene _____ 2-butene _____

□ Structural Formulas of Alkynes

NOTE: Follow the same rules as naming alkenes (use a number to indicate where the triple bond is)

Ethyne _____	Propyne _____	Hexyne _____
_____	_____	1-hexyne _____
		2-hexyne _____

Practice:

Which compound is a member of the same homologous series as C_3H_8 ?

- (1) CH_4 (3) C_5H_8
(2) C_4H_8 (4) C_6H_{10}

A molecule of a compound contains a total of 10 hydrogen atoms and has the general formula C_nH_{2n+2} . Which prefix is used in the name of this compound?

- (1) but- (3) oct-
(2) dec- (4) pent-

Which formula represents an alkene?

- (1) C_2H_6 (3) C_4H_{10}
(2) C_3H_6 (4) C_5H_{12}

Identify the homologous series of hydrocarbons to which CH_3CHCH_2 belongs.

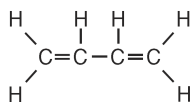
Hydrocarbons are compounds that contain

- (1) C, only (3) C, H, and O, only
(2) C and H, only (4) C, H, O, and N, only

Which general formula represents the compound $CH_3CH_2CCH_3$?

- (1) C_nH_n (3) C_nH_{2n-2}
(2) C_nH_{2n} (4) C_nH_{2n}

Given the formula of a substance:



What is the total number of shared electrons in a molecule of this substance?

- (1) 22 (3) 9 (2) 11 (4) 6

Skill 4: Saturated and Unsaturated Hydrocarbons

Saturated Hydrocarbons: hydrocarbons with _____

- **Family Name:** _____

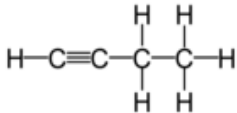
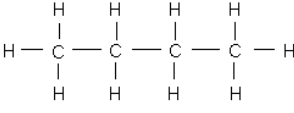
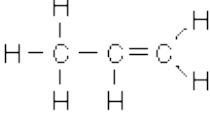
- **Example:** Butane

Unsaturated Hydrocarbons: hydrocarbons with _____

- **Family Names:** _____

- **Example:** 2-Butene

Below are the **STRUCTURAL FORMULAS** of three different hydrocarbons. Complete the table.

Structural formula			
Molecular formula			
Name			
Saturated or Unsaturated?			

Fill in the table below:

Molecular Formula	Name	Homologous Series	Saturated or Unsaturated?
C ₂ H ₆			
C ₄ H ₆			
C ₃ H ₄			
C ₇ H ₁₄			
C ₅ H ₁₂			
	propane		
	hexene		
	butyne		
	octane		

1. Which compound is a saturated hydrocarbon?

- (1) propanal (3) propene
(2) propane (4) propyne

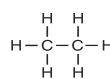
2. Which compound is a saturated hydrocarbon?

- (1) CH₂CH₂ (3) CH₃CHO
(2) CH₃CH₃ (4) CH₃CH₂OH

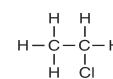
3. Which formula represents an unsaturated hydrocarbon?

- (1) CH₂CHCl (3) CH₃CH₂CH₃
(2) CH₃CH₂Cl (4) CH₃CHCH₂

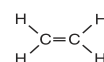
4. Which formula represents an unsaturated hydrocarbon?



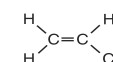
(1)



(3)



(2)



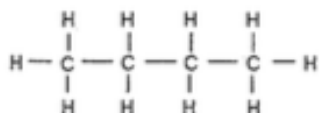
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Skill 5: Identifying and Naming Isomers

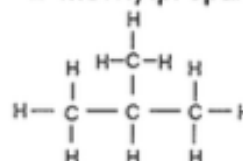
Shown below are a table of the physical and chemical properties and the structural formula of butane and 2-methylpropane. How are these two compounds different? How are they similar?

Property	Butane	2-methylpropane
Color	colorless	colorless
Melting point	-138 °C	-160 °C
Boiling point	-1 °C	-11.7 °C
Solubility in water	6.1 mg/100 mL water	insoluble
Flammability/reactivity with oxygen	Highly flammable	Flammable

butane



2-methylpropane



Calculate the % composition:

C:

C:

H:

H:

Summary: Butane and 2-methylpropane are _____ As the # of carbon atoms _____, so does the # of ISOMERS**

Isomers have the SAME:

Isomers have DIFFERENT:

1. Which has more isomers: C₆H₁₄ or C₁₀H₂₂: _____

2. For each of the pairs of compounds below, state whether they are isomers of one another:

Compounds		Isomers?
$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H}-\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array} $ <p>cyclohexane</p>	$ \begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & & & \\ \text{H}-\text{C} & =\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{H} \\ & & & & & & \\ & & \text{H} & \text{H} & \text{H} & \text{H} & \end{array} $ <p>hexene</p>	
$ \begin{array}{ccc} \text{H} & \text{O} & \text{H} \\ & & \\ \text{H}-\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & \\ \text{H} & & \text{H} \end{array} $ <p>2-propanone</p>	$ \begin{array}{ccc} \text{H} & \text{H} & \text{O} \\ & & \\ \text{H}-\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & \\ \text{H} & \text{H} & \end{array} $ <p>propanal</p>	

3. Which two compounds are isomers of each other?

- (1) $\text{CH}_3\text{CH}_2\text{COOH}$ and $\text{CH}_3\text{COOCH}_2\text{CH}_3$
- (2) $\text{CH}_3\text{CH}_2\text{CHO}$ and CH_3COCH_3
- (3) $\text{CH}_3\text{CHBrCH}_3$ and $\text{CH}_2\text{BrCHBrCH}_3$
- (4) $\text{CH}_3\text{CHOHCH}_3$ and $\text{CH}_3\text{CHOHCH}_2\text{OH}$

4. The compounds CH_3OCH_3 and $\text{CH}_3\text{CH}_2\text{OH}$ are isomers of each other. These two compounds must have the same

- (1) density
- (2) reactivity
- (3) melting point
- (4) molecular formula

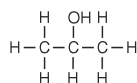
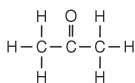
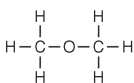
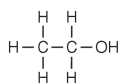
5. Given the structural formulas:

Formula A

Formula B

Formula C

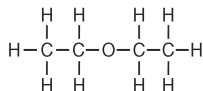
Formula D



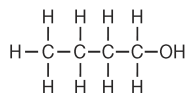
Which two formulas represent compounds that are isomers of each other?

- (1) A and B
- (2) A and C
- (3) B and D
- (4) C and D

6. Given the formulas for two compounds:



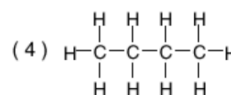
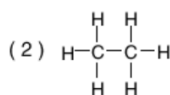
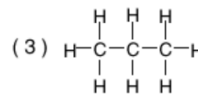
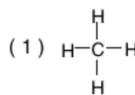
and



These compounds differ in

- (1) gram-formula mass
- (2) molecular formula
- (3) physical properties at STP

7. Which compound has an isomer?



8. The isomers butane and methylpropane differ in their

- (1) molecular formulas
- (2) structural formulas
- (3) total number of atoms per molecule
- (4) total number of bonds per molecule

9. Two substances have different physical and chemical properties. Both substances have molecules that contain two carbon atoms, one oxygen atom, and six hydrogen atoms. These two substances must be

- (1) isomers of each other
- (2) isotopes of each other
- (3) the same compound
- (4) the same hydrocarbon

10. Which pair of compounds are isomers?

- (1) NO_2 and N_2O_4
- (2) P_2O_5 and P_4O_{10}
- (3) HCOOH and CH_3COOH
- (4) CH_3OCH_3 and $\text{C}_2\text{H}_5\text{OH}$

In the boxes below, draw the following hydrocarbons. In the adjacent box, draw an isomer of the hydrocarbon AND NAME IT using IUPAC rules.

(a) pentane	Isomer name:
(b) 2-pentene	Isomer name:
(c) 2-pentyne	Isomer name:
(d) 2-butene	Isomer name:

Skill 6: Identifying and Naming Functional Groups (Table R)

Organic Functional Groups (Using Table R)

- Hydrogen atoms in hydrocarbons can be replaced with other groups of atoms called **functional groups** to make many different kinds of organic compounds (listed on Table R)
- Part of an organic molecule that is _____ in a chemical reaction and that determines the _____ of that compound
- Compounds with the same functional group have **SIMILAR** _____ !!

1. HALIDES (HALOCARBONS)

<u>Functional Group</u>	<u>Naming</u>	Draw: 1-chloro-2,2-difluoropropane
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2. ALCOHOLS *FORMULA CLUE: C_xH_yOH

<u>Functional Group</u>	<u>Naming</u>	Draw: 2-propanol
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3. ETHERS

<u>Functional Group</u>	<u>Naming</u>	Draw: dimethyl ether
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4. ALDEHYDES

<u>Functional Group</u>	<u>Naming</u>	Draw: 3 – methylbutanal
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5. KETONES

<u>Functional Group</u>	<u>Naming</u>	Draw: 2 – butanone
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6. ORGANIC ACIDS * weak ELECTROLYTES because they release H⁺ in solution (ACIDS)

<u>Functional Group</u>	<u>Naming</u>	Draw: ethanoic acid
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*FORMULA CLUE: C_xH_yCOOH

7. ESTERS * have strong, fragrant aromas (these compounds are responsible for odors of many foods and flavorings) "Whatever Ester COOCs (cooks) smells nice"

<u>Functional Group</u>	<u>Naming</u>	Draw: methyl butanoate
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8. AMINES

<u>Functional Group</u>	<u>Naming</u>	Draw: 2-propanamine
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9. AMIDES

<u>Functional Group</u>	<u>Naming</u>	Draw: ethanamide
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(a) In terms of bonding, how are alcohols and organic acids different?

(b) In terms of chemical properties, how are all organic acids alike?

(c) In terms of chemical properties, how are organic acids and alcohols different?

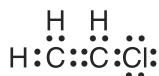
(d) In terms of structure, how are ketones and aldehydes different?

(e) In terms of bonding, how are esters and ethers different?

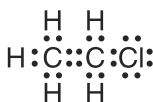
(f) In terms of bonding, how are ketones and esters different?

Practice:

1. Which Lewis electron-dot diagram represents chloroethene?



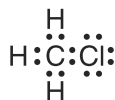
(1)



(3)

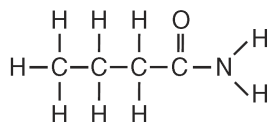


(2)



(4)

2. Given the formula:



This compound is classified as

- (1) an aldehyde (3) an amine
(2) an amide (4) a ketone

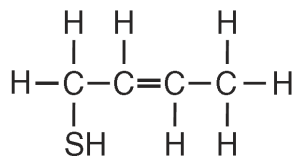
3. What is the total number of carbon atoms in a molecule of ethanoic acid?

- (1) 1 (3) 3
(2) 2 (4) 4

4. Which of these compounds has chemical properties most similar to the chemical properties of ethanoic acid?

- (1) $\text{C}_3\text{H}_7\text{COOH}$ (3) $\text{C}_2\text{H}_5\text{COOC}_2\text{H}_5$
(2) $\text{C}_2\text{H}_5\text{OH}$ (4) $\text{C}_2\text{H}_5\text{OC}_2\text{H}_5$

5. 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.

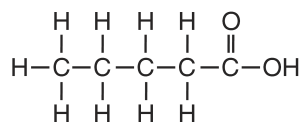


(a) Explain, in terms of composition, why this compound is a thiol.

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

- (c) A small amount of methanethiol, which has a distinct odor, is added to propane to help consumers detect a propane leak. In methanethiol, the odor is caused by the thiol functional group ($-\text{SH}$). Methanethiol, CH_3SH , has a structure that is very similar to the structure of methanol.

6. Given the structural formula:



What is the IUPAC name of this compound?

- (1) pentanal (3) methyl pentanoate
(2) pentanol (4) pentanoic acid

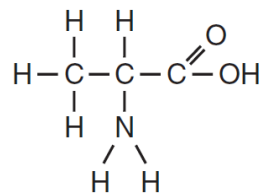
7. What is the IUPAC name for the compound that has the condensed structural formula $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$?

- (1) butanal (3) propanal
(2) butanol (4) propanol

8. What is the total number of pairs of electrons shared between the carbon atom and the oxygen atom in a molecule of methanal?

- (1) 1 (3) 3
(2) 2 (4) 4

9. Given the structural formula:



This structural formula represents a molecule of

- (1) an aldehyde (3) a ketone
(2) an ester (4) an amino acid

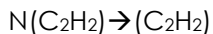
Skill 7: Seven Types of Organic Reactions....P.S. FACES!

P.....: **Making a MACROMOLECULE (huge molecule) by bonding lots of small units together.**

Ex:

Natural Polymers

- _____
- _____
- _____



Synthetic Polymers

- _____
 - _____
 - _____
-

S.....: **H atoms replaced with another atom or functional group**
*****Saturated hydrocarbons (alkanes) only*****

Ex:



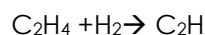
F.....: **Sugar is broken into an alcohol and carbon dioxide—what yeast does to make wine, beer and bread**

Ex: Balance the following using the lowest whole number coefficients:



A.....: **Adding one or more atoms to a double or triple bond**
****Unsaturated hydrocarbons only****

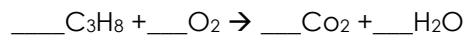
Ex:



C.....: **BURNING!! Oxygen MUST be present for combustion to happen**

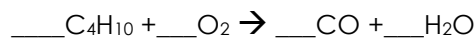
Complete Combustion: Lots of O_2 available to produce CO_2 and H_2O

Ex: Write the balanced equation for the following combustion reaction:



Incomplete combustion: _____ produces CO and H_2O

Ex: Write the balanced equation for the following combustion reaction:



E.....: **Making an ester!**

- Word Equation: Organic Acid + Alcohol → Ester + Water
- Chemical Equation: _____ + _____ → _____ + _____

S.....: **Making Soap!!!**

- Word Equation: Ester + Base → Alcohol + SOAP

SUMMARY OF ALL REACTIONS:

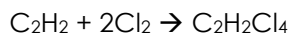
Reaction	General Formula	
Synthesis		
Decomposition		
Single Replacement		
Double Replacement		
Organic Reactions: P. S. F. A. C. E. S!	Polymerization:	
	Substitution:	
	Fermentation:	
	Addition:	
	Combustion:	
	Esterification:	
	Saponification:	

Skill 7 Practice:

1. The reaction that joins thousands of small, identical molecules to form one very long molecule is called

(1) esterification (3) polymerization
(2) fermentation (4) substitution

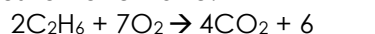
2. Given the balanced equation for an organic reaction:



This reaction is best classified as

(1) addition (3) fermentation
(2) esterification (4) substitution

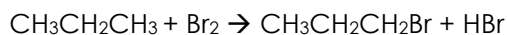
3. Given the incomplete equation for the combustion of ethane:



What is the formula of the missing product?

(1) CH_3OH (3) H_2O
(2) HCOOH (4) H_2O_2

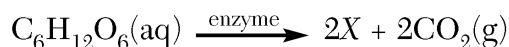
4. Given the balanced equation representing a reaction:



This organic reaction is best classified as

(1) an addition reaction
(2) an esterification reaction
(3) a polymerization reaction
(4) a substitution reaction

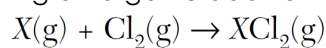
5. Given the balanced equation with an unknown compound represented by X:



Which compound is represented by X?

(1) $\text{CH}_3\text{OH}(\text{aq})$ (3) $\text{CH}_3\text{CH}_2\text{OH}(\text{aq})$
(2) $\text{CH}_2(\text{OH})_4(\text{aq})$ (4) $\text{CH}_2\text{OHCH}_2\text{OH}(\text{aq})$

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



Which compound could be represented by X?

(1) CH_4 (3) C_3H_8
(2) C_2H_4 (4) C_4H_{10}

7. The process of joining many small molecules into larger molecules is called

(1) neutralization (3) saponification
(2) polymerization (4) substitution

8. Given the equation:

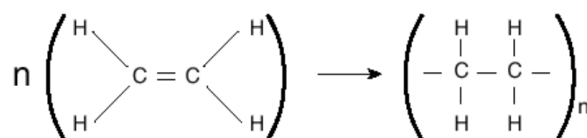


Which molecule is represented by X?

(1) C_2H_4 (3) C_3H_6
(2) C_2H_6 (4) C_3H_8

9. Which type of reaction is represented by the equation below?

Note: n is a very large number equal to about 2000

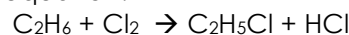


(1) esterification (3) saponification
(2) fermentation (4) polymerization

10. In which reaction is soap a product?

(1) addition (3) saponification
(2) substitution (4) polymerization

11. Given the equation:



This reaction is best described as

(1) addition involving a saturated hydrocarbon
(2) addition involving an unsaturated hydrocarbon
(3) substitution involving a saturated hydrocarbon
(4) substitution involving an unsaturated hydrocarbon

12. Given the reaction:



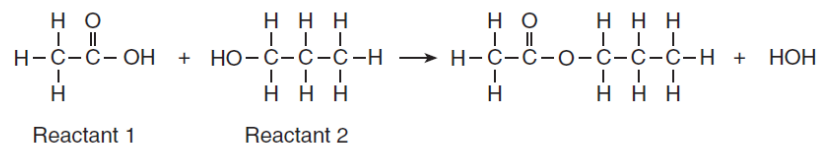
This reaction is an example of

(1) fermentation
(2) saponification
(3) hydrogenation
(4) esterification

13. Which formula correctly represents the product of an addition reaction between ethene and chlorine?

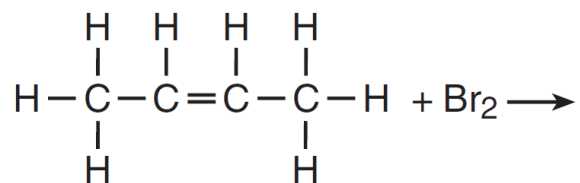
(1) CH_2Cl_2 (3) $\text{C}_2\text{H}_4\text{Cl}_2$
(2) CH_3Cl (4) $\text{C}_2\text{H}_3\text{Cl}$

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



- (a) What is the name of this organic reaction? _____
- (b) To what class of organic compounds does reactant 2 belong? _____
- (c) Draw the structural formula of an isomer of reactant 2.

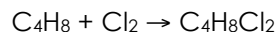
15. In the space to the right of the reactants and arrow below, draw the structural formula for the product of the reaction shown.



16. Given the equation: butanoic acid + 1-pentanol \rightarrow water + X

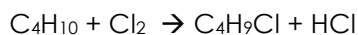
To which class of organic compounds does product X belong? _____

17. Given the reaction between 1-butene and chlorine gas:



- (a) Which type of chemical reaction is represented by this equation? _____
- (b) Draw the structural formula of the product 1,2-dichlorobutane.

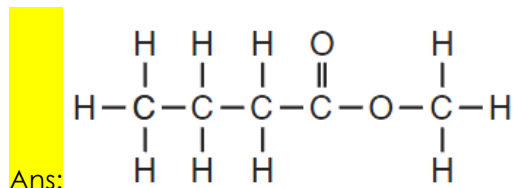
18. Given the balanced equation for an organic reaction between butane and chlorine that takes place at 300.°C and 101.3 kilopascals:



- (a) Identify the type of organic reaction shown. _____
- (b) Draw a structural formula for the organic product.

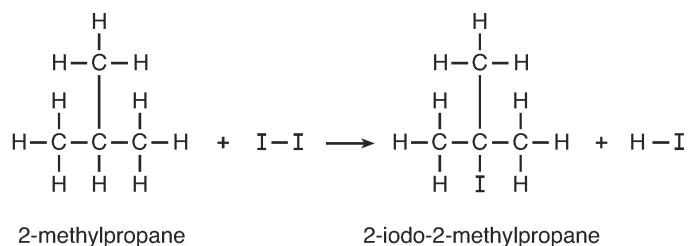
37. Many esters have distinctive odors, which lead to their widespread use as artificial flavorings and fragrances. For example, methyl butanoate has an odor like pineapple and ethyl methanoate has an odor like raspberry.

(a) Draw a structural formula for the ester that has an odor like pineapple.



(b) What is a chemical name for the alcohol that reacts with methanoic acid to produce the ester that has an odor like raspberry? **ethanol**

38. The hydrocarbon 2-methylpropane reacts with iodine as represented by the balanced equation below. At standard pressure, the boiling point of 2-methylpropane is lower than the boiling point of 2-iodo-2-methylpropane.



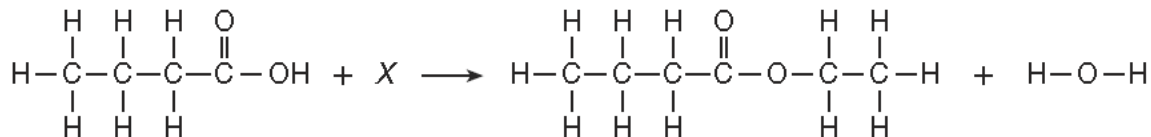
(a) To which class of organic compounds does this organic product belong? _____
halocarbons OR halides

(b) Explain, in terms of bonding, why the hydrocarbon 2-methylpropane is saturated.
There are only single bonds in methylpropane

(c) Explain the difference in the boiling points of 2-methylpropane and 2-iodo-2-methylpropane in terms of both molecular polarity and intermolecular forces.

The molecules of 2-iodo-2-methylpropane are more polar and have stronger IMF than the molecules of 2-methylpropane.

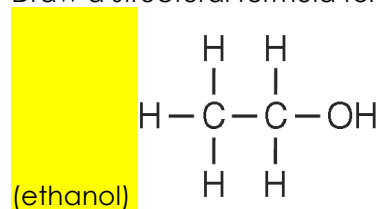
39. The equation below represents the reaction between butanoic acid and an unidentified reactant, X.



(a) Identify the type of organic reaction represented by the equation. _____
esterification

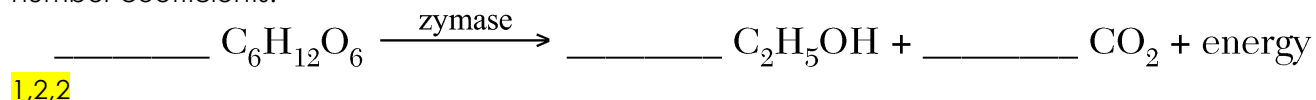
(b) Write the molecular formula of the organic product in the equation. _____ **C₆H₁₂O₂**

(c) Draw a structural formula for the unidentified reactant, X, in the equation.

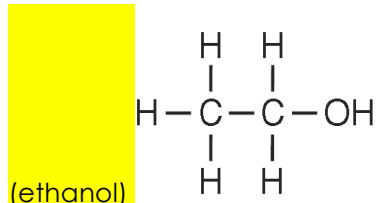


40. During a bread-making process, glucose is converted to ethanol and carbon dioxide, causing the bread dough to rise. Zymase, an enzyme produced by yeast, is a catalyst needed for this reaction.

(a) Balance the equation below for the reaction that causes bread dough to rise, using the smallest whole-number coefficients.



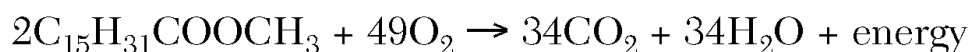
(b) Draw a structural formula for the alcohol formed in this reaction.



(c) State the effect of zymase on the activation energy for this reaction.

Zymase lowers the activation energy.

41. Biodiesel is an alternative fuel for vehicles that use petroleum diesel. Biodiesel is produced by reacting vegetable oil with CH_3OH . Methyl palmitate, $\text{C}_{15}\text{H}_{31}\text{COOCH}_3$, a compound found in biodiesel, is made from soybean oil. One reaction of methyl palmitate with oxygen is represented by the balanced equation below.



(a) Write an IUPAC name for the compound that reacts with vegetable oil to produce biodiesel.

methanol

(b) Explain, in terms of both atoms and molecular structure, why there is no isomer of CH_3OH .

There are too few atoms to create a different molecular structure.

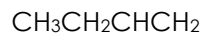
(c) Identify the class of organic compounds to which methyl palmitate belongs. ester

(d) Identify the type of organic reaction represented by the balanced equation. combustion

(e) State evidence from the balanced equation that indicates the reaction is exothermic.

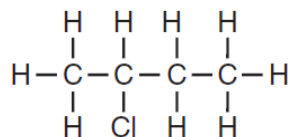
Energy is on the right side of the arrow.

42. Base your answers to the following questions on the condensed structural formula below.



(a) Draw the structural formula for this compound.

(b) The formula below represents a product formed when HCl reacts with $\text{CH}_3\text{CH}_2\text{CHCH}_2$.



What is the IUPAC name for this product? 2-chlorobutane

(c) Identify the type of organic reaction described in (b). addition