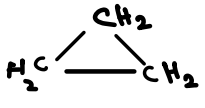
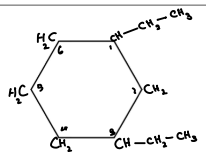
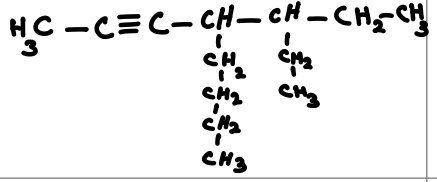
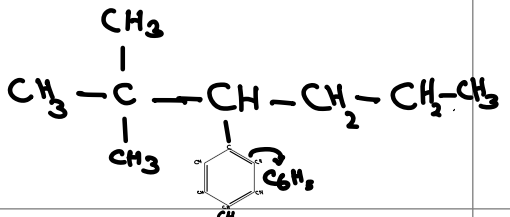
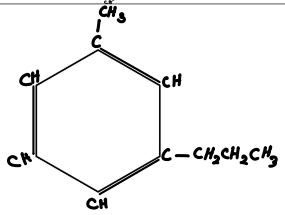
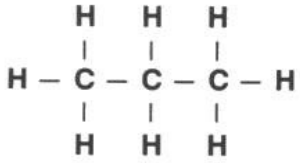
cyclopropane 3		C_3H_6
1,3-diethylcyclohexane 6 2-CH_2-CH_3		$C_{10}H_{20}$
5-ethyl-4-propyl-2-heptyne 7 carbon triple bond		$C_{12}H_{22}$
2,2-dimethly-3-phenylhexane benzene c:6		$C_{14}H_{22}$
1-methyl-3-propylbenzene		$C_{10}H_{14}$

Draw structural formulae and give the names for the five possible (noncyclic) isomers of C_6H_{14}.

NAMING HYDROCARBONS

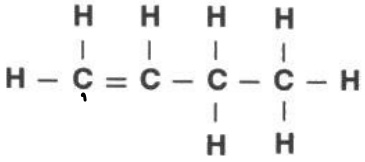
Name the compounds below according to the IUPAC naming system

1.



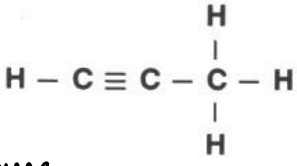
propane

2.



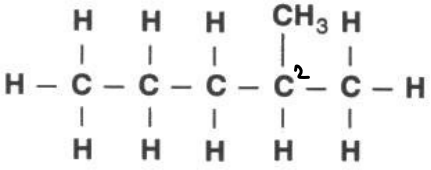
1- butene

3.



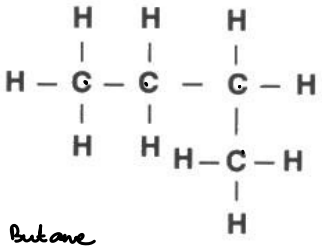
1- propyne

4.



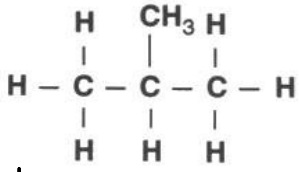
2-methyl pentane

5.



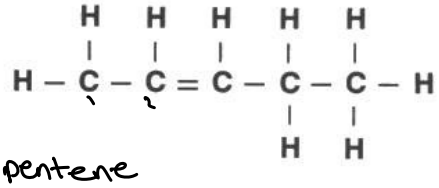
Butane

6.



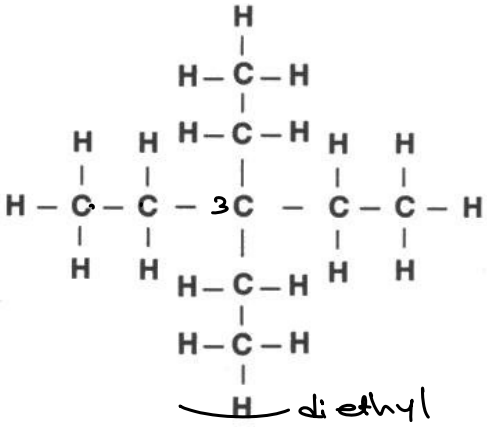
2-methyl propane

7.



2- pentene

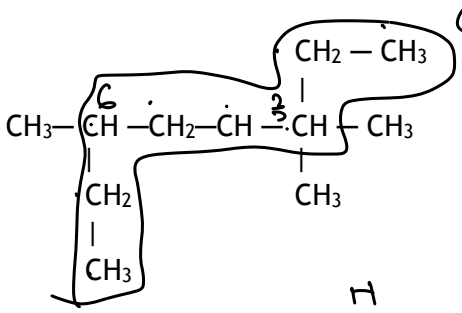
8.



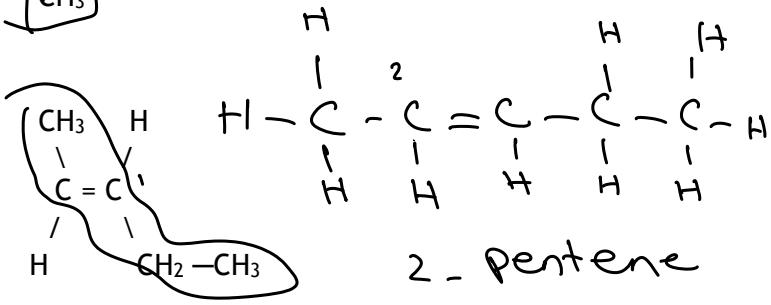
diethyl

3-diethyl pentane

Use IUPAC naming rules to name the following hydrocarbon compounds:

a) 

octane
2,3,6-trimethyl octane

b) 

2-pentene

c) ☐ cyclobutane

d) CH ≡ C— CH3 propyne

e) CH3 -CH2-CH2-CH=CH-CH3 2-hexene

f) CH2=CH-CH2-CH=CH-CH3 hexa-1,4-diene

g) CH3 - CH2 - C ≡ C- CH2- CH3 3-hexyne

h)  cyclohexene

30-C1.1k define organic compounds as compounds containing carbon, recognizing inorganic exceptions such as carbonates, cyanides, carbides and oxides of carbon

Organic Compounds

Organic compounds were originally thought to be compounds only synthesized by living organisms. Today, organic compounds are defined to be molecular compounds of carbon. Exceptions to this are the oxides of carbon, CO_2 and CO. These are inorganic compounds.

Ionic compounds containing carbon are also inorganic (e.g., carbonates such as Na_2CO_3, cyanides such as NaCN, and carbides such as SiC).

Use the following information to answer the next question.

> Global warming is a term used to describe the increase in the amount of greenhouse gases in the atmosphere. Gases are termed *greenhouse gases* if they allow sunlight to pass through them but then block infrared radiation from returning to space. News and other media coverage lists the main cause of global warming as the release of carbon dioxide into the atmosphere from the burning of fossil fuels. However, there are many more types of greenhouse gases, some of which are produced through biological processes.

1. Which of the following greenhouse gases would be classified as organic?

A. H_2O B. CO_2

C. CH_4 D. N_2O

30-C1.2k identify and describe significant organic compounds in daily life, demonstrating generalized knowledge of their origins and applications

Organic Compounds in Daily Life

A casual examination of society, whether in the context of nature or technology, reveals a thorough dependence and constant interaction with organic compounds and materials. The following is a short list of simple organic compounds that contribute to transportation, manufacturing, nutrition, and other fields of human endeavour.

Methane

Gaseous methane is the main component of natural gas, which is found trapped in underground rock formations. It is most commonly used as a fuel for heating homes. When used in this commercial capacity, methane is commonly mixed with a sulfur-based compound to make it detectable by smell since it is odourless.

- Chemical formula: $CH_{4(g)}$
- Family: Alkanes

Ethane

Most often found as a constituent part of natural gas deposits, ethane is important to the petrochemical industry because it can be cracked, or broken down, to form the double-bonded compound ethene. Ethene is a monomer used to form polyethylene, a commercially important plastic. Ethene also forms the polymers PVC , polystyrene (used in Styrofoam), and polytetrafluoroethene.

- Chemical formula: $C_2H_{6(g)}$
- Family: Alkanes

Propane

Although found in natural gas, propane is more commonly produced through the fractional distillation of crude oil. It is primarily used as a fuel for barbecues, camping lanterns, and camp stoves and as an alternative fuel for cars.

- Chemical formula: $C_3H_{8(g)}$
- Family: Alkanes

Octane

As it is a heavier hydrocarbon, octane is rarely found in a pure natural form. Most often, octane is distilled from crude oil in petroleum refineries. Whereas gasoline can be composed of a mixture of hydrocarbons including octane, most gasolines use isomers of octane, such as 2,2,4-trimethylpentane (also known as iso-octane), to help prevent pre-ignition or "knocking" in car engines.

- Chemical formula: $C_8H_{18(l)}$
- Family: Alkanes

Methanol

Commonly called wood alcohol, methanol can be produced from the reaction of methane and steam. Some natural anaerobic decomposition reactions can also produce methanol, which can be used as a fuel, a gasoline additive, and a solvent. The most frequent industrial use of methanol is as a feedstock for producing other chemicals, such as formaldehyde. Some of the more common commercial uses of methanol include automobile products, such as windshield wiper fluid and gasoline antifreeze.

- Chemical formula: $CH_3OH_{(l)}$
- Family: Alcohols

Ethanol

Sometimes called grain alcohol, ethanol was produced in one of the first historical examples of humans using organic reactions to create practical products. Since ancient times, people have used the fermentation of natural sugars and starches from grains to produce alcoholic beverages. An increased demand for ethanol has required it to be produced industrially through petroleum-refining processes. Ethanol is chemically valuable as both a solvent and a gasoline additive.

- Chemical formula: $C_2H_5OH_{(l)}$
- Family: Alcohols

Ethanoic Acid

Non-systematically known as acetic acid, ethanoic acid is produced by the further fermentation of ethanol that can be seen when wine turns into vinegar with oxygen and age. Although most commonly associated with the sour taste in vinegar, ethanoic acid is also used industrially as a reagent that can form polymers used to make fabrics, plastics, glues, and photographic film.

- Chemical formula: $CH_3COOH_{(l)}$
- Family: Carboxylic acids

Benzene

Benzene can be distilled from petroleum and coal tar, and it is often used as an industrial solvent and chemical precursor. It was used as an additive in gasoline, but when its carcinogenic properties became known, its presence was reduced to a very limited amount. Benzene-based compounds include ASA, TNT, salicylic acid, cinnamon, and polystyrene.

- Chemical formula: $C_6H_{6(l)}$
- Family: Aromatics

Glucose

An important source of metabolic energy and one of the key ingredients for cellular respiration in plants and animals, glucose is produced naturally through the process of photosynthesis.

- Chemical formula: $C_6H_{12}O_{6(s)}$
- Family: Monosaccharides

Polyethylene

Formed from ethene monomers, polyethylene is a polymer that forms a major constituent part of many plastics, but the most significant of these are strong and light sheet plastics. Cling films and plastic bags are typical examples of the sort of membranous products constructed from polyethylene.

- Chemical formula: $-(CH_2)_n-_{(s)}$
- Family: Polymers

2. Which of the following organic compounds is **not** produced from crude oil?

   A. Formaldehyde B. Polystyrene
   C. Glucose D. Ethene

30-C1.3k name and draw structural, condensed structural and line diagrams and formulas, using International Union of Pure and Applied Chemistry (IUPAC) nomenclature guidelines, for saturated and unsaturated aliphatic (including cyclic) and aromatic carbon compounds – containing up to 10 carbon atoms in the parent chain or cyclic structure – containing only one type of a functional group (with multiple bonds categorized as a functional group), including simple halogenated hydrocarbons, alcohols, carboxylic acids and esters, and with multiple occurrences of the functional group limited to halogens and alcohols

Organic Compound Nomenclature

Abbreviated lists of rules for the IUPAC nomenclature of organic compounds are available. Each family of compounds has a slightly different set of rules, but there are similarities.

The prefixes that are used to designate the number of carbons (C) are the same throughout all the families:

- 1C = Meth-
- 2C = Eth-
- 3C = Prop-
- 4C = But-
- 5C = Pent-
- 6C = Hex-
- 7C = Hept-
- 8C = Oct-
- 9C = Non-
- 10C = Dec-

The names of hydrocarbon-based compounds are determined by finding the longest continuous chain of carbon atoms. If there are a number of permutations that create equal chain lengths, then the root chain is the one containing the highest-priority functional group.

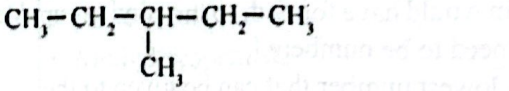
Branched groups use the same prefixes, except with a *-yl* ending.

Example

Draw the structural diagram for 3-methylpentane, and name the type or family of compounds to which it belongs.

- The primary carbon chain will be pentane, which has five single-bonded carbons.
- The third carbon in the chain will have a methyl group attached.
- A methyl group will consist of a single carbon and three hydrogens.
- There are no double or triple bonds, so the compound will be saturated.

The structural formula shown here represents 3-methylpentane, which is a saturated aliphatic (alkane) hydrocarbon.

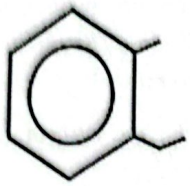


Example

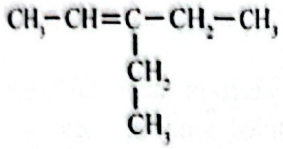
Draw the line diagram of 1-ethyl-2-methylbenzene, and name the type or family of compounds to which it belongs.

- The primary carbon chain is a benzene ring, which has six carbons arranged hexagonally with a resonating single and double bond, represented by a circle inside a hexagon.
- The first branch attached is named alphabetically, so it will be a two-carbon ethyl group represented by two lines joined by a 120° angle.
- The second branch will be joined to an adjacent carbon to the ethyl group and will be a methyl group represented by a single line.

Because there is a resonant ring structure in the molecule, this compound is an aromatic hydrocarbon with the following line diagram:



Example



Name the structure shown, and identify the type or family of compounds to which it belongs.

- The longest continuous carbon chain has a length of five carbons and should incorporate the double bond, so this will form a pentene molecule.
- The attached group is an ethyl group.
- The ethyl group must be attached to the third carbon in the chain or else a longer continuous chain would have formed, so the ethyl group does not need to be numbered.
- The lowest number that can be given to the location of the double bond is that it is attached to the second carbon in the chain, reading from left to right.
- The 2, signifying the location of the double bond, will go between the *pent-* prefix and the *-ene* suffix to show that it is referring to that bond.

Because there is a double bond, the molecule is an unsaturated aliphatic hydrocarbon (alkene) with the systematic name of ethylpent-2-ene

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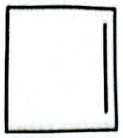
Example

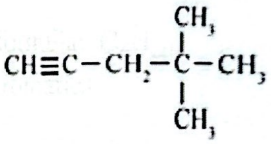


Name the structure represented by the given line diagram, and identify the type or family of compounds to which it belongs.

- The figure has four corners, so it has four carbons; the prefix will be *but-*.
- There is one line that has been duplicated, showing a double bond; this compound will use the suffix *-ene*.
- The figure is a closed cyclic structure, so the compound will have the prefix *cyclo-*.

This diagram represents cyclobutene, a cyclic aliphatic (cycloalkene).

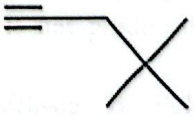
Example



Sketch a line diagram for the structure shown, and identify the type or family of compounds to which this compound belongs.

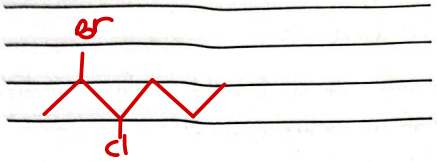
- The longest continuous carbon chain contains five carbons, so the root compound will have a prefix of *pent-*.
- There is a triple bond on the first carbon in the chain, so the root molecule will be pent-1-yne.
- There are two methyl groups attached to the fourth carbon in the chain.
- Triple bonds are always expressed as linear in a line diagram, and a carbon bonded to four other carbons should show bond angles of 90°.

The given structural diagram represents 4,4-dimethylpent-1-yne, which is an unsaturated aliphatic hydrocarbon (alkyne). The line diagram shown here represents this molecule.

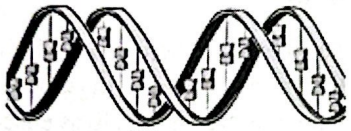


Written Response

3. Draw the line diagrams that represent 2-bromo-3-chlorohexane and pentane-1,3-diol. For each diagram, note the nomenclature rules that apply to naming the compound.



Use the following information to answer the next question.



Recently, it was discovered that carbon-containing molecules can survive the frigid (50 K and lower) high vacuum conditions of outer space. In laboratory tests, DNA has been shown to survive these interstellar conditions. The unusual molecules C_3 and C_5 have been identified by astronomers who study microwave radiation from space.

4. If these unusual molecules were saturated with hydrogen, they would be known as, respectively

A. propane and pentane

B. propane and pentene

C. propane and butane

D. butane and pentene

Use the following information to answer the next question.

On July 21, 1997, an explosion ripped through the main incinerator of the Swan Hills Waste Treatment Centre north of Edmonton. Concern arose since the explosion occurred around a highly volatile pile of benzene sludge. Officials said that the amount of the benzene that escaped from the plant was very little, if any. The concentration of benzene in the environment is significant because benzene is a potent carcinogen.

5. The number of carbon atoms in a benzene molecule is

A. 3 B. 4

C. 5 D. 6

Use the following information to answer the next question.

A list of substances is given.

- Methyl propenoate
- Propanoic acid
- Chloropropane
- Propanol
- Propyne
- Propene

alcohol C_3H_8O

$3+8+1=12$

Numerical Response

6. Determine the total number of atoms in the alcohol listed. 12 (Record your answer as a two-digit number.)

30-C1.4k identify types of compounds from the hydroxyl, carboxyl, ester linkage and halogen functional groups, given the structural formula

Organic Compound Functional Groups

Organic compounds are classified into families using the types of bonds within each molecule and by the types of functional groups within the molecular structure. Alkanes, alkenes, and alkynes are composed exclusively of carbon and hydrogen. Alkanes only contain carbon-carbon single bonds. Alkenes have at least one carbon-carbon double bond, and alkynes have at least one carbon-carbon triple bond. Cyclic compounds contain at least one carbon loop or ring. Cyclohexane is an example of an aliphatic cyclic compound. The following functional groups show how they are used to classify other hydrocarbon groups into specific families of compounds.

In each of these structural formulas, R represents a hydrocarbon group (C_xH_y).

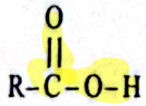
Hydroxyl Group

The hydroxyl functional group is a key identifier of members of the alcohol hydrocarbon family and has the structural formula R–O–H.

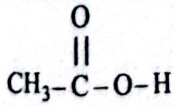
For example, the structural formula for ethanol is $CH_3–CH_2–O–H$.

Carboxyl Group

The carboxyl functional group is present in all members of the carboxylic acid family, and it is represented by the structural formula

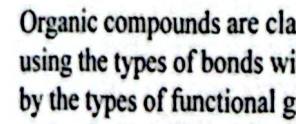


For example, the structural formula for ethanoic acid is

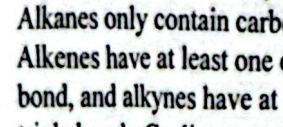


Ester Linkages

Ester linkages are found when the single-bonded oxygen component of a carboxyl group in a carboxylic acid bonds with another hydrocarbon group, forming an ester. The structural formula of an ester is



For example, the structural formula for methyl ethanoate (or methyl acetate) is



Halogens

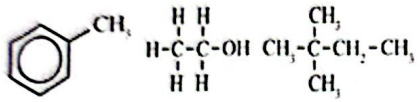
A halogenated hydrocarbon is formed whenever a halogen atom bonds with a hydrocarbon molecule. These compounds are referred to as either organic halides or alkyl halides, and they have the general structural formula of R – X, where X represents a halogen atom.

For example, the structural formula for 1-fluoropropane is CH_3-CH_2-CH_2-F.

Recognizing these functional groups is helpful in both organic nomenclature and in writing organic reaction equations.

Use the following information to answer the next question.

Gasoline must meet more stringent requirements as more and more government restrictions are placed on automobiles to increase fuel economy and reduce emissions. Catalytic converters, which oxidize unburned hydrocarbons and carbon monoxide and reduce nitrogen oxides, require compounds, like those shown here, to work more efficiently.



I II III

7. Compound II can be classified as

A. a halogenated hydrocarbon

B. an alcohol

C. an alkane

D. an ester

Use the following information to answer the next question.

1. Propane
2. Ethanol
3. 1,3-dichlorobutane
4. Propyne
5. Citric acid
6. Chlorobenzene
7. Methanoic acid
8. Ethyl butanoate

Numerical Response

8. The compounds from the given list that have a carboxyl group are _____ and _____. (Record your answer as a two-digit number.)

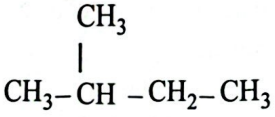
30-C1.5k define structural isomerism as compounds having the same empirical formulas, but with different structural formulas, and relate the structures to variations in the properties of the isomers

Structural Isomers

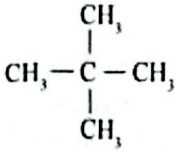
Structural isomers are compounds with the same molecular formula but different structural formulas. This is easily shown using an example.

For the molecular formula C_5H_{12}, there are 3 structural isomers:

1. Pentane
   $CH_3-CH_2-CH_2-CH_2-CH_3$
2. Methylbutane



3. Dimethylpropane

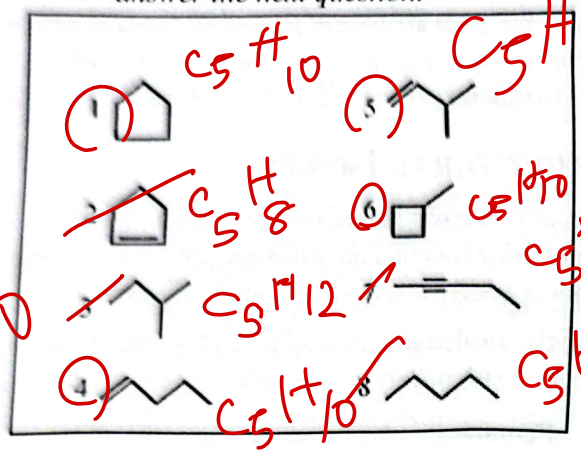


Structural isomers, provided they have the same functional group, will have similar chemical properties, but their physical properties will differ.

Isomer	Melting Point (°C)	Boiling Point (°C)
Pentane	−129.8	36.1
Methylbutane	−160	28
Dimethylpropane	−18	10

Differences in melting and boiling points can be related to the fact that the different shapes of the molecules change, depending on how closely they can pack together, and therefore affect the strength of the London Dispersion forces. Other properties, such as heat of formation, are also affected, since some isomers form more stable molecules than others.

Use the following information to answer the next question.



Numerical Response

9. The compounds shown that are structural isomers of pent-2-ene are _____, _____, _____, and _____. (Record your four-digit answer in increasing numerical order.)

30-C1.6k compare, both within a homologous series and among compounds with different functional groups, the boiling points and solubility of examples of aliphatics, aromatics, alcohols and carboxylic acids

Boiling Point and Solubility of Organic Compounds

The physical properties of hydrocarbons are primarily determined by intra- and intermolecular forces. For example, the boiling points of alkanes increase as the number of carbons increases because as the number of atoms in the molecule increases, so does the surface area and number of surrounding electrons. As the surface area and orbiting electrons increase, so do the intermolecular forces that hold molecules closer together.

On the other hand, solubility in water is a property primarily determined by the polarity of the molecule. Straight-chain alkanes will have symmetrical electronegativities, so they will behave as non-polar molecules. Since water is polar and "like dissolves like," straight-chain alkanes will be insoluble in water. The table shown illustrates the trend of the boiling point and solubility in the first 10 straight-chain alkanes.

Homologous Series—Non-Branched Alkane

Compound	Boiling Point(°C)	Solubility in Water
Methane	−162	Insoluble
Ethane	−89	Insoluble
Propane	−42	Insoluble
Butane	0	Insoluble
Pentane	36	Insoluble
Hexane	68	Insoluble
Heptane	98	Insoluble
Octane	126	Insoluble
Nonane	151	Insoluble
Decane	174	Insoluble

Compounds with Different Functional Groups but the Same Number of Carbons

The following is a comparison of four different six-carbon molecules: an alkane, a carboxylic acid, an alcohol, and an aromatic. The functional groups and bonding structures of each of these compounds result in different sets of physical properties, even though the number of carbons is identical.

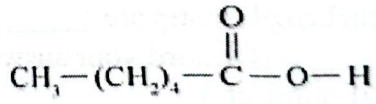
Hexane

Hexane has a structural formula of $CH_3–(CH_2)_4–CH_3$, contains no functional groups, and belongs to the family of alkanes.

- Boiling point (°C): −42
- Solubility in water: Insoluble

Hexanoic acid

The structural formula of hexanoic acid is represented by this structural diagram:



It is characterized by a carboxyl group and belongs to the family of carboxylic acids.

- Boiling point (°C): 202–203
- Solubility in water: 1.1 g / 100 mL

Hexan-1-ol

The structural formula for hexan-1-ol can be expressed as $CH_3-(CH_2)_5-O-H$. It is a member of the family of alcohols by virtue of its hydroxyl functional group.

- Boiling point (°C): 156.4
- Solubility in water: 0.59 g/100 mL

Benzene

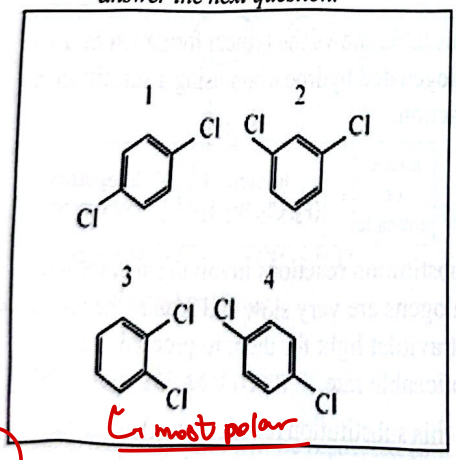
The ring-like resonance structure of benzene is represented by this structural diagram:

When joined to another hydrocarbon group, benzene is referred to as a phenyl group, and it is a member of the aromatic family.

- Boiling point (°C): 80.1
- Solubility in water: 0.08 g/100 mL

The presence of the hydroxyl group in both alcohols and carboxylic acids causes increased boiling points. Hydrogen bonding between the hydroxyl and the water leads to increased solubility in water.

Use the following information to answer the next question.



10. Which form of halogenated benzene is expected to be the **most** soluble in water?

A. 1 B. 2
C. 3 D. 4

Use the following information to answer the next question.

Stuart's teacher arranged two sets of compounds in the chemistry lab.

1. Propanol and butanol
2. Bromomethane and methane

11. Which of the following tables indicates the compound with the highest boiling point from each set?

A.

Set 1	Set 2
Propanol	Bromomethane

B.

Set 1	Set 2
Propanol	Methane

C.

Set 1	Set 2
Butanol	Bromomethane

D.

Set 1	Set 2
Butanol	Methane

30-C1.7k describe, in general terms, the physical, chemical and technological processes (fractional distillation and solvent extraction) used to separate organic compounds from natural mixtures or solutions

Separation of Organic Compounds

Bitumen recovery is the processes involved in removing oil from the oil sands (tar sands). Bitumen is the tarry substance coating the sand particles in the oil sands. One way the oil can be removed is to dissolve it into a solvent and allow the sand to settle out—a solvent extraction. Once the separation has occurred by a series of processes dependent on the depth and quality of the tar sands, petroleum refining occurs as it does for crude oil.

The first stage of petroleum refining is fractional distillation or fractionation. Most components of the crude oil are vapourized and then condensed at different heights in the fractionation tower, depending on their boiling points. The crude oil is thus separated into fractions of similar boiling points.

The fractions obtained from fractionation are further processed by chemical processes—cracking and reforming. Cracking takes compounds with larger numbers of carbons and breaks them down to compounds with smaller numbers of carbons. Reforming does the reverse. This allows the refining process to selectively pick which components will be the most abundant in their yield of products.

12. In what order would solvents be used to extract first methanoic acid, then 1-chlorobutane, and finally octane from a solution?
    A. Polar, slightly polar, non-polar
    B. Slightly polar, non-polar, polar
    C. Slightly polar, polar, non-polar
    D. Non-polar, polar, slightly polar

13. What physical property of hydrocarbons enables fractional distillation towers to be able to separate mixtures such as crude oil?
    A. Colour
    B. Density
    C. Solubility
    D. Boiling point

30-C2.1k define, illustrate and provide examples of simple addition, substitution, elimination, esterification and combustion reactions

Chemical Reactions of Organic Compounds

There are several different types of chemical reactions of organic compounds: simple addition, substitution, elimination, esterification, and combustion reactions.

Simple Addition Reactions

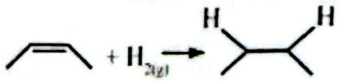
Addition reactions are when small diatomic molecules, such as hydrogen, are added across a double or triple bond. This occurs with alkenes and alkynes. Following are some examples of addition reactions:

alkene + H_2 → alkane
alkyne + H_2 → alkene
alkyne + $2H_2$ → alkane

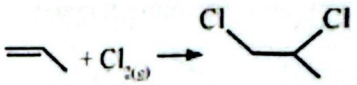
Unsaturated hydrocarbons can also react with halogens (HF, HCl, HBr, HI, F_2, Cl_2, Br_2, or I_2) to undergo addition reactions. Water can also react with unsaturated hydrocarbons to create alcohols.

The following equations show two addition reactions.

- alkene + H_2 → alkane



- prop–1–ene + chlorine → 1,2–dichloropropane



Note that aromatic molecules are not like normal alkenes; they are too stable to undergo addition reactions. They generally undergo substitution reactions.

Substitution Reactions

A substitution reaction is when an atom replaces an atom already present in the molecule. Substitution reaction equations are similar in appearance to addition reactions.

To distinguish between addition and substitution, remember this:

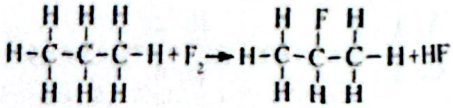
- *addition*—putting something into a molecule without taking any atoms out
- *substitution*—removing an atom and replacing it with another

This table shows the typical formation of a halogenated hydrocarbon using a substitution reaction.

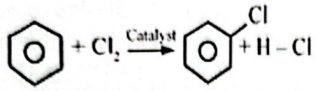
alkane or aromatic	+	halogen (F_2, Cl_2, Br_2, I_2)	→	halogenated hydrocarbon

Substitution reactions involving alkanes with halogens are very slow and require the presence of ultraviolet light for them to proceed at a noticeable rate.

In this substitution reaction, the fluorine can replace any of the hydrogens, though it will preferentially go in the position shown.

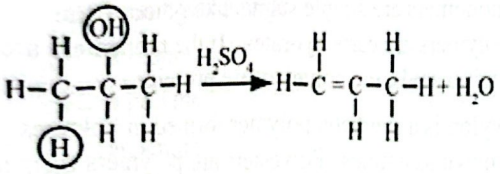


In the following reaction, benzene reacts with chlorine gas in the presence of a catalyst to form a halogenated aromatic compound and hydrogen chloride.



Elimination Reactions

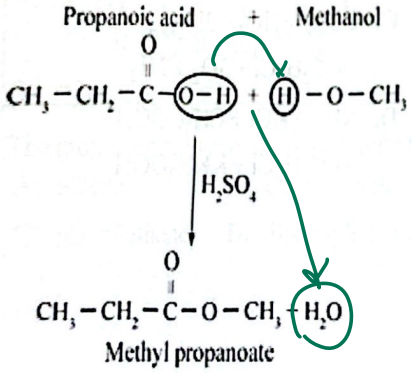
During elimination reactions, a molecule is removed from the organic molecule across two carbons, creating a double bond. These reactions, at the simplest level, are like *reverse addition reactions*.



Water and hydrogen halides (HF, HCl, HBr, or HI) are common products of an elimination process.

Esterification Reactions

Esterification reactions are similar to elimination reactions in which water is eliminated in the reaction between an alcohol and a carboxylic acid to make an ester.



Combustion Reactions

Combustion reactions (this will be restricted to complete combustions) are reactions in which hydrocarbons (C_xH_y) or alcohols (C_xH_yOH) react with oxygen (O_2) to produce carbon dioxide (CO_2) and water vapour (H_2O).

$2C_4H_{10(g)} + 13O_{2(g)} \rightarrow 8CO_{2(g)} + 10H_2O_{(g)}$

14. The addition reaction of ethene with hydrogen bromide yields
   - A. bromoethane
   - B. bromoethyne
   - C. bromoethanol
   - D. bromoethanoic acid

$C_2H_4 + HBr =$ BrC_2H_5

30-C2.2k predict products and write and interpret balanced equations for the above reactions

Equations Representing Organic Reactions

The biggest step in predicting and writing equations for organic reactions is the same as it is with any reactions—identifying the reaction type from the list of addition, substitution, elimination, esterification, halogenation, and combustion. Once the type is identified, the patterns can be used to predict products and write equations.

15. Propane can undergo a substitution reaction with chlorine gas. The balanced equation for this reaction is
   - A. $C_3H_8 + Cl \rightarrow C_3H_7Cl + H_2$
   - B. $C_3H_8 + Cl_2 \rightarrow C_3H_7Cl + HCl$
   - C. $C_3H_8 + 2Cl \rightarrow C_3H_6Cl_2 + H_2$
   - D. $C_3H_8 + Cl_2 \rightarrow C_3H_6Cl_2 + H_2$

Use the following information to answer the next question.

Naphthalene ($C_{10}H_{10(s)}$) is an aromatic compound that is commonly used in mothballs.

16. The balanced equation representing the complete combustion of naphthalene is
   - A. $C_{10}H_{10} + O_2 \rightarrow CO_2 + H_2O$
   - B. $C_{10}H_{10} + 12O_2 \rightarrow 10CO + 5H_2O$
   - C. $C_{10}H_{10} + 12O_2 \rightarrow 10CO_2 + 5H_2O$
   - D. $2C_{10}H_{10} + 25O_2 \rightarrow 20CO_2 + 10H_2O$

Use the following information to answer the next question.

Ethyne, commonly known as acetylene, is commercially used for welding and cutting steel and other materials because it burns with a very hot flame.
The unbalanced equation for the complete combustion of acetylene is shown.

$$C_2H_{2(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$$

2 5 4 2

Numerical Response

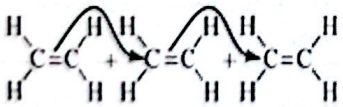
17. When the combustion reaction is balanced by using lowest whole number coefficients, the coefficients from left to right in the balanced equation are 2, 5, 4, and 2. (Record your answer as a four-digit number.)

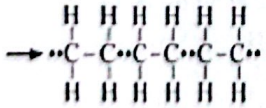
30-C2.3k define, illustrate and provide examples of monomers, polymers and polymerization in living systems and nonliving systems

Polymerization in Living and Non-Living Systems

Polymers are long chain molecules composed of simple repeating units known as monomers.

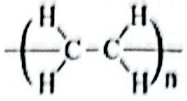
Polyethylene is a synthetic polymer formed from the monomer ethene, commonly known as ethylene. It is an addition polymer. Ethene molecules add across other ethene molecules as shown below.





The electrons in the double bond create a new bond with the next molecule

To show this repeating unit, often a polymer is shown with brackets around the repeating unit.

Here the product is  , the polymer polyethylene.

Other addition polymers include polyvinylchloride (PVC), polystyrene that is used to make styrofoam, and polytetrafluoroethylene that is used to make teflon.

Another type of polymer is a condensation polymer. Some types of condensation polymers can be produced by living or non-living systems.

Living systems polymers also form. If the monomers are simple sugars like glucose, the polymers are carbohydrates. If the monomers are amino acids, the polymers are proteins.

Nylon is a synthetic polymer formed in linkages known as amides. Polyesters are polymers formed from dialcohols and dicarboxylic acids in a continuous esterification reaction.

18. Which of the following chemical equations shows a valid reaction for the formation of chloroethene?

A. $C_2H_2 + HCl \rightarrow C_2H_3Cl$

B. $C_3H_7OH + HCl \rightarrow C_2H_3Cl + CH_3OH$

C. $2CO_2 + HCl + 2H_2O \rightarrow C_2H_3Cl + 3O_2 + 2H_2$

D. $NH_3 + KCl + CH_3COOH \rightarrow C_2H_3Cl + KNH_3OOH$

Use the following information to answer the next question.

The following reaction was accidentally discovered in 1922 by Joseph C. Patrick, an independent inventor and physician.

$n CH_2ClCH_2Cl + n Na_2S_4 \rightarrow [-CH_2CH_2S_4-]_n + 2NaCl$

The above organic product is still used to make gaskets, sealants for fuel cells, and electrical insulation.

19. This organic compound can be classified as

A. a monosaccharide

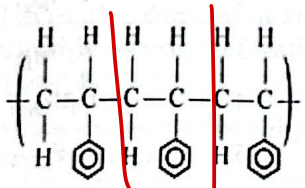
B. a monomer

C. a polymer

D. an amine

Use the following information to answer the next question.

The given molecule is part of a chain in polystyrene, the polymer in Styrofoam.



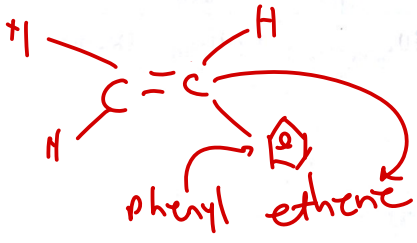
20. The monomer used to make polystyrene is

A. ethene

B. ethylbenzene

C. phenylethene

D. diphenylethane



30-C2.4k relate the reactions described above to major reactions that produce thermal energy and economically important compounds from fossil fuels.

Economic Significance of Reactions of Organic Compounds

Addition polymers are produced by addition reactions. Instead of adding hydrogen, water, or hydrogen halides across the double bond, addition polymerization involves addition of the monomer across itself, as shown in the previous section.

Polyesters are formed from esterification reactions between dicarboxylic acids containing two carboxyl groups and dialcohols containing two hydroxyl groups. A chain of esters forms.

Combustion reactions are the reactions that allow fossil fuels to produce heat. Along with heat, they also produce carbon dioxide, a greenhouse gas.

Use the following information to answer the next question.

The burning of fossil fuels produces carbon dioxide, which is thought to contribute to global warming.
When various hydrocarbons are burned, different amounts of carbon dioxide are produced based on the balanced chemical equations. Some of the more common fuels are octane (used in automobiles), methane (used to heat homes), propane (often used for outdoor grills), and butane (used in lighters).

21. Per mole of hydrocarbon, the combustion that produces the **most** carbon dioxide gas is

A. butane

B. octane

C. propane

D. methane

$2 C_8H_{18} + 25 O_2 \rightarrow 16 CO_2 + 18 H_2O$

ANSWERS AND SOLUTIONS

CHEMICAL CHANGES OF ORGANIC COMPOUNDS

1. C	6. 12	11. C	16. D	21. B
2. C	7. B	12. A	17. 2542	
3. WR	8. 57	13. D	18. A	
4. A	9. 1456	14. A	19. C	
5. D	10. C	15. B	20. C	

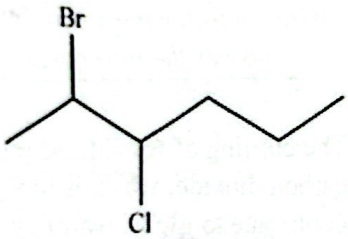
1. C

Of the alternatives listed, only methane is a carbon-containing compound that is not an oxide.

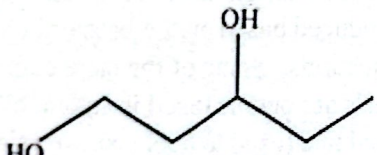
2. C

Glucose is a simple sugar that is important for animal metabolism. It is produced by photosynthesis in plants. All of the other compounds are petrochemical derivatives.

3. WR



2-bromo-3-chlorohexane



pentane-1,3-diol

Notes on IUPAC rules for organic halides:

1. Attached halogens are numbered in such a way as to have the lowest numbers possible. It is not 5-bromo-4-chlorohexane.
2. The functional groups are listed in alphabetical order.
3. The alkane name represents the longest chain and is attached to the last halogen prefix as listed alphabetically.

Notes on IUPAC rules for alcohols:

1. The alkane name represents the longest carbon chain and is listed first.
2. Attached OH groups are numbered in such a way as to have the lowest numbers possible. It is not pentane-3,5-diol.
3. The two alcohol functional groups are represented with the *di-* prefix.

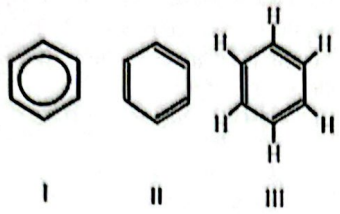
4. A

Saturated hydrocarbons contain C and H bonded with single bonds only. This class of hydrocarbon is called the alkanes. The first ten hydrocarbons are listed below.

Number of Carbons	Formula	Name
1	$CH_{4(g)}$	Methane
2	$C_2H_{6(g)}$	Ethane
3	$C_3H_{8(g)}$	Propane
4	$C_4H_{10(g)}$	Butane
5	$C_5H_{12(l)}$	Pentane
6	$C_6H_{14(l)}$	Hexane
7	$C_7H_{18(l)}$	Heptane
8	$C_8H_{18(l)}$	Octane
9	$C_9H_{20(l)}$	Nonane
10	$C_{10}H_{22(l)}$	Decane

5. D

Benzene has a characteristic ring structure commonly represented as



I II III

For the sake of convenience, representations I and II, wherein the hydrogens are assumed, are the most common ones used. It is obvious from representation III that a benzene molecule contains 6 hydrogen and 6 carbon atoms.

6. 12

Propanol is the only alcohol in the list. It has the formula C_3H_8O. Therefore, a molecule of propanol has 3 + 8 + 1 = 12 atoms.

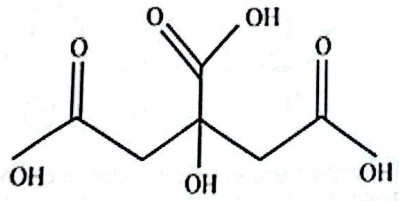
7. B

The hydroxyl group (–OH) on compound II indicates that it is an alcohol. The compound is ethanol, also known as ethyl alcohol.

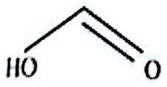
8. 57

Citric acid contains three carboxyl groups and one hydroxyl group. (You do not need to know its structural formula, just recognize from the name it is a carboxylic acid.)

Methanoic acid contains one carboxyl group and is the simplest carboxylic acid.



Citric acid



Methanoic acid

9. 1456

Isomers have the same molecular formula, so pent-2-ene is C_5H_{10}.

The other compounds that share this molecular formula are 1, 4, 5, and 6.

In order to have a formula of C_nH_{2n}, a hydrocarbon must have a double bond or a cyclical structure, but not both.

All eight compounds have five carbons, and the following list shows the formula of each compound:

1. C_5H_{10}—cyclopentane is an isomer of pent-2-ene.
2. C_5H_8—cyclopentene is unsaturated in two ways, so it has four fewer hydrogen atoms than a linear alkane with five carbons.
3. C_5H_{12}—methylbutane, also known as isopentane, is a saturated alkane, so it is not an isomer of pent-2-ene.
4. C_5H_{10}—pent-1-ene has a double bond, is unsaturated, and is an isomer of pent-2-ene.
5. C_5H_{10}—3-methylbut-1-ene is a branched, but not cyclical alkene, and is an isomer of pent-2-ene.
6. C_5H_{10}—methylcyclobutane is a cyclical alkane and an isomer of pent-2-ene.
7. C_5H_8—pent-2-yne is an unsaturated alkyne and has two fewer hydrogen atoms than pent-2-ene.
8. C_5H_{12}—pentane is a saturated linear alkane and has two more hydrogen atoms than pent-2-ene.

10. C

1,2-dichlorobenzene is the most polar of the three compounds and is therefore expected to be the most soluble in water, which is a polar solvent. Note that compounds 1 and 4 are actually the same compound, 1,4-dichlorobenzene.

11. C

In set 1, the only difference between propanol and butanol is that butanol has an extra CH_2 group. Since butanol has an extra CH_2 structure, butanol has larger intermolecular forces. This leads to a higher boiling point.

In set 2, bromomethane is polar and methane is not. Bromomethane also has more electrons. This leads to larger intermolecular forces in bromomethane. Thus, bromomethane has the higher boiling point of the two compounds.

Table C correctly indicates the compound from each set with the highest boiling point.

Set 1	Set 2
Butanol	Bromomethane

12. A

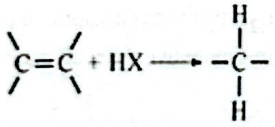
Methanoic acid is highly polar, so the polar solvent would be best for extracting it from a solution. 1-chlorobutane is slightly polar, and octane is non-polar. These principles are used in the petroleum industry in combination with fractionation.

13. D

A fractional distillation tower relies on the different boiling points of the various hydrocarbons found in crude oil. Those with the highest boiling points condense at the bottom of the tower, where the temperature is the hottest, and those with the lowest boiling points condense at the top, where the temperature is the coldest.

14. A

In an addition reaction, two reactants combine to form one product. Typically, a small molecule adds to a double (or triple) bond of an unsaturated organic molecule. Hydrohalogenation is the addition of HX to an alkene or alkyne, where X is any halogen atom (F, Cl, Br, or I). The reaction is as follows (simple version):



The reaction of ethene and HBr is
$CH_2 = CH_2 + HBr \rightarrow CH_3 - CH_2 - Br$.

The product is bromoethane.

15. B

A substitution reaction occurs when two reactants exchange atoms to give two products. In a substitution reaction of an alkane with a halogen, one H atom of the alkane is replaced by one halogen atom for every mole of halogen added. Halogen substitution reactions are slow in the dark, but they are difficult to control and can even proceed explosively under ultraviolet light or sunlight. The reaction of propane and chlorine proceeds as follows:

$CH_3{-}CH_2{-}CH_3 + Cl_2$
$\rightarrow CH_3{-}CH_2{-}CH_2{-}Cl + HCl$

16. D

When balancing the complete combustion of a hydrocarbon, it is often necessary to use multiples of the reactant to maintain a balance of oxygen on both sides of the reaction equation. The balanced equation for the complete combustion of naphthalene is as follows:
$2C_{10}H_{10} + 25O_2 \rightarrow 20CO_2 + 10H_2O$

17. 2542

When balancing the complete combustion reaction of $C_2H_{2(g)}$, double the number of moles of acetylene to ensure there will be equal numbers of moles of $H_2O_{(g)}$ and moles of O on both sides of the equation.
$2C_2H_{2(g)} + 5O_{2(g)} \rightarrow 4CO_{2(g)} + 2H_2O_{(g)}$

18. A

Polyvinylchloride (PVC), one of the most widely used plastics, is made from chloroethene.

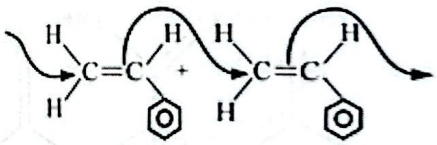
The chemical equation for the formation of chloroethene is $C_2H_2 + HCl \rightarrow C_2H_3Cl$.

19. C

The formula $[-CH_2CH_2S_4-]_n$, in which n is an indeterminate but usually very large number, indicates that the compound is made from many repeating $-CH_2CH_2S_4-$ subunits. This is a description of a polymer.

20. C

The monomer used to make polystyrene is phenylethene.



The curved arrows indicate where a carbon-carbon double bond has been broken to form a single bond with the next monomer.

21. **B**

The formula for the combustion of octane is as follows:

$2C_8H_{18(l)} + 25O_{2(g)} \rightarrow 16CO_{2(g)} + 18H_2O_{(g)}$

For every two moles of octane burned, 16 moles of CO_2 are produced. In contrast, the burning of methane produces only 1 mole of CO_2 for every mole of methane. The carbon in the simple alkane is the sole contributor to the carbon in CO_2. Therefore, those alkanes that have more carbon per molecule will produce more CO_2 per molecule.

UNIT TEST — CHEMICAL CHANGES OF ORGANIC COMPOUNDS

1. Which of the following essential compounds found in the human body can be classified as organic?

   A. H_2O
   B. CO_2
   C. HCO_3^-
   D. $C_2H_5NO_2$

2. Which of the following alcohols is commonly used in products for human consumption?

   A. Ethylene glycol
   B. Isopropanol
   C. Methanol → toxic
   D. Ethanol

Use the following information to answer the next question.

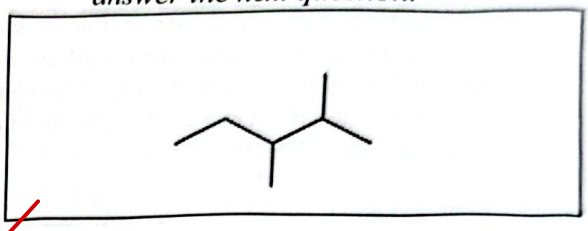
Petroleum from California contains a class of organic molecules known as naphthenes or cycloparaffins.
These organic molecules consist of single bonded cyclic units. Cyclohexane, which has a boiling point of 81°C, is an example of a naphthene.

Numerical Response

3. The number of atoms in a molecule of the naphthene cyclohexane is 18.

C_6H_{12} $6+12=18$

Use the following information to answer the next question.



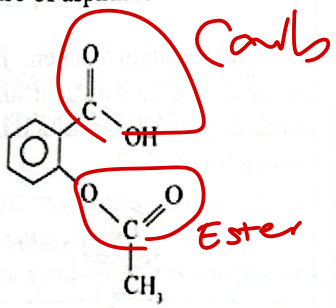
4. What is the name of this compound?

   A. 2-ethyl-3-methylbutane
   B. 2,3-dimethylpentane
   C. 3,4-dimethylpentane
   D. Hexane

Use the following information to answer the next question.

Acetylsalicylic acid (ASA), found in aspirin, is a derivative of the active ingredient in willow bark tea, namely salicylic acid. Interestingly enough, Compound W, a proprietary wart remover, is a concentrated aqueous salicylic acid solution. In aspirin, however, it was found necessary to modify salicylic acid to ASA to avoid the burning sensation salicylic acid causes when taken internally.

The structure of aspirin is



Carb

Ester

5. Two functional groups present in aspirin are

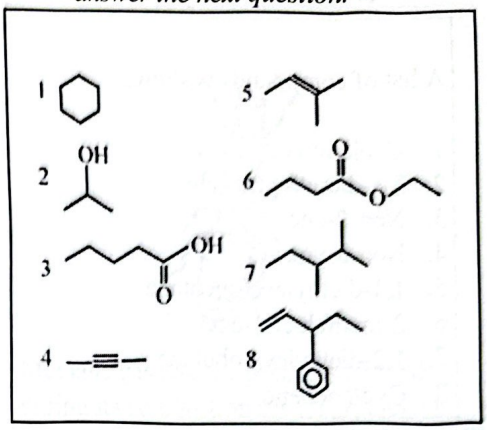
A. halogen and ester

B. ester and carboxylic acid

C. carboxylic acid and alcohol

D. halogen and carboxylic acid

Use the following information to answer the next question.



Numerical Response

6. Match the given organic compound structures with the following descriptions. (Record your answer as a four-digit number.)

Description	Structure Number
A saturated and non-cyclic hydrocarbon	7
A carboxylic acid	3
An aliphatic alkene	5
An aromatic	8

Use the following information to answer the next question.

A list of compounds is shown.

1. Cyclononane
2. 3,4-dimethylnonane
3. Non-2-ene
4. Non-3-yne
5. 1,1-diethylcyclopentane
6. 2-methyloct-1-ene
7. 1,2-diethylcyclobutane
8. Cyclononene

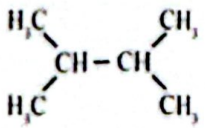
Numerical Response

7. The given compounds that are structural isomers of 1-ethyl-2-propylcyclobutane are ____, ____, ____, and ____. (Record your four-digit answer in increasing numerical order.)

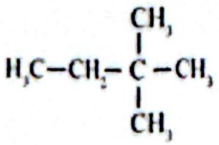
Use the following information to answer the next question.

Four hydrocarbon structures are shown.

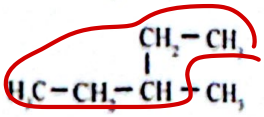
I.



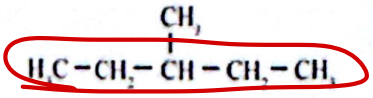
II.



III.



IV.



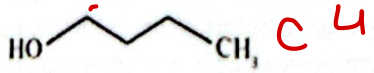
8. Which two of the given hydrocarbon structures have the same molecular formula and name?

A. I and II
B. I and III
C. II and IV
D. III and IV

9. Which of the following alcohols has the highest boiling point?

A.

B.

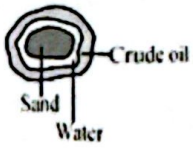


C.

D.

Use the following information to answer the next question.

Oil sands contain bitumen. Bitumen consists of a sand particle surrounded by a thin layer of water, which is then coated with a layer of oil.



10. Which of the following solvents would best dissolve the oil in order to retrieve it from the bitumen?

A. Water
B. Ethanol
C. Pentane
D. Methyl ethanoate

Use the following information to answer the next question.

Although inert to most reagents, alkanes react readily with chlorine in the presence of ultraviolet light. An example of this reaction is shown below.

$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

11. This reaction is an example of

A. an addition

B. a substitution

C. an elimination

D. an esterification

Use the following information to answer the next question.

Methanol has many uses. It is used as a fuel in race cars. It is also used in the production of synthetic fibres and plastics.

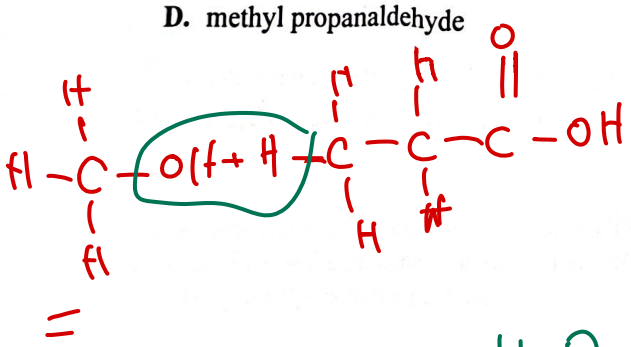
12. The product of the esterification reaction of methanol with propanoic acid is

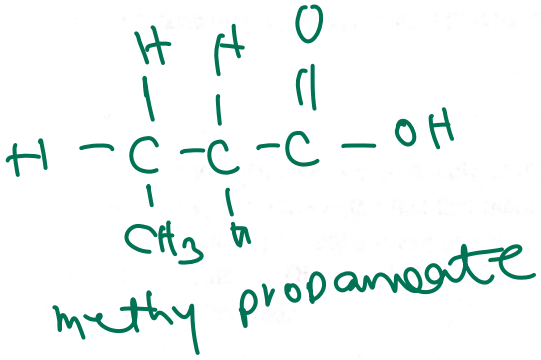
A. methyl ethyl ester

B. propyl methanoate

C. methyl propanoate

D. methyl propanaldehyde





methyl propanoate

Use the following information to answer the next question.

Methane gas and the products formed during its combustion are all greenhouse gases. Sources of methane include termites, which are believed to produce 16.5 million tons per year.

13. The balanced equation for the complete combustion of methane is

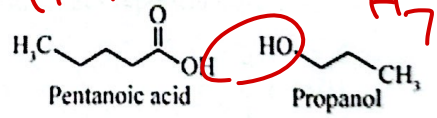
A. $2CH_{4(g)} + 4O_{2(g)} \rightarrow 2CO_{2(g)} + 4H_2O_{(g)}$

B. $CH_{4(g)} + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 2H_2O_{(g)}$

C. $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$

D. $CH_{4(g)} + 4O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$

Use the following information to answer the next question.



Numerical Response

14. When the given compounds react together, the molecular weight of the organic product is 144 g/mol. (Record your answer to four digits.)

$C_8H_{16}O_2$

$32 + 16 + (8 \times 12) = 144$

Use the following information to answer the next question.

Polyvinylchloride (PVC) is an important compound as it is one of the most widely used plastics. It is used for such things as cling wrap, bottles, credit cards, and pipes. Polyvinylchloride is made from chloroethene.

Chloroethene is the ___*i*___ used to create PVC in ___*ii*___ polymerization.

15. Which of the following tables completes the given statement?

A.

i	ii
monomer	addition

B.

i	ii
monomer	condensation

C.

i	ii
polymer	addition

D.

i	ii
polymer	condensation

ANSWERS AND SOLUTIONS — UNIT TEST

1. D	5. B	9. D	13. C
2. D	6. 7358	10. C	14. 144.2
3. 18	7. 1356	11. B	15. A
4. B	8. D	12. C	

1. D

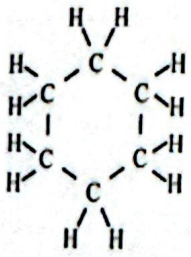
This is the formula for glycine, an amino acid present in nearly all proteins. Carbon dioxide and bicarbonate are important compounds for respiration and maintaining blood pH levels. Water is thought to be essential to all life.

2. D

Ethanol is the alcohol contained in commercially available alcoholic beverages. Methanol is used mostly as fuel, isopropanol is used as rubbing alcohol, and ethylene glycol is used as antifreeze.

3. 18

Cycloalkanes have the same general formula as alkenes, namely C_nH_{2n}. Alternatively, cyclohexane has the following structure:



C_6H_{12} corresponds to the general formula C_nH_{2n}. Therefore, the answer is 6 + 12 = 18 atoms.

4. B

The longest chain is 5 carbons long, so numbering the chain to give the branches the lowest numbers possible gives 2,3-dimethylpentane.

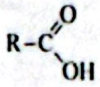
5. B

The functional groups present in acetylsalicylic acid are a benzene ring, a carboxylic acid group, and an ester.

6. 7358

Saturated means that there are no double or triple bonds. Non-cyclic refers to the fact that there is no ring, and a hydrocarbon contains exclusively carbon and hydrogen atoms. Diagram 7 is a saturated and non-cyclic hydrocarbon.

Carboxylic acids have the structure , which is shown in diagram 3.



Aliphatic molecules do not contain a benzene ring, and an alkene has a double bond, which is shown in diagram 5.

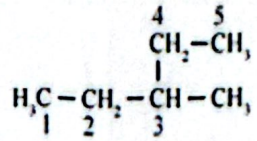
An aromatic molecule is one that contains a resonant ring structure, such as benzene, or a compound with a phenyl group. Diagram 8 is an aromatic.

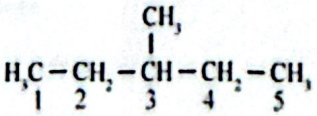
7. 1356

The compound 1-ethyl-2-propylcyclobutane is a cyclic hydrocarbon based on a cyclobutane molecule with formula C_9H_{18}. Isomers of 1-ethyl-2-propylcyclobutane will have the same chemical formula (C_9H_{18}). The molecules that meet this criterion are cyclononane (1), non-2-ene (3), 1,1-diethylcyclopentane (5), and 2-methyloct-1-ene (6).

8. D

Structures III and IV represent the same molecule even though they at first appear different. This is because how you draw a hydrocarbon structure is open for interpretation. For example, the following two structures represent C_6H_{14}:





When the longest continuous chain of carbon atoms is numbered, you can see that both structures are 3-methylpentane.

9. **D**

When looking at a homologous series of functional groups, boiling points can be compared based on molecular weight (assuming the molecules also have the same branching patterns). The highest molecular weight has the highest boiling point. It should also be noted that the longer carbon chains have stronger intermolecular forces.

10. **C**

Since oil is non-polar, a non-polar solvent, such as pentane, should be used to dissolve the oil.

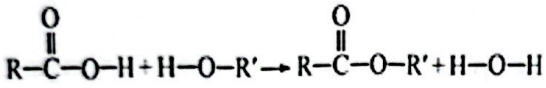
Water, ethanol, and methyl ethanoate are all polar solvents because of their asymmetrical conformational geometry.

11. **B**

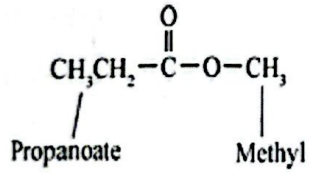
The reaction of a hydrocarbon with a halogen in which one hydrogen on the organic compound is replaced by a single halogen atom is called a radical substitution reaction. One mole of halogen atom (Cl, Br, F) ends up bonded to the organic product per mole of reactant halogen molecule (Cl_2, Br_2, F_2) added.

12. **C**

Esterification, the reaction of an alcohol with a carboxylic acid, produces water and an ester. The reaction is shown as follows:



The oxygen of the water produced originated in the acid reactant. The systematic names for esters consist of the name of the alkyl group on O (R′) followed by the name of the acid in which the suffix *-ic* is replaced by *-ate*. The product in this question can be represented as follows:



The name of this product is methyl propanoate.

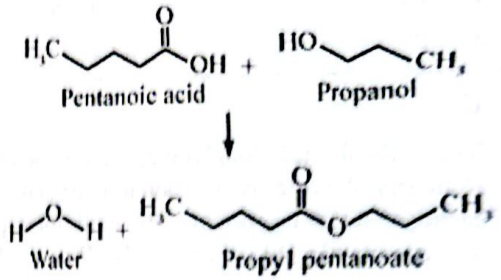
13. **C**

The products of the complete combustion of a hydrocarbon compound are $CO_{2(g)}$ and $H_2O_{(g)}$. Remember to balance the C and H in $CO_{2(g)}$ and $H_2O_{(g)}$, respectively, before balancing the O in $O_{2(g)}$. The balanced equation is as follows:

$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)}$

14. **144.2**

Carboxylic acids and alcohols react in esterification reactions to produce an ester and water. In this case, the ester produced is propyl pentanoate ($C_8H_{16}O_2$).



Calculate the molecular weight for the molecule $C_8H_{16}O_2$.

$$M = 8C + 16H + 2O$$
$$= 8\left(\frac{12.01g}{mol}\right) + 16\left(\frac{1.01g}{mol}\right) + 2\left(\frac{16.00g}{mol}\right)$$
$$= 144.2 \text{ g/mol}$$

15. **A**

Chloroethene is the monomer used to create the polymer PVC.

When chloroethene reacts, it uses the electrons in its double bonds to do an addition polymerization reaction with the next monomer, which creates an addition polymer.

Scholars Of Calgary Northwest

Chemistry 30, Unit 3: Chemical Changes of Organic Compounds, 10 Questions

Your score was 9/10=90%. You took 4 minutes, 5 seconds to complete the test.

Click here to do this test again!

---

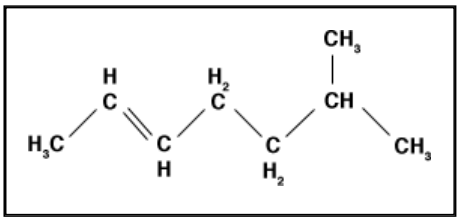
1. In which one of the following compounds is there a triple bond?

   A) C_2H_4
   B) $CH_3CHCHCH_2CH_3$
   C) $CH_2CHCH_2CHCH_2$
   D) $CH_3CH_2CCCH_2CH_3$

   Correct. *Your answer=D, Correct answer=D*

   Explanation:

   Molecules with triple bonds have the general formula C_nH2_{n-2} where n is the number of carbons. The only possible answer that fits this general formula is d).

2. 

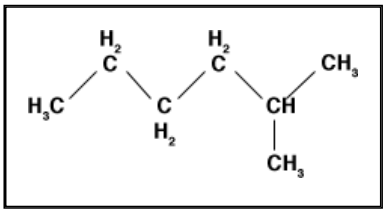
   The correct name for the substance represented in the diagram is

   A) 6-methylhept-2-ene
   B) 6-methylheptane
   C) 4-isopropylpent-2-ene
   D) 2-methylhept-5-ene

   Correct. *Your answer=A, Correct answer=A*

   Explanation:

   To work out the name for this molecule, we first need to find the longest carbon chain in the substance. Starting from the left and counting along, there are 7 carbon atoms in the longest chain, with a CH_3 attached to the penultimate carbon atom in the chain. This means that we have a hept- chain. We then need to look for any unsaturation in the molecule and describe the position of any double or triple bonds. In this case, there is a double bond between carbons 2 and 3 in the chain, and following IUPAC rules we give this the lowest number possible so we have something-hept-2-ene. The something part is named according to any side groups attached to the hept- backbone. Counting along we see a methyl (CH_3) group attached to the sixth carbon atom, so we now have 6-methylhept-2-ene.

3. 

   The correct name for the substance represented in the diagram is

   A) methylhexane
   B) 2-methylhexane

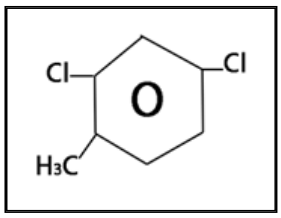
C) 3-methylhexane
D) 4-methylhexane

Correct. *Your answer=B, Correct answer=B*

Explanation:

Branches on an alkane molecule are always numbered so that the branches have the lowest number possible. So this molecule is numbered from right to left. The single carbon branch has the name "methyl" and the six carbon main chain has the name hexane so the entire molecule is called "2-methyl-hexane"

4.



What is the name of the organic compound shown above?

A) 1-methyl-4,6-dichlorobenzene
B) 2,4-dichloromethylbenzene
C) 1,5-dichloro-2-methylbenzene
D) 1,3-dichloro-4-methylbenzene

Correct. *Your answer=D, Correct answer=D*

Explanation:

The circle inside the hexagon indicates the presence of a benzene ring. The chlorine (halogen) atoms present are the next most important functional group. Numbering will start on the right-most chlorine, and proceed counterclockwise around the molecule.

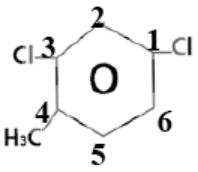
The rules for naming are as follows:

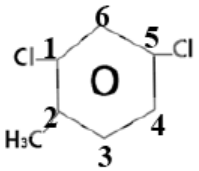
· Similar to naming other hydrocarbons
· Benzene is treated as the ROOT
· Carbons on the benzene are numbered IF there is more than one side group

Numbering is **based on priority** of side group.
Numbering is continued in the direction of the nearest group.

· Highest priority
-OH
-NH_2
-halogen

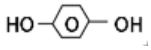
· Lowest priority
-Alkane groups with less than 6 carbons, in alphabetical order.



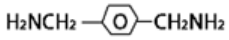


Both the above numbering follow the rules, but the one on the left ends up with a lower set of numbers (1,3,4 compared to 1,2,5) so the numbering on the right is the correct numbering.

5. Which one of the following compounds could be used as starting material to produce a polyester?

A) 

B) 

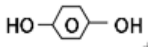
C) 

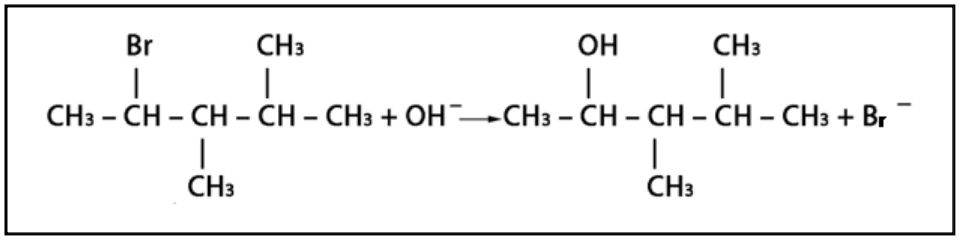
D) 

Incorrect. *Your answer=B, Correct answer=A*

Explanation:

Polyesters are formed in a condensation reaction involving an alcohdiol and a dicarboxylic acid.

 is the only answer with two alcohol functional groups.

6. 

The example shown is a(n) _____ reaction.

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

Correct. *Your answer=A, Correct answer=A*

Explanation:

In the example given, the bromide is replaced by a hydroxide group. This is, by definition, a substitution.

7. When water reacts with an alkene in the presence of a catalyst, what compound is produced?

A) an alcohol
B) an aldehyde
C) a carboxylic acid
D) a ketone

Correct. *Your answer=A, Correct answer=A*

Explanation:

The alkene is reactive due to the strain placed on the double bond by having four electrons in close proximity to one another. Alkenes can react with water in the form of steam, which contains enough thermal energy to initiate the reaction, or else a catalyst can be used to lower the activation energy of the reaction allowing alkanes to react with water in its liquid form. The double bond breaks open, and the lone electron exposed by this break attaches to the hydrogen to form a carbon-hydrogen bond. At the other end of the ethene molecule, the OH- part of the water molecule donates its spare electron to the carbon to form a C-OH bond, which is the alcohol functional group.

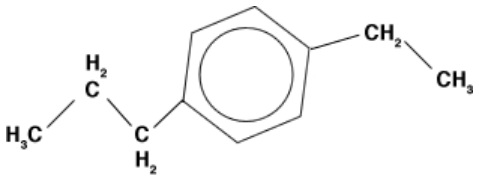
8. Which of the following is an INCORRECT name for CH_3COOH?

A) ethanedoic acid
B) ethanoic acid
C) acetic acid
D) vinegar

Correct. *Your answer=A, Correct answer=A*

Explanation:

CH_3COOH has historical names as well as an IUPAC name. Acetic acid and vinegar are the common historical names for this substance, ethanoic acid is the official IUPAC name. The odd one out on the list is ethanedoic acid.

9. 

The correct name for the substance represented in the diagram is

A) 1-ethyl-4-propylbenzene
B) 4-ethyl-1-propylbenzene
C) 1-ethyl-4-cyclohexane
D) 1-propyl-4-ethylbenzene

Correct. *Your answer=A, Correct answer=A*

Explanation:

To work out the name for this molecule, we first start with the benzene ring. Attached to the benzene ring are an ethyl group and a propyl group. We start with the ethyl group as this is first in the alphabet, so this is attached to position 1 on the benzene. Counting around the ring, we see the propyl group is attached to the fourth carbon on the ring, so the correct name for this molecule is 1-ethyl-4-propylbenzene.

10. The molecular formula, C_6H_{12} could represent

A) a cycloalkene
B) an alkyne
C) a cycloalkane
D) an alkane

Correct. *Your answer=C, Correct answer=C*

Explanation:

To solve this problem, calculate the ratio of hydrogen atoms to carbon atoms to determine whether you have an alkane, alkene or an alkyne. In this case, the formula is C_6H_{12}, so there are exactly 2 hydrogens for each carbon, which means this is an alkene. However, you need to take care as cyclic groups can change the ratio, and this is the case in this question. We have cycloalkenes and cycloalkanes in the list of answers. Cycloalkanes also have a ratio of 2H:C in their molecular formula. As there are no alkenes in the list, we can safely assume that the molecule is a cycloalkane.

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