

Organic Chemistry

UNIT 5: ORGANIC CHEMISTRY

All important vocabulary is in Italics and bold.

- Compare and contrast *inorganic* and *organic* chemistry.
- Describe the structural characteristics of carbon.
- Name, draw, and construct structural models of alkanes
*Include: **branched alkanes**, **structural isomers***
- Compare and contrast the molecular structures of *alkanes*, *alkenes*, and *alkynes*.
Include: trends in melting points and boiling points
- Name, draw, and construct molecular models of alkenes and alkynes
*Include: **branched alkenes** and **alkynes***
- Outline the transformation of alkanes to alkenes or alkynes and vice versa.
*Include: **dehydrogenation/hydrogenation***
- Compare and contrast the structure of *aromatic* and *aliphatic* hydrocarbons.
*Include: **molecular models**, **structural formulas**, **common uses***
- Write condensed structural formulas for and name common *alcohols*.
*Include: **uses of common alcohols***
- Write condensed structural formulas for and name *organic acids*.
*Include: **uses and functions of common organic acids***
- Write condensed structural formulas for and name *esters*.
*Include: **uses and functions of common esters***
- Write condensed structural formulas for and name *alkyl halides*.
- Describe some common organic reactions.
*Including: **esterification**, **halogenation**, **hydration**, **hydrogenation***
- Describe the process of *polymerization* and identify important natural and synthetic *polymers*.

Additional KEY Terms

distillation
cycloalkanes
resonance

alkyl group
saturated
functional group

substituent
unsaturated
monomer

HYDROCARBONS

Number of carbons	Associated prefix	Prefix + ane (ending)	Formula of hydrocarbon
1	meth-	meth <u>ane</u>	CH ₄
2	eth-	eth <u>ane</u>	C ₂ H ₆
3	prop-	prop <u>ane</u>	C ₃ H ₈
4	but-	but <u>ane</u>	C ₄ H ₁₀
5	pent-	pent <u>ane</u>	C ₅ H ₁₂
6	hex-	hex <u>ane</u>	C ₆ H ₁₄
7	hept-	hept <u>ane</u>	C ₇ H ₁₆
8	oct-	oct <u>ane</u>	C ₈ H ₁₈
9	non-	non <u>ane</u>	C ₉ H ₂₀
10	dec-	dec <u>ane</u>	C ₁₀ H ₂₂

ANSWER THE FOLLOWING QUESTIONS OF ALKANES:

1. If an alkane has:

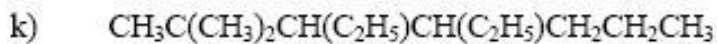
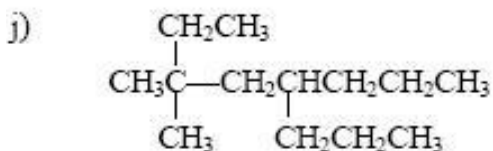
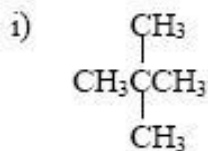
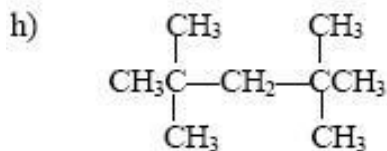
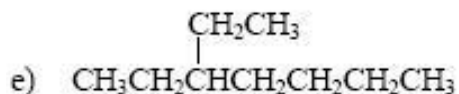
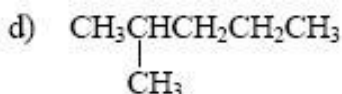
- a) 6 carbons, how many H atoms will it have?
- b) 20 H atoms, how many C atoms will it have?
- c) 25 C atoms, how many H atoms will it have?
- d) 12 H atoms, how many C atoms will it have?

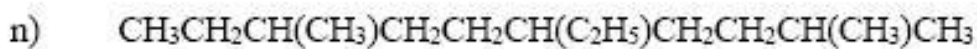
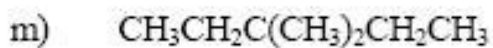
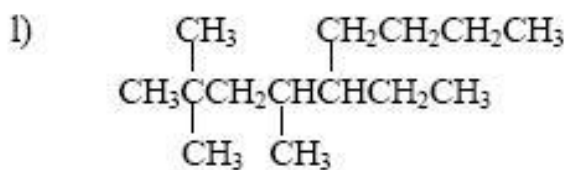
2. Identify each of the following as organic or inorganic.

- a) NaHCO_3
- b) CH_4
- c) $\text{HC}_2\text{H}_3\text{O}_2$
- d) HCN
- e) Ca_2C
- f) C_2H_2

3. Name each of the following:

- a) C_7H_{16}
- b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$





4. Draw the structural formulas for each of the following:

a) butane

h) 2,2,3,4-tetramethylpentane

b) decane

i) 3-ethyl-2,2-dimethylhexane

c) heptane

j) 5-butyl-2,2-dimethylnonane

d) 2,3-dimethylpentane

k) 3-ethyl-2-methylpentane

e) 3-ethylhexane

l) 3,3-diethylheptane

f) 3-ethylpentane

m) 2,3,5-trimethylhexane

g) 2,3-dimethylbutane

n) 3,4-diethyl-2,2,7-trimethyloctane

5. Determine if there is anything *wrong* with these compound names?

Correct the error if found. (*Hint: Draw the structures first*)

a) 5-methylhexane

e) 4-methyloctane

b) 2-ethyl-2-methylpropane

f) 2,3-trimethylheptane

c) 1-methylbutane

g) 1,4-dimethylpentane

d) 3,5-ethyl-2-methylheptane

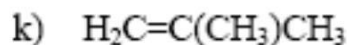
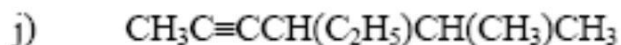
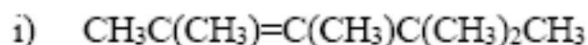
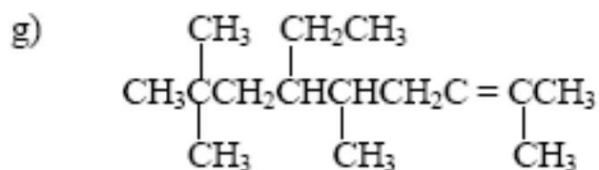
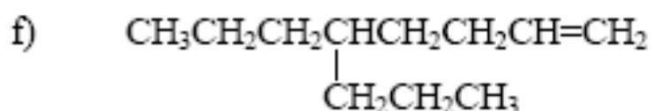
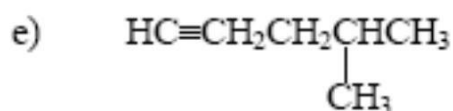
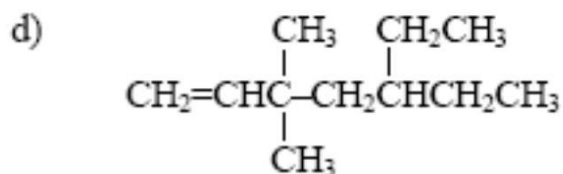
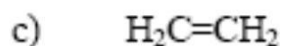
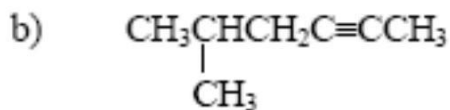
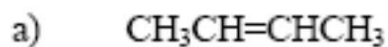
h) 1,3,5-trimethylnonane

ANSWER THE FOLLOWING QUESTIONS ON ALKENES AND ALKYNES:

1. If you have an alkene with
 - a) 6 carbons, how many H's do you have?
 - b) 12 carbons, how many H's do you have?
 - c) 20 H's, how many carbons do you have?
 - d) 17 carbons, how many H's do you have?
 - e) 6 H's, how many carbons do you have?
2. If you have and alkyne with
 - a) 6 carbons, how many H's do you have?
 - b) 12 carbons, how many H's do you have?
 - c) 20 H's, how many carbons do you have?
 - d) 17 carbons, how many H's do you have?
 - e) 6 H's, how many carbons do you have?
3. What is the difference between saturated and unsaturated organic compounds?
4. What properties of hydrocarbons change as the length of the chain increases?
5. Draw the following structures:

a) propyne	f) 2,3,5-trimethyl-2-hexene
b) 4-ethyl-2-nonene	g) 3,5-dimethyl-1-heptyne
c) 3-decyne	h) 4,4-diethyl-7-methyl-2-decene
d) 4,4-dimethyl-2-pentyne	i) 3-methyl-1-butene
e) 3-methyl-1-butyne	j) 5-ethyl-2,2,4,6-tetramethyl-4-octene

6. Name the following compounds.



7. What, if anything, is wrong with the following names?

a) 2-methyl-3-butene

d) 2,2-dimethyl-1-hexene

b) 2,2-dimethyl-3-pentyne

e) 3-methyl-1-octyne

c) 1-butene f) 5-octyne

8. Write the balanced equation, using structural formulas, for the following reactions.

a) hydrogenation of 2-butene

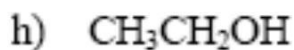
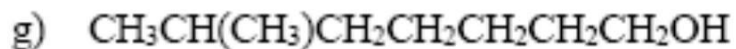
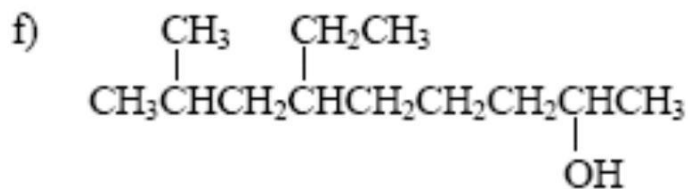
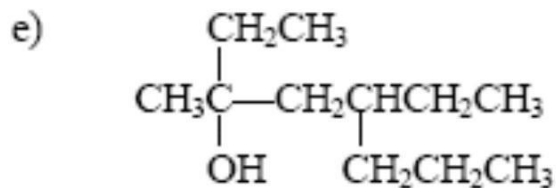
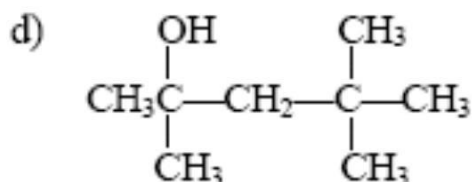
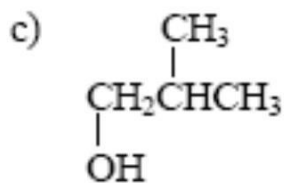
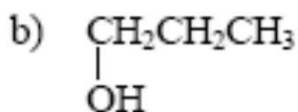
b) dehydrogenation of propane

c) 4-methyl-2-hexyne + 1 H₂

ANSWER THE FOLLOWING QUESTIONS OF ALCOHOLS:

1. Compare and contrast the effect of the OH group in organic and inorganic chemistry.

2. What is the IUPAC name of each of the following alcohols?



3. Draw the structural formula of each alcohol.

a) Methanol

b) 1-pentanol

c) 4-methyl-2-heptanol

d) 9,9-dimethyl-6-propyl-4-decanol

e) 3-ethyl-2-methyl-1-pentanol

f) 2,4,5-trimethyl-2-hexanol

g) 3,3-dimethyl-2-butanol

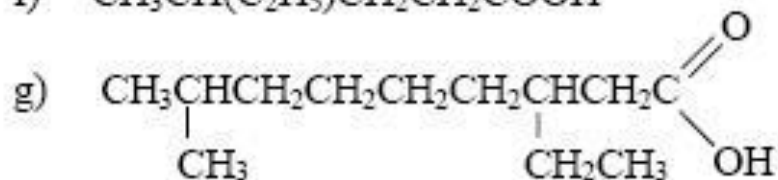
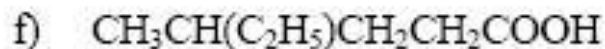
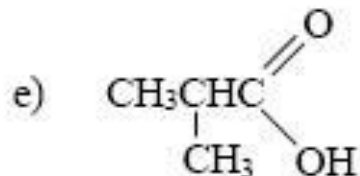
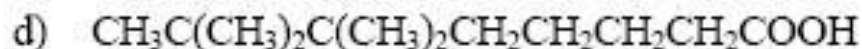
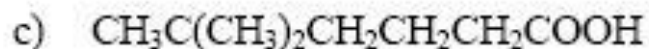
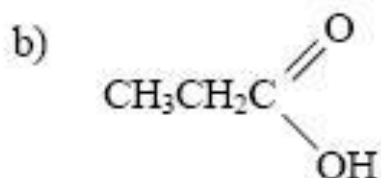
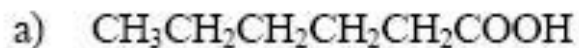
h) 3,5-diethyl-3-octanol

i) phenol

j) 2,4-diethylphenol

ANSWER THE FOLLOWING QUESTIONS OF CARBOXYLIC ACIDS:

1. Give the IUPAC name for each of the following.



2. Draw the structure of each of the following.

a) ethanoic acid

b) octanoic acid

c) 3-methylhexanoic acid

d) 4,4-dimethylheptanoic acid

e) 3,3-dimethyl-4-propyldecanoic acid

f) 2,2,3-trimethylbutanoic acid

g) 3-ethylheptanoic acid

ANSWER THE FOLLOWING QUESTIONS OF ESTERS:

1. Write the esterification equation for each of the following. Name and draw the structural formula for each reactant and product formed.

a) propanoic acid and 1-butanol

b) butanoic acid and 1-hexanol

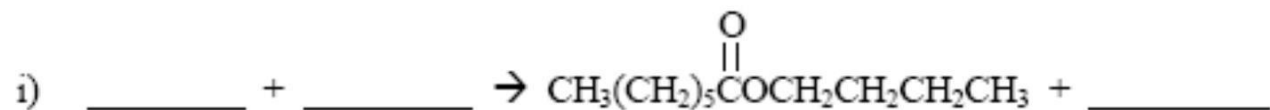
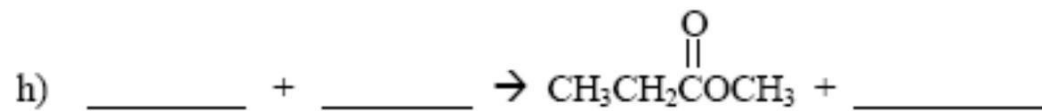
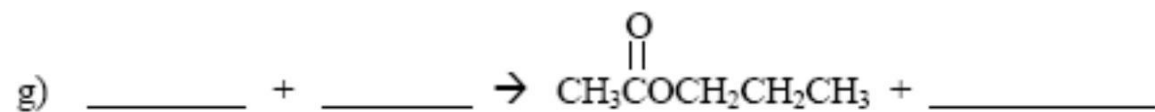
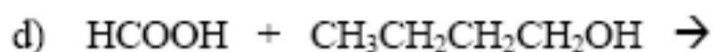
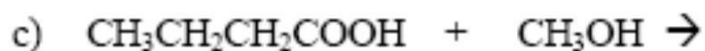
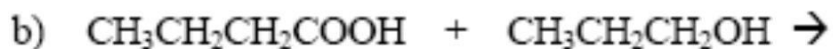
c) pentanoic acid and 1-octanol

d) methanoic acid and ethanol

e) hexanoic acid and 1-propanol

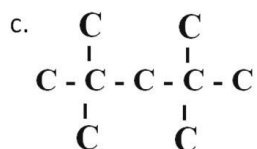
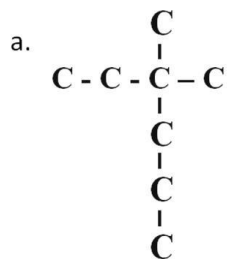
f) butanoic acid and methanol

2. Draw the condensed formula that completes each of the following equations.
Name each reactant and product.

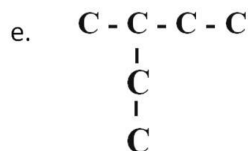
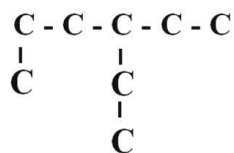


Organic Unit Review

1. Draw complete structural formulas for alkanes with two and six carbons. Name the structures.
2. Draw condensed structural formulas for pentane and heptane.
3. Name the compounds that follow:



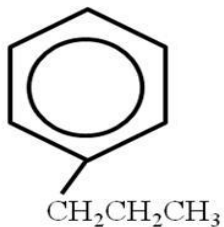
d.



4. Draw complete structural formulas for the following compounds:
 - a. 3-ethyl-2,4-dimethyloctane
 - b. 2,2,4-trimethylpentane
 - c. 3-ethylhexane
 - d. 3,5-diethyl-2,3-dimethyl-5-propyldecane
 - e. Propyne
 - f. cyclopentane
5. Draw the structural formulas for the following alkenes. If a compound has geometric isomers, draw both the *cis* and *trans* forms.
 - a. 1-pentene
 - b. 2-hexene
 - c. 2-methyl-2-hexene
 - d. 2,3-dimethyl-2-butene

6. Name the following compounds:

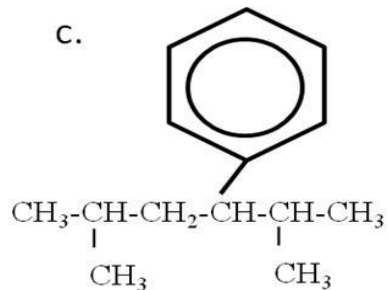
a.



b.



c.



7. Why are the following names incorrect?

- 2-dimethylpentane
- 1,3-dimethylpropane
- 3-methylbutane
- 3,4-dimethylbutane

8. Explain the difference between *saturated* and *unsaturated* hydrocarbon compounds.

9. Draw all the possible alkenes with the molecular formula C_4H_8 . Name each compound.

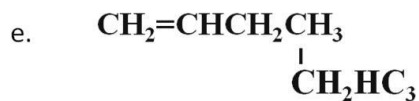
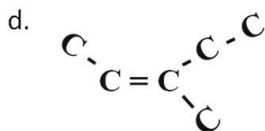
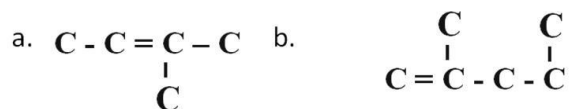
10. Explain why alkenes have *cis/trans* isomers and alkanes don't.

11. Draw a structure for each compound.

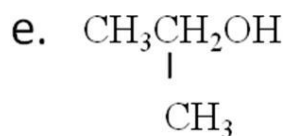
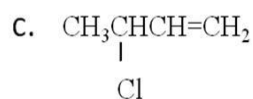
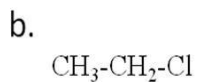
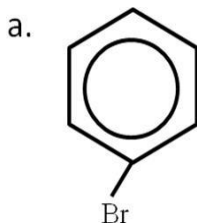
- p*-diethylbenzene
- 2-methyl-3-phenylpentane
- p*-xylene
- toluene

12. Write a complete balanced equation for the combustion of pentane.

13. Name the following compounds:



14. Name the following compounds:



15. Give the structural formula for each of the following compounds:

a. 2-chloropropane

b. 1-iodo-2,2-dimethylpentane

c. *p*-bromobenzene.

d. 2-methylphenol

e. 1,2-dichlorocyclohexane

f. 1,2-ethandiol

16. Give the name for the following carboxylic acids and esters:

- a. HCOOH
- b. $\text{CH}_3\text{CH}_2\text{COOH}$
- c. $\text{CH}_3\text{COOCH}_2\text{CH}_3$
- d. CH_3COOH
- e. $\text{CH}_3(\text{CH}_2)_4\text{COOH}$

- f. $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_3$

17. Use the ester from question 16c to show a complete *de-esterification* reaction.

18. Use 2-butene to show a *hydration* reaction.

19. Write the structure for the reactants and expected products from each reaction:

- a. propene + bromine gas \rightarrow
- b. 2-pentene + iodine gas \rightarrow
- c. 3-octyne + hydrogen gas \rightarrow
- d. *trans* 2-butene + hydrogen gas \rightarrow

20. Explain the difference between addition and condensation polymerization.