For XAT , CMAT , MAT , IIFT Exam

ACIDS, BASES AND SALTS

- **Acids** are **sour** in taste and change the colour of **blue litmus** to **red**, whereas, **bases** are **bitter** and change the colour of the **red litmus** to **blue**
- Curd, lemon juice, orange juice and vinegar taste sour. These substances taste sour because they contain acids. The chemical nature of such substances is acidic.
- An acid and a base neutralize each other and form a salt and water. A salt may be acidic, basic or neutral in nature.
- Special types of substances are used to test whether a substance is acidic or basic. These substances are known as indicators. The indicators change their colour when added to a solution containing an acidic or a basic substance. Turmeric, litmus, China rose petal are some of the naturally occurring indicators.
- The solutions which do not change the colour of either red or blue litmus are known as neutral solutions. These substances are neither acidic nor basic.

LITMUS

- Litmus solution is a purple dye, which is extracted from lichen, a plant belonging to the division **Thallophyta**, and is commonly used as an indicator. When the litmus solution is neither acidic nor basic, its colour is purple. There are many other natural materials like red cabbage leaves, turmeric, coloured petals of some flowers such as Hydrangea, Petunia and Geranium, which indicate the presence of acid or base in a solution. These are called acid-base indicators or sometimes simply indicators.

ACIDS

- Acidic nature of a substance is due to the formation of H+ ions in solution
- When an acid reacts with a metal, hydrogen gas is evolved and a corresponding salt is formed

  Acid + Metal → Salt + Hydrogen gas

- Some metals do not react with acid and liberate hydrogen gas. Example: Ag, Cu.
- When an acid reacts with a metal carbonate or metal hydrogen carbonate, it gives the corresponding salt, carbon dioxide gas and water

  $Na_2 CO_3 + 2HCl \rightarrow 2NaCl + H_2 O + CO2$

  $NaHCO_3 + HCl \rightarrow NaCl + H_2 O + CO2$
- Acidic solutions in water conduct electricity because they produce hydrogen ions
- Acid is a molecule or ion which is capable of donating proton
- An acid is a substance which can accept the electron
- **Some naturally occurring acids**

Natural source	**Acid**
Vinegar	Acetic acid
Orange	Citric acid
Spinach	Oxalic acid
Tomato	Oxalic acid
Sour milk (Curd)	Lactic acid
Lemon	Citric acid
Ant sting	Formic acid
Nettle sting	Formic acid
Apple	Malic acid
Amla, Citrus fruits	Ascorbic acid
Tamarind, grapes, unripe mangoes, etc.	Tartaric acid

Note

- The atmosphere of Venus is made up of thick white and yellowish clouds of sulphuric acid
- The accidental touch of Nettle leaves creates a pain and burning sensation, which is due to inject of Methanoic acid into the skin of the person

BASE

- Basic nature of a substance is due to the formation of OH- ions in solution
- Bases react with metals to form salt with the liberation of hydrogen gas.

  $Zn + 2\ NaOH \rightarrow Na_2\ ZnO_2 + H_2 \uparrow$
- Bases react with acids to form salt and water. The reaction between a base and an acid is known as Neutralisation reaction

  $KOH + HCl \rightarrow KCl + H_2O$
- In neutralisation reaction a new substance is formed. This is called salt. Salt may be acidic, basic or neutral in nature.
- Basic solution in water conduct electricity because they produce hydroxide ions
- Base is a molecule or ion which is capable of accepting proton
- An base is a substance which can produce the electron

Name of base	**Found in**
Calcium hydroxide	Lime water
Ammonium hydroxide	Window cleaner
Sodium hydroxide/Potassium hydroxide	Soap
Magnesium hydroxide	Milk of magnesia

- The process of dissolving an acid or a base in water is a highly exothermic one.
- Mixing an acid or base with water results in decrease in the concentration of ions (H_3O^+/OH^-) per unit volume. Such a process is called dilution and the acid or the base is said to be diluted.

HOW STRONG ARE ACIDS AND BASE SOLUTIONS

- A scale for measuring hydrogen ion concentration in a solution is called pH scale. The ‘p’ in pH stands for ‘potenz’ in German meaning power. pH scale is a set of numbers from 0 to 14 which is used to indicate whether a solution is acidic, basic or neutral
- The pH of a neutral solution is 7. Values less than 7 on the pH scale represent an acidic solution. As the pH value increases from 7 to 14, it represents an increase in OH– ion concentration in the solution, that is, increase in the strength of alkali
    1. Acids have pH less than 7
    2. Bases have pH greater than 7
    3. A neutral solution has pH equal to 7
- Strength of acids and bases depends upon the number of H+ ions and OH– ions produced, respectively. If we take hydrochloric acid and acetic acid of the same concentration, say one molar, then these produce different amounts of hydrogen ions. Acids that give rise to more H+ ions are said to be strong acids, and acids that give less H+ ions are said to be weak acids.

Substances	**pH values**
Human blood	7.35-7.45
Pure water	7
Lemon juice	2.2
Gastric juice	1.2
Milk of magnesia	10
Human urine	6
Beers	4.5
Wines	2.8-3.8
Black coffee	5.2
Milk	6.5 – 6.7
Normal rain	5.6 - 6

Acid rain	4.2-4.4

IMPORTANCE OF PH IN EVERYDAY LIFE DAY LIFE

- Our body works within the pH range of 7.0 to 7.8. Living organisms can survive only in a narrow range of pH change
- When pH of rain water is less than 5.6, it is called acid rain. When acid rain flows into the rivers, it lowers the pH of the river water. The survival of aquatic life in such rivers becomes difficult.
- Tooth decay starts when the pH of the mouth is lower than 5.5. Tooth enamel, made up of **calcium hydroxyapatite** (a crystalline form of **calcium phosphate**) is the hardest substance in the body. It does not dissolve in water, but is corroded when the pH in the mouth is below 5.5. Using toothpastes, which are generally basic, for cleaning the teeth can neutralise the excess acid and prevent tooth decay
- It is very interesting to note that **our stomach produces hydrochloric acid**. It **helps in the digestion of food** without harming the stomach. During indigestion the stomach produces too much acid and this causes pain and irritation. To get rid of this pain, people use bases called **antacids**. These antacids neutralize the excess acid. Magnesium hydroxide (Milk of magnesia), a mild base, is often used for this purpose

USES OF ACIDS „

- **Sulphuric acid** is called **King of Chemicals** because it is used in the preparation of many other compounds. It is used in car batteries also.
- Hydrochloric acid is used as a cleansing agent in toilets.
- Carbonic acid is used in aerated drinks. „
- Tartaric acid is a constituent of baking powder
- Citric acid is used in the preparation of effervescent salts and as a food preservative. „
- Nitric acid is used in the manufacture of fertilizers, dyes, paints and drugs. „
- Oxalic acid is used to clean iron and manganese deposits from quartz crystals. It is also used as bleach for wood and removing black stains. „

USES OF BASES

- Sodium hydroxide is used in the manufacture of soap.
- Magnesium hydroxide is used as a medicine for stomach disorder.
- Ammonium hydroxide is used to remove grease stains from cloths.
- Calcium hydroxide is used in white washing of building.

SALTS

- Salt is the product of reaction between acids and bases.
- Salts of a strong acid and a strong base are neutral with pH value of 7. On the other hand, salts of a strong acid and weak base are acidic with pH value less than 7 and those of a strong base and weak acid are basic in nature, with pH value more than 7.
- Most of the salts are soluble in water. For example, chloride salts of potassium and sodium are soluble in water. But, silver chloride is insoluble in water
- Salt is hygroscopic in nature.

USES OF SALTS

COMMON SALT (SODIUM CHLORIDE - NaCl)

- It is used in our daily food and used as a preservative.

BLEACHING POWDER ($CaOCl_2$)

- For bleaching cotton and linen in the textile industry, for bleaching wood pulp in paper factories and for bleaching washed clothes in laundry.
- Oxidizing agent in many chemical industries.
- To make drinking water free from germs.

BAKING SODA ($NaHCO_3$)

- The baking soda is commonly used in the kitchen for making tasty crispy pakoras, etc. Sometimes it is added for faster cooking

- Baking soda is also an ingredient in antacids. Being alkaline, it neutralizes excess acid in the stomach and provides relief.
- It is also used in soda-acid fire extinguishers

WASHING SODA ($Na_2CO_3.10H_2O$)

- Sodium carbonate (washing soda) is used in glass, soap and paper industries.
- It is used in the manufacture of sodium compounds such as borax.
- Sodium carbonate can be used as a cleaning agent for domestic purposes.
- It is used for removing permanent hardness of water.

PLASTER OF PARIS ($CaSO_4$ .1/2 H_2O)

- Plaster of Paris, the substance which doctors use as plaster for supporting Structured bones in the right position.
- Plaster of Paris is used for making toys, materials for decoration and for making surfaces smooth

On heating gypsum at 373 K, it loses water molecules and becomes calcium sulphate hemihydrate. This is called Plaster of Paris.

GYPSUM (CaSO4 .2H2O)

- Manufacture of wallboard, cement, plaster of Paris, soil conditioning, a hardening retarder in Portland cement