

Test Course

Naming Chemical Compounds

Final Report - Answer Guide

Institution	SI Curriculum Development University
Session	Test Course
Course	Test Course
Instructor	Corinne Brown

Test Your Knowledge

Match each term with the best description.

IUPAC	Reference for organizing elements by their chemical properties	1
Hydrocarbon	Nonmetallic elements that are held together by covalent bonds	2
Ionic compound	Cation and anion held together by electrostatic forces	3
Molecular compound	Organic compound containing only carbon and hydrogen	4
Periodic table	Naming system for chemical compounds	5

Correct answers:

- | | | | | | |
|---|----------------|---|--------------------|---|----------------|
| 1 | Periodic table | 2 | Molecular compound | 3 | Ionic compound |
| 4 | Hydrocarbon | 5 | IUPAC | | |

Match the number of carbon atoms with the correct prefix.

1	Eth-	1
2	Hept-	2
3	Non-	3
6	Meth-	4
7	Hex-	5
9	Dec-	6
10	Prop-	7

Correct answers:

1 2 2 7 3 9 4 1 5 6 6 10 7 3

Categorize each statement as a naming property for molecular compounds, ionic compounds, or polyatomic ions.

⚡ Cations with a fixed or variable charge	
⚡ Greek prefix may be on first & second element	
⚡ No charge indicated in the formula	⚡ No prefix on the first or second element
⚡ Roman numerals used to denote charges	
⚡ Second element name ends with the suffix "-ide"	
Ionic Compounds	Molecular Compounds
1	2

Correct answers:

1 Cations with a fixed or variable charge

No prefix on the first or second element

Roman numerals used to denote charges

2 Greek prefix may be on first & second element

No charge indicated in the formula

Second element name ends with the suffix "-ide"

Exploration

Elements are arranged in the periodic table according to their chemical properties.

- ☒ True
- ☐ False



Every known chemical has a unique name that is derived from the IUPAC naming system.

☐ True



☐ False

A substituted hydrocarbon is an organic compound in which one or more hydrogen atoms is replaced by another type of atom or group of atoms.

☐ True



☐ False

The prefix for a hydrocarbon with 6 carbons is ____.

☐ but-

☐ hex-



☐ pent-

☐ hept-

The suffix for a hydrocarbon with a carbon-carbon double bond is ____.

☐ -ene



☐ -yne

☐ -ane

☐ -oxy

Binary molecular compounds consist of ____.

☐ one nonmetal and one metal element

☐ two metal elements

☐ two nonmetal elements



☐ one metal element and one polyatomic ion

Molecular compounds must be balanced by mathematically calculating the charge.

☐ True

☒ False

✓

The ____ must be known to ensure the correct number of atoms of each element are present in an ionic compound.

☐ polyatomic ions

☐ binary molecules

☒ oxidation state

☐ Greek prefix

✓

The sum of the charges for the cation and anion of a neutral ionic compound must equal ____.

☒ 0

☐ 1

☐ -1

☐ 10

✓

Exercise 1

Determine the molecular formula for the following hydrocarbons:

- a. Hexane**
- b. Propyne**
- c. 2-octyne**
- d. Decane**
- e. 4-nonene**

- a. C_6H_{14}
- b. C_3H_4
- c. C_8H_{14}

- d. $C_{10}H_{22}$
e. C_9H_{18}

Describe the difference between a saturated hydrocarbon and an unsaturated hydrocarbon. Name a total of 3 saturated hydrocarbons and a total of 3 unsaturated hydrocarbons from Data Table 1 and Photo 1-5.

A saturated hydrocarbon is a hydrocarbon consisting of all carbon-carbon single bonds allowing for a maximum amount of bonds to hydrogen; whereas an unsaturated hydrocarbon is a hydrocarbon consisting of one or more double or triple bonds. The saturated hydrocarbons from Data Table 1 and Data Table 2 include butane, decane, nonane, and propane. The unsaturated hydrocarbons from Data Table 1 and Data Table 2 include propyne, ethene, 2-octyne, 2-pentyne, 1-heptyne, and 4-decyne.

In your own words list the rules for naming hydrocarbons and substituted hydrocarbons. Be detailed in listing all rules including the priority for numbering carbons, prefixes and suffixes, and the structure of the name.

First, the number of carbons in the longest chain must be counted. Then, the suffix for the base name must be determined based on the type of carbon-carbon bonds present. The prefix for the base name is determined by the number of carbons present in the parent chain. Next, the carbons in the longest chain are counted with priority given to any double or triple bonds, followed by the location of any substituents. If there are no double or triple carbon-carbon bonds, then the priority is given to the substituent with the lowest number. Substituents should be named with the suffix -yl, except for the halogens which will replace the -ine with -o. Greek prefixes are used in naming the substituents if more than one of the same substituent are present on each compound. Each substituent will be given its own number corresponding to the carbon it is attached to. If a double or triple bond is present then the number of the first carbon for which the bond exists must also be included in the name. The name of the compound is written using hyphens to separate numbers from letters, and commas to separate numbers from numbers.

Data Table 1: Hydrocarbon Names
(SAMPLE ANSWER BELOW)

#	Compound Name
1	Butane
2	Propyne
3	Ethene
4	2-octyne

Photo 1: 2-pentyne
(SAMPLE ANSWER BELOW)

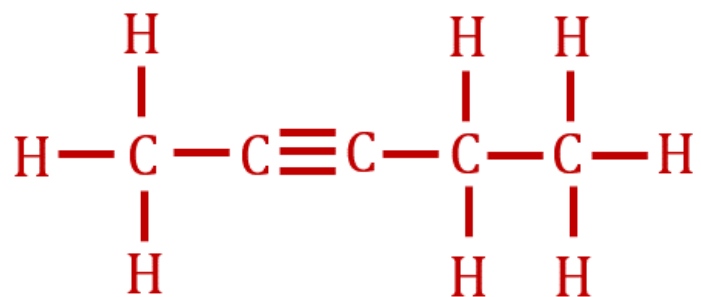


Photo 2: Decane
(SAMPLE ANSWER BELOW)

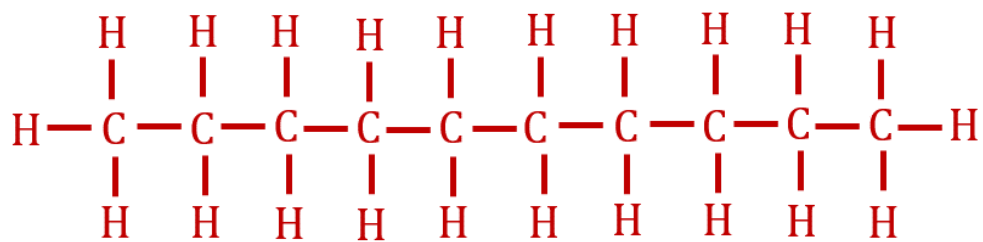


Photo 3: 1-heptyne
(SAMPLE ANSWER BELOW)

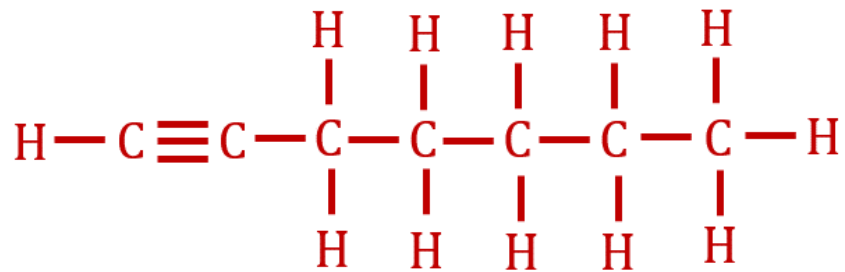


Photo 4: 4-decyne
(SAMPLE ANSWER BELOW)



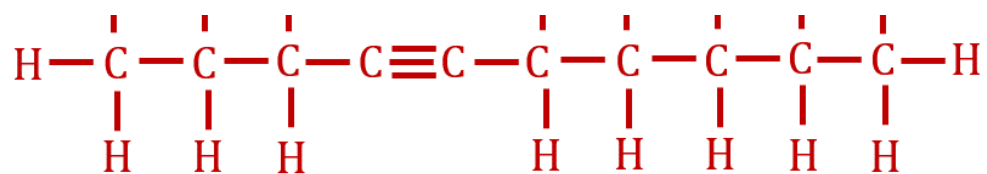
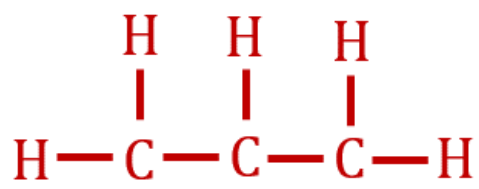


Photo 5: Propane
(SAMPLE ANSWER BELOW)





Data Table 2: Organic Compound Names
(SAMPLE ANSWER BELOW)

#	Compound Name
1	2-chloropentane
2	2,3-difluoro-4-methyl-1-hexene
3	3-bromo-3-chloro-1-butyne
4	2-bromo-3,6,6-trichloro-4-methyl-1-octene
5	2,2,8,8-tetrabromo-6-fluoro-4,6-diethyldecane

Photo 6: 3-bromo-2,2-dimethylbutane

(SAMPLE ANSWER BELOW)

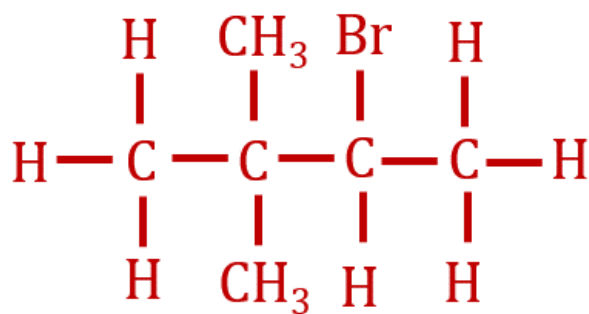


Photo 7: 3-bromo-4-ethyl-1,1,1-trifluoro-5-methylheptane
(SAMPLE ANSWER BELOW)

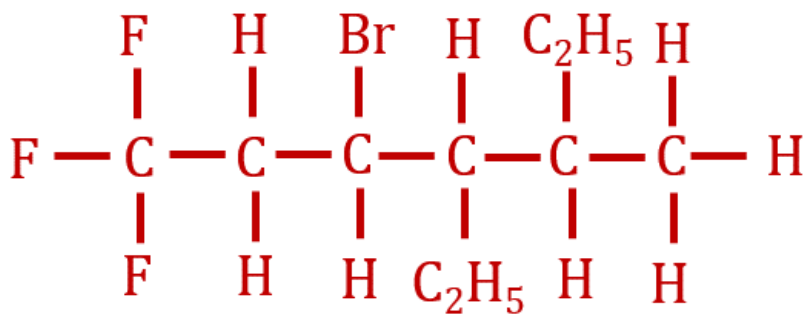


Photo 8: 5-bromo-4,4-dichloro-1-hexyne
(SAMPLE ANSWER BELOW)





Photo 9: 1,2-dichloroethene
(SAMPLE ANSWER BELOW)

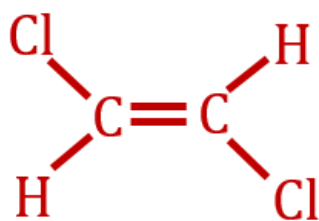
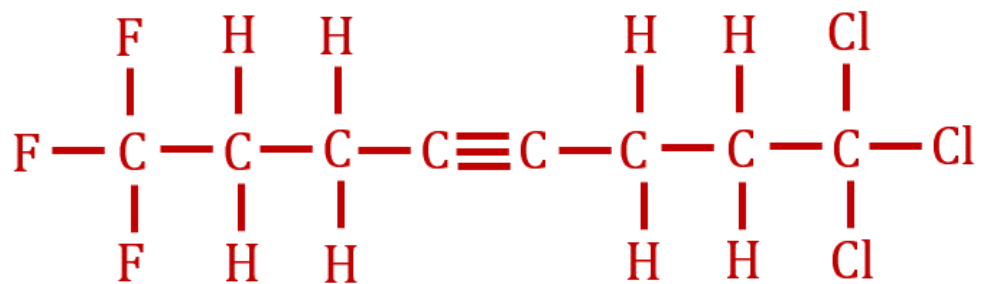


Photo 10: 1,1,1-trichloro-8,8,8-trifluoro-4-octyne
(SAMPLE ANSWER BELOW)



Exercise 2

The metals in Group IIIA, IVA, and VA of the periodic table are not transition metals. However, all but 1 have variable charges. What element in Group IIIA, Period 3 has a fixed charge, and what is that charge?

Aluminum 3+

Describe the difference between molecular and ionic compounds.

Molecular compounds consist of nonmetallic elements that combine through covalent bonds. Ionic compounds consist of one metal (cation) and one nonmetal (anion or polyatomic ion) held together by ionic bonds.

Data Table 3: Binary Molecular and Ionic Compound Names
(SAMPLE ANSWER BELOW)

	Formula	Molecular or Ionic Compound?	Compound Name
1	B ₂ O ₃	Molecular	Diboron trioxide
2	N ₂ O	Molecular	Dinitrogen monoxide
3	LiCl	Ionic	Lithium chloride
4	N ₂ O ₄	Molecular	Dinitrogen tetroxide
5	BrF ₃	Molecular	Bromine trifluoride
6	AlBr ₃	Ionic	Aluminum bromide
7	SnF ₂	Ionic	Tin(II) fluoride
8	SiCl ₄	Molecular	Silicon tetrachloride
9	NaCl	Ionic	Sodium chloride
10	TiCl ₃	Ionic	Titanium(III) chloride
11	CuF ₂	Ionic	Copper(II) fluoride
12	SF ₆	Molecular	Sulfur hexafluoride
13	P ₄ S ₃	Molecular	Tetraphosphorus trisulfide
14	Xe ₃ F ₄	Molecular	Trixenon tetrafluoride
15	PtCl ₂	Ionic	Platinum(II) chloride

Data Table 4: Binary Molecular and Ionic Compound Formulas
(SAMPLE ANSWER BELOW)

#	Compound Name	Molecular or Ionic Compound?	Formula
1	Tribromine octoxide	<i>Molecular</i>	<i>Br₃O₈</i>
2	Lithium selenide	<i>Ionic</i>	<i>Li₂Se</i>
3	Iodine monochloride	<i>Molecular</i>	<i>ICl</i>

4	Iron(II) sulfide	<i>Ionic</i>	<i>FeS</i>
5	Diboron hexahydride	<i>Molecular</i>	<i>B₂H₆</i>
6	Barium iodide	<i>Ionic</i>	<i>BaI₂</i>
7	Cadmium sulfide	<i>Ionic</i>	<i>CdS</i>
8	Bromine trichloride	<i>Molecular</i>	<i>BrCl₃</i>
9	Nitrogen trihydride	<i>Molecular</i>	<i>NH₃</i>
10	Molybdenum(IV) fluoride	<i>Ionic</i>	<i>MoF₄</i>
11	Carbon tetrabromide	<i>Molecular</i>	<i>CBr₄</i>
12	Lead(II) chloride	<i>Ionic</i>	<i>PbCl₂</i>
13	Iodine hexafluoride	<i>Molecular</i>	<i>IF₆</i>
14	Tetraphosphorus decasulfide	<i>Molecular</i>	<i>P₄S₁₀</i>
15	Potassium chloride	<i>Ionic</i>	<i>KCl</i>

Competency Review

The Periodic Table includes an element's atomic number and atomic mass.

- ☒ True
- ☐ False
- ✓

The IUPAC name consists of ____.

- ☐ numbered substituents
- ☐ an ending suffix
- ☐ the number of carbons and numbered substituents
- ☒ All of the above

✓

____ compounds include a prefix on the first and second elements and a suffix on the second element, whereas ____ compounds do not have prefixes and only include a suffix on the second element.

- ☐ Ionic; molecular
- ☒ Molecular; ionic
- ☐ Molecular; binary
- ☐ Binary; molecular

✓

A hydrocarbon consists entirely of carbon and hydrogen atoms.

- ☒ True
- ☐ False

✓

A hydrocarbon chain consisting of a triple carbon-carbon bond will have the suffix ____.

- ☐ -one
- ☐ -ene
- ☒ -yne
- ☐ -ane

✓

Greek prefixes are used in the naming of the number of atoms of each element for ionic compounds.

- ☐ True
- ☒ False

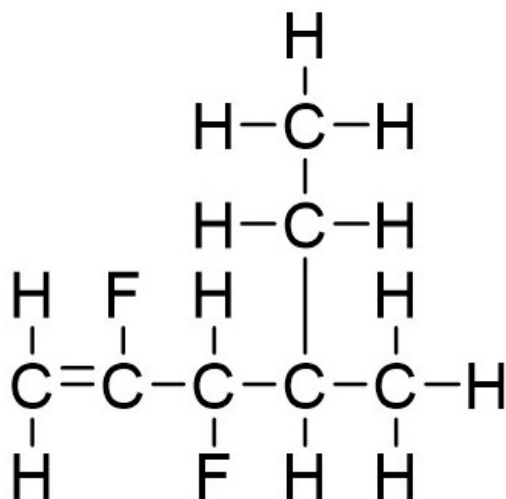
✓

A ____ has priority over substituents when numbering the parent carbon chain.

- ☐ single bond
- ☐ double bond
- ☐ triple bond
- ☒ double or triple bond

✓

The name for the chemical structure in the image below is ____.



- ☐ 2-fluoro-3-fluoro-1-methylbutene
- ☐ 1-ethyl-2,3-fluoro-1-methylbutene
- ☒ 2,3-difluoro-4-methyl-1-hexene
- ☐ 2,3-fluoro-4-ethyl-5-methylpentene

✓

In order to draw the chemical structure for 1-butyne, a ____ must be placed between the first and second carbons of the chain.

- ☐ single bond
- ☐ double bond
- ☐ methyl group
- ☒ triple bond

✓

The name for the formula CuCl_2 is ____.

- ☐ monocopper(II) dichloride
- ☐ copper(III) chloride
- ☒ copper(II) chloride
- ☐ copper(III) dichlorine

✓

Dichlorine trioxide is a(n) ____ compound with the formula ____.

- ☐ molecular; Cl_3O_2
- ☒ molecular; Cl_2O_3
- ☐ ionic; ClO_3
- ☐ ionic; Cl_3O_2

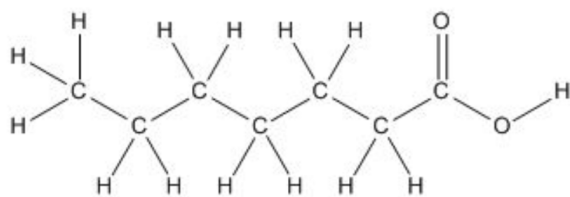
✓

Extension Questions

Carboxylic acids are a type of organic compound that contains a carbon attached to both an alcohol (-OH) group and a carbonyl (=O) group. Writing the IUPAC name for a simple carboxylic acid's name uses the following steps:

- Determine the longest carbon chain (include the carbon to which the alcohol and carbonyl group are attached).
- Name the longest carbon chain using the IUPAC prefixes.
- Subtract the "-e" from the end of the carbon chain name and replace it with "-oic acid."

Using these steps, name the following carboxylic acid:



(SAMPLE ANSWER BELOW)

heptanoic acid