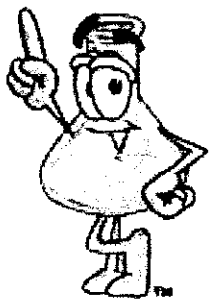
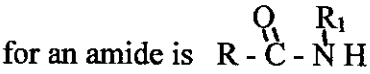
Helpful Hints

There are many different classes of organic compounds to identify and name.
Remember!

1) In most cases you will find examples of compounds in Table "R".
2) The name is usually a variation of the hydrocarbon from which it was derived.
3) Do not forget to give the locations of functional groups when necessary by using a numbered carbon atom. Always number in the direction that places the alkyl or functional group on the lowest number carbon atom.
4) Use common sense and take your time.
5) Take some extra time to practice naming and drawing esters.
6) **Remember! Organic Chemistry is Fun!**

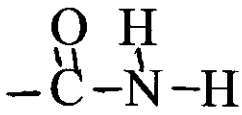


Amides

The general formula for an amide is 

Naming amides: To name an amide, drop the last "e" from the hydrocarbon name and add "**amide**". Remember if it ends with "amide", it is an amide.
The amide functional group is always on an end carbon, therefore, its location does not require a number.

Examples:



Draw the structural formula of ethanamide:

Draw the structural formula of propanamide:

Amino Acids

Amino acids combine an amine functional group and an organic acid functional group on the same carbon of a hydrocarbon.

For some strange reason, amino acids are not in Table R. Logically, an amino acid combines an amine and an organic acid.

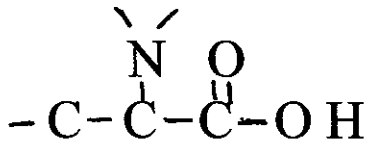
Amino acids have the general formula: **R - C(NH$_2$) - COOH.**

Amino acids play a very important role in biochemistry.
Amino acids combine in a condensation polymerization reaction to form proteins.

Naming Amino acids: Biochemistry (AP BIO) uses its own set of names for amino acids.
To name an amino acid in this course:
Step 1: State the amine's location by using a numbered carbon atom.
Step:2 Say **amino** followed by the name the organic acid.

Remember! If the name ends with amino acid it is an amino acid.

Example:



Draw the structural formula for 1-amino propanoic acid:

Draw the structural formula for 2-amino butanoic acid:

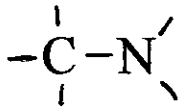
Amines

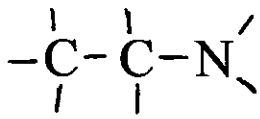
Amines have the functional group **-NH_2**. The general formula for an amine is **R-NH_2**. The location of the amine must be designated with a numbered carbon atom when it is attached to a hydrocarbon larger than 2 carbon atoms.

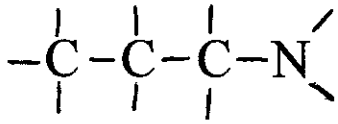
What is the functional group of an amine? _____

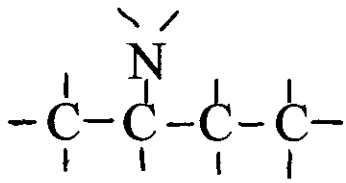
Naming amines: To name an amine drop the last "e" from the name of the hydrocarbon and add "**amine**". Remember if the name ends with "amine", it is an amine.

Examples: Circle the functional groups and name the following compounds.









Draw the structural formula of 1-propanamine:

Draw the structural formula of 2 pentanamine:

Halides

The functional group of a halide is **R - X.** (X is any halogen).
Remember a halogen is a Group 17 element. **F, Cl, Br, I, At** (all very reactive).

The functional group of a halide is **- X** (X is any halogen)

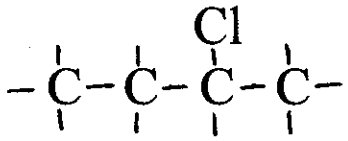
What is the functional group of any halide? _____

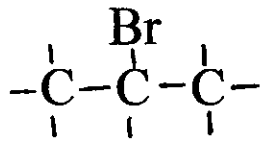
What group are the halogens? _____

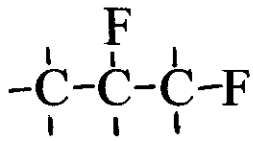
Halides have become infamous (not good). They are known to cause cancer. Other halides such as chlorofluorocarbons (CFC'S) are blamed for causing a hole in the ozone layer.

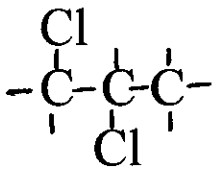
Naming Halides: A halogen forms a single covalent bond with carbon and therefore can join a hydrocarbon anywhere by replacing a hydrogen atom. The location of the halogen must be designated with a numbered carbon atom. If two of the same halogens are present, the prefix **"di"** is used, if there are three of the same halogens, the prefix **"tri"** is used. If 4 of the same halogen are present the prefix **"tetra"** is used. If more than one type of halogen is attached to the same compound, their locations and names are listed alphabetically. (bromo, chloro, fluoro, iodo)

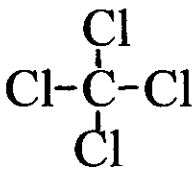
Examples:

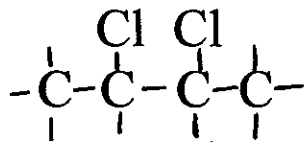












Draw the structural formula for 2,2-dichloroethane:

Draw the structural formula for 1,2-dichlorobutane:

How to Draw an Ester:

Step 1: Draw the functional group of an ester.

Step 2: Attach the alkyl group to the single bond oxygen.

Step 3: Add enough Cs to the other side of the functional group to complete the "oate" part of the molecule. The "oate" part matches the prefix (meth, eth, prop, et.)

Draw the structural formula of methyl propanoate:

Draw the structural formula of propyl butanoate:

Properties of esters: An interesting property of esters is that they are often the chemicals that are responsible for the flavors and aromas of fruits. Artificial flavorings contain esters.
What is an interesting property of esters? _____

A reaction between an organic acid and an alcohol produces an ester and water. Another way of naming esters is to start with the name of the alkyl group that corresponds to the alcohol. This is followed by changing the name of the organic acid to end in "oate".

Example: If **eth**anol (alcohol) reacts with **butan**oic acid (organic acid), the resulting product will be an ester named **eth**yl **butan**oate. Remember if it ends with "**oate**" it is an ester.

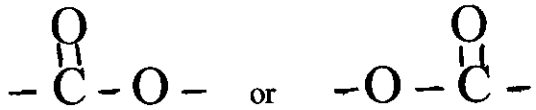
If methanol (alcohol) reacts with ethanoic acid (organic acid) what will be the name of

the product ester? _____

If ethanol (alcohol) reacts with octanoic acid (organic acid) what will be the name of

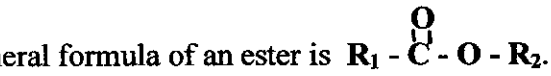
the product ester? _____

Esters

The functional group of an ester is:  or

These are the same. They are just turned around.

What is the functional group of an ester? _____

The general formula of an ester is  .

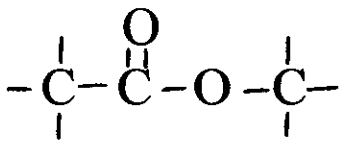
Naming esters is difficult. There are two steps to naming an ester.

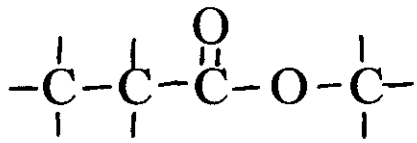
Step 1: Name the alkyl group that the - O - is attached to.

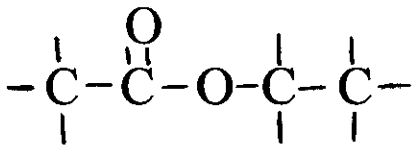
Step 2: Name the rest of the molecule based on the prefix for the rest of the carbon atoms of the corresponding alkane and end with"**oate**". Remember if it ends with "**oate**", it is an ester.

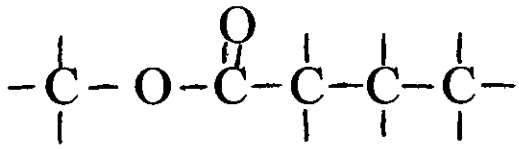
Examples: Circle the functional group and draw a rectangle around the alkyl group attached to the single bond oxygen.

Name the following compounds.









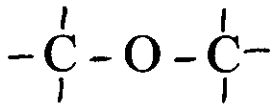
Ethers

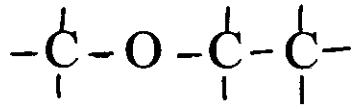
The functional group of an ether is $-O-$.

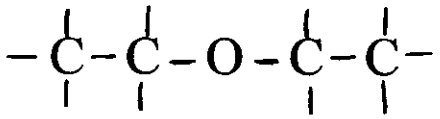
What is the functional group of an ether? _____

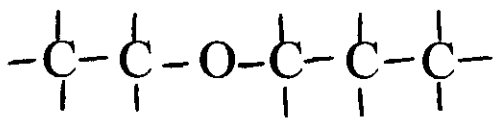
The general formula for an ether is $R_1 - O - R_2$. Uses of ethers include anesthetics and starting fluid for internal combustion engines.
Naming Ethers: It is easy to name ethers. All you have to do is name the alkyl groups on each side of the oxygen. State the alkyl groups in alphabetical order. If both alkyl groups are the same, use the prefix "**di** ". Remember! If the name ends with **ether** , it is an ether.

Examples : Circle each **alkyl group** and name the following compounds.









Draw the structural formula of methyl propyl ether:

Draw the structural formula of dipropyl ether:

Ketones (rhythms with stones)

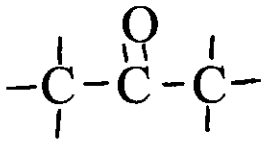
The functional group of a ketone is 

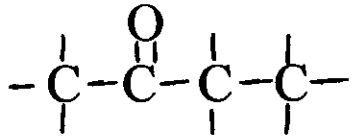
What is the functional group of a ketone? _____

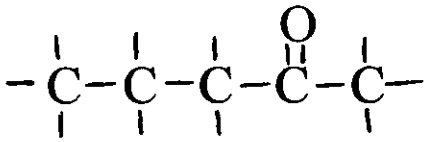
The general formula of a ketone is 
Naming Ketones: Ketones are named by dropping the last "e" of the hydrocarbon and replacing it with "**one**" (rhythms with stone). Remember if it ends in "**one**" it is a ketone. If the ketone contains more than 3 carbon atoms the functional group must be designated with a numbered carbon atom. A ketone must always be between 2 or more carbon atoms, therefore, the minimum # of carbon atoms in a ketone is 3 (that means there is no such thing as methanone or ethanone).

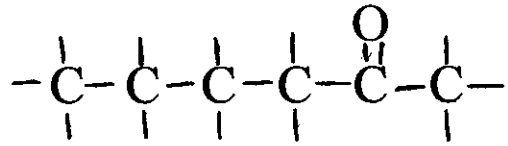
What is the minimum number of carbon atoms in a ketone? _____

Examples: Circle the functional groups and name the following compounds.





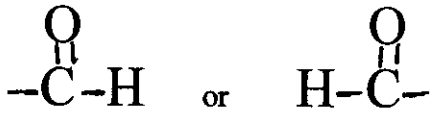




Draw the structural formula of 2-heptanone:

Draw the structural formula of 3-heptanone:

Aldehydes

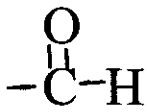
The functional group for an aldehyde is  or

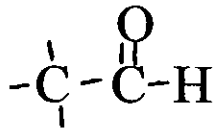
These are the same.
They are just turned.

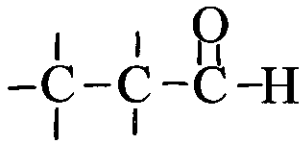
What is the functional group of an aldehyde? _____

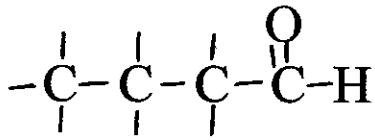
Its general formula is **R-C-H**. The functional group "aldehyde" always comes at the end of the compound. Therefore, it does not have to be located with a numbered carbon atom.
Naming aldehydes: Aldehydes are named by dropping the last "e" from its hydrocarbon and replacing it with "al". Remember! If the name ends in **al** it is an **al**dehyde.

Examples: Circle the functional groups and name the following compounds.







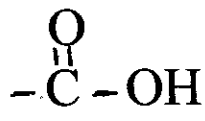


Draw the structural formula for pentanal:

Draw the structural formula for hexanal:

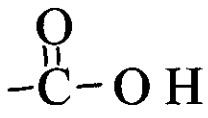
Organic Acids: The functional group of an acid is **-COOH**.
The general formula is **R-COOH**. Remember **"R"** represents the rest of the compound. A common organic acid is ethanoic acid (also known as acetic acid). Etahnoic acid is commonly known as vinegar.
Table K shows the 2 ways or representing the formula for ethanoic acid.

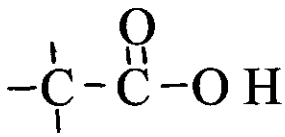
What is the functional group of an organic acid? _____

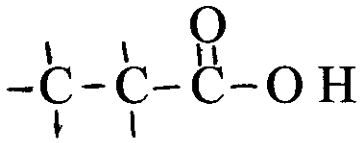
The -COOH group is also represented as 

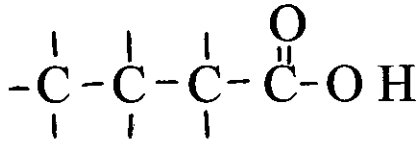
Naming organic acids: Organic acids are named by dropping the last "e" from the name of the corresponding hydrocarbon and adding " oic acid". This functional group can only be attached to the end of a hydrocarbon therefore it is not necessary to designate its location with a numbered carbon atom. Remember! if it ends in **oic acid** it is an organic acid.

Examples: Circle the functional groups and name the following compounds.









Draw the structural formula of pentanoic acid:

Draw the structural formula of hexanoic acid:

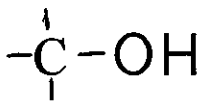
Alcohols: The functional group for alcohols is the (-OH) group. In an alcohol one or more hydrogens of a hydrocarbon have been replaced by an (-OH) group. When an (-OH) group is bonded to an organic compound it is not a polyatomic ion and therefore not ionic. We can say that alcohols are not ionic, they are molecular. When an alcohol dissolves in water it remains a molecule, it does not separate into ions. Alcohols are not electrolytes. The general formula for any alcohol is **R**-OH. Remember **"R"** represents the rest of the hydrocarbon.

Are alcohols ionic compounds? _____

Are alcohols electrolytes? _____

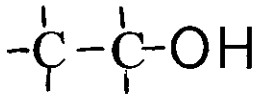
Naming alcohols: To name an alcohol drop the last "e" from the name of the starting hydrocarbon and replace it with **"ol"**. Remember! If the name ends in **"ol"** it is an alcohol.

Examples:
The alcohol formed from methane is called methan**ol**.



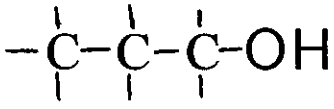
In the topic of organic chemistry, the bond between O and H may be omitted. It is understood that there is a single covalent bond between O and H.

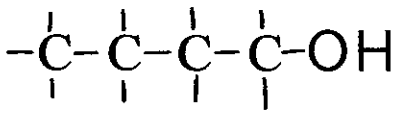
The alcohol formed from ethane is called ethan**ol**.



If the (-OH) group is attached to a hydrocarbon larger than ethane (2 carbon atoms) the location must be given using the same numbering system that is used for locating alkyl groups on hydrocarbons.

Examples: Circle the functional groups and name the following compounds.





Draw the structural formula of 2-propanol:

Draw the structural formula of 2-pentanol:

The examples in Table R are only useful if we know what we are looking at.
Let's transform the condensed structural formula on the right to its structural formula.

Class of Compound	**Structural Formula**	**Example** condensed structural formula (given in Table R)
halide (halocarbon)		$CH_3CHClCH_3$ 2-chloropropane
alcohol		$CH_3CH_2CH_2OH$ 1-propanol
ether		$CH_3OCH_2CH_3$ ethyl methyl ether
aldehyde		$CH_3CH_2\overset{O}{\overset{\|\|}{C}}\text{-}H$ propanal
ketone		$CH_3\overset{O}{\overset{\|\|}{C}}CH_2CH_2CH_3$ 2-pentanone
organic acid		$CH_3CH_2\overset{O}{\overset{\|\|}{C}}\text{-}OH$ propanoic acid
ester		$CH_3CH_2\overset{O}{\overset{\|\|}{C}}OCH_3$ methyl propanoate
amine		$CH_3CH_2CH_2NH_2$ 1-propanamine
amide		$CH_3CH_2\overset{O}{\overset{\|\|}{C}}\text{-}NH_2$ propanamide

Table R
Organic Functional Groups

Table R is super-important. To better understand the table transfer the information from Table R into the blank Table R below.

Class of Compound	Functional Group	General Formula	Example
halide (halocarbon)			
alcohol			
ether			
aldehyde			
ketone			
organic acid			
ester			
amine			
amide			

Functional Groups

Functional groups are groups of atoms that are covalently bonded to hydrocarbon molecules. These functional groups contain atoms other than hydrogen and carbon. Once a functional group is bonded to a hydrocarbon, the resulting molecule is no longer a hydrocarbon. Remember! **Hydrocarbons only contain hydrogen and carbon.** Functional groups give organic compounds distinctive chemical and physical properties. Since a functional group can be attached to any hydrocarbon, we can describe the class of compound by using the letter **"R"** to represent the rest of the hydrocarbon.

Important! Carbon always forms 4 bonds; nitrogen always forms 3 bonds; oxygen always forms 2 bonds hydrogen and any halogen (group 17) always form 1 bond.

A single bond — is counted as 1 bond.

A double bond = is counted as 2 bonds.

A triple bond ≡ is counted as 3 bonds.

Names and examples of functional groups can be found in Table R.

What only 2 elements does any hydrocarbon contain? _____ and _____.

Can molecules that contain functional groups be hydrocarbons? _____**Why?**

_____

How many bonds will carbon always form? _____

How many bonds will nitrogen always form? _____

How many bonds will oxygen always form? _____

How many bonds will hydrogen or any halogen always form? _____

What group are the halogens? _____

As a regents chemistry student you will have 2 main tasks to perform regarding functional groups.

Task 1: Draw the structural formula of an organic compound from the name.

Task 2: Name an organic compound from a structural formula or a condensed structural formula.