4.5 Acids and Base

We've discussed acids and bases throughout the course. In this section, we'll look at them in terms of concentration, solubility, and solutions.

Your group will be assigned one of the following questions to complete. You can use the textbook or the internet to answer the questions. Make sure to write answers in your own words and make sure they can be easily understood by your classmates. You can include images and links to other media in addition to a written description.

1. Describe the Arrhenius definition of acids and bases. Give examples of each. Are there any acids and bases that do not follow the Arrhenius Theory? Explain.
2. What is pH and how is it related to concentration in acids and bases? How does the concentration of an acid
3. when moving up or down the pH scale? Discuss some of the ways the pH of a substance can be determined.
4. Describe the difference between strong and weak acids and bases. Give examples of each. How are strong acids different from concentrated acids?
5. Describe what acid rain is and the chemical processes that create it. What are its effects on the environment? What can we do to reduce the formation of acid rain and its effects?
6. Discuss the physical and chemical properties of acids and bases (conductivity, pH, taste, feel, substances they react with, potential dangers, etc). Give examples for each.

Answer the questions in the spaces below:

1. Describe the Arrhenius definition of acids and bases. Give examples of each. Are there any acids and bases that do not follow the Arrhenius Theory? Explain?

Arrhenius theory was introduced in 2007 by the Swedish scientist Svante Arrhenius. The Arrhenius definition of acids is that acids are substances which produce hydrogen ions in solution and bases are substances which produce hydroxide ions in solution. An Arrhenius acid when added to water increases the concentration of H 1+ ions. The chemical formula for an Arrhenius acid is written with the acidic hydrogen first. An Arrhenius base is a substance, when added to water, increases the concentration of OH1- ions present. HCl is an example of an Arrhenius acid and NaOH is an example of a base.

A major problem with the **Arrhenius** definition of **acids** and bases is that it limits **acids** and bases to water (aqueous) solutions. Since an **acid** requires water to ionize and form hydronium ions, there can be **no Arrhenius acids** unless water is involved as the solvent.

Theories of Acids & Bases

- **Arrhenius Theory of Acids & Bases:**
  - Properties of acids are due to the presence of H^+ ions
    - Example:

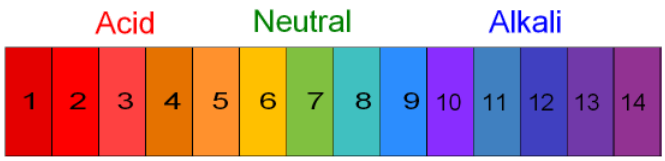
$$HCl \rightarrow H^+ + Cl^-$$

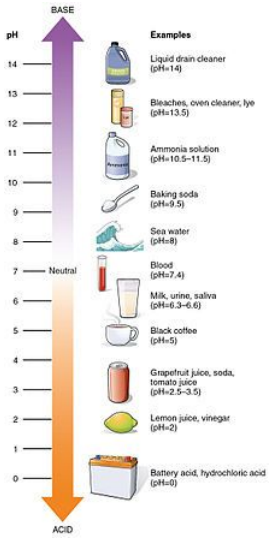
  - Properties of bases are due to the presence of OH^- ions
    - Example:

$$NaOH \rightarrow Na^+ + OH^-$$

2. What is pH and how is it related to concentration in acids and bases? How does the concentration of an acid change when moving up or down the pH scale? Discuss some of the ways the pH of a substance can be determined.

The letter pH stands for “power of hydrogen”. The pH of a solution is the measure of a molar concentration of hydrogen ions in the solution. This measure is known as the acidity or the basicity of a solution.To increase the pH of an acid you can add water. Since water is neutral with a pH of 7 it will raise the pH level of an acid, if enough is added, an acid can be neutralized. A universal indicator can be used to find the pH of a substance. It determines the pH from the colour that shows up in the substance that shows how acidic or basic the substance is. For example, a solution made of hydrogen ions has a pH of 4, it is 10^{-4} mol/L concentrated with hydrogen ions. This means it contains 0.0001 mol/L of hydrogen ions. Compare a pH of 4 to a pH of 5, the pH of a concentrated solution contains 10^{-5} mol/L of hydrogen ions. As you go down on the pH scale, the concentration is 1000 times higher than it is in the amount below it (10^{-4} = 0.0001, 10^{-5} = 0.00001). The strength of the hydrogen bonds within the solution determines how acidic or alkaline a solution will be.





what is ph?

3. Describe the difference between strong and weak acids and bases. Give examples of each. How are strong acids different from concentrated acids?

The difference is that strength is an acid's ability to lose protons. Concentration is the measure of how much of a given acid there is mixed with another substance.

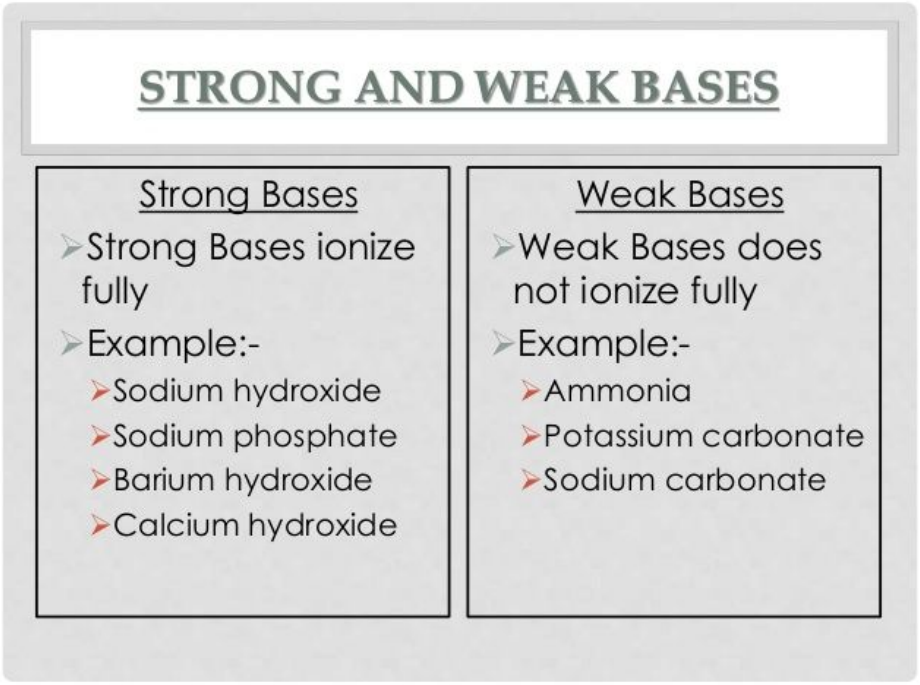
Acid solutions contain hydrogen ions. The higher the concentration of hydrogen ions, the lower the pH level. For instance hydrochloric acid is a strong acid and ethanoic acid is a weak acid. Therefore strong acids are fully ionised (converted from an atom, molecule, or substance to its ion or ions) but weak acids are only partly ionised in solution. However for bases, the difference between a strong and weak base is that weak bases do not ionize (do not convert an atom, molecule, or substance to its ions) completely when placed in a solution but strong bases can ionise is a solution.

TABLE OF STRONG ACIDS

HI	$H^+(aq) + I^-(aq)$
HBr	$H^+(aq) + Br^-(aq)$

TABLE OF STRONG BASES

NaOH	**$Na^+(aq) + OH^-(aq)$**
KOH	**$K^+(aq) + OH^-(aq)$**
LiOH	$Li^+(aq) + OH^-(aq)$

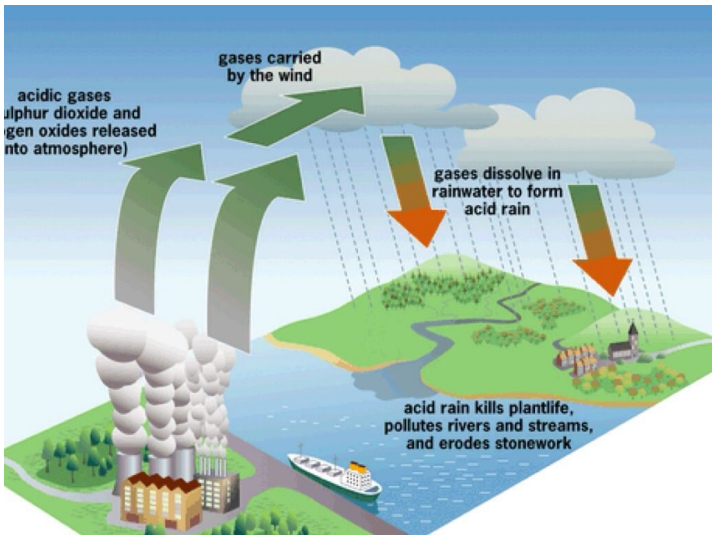


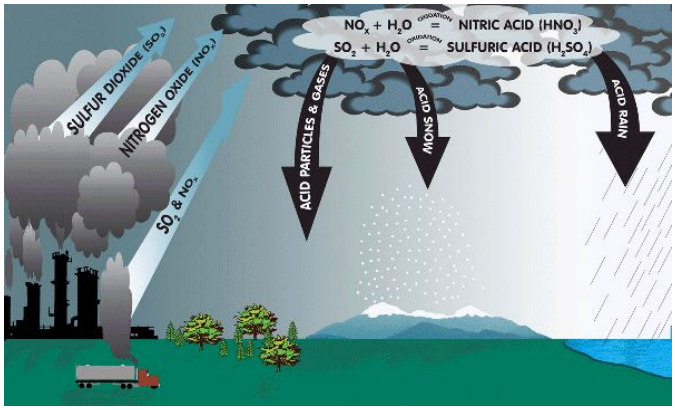
4. Describe what acid rain is and the chemical processes that create it. What are its effects on the environment? What can we do to reduce the formation of acid rain and its effects?

$$3\ NO_{2(g)} + H_2O \rightarrow 2\ HNO_{3(aq)} + NO_{(g)}$$

$$SO_{2(g)} \xrightarrow{O_2} SO_{3(g)} \xrightarrow{H_2O} H_2SO_{4(aq)}$$

Acid rain is a form of precipitation that is unusually acidic. It contains elevated levels of hydrogen ions causing it to have a pH less than 5.6. The chemical process that creates it is the combustion of fossil fuels and other natural processes that create nitrogen oxide and sulfur dioxide (nitric acid and sulfuric acid). The effects it has on the environment is mostly geared toward lakes, streams, wetlands, and other aquatic environments. It makes water acidic and thus toxic to aquatic life. This impact can then affect food chains and non-aquatic species (e.g. birds) and eventually could destroy whole ecosystems (lessening the biodiversity and the area's ability to prepare for natural disasters). Acid rain also damages forests at higher elevations by robbing the soil of essential nutrients and releases aluminum, making it hard to absorb water, leaving plants and trees weak. To reduce the formation of acid rain and its effects the use of renewable energy (e.g. solar and wind energy) would be a good solution. Using limestone or lime in a process called liming can repair the damage done to bodies of water. Adding lime balances the water's acidity although it is very expensive and has to be done many times.





Acid rain effect on trees

Acid rain effect on lakes

5. Discuss the physical and chemical properties of acids and bases (conductivity, pH, taste, feel, substances they react with, potential dangers, etc). Give examples for each.

Property	Acid	Base
Taste	Sour (vinegar)	Bitter (baking soda)
Smell	Frequently burns nose	Usually no smell (except NH_3!)
Texture	Sticky	Slippery
Reactivity	Frequently react with metals to form H_2	React with many oils and fats