MODERN MODEL OF THE ATOM

Atoms and Elements:
- review energy levels ==> rings on Bohr Rutherford Diagrams are now energy levels
- 7 energy levels
- 4 sub levels: s, p, d, f
  - s = 1 orbital (2 electrons)
  - p = 3 orbitals (6 electrons)
  - d = 5 orbitals (10 electrons)
  - f = 7 orbitals (14 electrons)
- each orbital houses **TWO** electrons...half fill, opposite spins, lowest energy filled first.

**Diagram:** (memorize)

Atoms vs Ions....
**Aufbau Diagrams:** Means “to build” and is a diagrams representation of an atom

**Electron Configurations:** More of a statement that represents electron probability in an atom

- electrons on the outermost energy level are the only ones that are involved in bonding.
- these electrons on the outer ring/energy level are called **valence electrons**. (equal to the group #)

*Aufbau Diagram and Electron Configuration Assignment*
STOICHIOMETRY

Chapter 2  Section 1  p. 43

Stoichiometry: the study of the quantities of reactants and products in chemical reactions

Isotope: atoms of an element that have the same number of protons, but different numbers of neutrons.

Eg: Oxygen

Hydrogen

Atomic Mass Units (AMU): measure of the mass of an atom defined by carbon.

- mass of electrons, protons, and neutrons are so tiny that they use this measure.

Sample problem p. 45 (problems p.45)

Isotopic Abundance: the relative amount of each isotope that is present in an element.
- represented as a decimal or a fraction.

*Average Atomic Mass Lab*

Chapter 2  Section 2  p. 47

Read “Green Pea Analogy” story

Green Pea Analogy: 1 mol of salt (NaCl) => 22.99 + 35.45 = 58.44 g/mol

1 mol = 6.02 x 10^{23} representative particles (which are formula units, ions, atoms, and molecules)

6.02 x 10^{23} is called Avogadro’s Number
Example: How many atoms are in 2.5 moles of Calcium?

\[
2.5 \text{ moles of Ca} \times \frac{6.02 \times 10^{23}}{1 \text{ mole}} = 1.5 \times 10^{24} \text{ atoms of Ca}
\]

*Do an example finding atoms of a compound.

problems p. 53

Chapter 2 Section 3 p. 55

Molar Mass Problems (Sample Problem p. 56) (problems p. 57)

Mole to Mass Problems (Sample Problem p. 58) (problems p. 59)

Double Conversion Factors: (converting between moles, mass, and number of particles) (Sample Problem p. 62-63) (problems p. 63-64)

Chapter 2 Section 4 p. 66

Molar Volume: 1 mole of gas at STP = 22.4 L (standard temperature= 0\(^\circ\) and pressure=101.3 kPa) (Sample problem p. 70) (practice problems p. 73)

Chapter 3 Section 1 p.

Law of Definite Proportions: the elements in a given chemical compound are always present in the same proportions by mass.

Percent Composition: the percent of elements that a compound is composed of.

\[
\% = \frac{\text{mass of element}}{\text{mass of compound}} \times 100\%
\]

3 Types of Problems....show all three!

1. Given the mass of each element in the compound
2. Given just the chemical formula of the compound
3. Finding the percent by mass of a compound

(practice problems p. 82)
Empirical Formula: (simplest formula) shows the lowest whole number ratio of the elements in the compound.

(Sample problem p. 88) (practice problems p. 89)

Molecular Formula: (actual formula) shows the number of atoms of each element in a molecule.

(Sample problem p. 97) (practice problems p. 97)

Hydrate: a compound that has a specific number of water molecules bonded to each formula unit.

When the compound loses its water it becomes an anhydrous salt and is said to have effloresed (lose water)

Dessicant: any compound that has the ability to absorb moisture from the air.
   Eg: beads in shoes, and leather products.

Finding the Formula of a Hydrate

2 Types of Problems
1. Determining the formula
2. Finding the percent by mass of water

(small problem p. 102-102) (practice problems p. 103)

*Formula of a Hydrate Lab*

*Test on Chapter 2 and 3*
Chapter 4  Section 1  p. 110

Interpreting Equations

\[
2 \text{ Na} + 1 \text{ Cl} \rightarrow 2 \text{ NaCl}
\]

moles (co-efficients)

mass (molar mass)

representative particles

(6.02x10^{23})

volume

(22.4 L)

Mole to Mole Relationships: Go over problems to prepare for mass to mass problems (make up examples for this)

Example:

\[
2 \text{ Na} + 1 \text{ Cl}_2 \rightarrow 2 \text{ NaCl}
\]

How many moles of sodium are required to react completely with chlorine to produce sodium chloride?

Law of Conservation of Mass: in any chemical reaction the mass of your reactants is always equal to the mass of the products.

Mass to Mass Problems
(Sample problem p. ) (practice problems p. )

Chapter 4  Section 2  p.

Limiting Reagent: the reactant that is completely used up in a reaction, therefore, limits the reaction.

Excess Reagent: the reactant that remains once the reaction is over.

Eg: peanut butter and bread analogy
Example Problem: \[ \text{Li}_3\text{N} + 3 \text{H}_2\text{O} \rightarrow \text{NH}_3 + 3 \text{LiOH} \]

Chapter 4  Section 3  p.

Percent Yield: used to predict the amount of product that can be expected from a chemical reaction. This procedure is used to determine how accurate your experiment is. If the percent yield is low, that indicates that the conditions were not optimal. At this point, steps can be changed to the process to, hopefully, achieve better results.

The percent yield is very rarely close to 100% because there is almost always human error present in any experiment.

- the amount of product predicted = theoretical yield
- the amount of product obtained = actual yield

\[
\% \text{ Yield} = \frac{\text{actual}}{\text{theoretical}} \times 100 \%
\]

- The percent yield of a chemical reaction compares the mass of product obtained by the experiment (actual yield) with the mass of the product determined by stoichiometric calculations (theoretical yield)

- actual yield will always be smaller than theoretical due to human error and situations.

*practice problems worksheet*

*Chapter 4 Quiz*
Chapter 5  Section 1  p.

The difference between elements and compounds...(introduction through discussion)

- both pure substances (mention the break down of matter, grade 10 material)
- capital letters when looking at the symbol/chemical formula/molecular formula
- compounds can be broken down further into elements
- elements cannot be broken down
- compounds are in fixed ratios/proportions

What is a physical property?
A property that can be measured without changing the chemical composition/make-up of a substance.

example: smell, taste, colour, melting point, boiling point, state etc.

Properties of Ionic and Molecular Compounds

<table>
<thead>
<tr>
<th>Ionic Compounds</th>
<th>Molecular Compounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>- metal and a non-metal</td>
<td>- 2 non-metals</td>
</tr>
<tr>
<td>- transfers electrons</td>
<td>- shares electrons</td>
</tr>
<tr>
<td>- solid at room temperature</td>
<td>- solid, liquid, or gas at room temperature</td>
</tr>
<tr>
<td>- high solubility in water</td>
<td>- low solubility in water</td>
</tr>
<tr>
<td>- high melting point</td>
<td>- low melting point</td>
</tr>
<tr>
<td>- conducts electricity when dissolved in water</td>
<td>- does not conduct electricity when dissolved</td>
</tr>
</tbody>
</table>

Lewis Dot Diagrams: Using valence electrons to show electron arrangement around a nucleus.
- any electron that is not paired up is called an unshared pair, but are still involved in bonding

Chapter 5  Section 2  p.

Octet Rule: when bonds form, atoms lose or gain electrons so that they create a full outer ring/energy level.  (hydrogen and helium are exceptions!)

Three Types of Bonding:
Ionic Bonding: review  group 1,2,3 lose electrons  group 5,6,7 gain electrons

Using Lewis Dot Diagrams to show bonding

\[ \text{Na} + \text{Cl} \Rightarrow \]

What is an ionic bond?
An attraction between positive and negative ions that forms a crystal lattice

-when the ratio is not 1-1 the crystal lattice becomes more complex, but still is arranged so the positive and negative are as close as possible.

**Covalent Bonding:** (Molecular Compounds)
- review - made up of molecules connected by covalent bonds.
- made up of two non-metals
- shares electrons to follow the octet rule

example: \( \text{Cl} \quad \text{Cl} \)

**Metallic Bonding:** unlike ionic and covalent
- all metals are cations (which have positive charges)
  - when they bond it’s the attractive force between the positive charged ions and “sea” of electrons that forms a metallic bond

(See figure 5.16 p. 172)

*worksheet for Section 2*

Chapter 5  Section 3  p.

**Trend In Atomic Size:**

1. **Atomic Size:**
   a) **DECREASES** as you move across the **PERIOD** (left to right)
      Why? We remain in the same energy level. Electrons are being added to the same energy level, new energy levels are not added. The increase in the nucleus charge causes a greater pull on the outer electrons toward the nucleus.

   b) **INCREASES** as you move down the **GROUP**
      Why? As you go down electrons are being added to higher energy levels. The nucleus charge increases as well, but because the amount of rings/energy levels increases the shielding effect increases. This means the inner electrons shield out the pull that the positive nucleus would have on the electrons.

**Trend In Ion Size:**
2. **Ionic Size:**
   
a) **POSITIVE IONS** are always smaller than the neutral atoms from which they are formed.
   
   Why? The loss of the outer ring/energy level results in an increased attraction by the nucleus for the fewer remaining electrons.
   
   Lithium Atom
   
   Lithium Ion
   
   b) **NEGATIVE IONS** are always larger than the neutral atoms from which they are formed.
   
   Why? The effective nuclear attraction is less for an increased number of electrons.
   
   Nitrogen Atom
   
   Nitrogen Ion
   
   **Trend In Electronegativity:**
   
   **Electronegativity of Elements:** some atoms share the electrons more often than other atoms
   
   eg:
   
   | O | C | O |
   
   **Increases:** because as the number of protons in the nucleus increases, the attractive forces are increased between the nucleus and the valence electrons, therefore, pulling them closer (smaller size)
   
   **Decreases:** because adding electrons as you go down the group so the more electrons, the more rings/energy levels, therefore the further away from the nucleus, which has therefore a bigger size.
   
   Bond Type and Electronegativity p. 176
   
   - when a covalent bond is formed, if the molecules share the electrons equally then it is called a **nonpolar covalent bond**.
   
   ex: diatomic molecules; H, N, O, F, Cl, Br, I
- BUT if there is a difference in electronegativities you can predict the type of bond that will form between atoms of any two elements.
  - find electronegativity values
  - find the difference between these values
  - use table to decide the type of bond

<table>
<thead>
<tr>
<th>Electronegativity Difference</th>
<th>Type of Bond</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 0.5</td>
<td>non-polar covalent bond</td>
</tr>
<tr>
<td>0.5 - 1.7</td>
<td>polar covalent bond</td>
</tr>
<tr>
<td>greater than 1.7</td>
<td>ionic bond</td>
</tr>
</tbody>
</table>

- the atom with the larger electronegativity value has the electron more than the other atom, therefore, gains a slightly negative charge $\delta^-$
- the other atom is slightly positive $\delta^+$
- this bond is called dipole because the bond has two different poles, one positive and one negative

(practice problems)

Chapter 6  Section 1  p.

Drawing Lewis Structures: for simple molecules and ions with a central atom
  - when drawing, atoms with the lowest group number are written first in the middle

(practice problems)

Co-ordinate Covalent Bonds: one atom contributes both electrons to the shared pair

(practice problems)

*worksheet for co-ordinate covalent bonding*

Valence Shell Electron Pair Repulsion (VSEPR Theory)
The VSEPR Theory states that the bonding pairs and the lone pairs of electrons in the valence level of an atom repel one another due to their negative charges.

<table>
<thead>
<tr>
<th>Shape</th>
<th>Bond Angle</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bent</td>
<td>105°</td>
<td></td>
</tr>
<tr>
<td>Linear</td>
<td>180°</td>
<td></td>
</tr>
<tr>
<td>Pyramidal</td>
<td>107°</td>
<td></td>
</tr>
<tr>
<td>Tetrahedral</td>
<td>109.5°</td>
<td></td>
</tr>
</tbody>
</table>

Polar Bonds and Molecular Shapes
- **non-polar molecule**: one bond cancels the polar effect of the other
- **polar molecule**: a molecule that has two polar ends.

**Network Solids**: atoms bond covalently in continuous 3-dimensional arrays

**Allotropes**: are different crystalline or molecular forms of the same element that differ in physical and chemical properties.

**Intermolecular Attractions vs Intramolecular Attractions**
INTERmolecular attractions occur between two molecules while INTRAmolecular attractions occur within a molecule.

**Two Types of Intermolecular Attractions:**
1. **Van Der Waals Forces**:
   a. dipole-dipole forces: occur between the opposite ends of two dipole molecules
   b. dispersion forces: very weak forces that cause the state of matter to change. The more electrons present around the atom, the greater the force.

   group 7 elements demonstrate this force
   - Fluorine 9 e⁻ gas
   - Chlorine 17 e⁻ gas
   - Bromine 35 e⁻ liquid
   - Iodine 54 e⁻ solid

2. **Hydrogen Bonding**: - must involve hydrogen
- occurs between hydrogen and a highly electronegative atom (usually N, O, F) - hydrogen is bonded to the unshared pair of electrons on the other molecule

- Hydrogen Bonding is responsible for many properties of water.
  1. It’s the only liquid where its solid will float in it. Why? It forms a HONEYCOMB FRAMEWORK
     The molecules expand rather than condense making it less dense than the liquid water therefore it floats.
     - show diagram

  2. It has a higher melting point and boiling point compared to other compounds with a similar make up (ie: bonds and molar mass)

  3. Importance for aquatic life:
     - water would freeze in a lake/ocean from the bottom up because it would sink
     - all water would freeze killing aquatic life
     - it insulates the water beneath it because floats

Bonding and Biological Molecules:

Proteins can only carry out their function if the amino acid is folded correctly. Therefore, hydrogen bonds are very important to stabilize this fold.

*molecular model lab*

Chapter 6  Section 3  p.

Melting Points and Boiling Points

- solids begin to meet when the average kinetic energy of the particles is great enough to overcome the attraction, therefore changes to a liquid
- more kinetic energy ==> liquids can overcome attractions and change to a gas
- gases have no attractions between molecules

Melting points and boiling points are different depending on the type of bond that has to be broken:

Ionic Compounds: break ionic bonds
Mg₃P₂

Metallic Bonds: break metallic bonds
Mg²⁺

Molecular Compound intermolecular bonds break (between molecules), NOT
intramolecular bonds
C₆H₁₂O₆

Table 6.4 p. 217

Mechanical Properties of Solids:
- Metals are **malleable** (can be hammered into sheets) and **ductile** (can be drawn into wires)
- Ionic compounds are hard and brittle

Electrical Conductivity:
- Metals are great conductors in solid state
- Ionic compounds conduct electricity in a molten state when dissolved in water
- Molecular substances, regardless of state or when dissolved in water, will not conduct electricity

Electric current is a flow of charge carried by moving electrons or ions.

<table>
<thead>
<tr>
<th>Metal</th>
<th>Ionic Compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>electrons are given off</td>
<td>electrons can move</td>
</tr>
<tr>
<td>to conduct the current</td>
<td>freely</td>
</tr>
</tbody>
</table>

Thermal Conductivity:
- An increase in electrical conductivity means an increase in the thermal conductivity
- Ions and electrons move freely picking up kinetic energy and getting warmer and staying warm

*test on Chapter 5/6 test*

Chapter 9    Section 1    p.
**organic compound:** - a molecular compound of carbon
- consists mainly of carbon and hydrogen
- all living things are consisted of organic compounds

examples: carbohydrates, proteins, fats

**inorganic compound:** - a molecular compound that does not have a combination of carbons and hydrogens

examples: carbon dioxide, water, ammonia

**hydrocarbons:** - class of compounds containing carbon and hydrogen

**fossil fuels:** - dead plant and animal matter decompose
- over time it is covered with layers of mud and soil
- as the layers build, an increase in heat and pressure turns the dead plant and animal matter into fossil fuels (ie: coal, gas, petroleum)

<table>
<thead>
<tr>
<th>Organic Compounds</th>
<th>Hydrocarbons</th>
<th>Hydrocarbon Derivatives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aliphatic</td>
<td>Aromatic</td>
</tr>
<tr>
<td>Alkanes</td>
<td>Alkenes</td>
<td>Alkynes</td>
</tr>
</tbody>
</table>

**Chapter 9  Section 2  p.**

The CARBON atom: - each carbon can from 4 covalent bonds
- therefore it can connect to as many as four different atoms
- can form single, double, or triple bonds with itself
- carbon atoms can bond together to form a variety of geometrical structures including chains, spheres, rings and tubes.

Drawing Organic Compounds (can be complex)
- **structural diagram:** a two-dimensional representation of a structure of a compound

Three main ways to show a structural diagram:
1. complete structural diagrams: - shows all atoms and how they are bonded
   ex:

2. condensed structural diagrams: - simplifies the complete structural design
   - shows bonds between carbons, but not between carbon and hydrogens
   ex:

3. line structural diagrams: - the simplest
   - the end of each line and the points where they meet represent carbons
   - hydrogens are not included
   ex:

Chapter 9  Section 3  p.

Alkanes: - are hydrocarbon molecules that contain only single covalent bonds
         - they all form chains of carbon, NOT rings

Facts about alkanes:
   - each carbon is bonded to the maximum number of atoms (either carbon or hydrogen)
   - they are called saturated hydrocarbons
   - each molecule differs from the next by a structural unit (CH₂)
   - if the same structural unit is used it is called a homologous series
   ______ general formula = CₙH₂ₙ₊₂
   - METHANE is the simplest alkane
     it is a gas at STP
     major component of natural gas
formula is $\text{CH}_4$

-ETHANE is the simplest alkane containing a carbon to carbon bond

formula is $\text{C}_2\text{H}_6$

Prefixes for parent chain:

- $1 = \text{meth}$
- $2 = \text{eth}$
- $3 = \text{prop}$
- $4 = \text{but}$
- $5 = \text{pent}$
- $6 = \text{hex}$
- $7 = \text{hept}$
- $8 = \text{oct}$
- $9 = \text{nona}$
- $10 = \text{deca}$

**Branched Chain Alkanes**

If an atom(s) takes the place of a hydrogen atom on a parent hydrocarbon molecule, that atom is called a SUBSTITUTE. Common substituents are halogens or groups of atoms containing hydrogen, oxygen, nitrogen, sulfur, and phosphorus.

A hydrocarbon substituent is called an ALKYL GROUP. They are named by removing the -ane ending from the parent hydrocarbon and adding the ending -yl.

An alkane with one or more alkyl groups is called a BRANCHED CHAIN ALKANE.

**RULES:**

- find the longest, continual carbon “parent” chain
- circle the substituents
- count in the direction so that the substituents get the lowest possible number
- when naming substituents, the prefixes are the same as what you used for the parent chain, but the ending becomes -yl (they are called alkyl groups)
- use prefixes for appearances of a group more than once (di, tri, tetra, penta)
- List the names of the alkyl groups alphabetically. NOTE the prefixes di, tri, etc are ignored when alphabetizing
- Use punctuation:
  * commas separate numbers from each other
  * hyphens separate numbers and words
  * write last alkyl and parent name together

(practice problems)
Physical Properties of Alkanes
- the electron pair is shared almost equally in a C-C bond or a C-H bond so hydrocarbon molecules are NONPOLAR so alkanes are not attracted to water (because “like dissolves like” and water is polar)

- alkanes are held together by weak Van der Waals forces, therefore, they often exist as gases and have low boiling liquids. As the number of atoms in the hydrocarbon molecule increases the boiling point increases.

- alkanes are often found a STRUCTURAL ISOMERS, that is the compounds have the same molecular formula, but have different molecular structures.
  * Structural isomers differ in their physical and chemical properties. Generally, the more branched the hydrocarbons the lower the melting point compared with its other structural isomers

Problem: do structural isomers of alkanes here, but do again for alkenes and alkynes later.

Practice Problems

Reactions of Alkanes

COMPLETE COMBUSTION
- occurs if enough oxygen is present
- a blue flame indicates complete combustion
- a hydrocarbon that undergoes complete combustion always produces carbon dioxide and water

Problem: write balanced equations for the complete combustion of a hydrocarbon

INCOMPLETE COMBUSTION
- occurs when there is not enough oxygen present
- indicated by a yellow flame
- produces are still carbon dioxide and water BUT also include CO and C

Problem: write balanced equations for the incomplete combustion of hydrocarbon. NOTE: more than one answer is possible.

*Worksheet*

Alkenes and Alkynes
UNSATURATED COMPOUNDS are organic compounds that contain double and triple carbon-carbon bonds. (ie: it holds fewer than the maximum number of hydrogens than it can hold).

- alkanes are saturated compounds, alkenes and alkynes are unsaturated compounds

ALKENES
- organic compounds containing carbon-to-carbon DOUBLE BONDS
- boiling point are usually lower than that of a similar sized alkane
- low solubility in water
- non-polar so dissolve in nonpolar solvents
- general formula = C\text{\textsubscript{n}}H\text{2n}

Rules for Naming Alkenes:
- same rules as alkanes, EXCEPT, the double bond gets the lowest number regardless of the substituents and must be included in the parent chain
- ending changes to -ene

(ALKENES)

ALKYNES
- are organic compounds that contain TRIPLE bonds
- unsaturated compounds
- not plentiful in nature
- name the same way as alkenes except make the ending -ynes
- general formula - C\text{\textsubscript{n}}H\text{2n-2}
- eg: ethyne
  * also called acetylene
  * used in welding
  * linear molecule

Cyclic Hydrocarbons and Aromatic Compounds

CYCLIC HYDROCARBONS
- are compounds that contain a hydrocarbon ring
- nonpolar
- flammable

AROMATIC HYDROCARBONS
- a special group of unsaturated cyclic compounds
- originally called ARENES
- forms bonds like benzene

** Chemists do not always use position numbers to describe the branches on a benzene ring. When two branches are present you can use ortho- (1,2 position), meta-(1,3 position), and para- (1,4 position).

The benzene compound can be a substituent on a carbon chain as C₆H₅ or PHENYL.

* Do isomers of alkenes and alkynes and geometric*

** Geometric Isomers**

**CIS and TRANS Isomers:** - show how atoms can be arranged around a double bond
- double bonds cannot rotate around like single bonds
  (show using the molecular model kits)

**CIS Isomer:** both groups of atoms are on the same side of the double bond
  ex:

**TRANS Isomer:** groups of atoms are on opposite sides of the double bond
  ex:

*Lots of Practice Problems*

*Hydrocarbon Lab*
*Chapter 9 Review*
*Chapter 9 Test*
**Functional Groups**

The substituents of organic molecules often contain O, N, S, or P. They are called **FUNCTIONAL GROUPS** because they are the functional parts of the molecule (ie: the chemically reactive part of the molecule).

Table 26-1  p. 616  (from the old book)

**Halocarbons**

HALOCARBONS are organic compounds containing F, Cl, Br, or I.
- their functional group is called a **HALOGEN**
- compound structure is R-X, where X is a halogen and R is a carbon chain or ring.

**Naming Halocarbons**
- same as before, just add the halogen group as a substituent.
- number in the direction to get the lowest combination of numbers, if there is a tie, give the substituent who comes first alphabetically the lowest number.

**Substitution Reactions**

Organic reactions take place very slowly because the bonds holding the molecules together are very strong. So, catalysts and improved procedures are often needed to hurry the process.

One type of organic reaction is a **SUBSTITUTION REACTION** whereby an atom(s) is replaced by another atom(s).

Eg: Forming a halocarbon $\rightarrow$ **HALOGENATION**

$$R-H + X_2 \rightarrow R-X + HX$$

alkane  halogen  halocarbon  hydrogen  halide

**Alcohols**
ALCOHOLS
- are organic compounds with an -OH group
- the -OH functional group in alcohols is called a HYDROXYL GROUP
- general formula is R-OH

Naming Alcohols
- drop the -e of the parent alkane name and add the ending of -ol
- in numbering the parent chain, the position of the hydroxyl group is given the lowest possible number

** Primary, Secondary, Tertiary Alcohols: go over and give examples for each

PHENOLS are compounds in which a hydroxyl group is attached directly to an aromatic ring.

Properties of Alcohols
- alcohols have high boiling points because of their intermolecular hydrogen bonding
- somewhat soluble in water (the carbon chain is non-polar, but the polar hydroxyl group dissolves well in water)
  - isopropyl alcohol - rubbing alcohol
  - ethylene glycol - antifreeze ingredient
  - ethyl alcohol - the intoxicating substance in alcoholic beverages. Produces by fermenting sugar with yeast. It damages the liver.
- For industrial use, it is mandatory for ethyl alcohol to be DENATURED (having a substance added to it to make it toxic - eg methyl alcohol (wood alcohol) which can cause permanent blindness or even death...10 ml can cause permanent blindness while 30 ml is fatal)

Addition Reactions

In an ADDITION REACTION a substance is added at the double or triple bond of an alkene or an alkyne.
- the multiple bond is weak and other substances quite easily add to this bond
- this is an important method of introducing functional groups into organic compounds
Eg: A HYDRATION REACTION is the addition of water to an alkene

Eg: A HYDROGENATION REACTION is the addition of hydrogen to an alkene. Plant oil is often hydrogenated to make margarine.

**Ethers**

ETHERS are compounds which have oxygen bonded to two carbon groups. The general formula is R-O-R

To name:
- the alkyl groups attached to the ether linkage are named in alphabetical order and followed by the word ether. If the alkyl is the same prefix di-is used

Eg:

Diethyl ether is a volatile liquid that was the first reliable general anesthetic. It has been replaced by other anesthetics because it is highly flammable and causes nausea.

**Aldehydes and Ketones**

A CARBONYL FUNCTIONAL GROUP consists of a carbon atom and an oxygen atom joined by a double bond. It is found in two groups of compounds called ALDEHYDES and KETONES. They are mostly used as solvents.
ALDEHYDES are organic compounds in which the carbonyl group is always joined to at least one hydrogen. It has the general formula RCHO.

Propanone is commonly referred to as acetone.

Naming aldehydes
- the -e ending is replaced by -al
- the parent chain must be the longest chain that contains the carbonyl
- the parent chain must be numbered so that the carbonyl gets the lowest number possible
- Since the carbonyl group must always be in the number one carbon position of the parent chain you do not have to state it position.

KETONES are organic molecules in which the carbon of the carbonyl group is joined to two other carbons. The general formula is RCOR.

Naming ketones
- the -e ending on the parent chain is replaced by -one
- the parent chain must be the longest chain that contains the carbonyl
- the parent chain must be numbered so that the carbonyl gets the lowest number possible
- since the carbonyl group on the parent chain can be in more than one position it’s positioning must be stated.

Carboxylic Acids
A CARBOXYLIC ACID is a compound with a carboxyl functional group. A CARBOXYL group consists of a carbonyl group attached to a hydroxyl group. Its general formula is RCOOH.

Naming Carboxylic Acids
- the -e ending on the parent chain is replaced by -oic acid
- the parent chain is the longest continuous chain that contains the carboxyl group

Carboxylic Acids:
- are weak acids because they ionize to release a hydrogen ion.
- are abundant in nature. Eg: acetic acid (vinegar)
- continuous chains of carboxylic acids found in fats are called FATTY ACIDS
- these compounds form hydrogen bonds therefore they have high mp and bp
- the carboxyl group is polar

Esters

ESTERS are derivatives of carboxylic acids in which the -OH of the carboxyl group has been replaced by an -OR from an alcohol. The general formula is RCOOR.

Naming Esters:
- Identify the main part of the ester which contains the C=O group. This part will be the parent chain.
- Name the parent chain by dropping the -e and adding -oate
- The second part of the ester is the alkyl group that is attached to the oxygen atom. This gets named as an alkyl group (branch).

ESTERIFICATION - the formation of an ester from a carboxylic acid from an alcohol.
Polymerization

A POLYMER is a large molecule formed by the covalent bonding of repeating smaller molecules.

MONOMERS are molecules that combine to form the repeating unit of a polymer. Some polymers contain only one type of monomer, while others contain two or more.

Monomers are joined together to form polymers in two common ways:

1. ADDITION POLYMERIZATION:
   - occurs when unsaturated monomers (must contain a double or triple bond) to form a polymer. Eg: ethene becomes polyethylene

2. CONDENSATION POLYMERIZATION:
   - occurs by the head to tail joining of monomer units
   - usually accompanied by the loss of a smaller molecule (usually water, $\text{H}_2\text{O}$)
   - requires two functional groups on each molecule
   Eg: esterification

Two Types of Polymers:
1. Synthetic: plastics
2. Natural: glucose
* Both can be spun into fibres. Natural can form wool and cotton fibres, while synthetic can form rayon and nylon fibres.

Lots of worksheets and problems

*Hydrocarbon Derivative Lab*
* Chapter 10 Review*
*Chapter 10 Test*