

# Mixtures, Solubility and Acid/Base Solutions

## Lesson 1 – Properties of Solutions

# Mixtures and Solutions

- Recall that a solution is a type of mixture.

Which type of mixture? **Homogeneous**

- What makes up a mixture?

**Two or more  
substances**

- What makes up a solution?

**A solvent and at  
least one solute**

- How are solvents and solutes different?

**A solvent is the substance you have the most of. A  
solute dissolves in the solvent**

# Types of Solutions

- Do you think a solution is always a liquid?

A solution can exist in all 3 states of matter

- What determines whether a solution is a solid, liquid or gas? The state of the solvent

- Why does the solvent determine the state of the solution? Because the solvent exists in the greatest quantity

# Types of Solutions



**70% Copper**  
30% Zinc



40% Carrot juice  
30% Orange juice  
20% Pineapple juice  
7% Sugar  
3% Water



95% Methane  
3.2 % Ethane  
0.2% Propane  
0.03% Butane

# Water as a Solvent

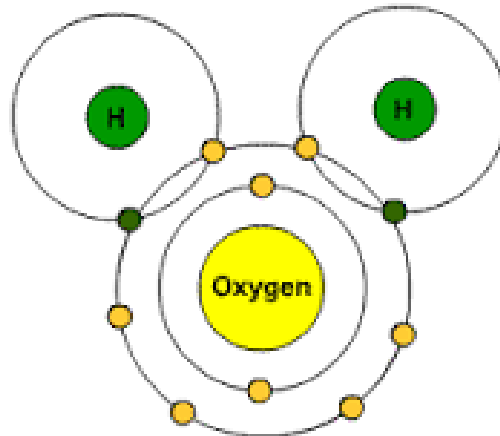
- Nearly all water on Earth contains dissolved solutes.
- But not everything can dissolve in water.



Why do you think some substances do not dissolve in water?

# Polarity

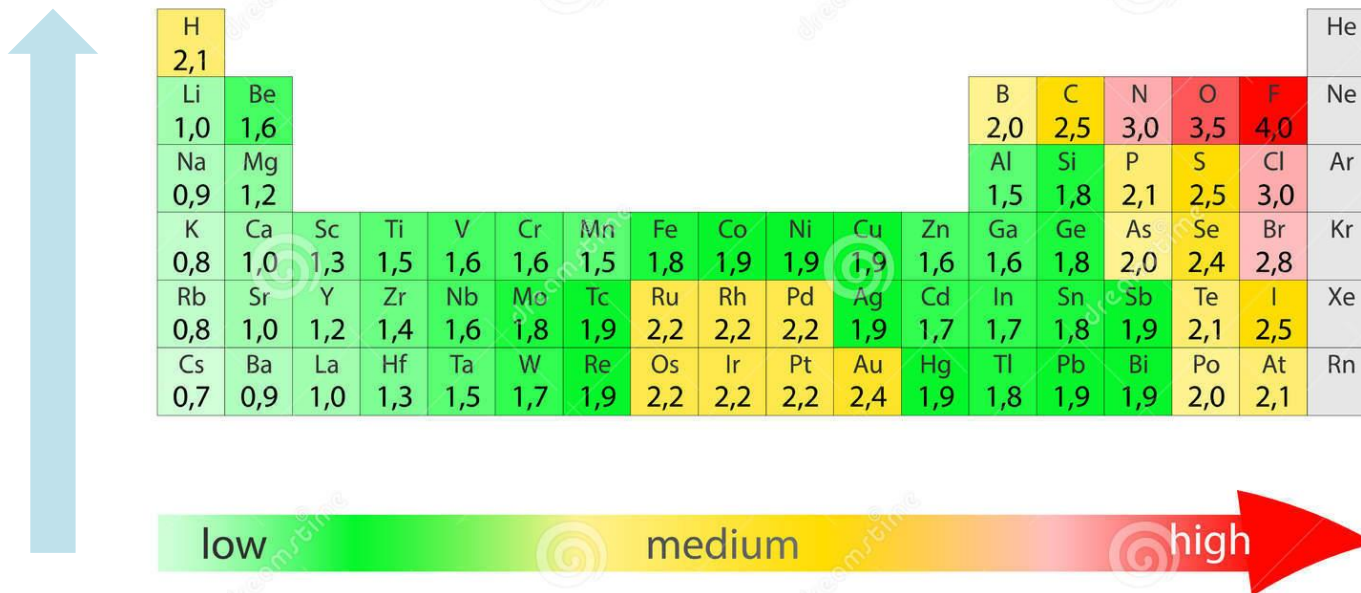
- Water is a compound containing two hydrogen atoms and an oxygen atom.
- They are bonded together with **covalent** bonds.
- This means that the **atoms are sharing electrons.**



# Polarity

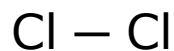
- Although electrons are shared in covalent bonds they are not always shared equally.

## ELECTRONEGATIVITY

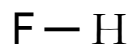
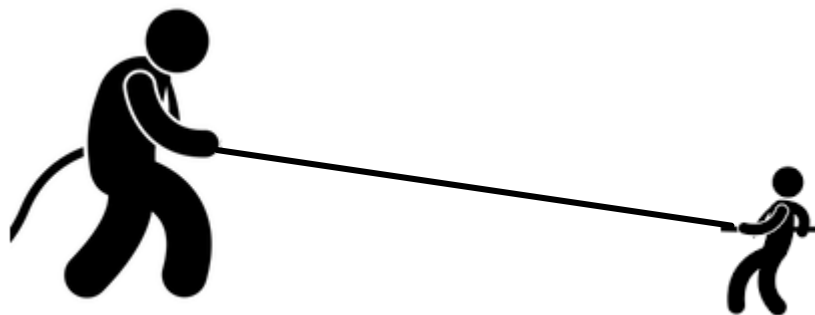


# Electronegativity

When atoms covalently bond they share electrons



Two atoms with equal electronegativity will result in the equal sharing

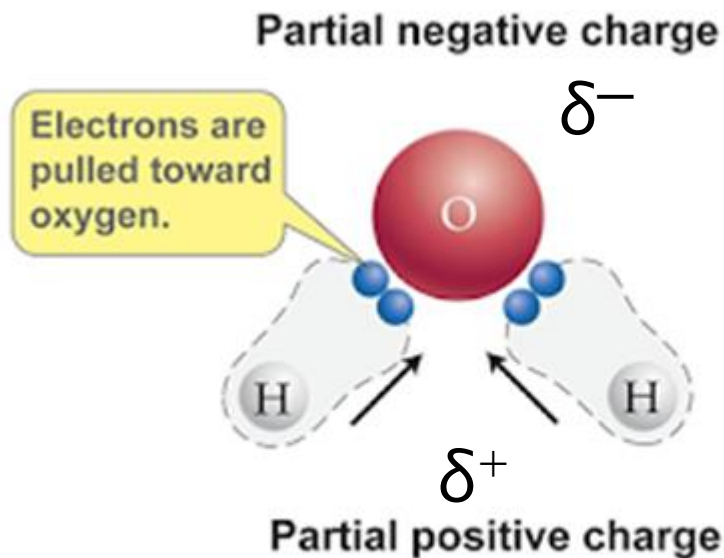


Fluorine is the most electronegative atom (strongest pull on bonding electrons).



# Polarity

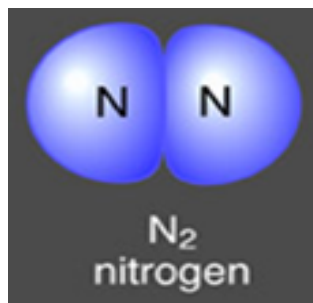
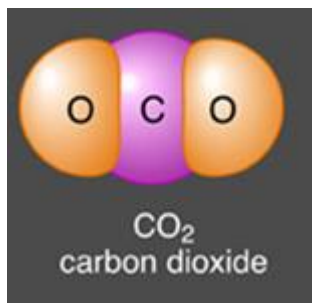
- Oxygen is more electronegative than hydrogen.
- How will this affect the charges within the molecule?



$\delta$  = slight/partial

# Polarity

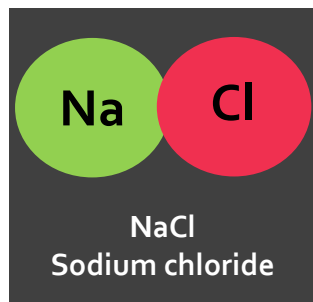
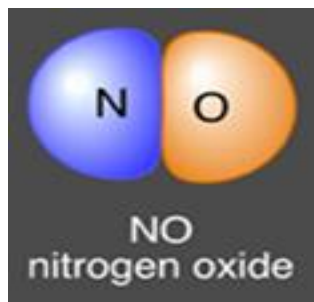
Determine whether these molecules are polar, nonpolar or ionic



**0 – 0.4 = Nonpolar**

**0.5 – 1.9 = Polar**

**>2.0 = Ionic**



Exception: If the  $\Delta EN$  is between 1.6 and 2.0 and if a metal is involved, then the bond is considered ionic.

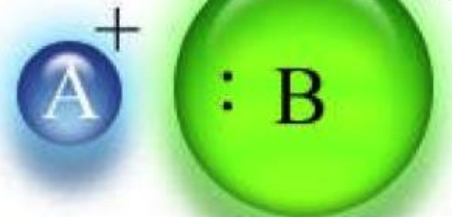
Nonpolar Covalent



Polar Covalent



Ionic



No charges

Partial charges

Full charges

# Solubility

- A polar solute dissolves in a polar solvent
- A nonpolar solute dissolves in a nonpolar solvent
- An ionic solute dissolves in a polar solvent



# How much can dissolve?

- What would happen if I kept adding salt to water?
- Solubility is the maximum amount of solute that can dissolve in a given amount of solvent at a given temperature and pressure.
- In other words it's a measure of **how much solute you can dissolve in a solvent.**

# Saturated and Unsaturated Solutions



Unsaturated –  
more solute can  
dissolve



Saturated –  
No more solute  
can dissolve



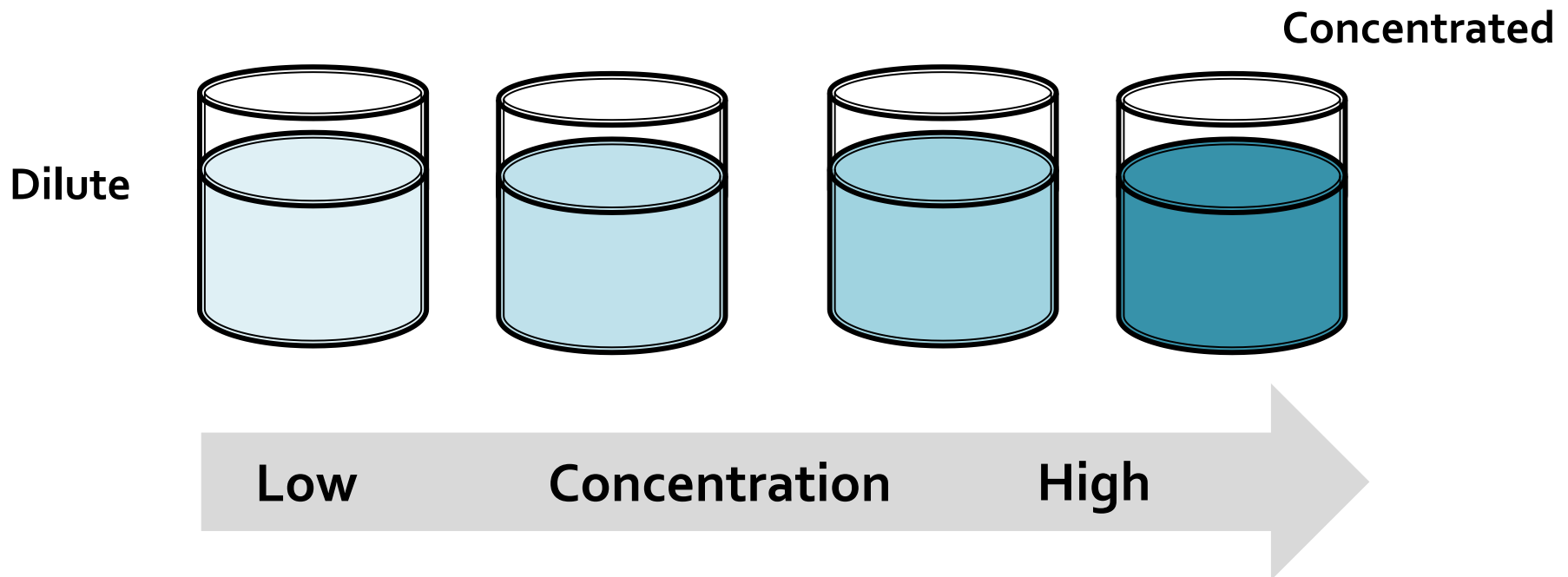
Supersaturated –  
Becomes unstable.  
Crystals form

# Effect of Temperature

- Solubility changes with temperature
- For many **solid solutes** **solubility increases with temperature**. E.g. You can dissolve more sugar in hot water than you can in cold water.
- The **solubility of a gas in a liquid decreases with temperature**. E.g. A fizzy drink goes flat quicker if it is warm.

# Concentration

- Concentration is a measure of how much solute is in a solution.





# Describing Concentration

- The word dilute is not an accurate way of describing concentration.
- It is better to state the **quantity of the solute in the solution**. This is done using mass and volume.



# Mass per Volume

- When you have a **solid solute** and a **liquid solvent** you calculate the concentration using the following equation.
- $$\text{Concentration (C)} = \frac{\text{Mass of solute (M)}}{\text{Volume of solution (V)}}$$

If I dissolve 5 grams of salt in 200ml of water, what is the concentration of the solution?

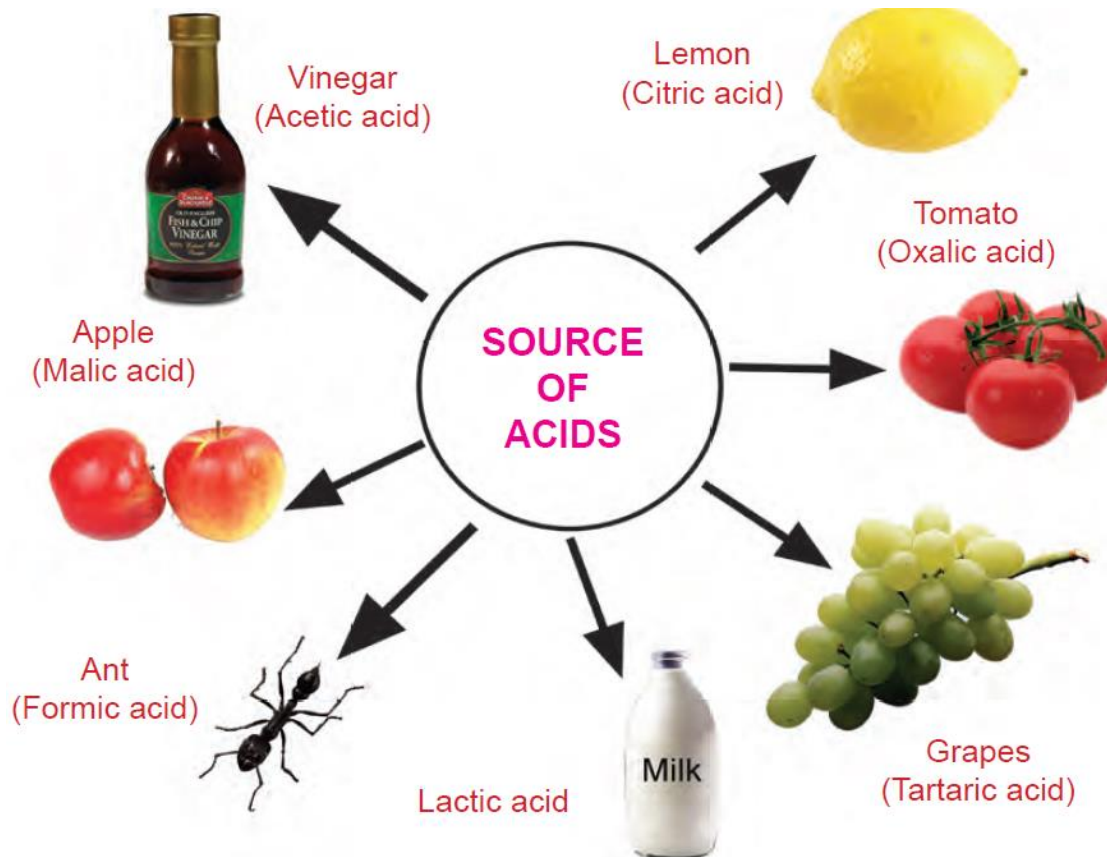
# Percent by Volume

- If a solution contains only liquids or gases its concentration is stated as a **percentage**.
- To do this you need to know the volume of both the solvent and the solute, and **the units need to match**. E.g. Both ml or litres.
- Concentration =  $\frac{\text{volume of solute}}{\text{volume of solution}} \times 100$

# Lesson 2 – Acid and Base Solutions

# Acids

- Would you eat or drink something acidic?



Acids taste  
sour

# Bases

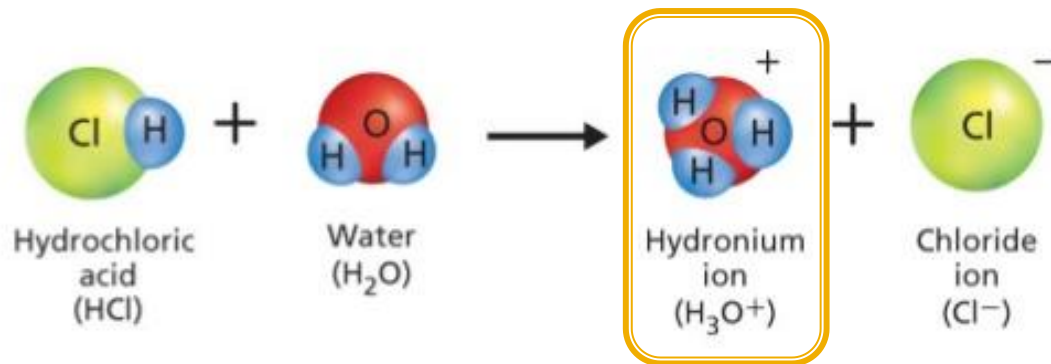
- Would you eat something alkaline?



Acids are bitter

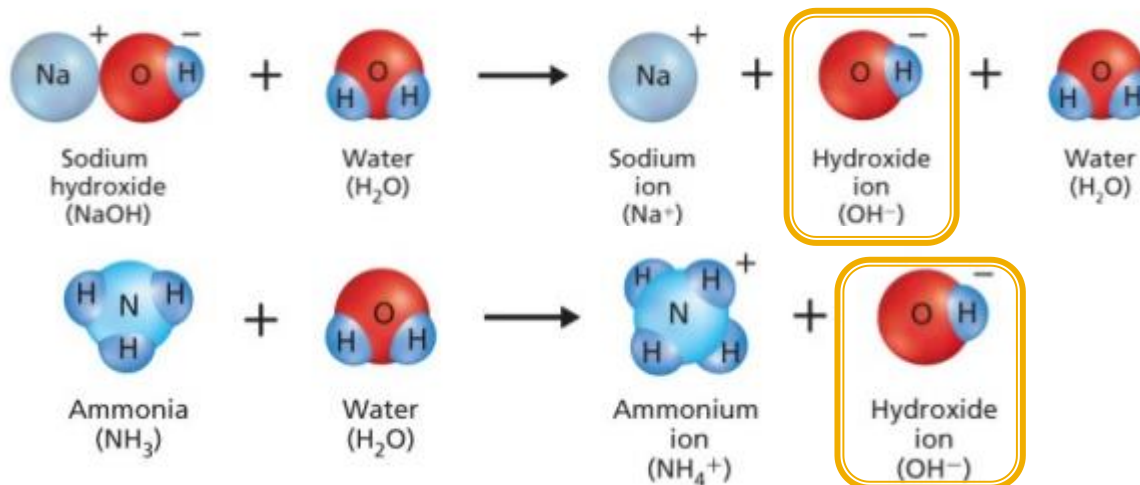
# What are acids?

- Acids are a substance that produces a **hydronium ion** when dissolved in water.
- Nearly all acids contain one or more hydrogen atoms.



# What are bases?

- A base is a substance that produces **hydroxide ions** when dissolved in water.
- Some bases contain hydroxide ions (NaOH), others produce them by taking hydrogen atoms away from water.





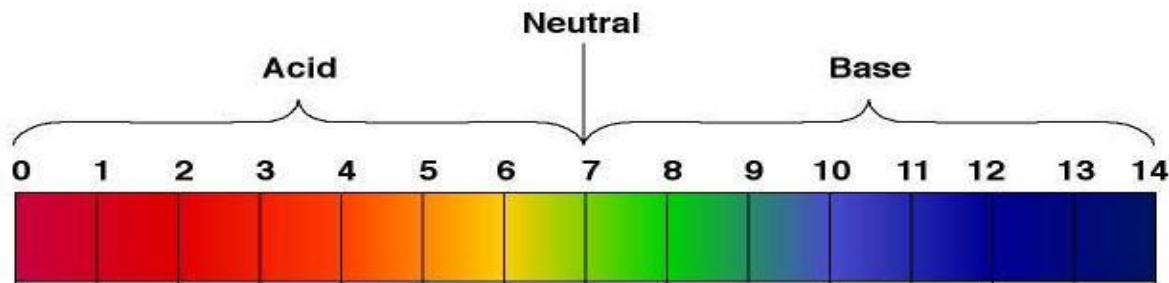
# What is pH

- How do we know if a substance or mixture is acidic or alkaline (basic)? We measure the pH
- What are we measuring when we test the pH of a substance or mixture? The concentration of hydronium ions
- What does the pH mean?

The lower the pH the more acidic, the higher the pH the more alkaline

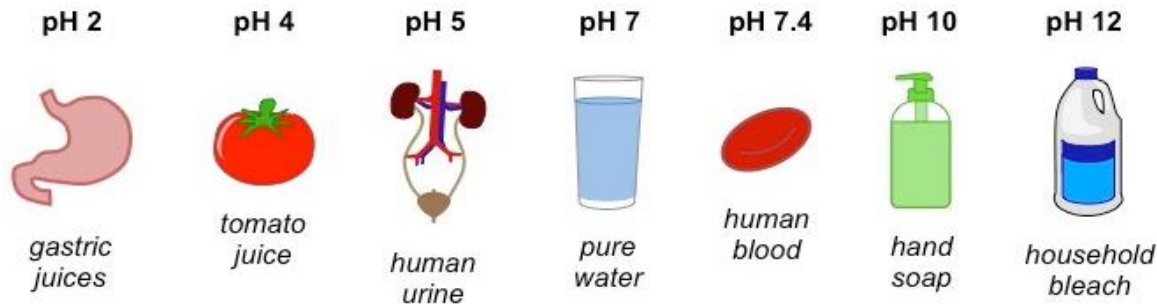
# The pH scale

- When pH is measured it is given a value between 1 and 14.



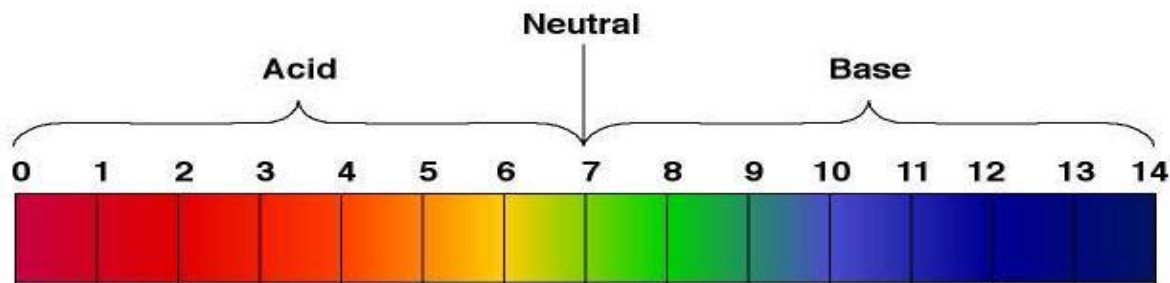
Logarithmic scale (base 10)

The pH Scale

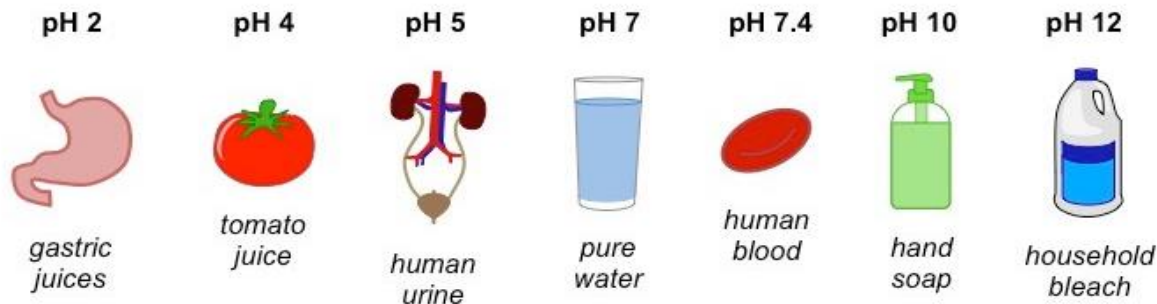


# The pH scale

- A pH of 7 means it is neither an acid or a base
- A change in one pH unit means a **tenfold** (x10) change in acidity or basicity.



The pH Scale



# The pH scale

- To calculate how much more acidic or basic a solution is compared to another we can use the formula  $10^n$
- $n$  = the difference between the pH values
- Example: How much more acidic is lemon juice than wine?



pH = 2



pH = 4

$$10^{(4-2)} = 100$$

Lemon juice is 100 times more acidic than wine

# Measuring pH

- There are 3 different ways that pH can be measured:
- **Indicators** – a compound that changes colour at different pH values
- **Testing strips** – these strips contain an indicator that changes to a different colour depending on the pH
- **pH meters** – the most accurate method. An electronic instrument that uses an electrode sensitive to hydronium ion concentration.



# Chapter Review Questions

What determines the state of a solution?

- a) The state of the solutes
- b) The state of the solvent
- c) The concentration of solutes
- d) The concentration of the solvent

# Chapter Review Questions

What is the solvent in the solution?

- a) Propane
- b) Ethane
- c) Methane
- d) Butane



95% Methane  
3.2 % Ethane  
0.2% Propane  
0.03% Butane

# Chapter Review Questions

What do atoms share in covalent bonds?

- a) Protons
- b) Neutrons
- c) Electrons
- d) All of the above



# Chapter Review Questions

Which statements are false?

- a) Nonpolar molecules do not have charges
- b) Nonpolar molecules have charges
- c) Polar molecules have charges
- d) Polar molecules do not have charges

# Chapter Review Questions

What is electronegativity a measure of?

- a) An atoms attraction on a bonding pair of protons
- b) An atoms attraction on a bonding pair of electrons
- c) An atoms attraction on a bonding pair of neutrons

# Chapter Review Questions

What is solubility?

- a) The maximum amount of solute that can dissolve in a given amount of solvent.
- b) The maximum amount of solvent that can dissolve in a given amount of solute
- c) A measure of how much solute is dissolved in a solvent
- d) A measure of how much solvent is dissolved in a solute

# Chapter Review Questions

How are saturated solutions different to unsaturated solutions?

- a) More solute can dissolve in a saturated solution. No more solute can dissolve in an unsaturated solution
- b) More solute can dissolve in an unsaturated solution. No more solute can dissolve in a saturated solution

# Chapter Review Questions

How is concentration measured?

- a) Using solubility and volume
- b) Using solubility and mass
- c) Using mass and volume

# Chapter Review Questions

What do acids produce when they are dissolved in water?

- a) Hydrogen ions
- b) Hydronium ions
- c) Hydroxide ions

# Chapter Review Questions

What is pH a measure of?

- a) The concentration of hydroxide ions
- b) The concentration of hydronium ions
- c) The concentration of hydrogen ions

# Chapter Review Questions

If solution A has a pH of 6 and solution B has a pH of 10, how much more acidic is solution A?

- a) 4 times
- b) 100 times
- c) 1000 times
- d) 10,000 times



# Chapter Review Questions

What is the most accurate way of measuring pH?

- a) A pH meter
- b) Testing strips
- c) Indicators
- d) Taste