

Acids, Bases and Salts

Exercises

Q. 1. Identify the odd one out and justify.

- A. Chloride, nitrate, hydride, ammonium
- B. Hydrogen chloride, sodium hydroxide, calcium oxide, ammonia
- C. Acetic acid, carbonic acid, hydrochloric acid, nitric acid
- D. Ammonium chloride, sodium chloride, potassium nitrate, sodium sulphate
- E. Sodium nitrate, sodium carbonate, sodium sulphate, sodium chloride
- F. Calcium oxide, magnesium oxide, zinc oxide, sodium oxide.
- G. Crystalline blue vitriol, crystalline common salt, crystalline ferrous sulphate, crystalline sodium carbonate.
- H. Sodium chloride, potassium hydroxide, acetic acid, sodium acetate.

Answer : A. The odd one(s) – ammonium

Explanation: Ammonium(NH_4^+) is the odd one out because it is the only positively charged ion (cation). While chloride (Cl^-), nitrate (NO_3^-) and hydride (H^-) are the negatively charged ion (anion)

B. The odd one(s) – Hydrogen chloride

Explanation: Hydrogen chloride is odd one out because it is the only acid among the given compounds. While sodium hydroxide (NaOH), calcium oxide (CaO) and ammonia (NH_3) are the bases.

C. The odd one(s) – Acetic acid

Explanation: Acetic acid is odd one out because it is the only organic acid. While carbonic acid, hydrochloric acid and nitric acid are inorganic acids.

D. The odd one(s) – Ammonium chloride

Explanation: Ammonium chloride is the odd one out among the given compounds because it is an acidic salt. While

sodium chloride, potassium nitrate, sodium sulphate are the neutral salts.

Note:

Acidic salts are formed by the neutralization reaction between a strong acid and a weak base.

Neutral salts are formed by the neutralization of a strong acid and a strong base.

Salts are formed by the combination of acid and base. The reaction takes place is called neutralization reaction.

E. The odd one(s) – Sodium chloride

Explanation: sodium chloride is the odd one out because it the only neutral salt present.

F. The odd one(s) – ZnO

Explanation: ZnO is odd one out because it is the only amphoteric oxides among the given oxides. While CaO, MgO and Na₂O are basic oxides.

G. The odd one(s) – Crystalline common salt

Explanation: Crystalline common salt is the odd one out

because it does not lose its crystallization on heating.

H. The odd one(s) – Potassium hydroxide

Explanation: Potassium hydroxide is odd one out because it is not salt. While all others are salts

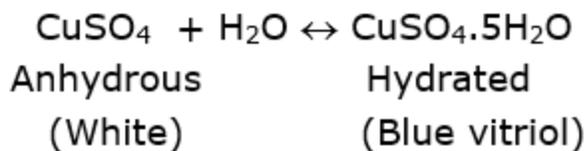
Q. 2 A. Write down the changes that will be seen in each instance and explain the reason behind it.

50ml water is added to 50ml solution of copper sulphate.

Answer : The changes observed when 50ml water is added to 50ml solution of copper sulphate are:

- i. A reversible reaction takes place.
- ii. Colour of copper sulphate changes.
- iii. Anhydrous copper sulphate changes to hydrated copper sulphate.

Explanation: The changes occur due to the following reaction



The water of crystallization is taking place in the above reaction. Thus, the colour changes from white to blue

Q. 2 B. Write down the changes that will be seen in each instance and explain the reason behind it.

Two drops of the indicator phenolphthalein were added to 10ml solution of sodium hydroxide.

Answer : The change observed when two drops of the indicator phenolphthalein was added to 10ml solution of sodium hydroxide is:

The solution changes from colorless to dark pink in colour.

Explanation: Phenolphthalein is a basic indicator.

- i. When it is mixed with any acid, it remains colourless.
- ii. When mixed with any base, its colour changes to pink. NaOH is a base.

Thus, the solution becomes dark pink in colour.

Q. 2 C. Write down the changes that will be seen in each instance and explain the reason behind it.

Two or three filings of copper were added to 10ml dilute nitric acid and stirred.

Answer : The changes observed when two or three filings of copper were added to 10ml dilute nitric acid and stirred are:

- i. The solution changes to bluish red.
- ii. A red toxic gas is evolved.
- iii. Copper is completely consumed.

Explanation: The changes occur due to the following reaction



In the above reaction, the copper metal is oxidized by nitric acid. The nitrogen dioxide (NO₂) formed in the reaction is so dangerous and toxic.

Q. 2 D. Write down the changes that will be seen in each instance and explain the reason behind it.

A litmus paper was dropped into 2ml dilute HCl. Then 2ml concentrated NaOH was added to it and stirred.

Answer : The changes observed when a litmus paper was dropped into 2ml dilute HCl. Then 2ml concentrated NaOH was added to it and stirred are:

- i. With HCl, the litmus paper turns red.
- ii. With NaOH, the litmus paper turns blue.

Explanation: HCl is an acid and has pH lesser than 7, thus its colour changes to red.

NaOH is a base and has pH greater than 7, thus its colour changes to blue.



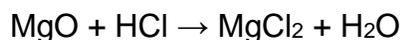
Q. 2 E. Write down the changes that will be seen in each instance and explain the reason behind it.

Magnesium oxide was added to dilute HCl and magnesium oxide was added to dilute NaOH.

Answer : The changes observed when magnesium oxide was added to dilute HCl and magnesium oxide was added to dilute NaOH are:

- i. With HCl, magnesium oxide forms salt and water.
- ii. With NaOH, no reaction takes place.

Explanation: When magnesium oxide being a basic oxide reacts with HCl (an acid), it forms a salt.



The above reaction is an example of neutralization reaction.

On the other hand, when magnesium oxide being a basic oxide reacts with NaOH (a base), no reaction takes place. Because to carry out a neutralization reaction, there must be a combination of acid and base. But here both are bases, that's why no reaction takes place.

Q. 2 F. Write down the changes that will be seen in each instance and explain the reason behind it.

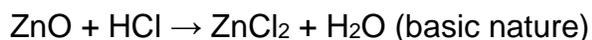
Zinc oxide was added to dilute HCl and zinc oxide was added to dilute NaOH.

Answer : The changes observe when zinc oxide was added to dilute HCl and zinc oxide was added to dilute NaOH are:

- i. With HCl, zinc oxide forms salt and water which shows basic properties.
- ii. With NaOH, zinc oxide forms salt and water which shows acidic properties.

Explanation: Zinc oxide is an amphoteric oxide which shows both the properties of an acid as well as a base.

When zinc oxide reacts with HCl (acid), shows basic properties:



When zinc oxide reacts with NaOH (base), shows basic properties:



Q. 2 G. Write down the changes that will be seen in each instance and explain the reason behind it.

Dilute HCl was added to limestone.

Answer : The changes observe when dilute HCl was added to limestone are:

- i. Effervescence of carbon dioxide gas is formed.
- ii. Bubbles are also produced.

Explanation: When dilute HCl was added to limestone (CaCO_3), effervescence of carbon dioxide is formed due to the following reaction:



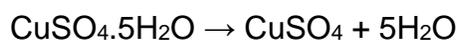
Q. 2 H. Write down the changes that will be seen in each instance and explain the reason behind it.

Pieces of blue vitriol were heated in a test tube. On cooling, water was added to it.

Answer : The changes observe when pieces of blue vitriol were heated in a test tube and on cooling, water was added to it are:

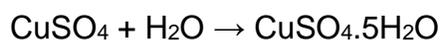
- i. On heating, the crystalline structure of blue vitriol broke down to form a colorless powder.
- ii. On adding water, the color changes back to blue color.

Explanation: When blue vitriol (hydrated CuSO_4) is heated, it becomes anhydrous and colorless (white).



(blue) (white)

Now, when water was added, it regained its blue colour and becomes hydrated again.



(white) (hydrated)

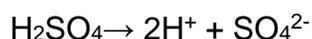
Q. 2 I. Write down the changes that will be seen in each instance and explain the reason behind it.

Dilute H_2SO_4 was taken in an electrolytic cell and electric current was passed through it.

Answer : The changes observe when dilute H_2SO_4 was taken in an electrolytic cell and electric current was passed through it are:

- i. Conduction of electricity becomes better.
- ii. SO_4^{2-} remains in the solution.

The acid makes the electrolytic cell a better conductor. The reaction takes place is:



Q. 3. Classify the following oxides into three types and name the types.

CaO , MgO , CO_2 , SO_3 , Na_2O , ZnO , Al_2O_3 , Fe_2O_3

Answer : There are three types of oxides:

i. Acidic oxides: Acidic oxides are the oxides of non-metals. When these oxides are combined with water, they form acid and when combined with base, form salts.

CO₂ and SO₃ are the acidic oxides

ii. Basic oxides: Basic oxides are the oxides of metals. They combined with water to form hydroxides and when combined with acid, they form salts.

CaO, MgO and Na₂O are the basic oxides

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CaO, MgO and Na₂O are the basic oxides

iii. Amphoteric oxides: These are metallic oxides and exhibit the property of both acid and base.

When react with an acid , they form salt and water, this shows the basic properties.
When react with a base, they form salt and water, this shows the acidic properties.

ZnO, Al₂O₃ and Fe₂O₃ are the amphoteric oxides

. Amphoteric oxides: These are metallic oxides and exhibit the property of both acid and base.

When react with an acid , they form salt and water, this shows the basic properties.
When react with a base, they form salt and water, this shows the acidic properties.

ZnO, Al₂O₃ and Fe₂O₃ are the amphoteric oxides

Q. 4 A. Explain by drawing a figure of the electronic configuration.

Formation of sodium chloride from sodium and chlorine.

Answer : A. The atomic number of sodium(Na) = 11

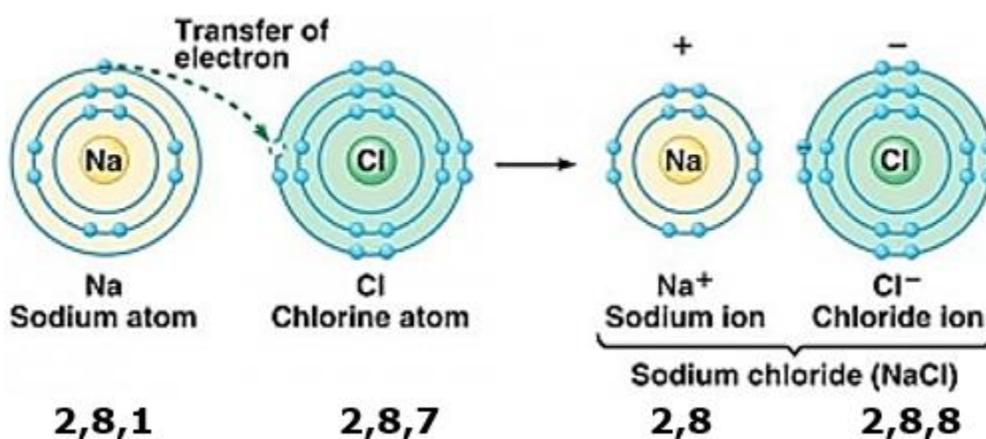
The electronic configuration of $_{11}\text{Na} = 2,8,1$

The atomic number of chlorine(Cl) = 17

The electronic configuration of $_{17}\text{Cl} = 2,8,7$

Na transfer its one electron to Cl, so that it can achieve noble

gas configuration (2,8) whereas Cl accepts one electron from Na so that it can achieve noble gas configuration (2,8,8) as shown below:



Q. 4 B. Explain by drawing a figure of the electronic configuration.

Formation of a magnesium chloride from magnesium and chlorine.

Answer : The atomic number of magnesium(Mg) = 12

The electronic configuration of $_{12}\text{Mg} = 2,8,2$

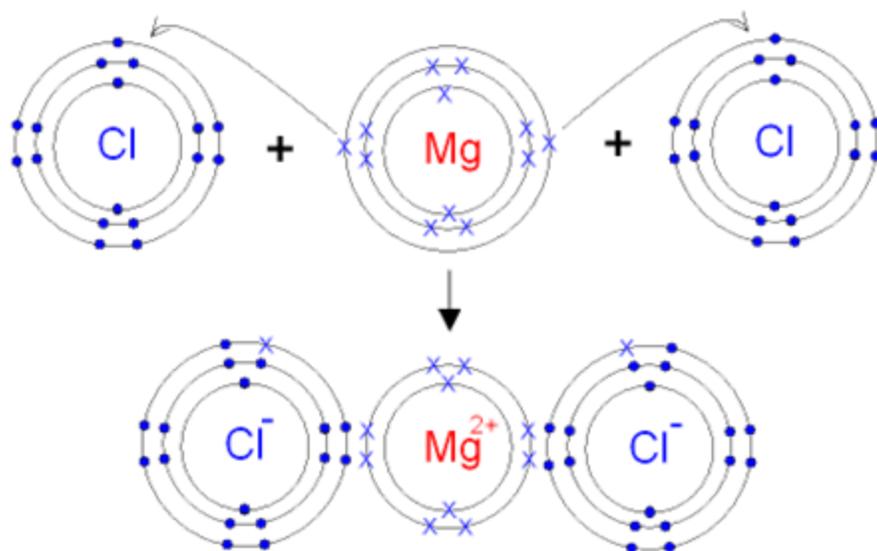
The atomic number of chlorine(Cl) = 17

The electronic configuration of $_{17}\text{Cl} = 2,8,7$

Mg transfer its two electrons to each Cl, so that it can

achieve noble gas configuration (2,8) whereas each Cl accepts one electron from Mg so that both can achieve noble gas

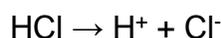
configuration as shown below:



Q. 5 Show the dissociation of the following compounds on dissolving in water, with the help of chemical equation and write whether the proportion of dissociation is small or large.

Hydrochloric acid, Sodium chloride, Potassium hydroxide, Ammonia, Acetic acid, Magnesium chloride, Copper sulphate.

Answer : 1. Dissociation of hydrochloric acid in water



The proportion of dissociation is large as 100% of the HCl dissociates into ions.

2. Dissociation of sodium chloride in water



The proportion of dissociation is large as it completely dissolves in water.

3. Dissociation of potassium hydroxide in water



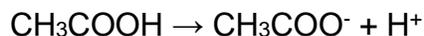
The proportion of dissociation is large as it completely dissolves in water.

4. Dissociation of ammonia in water



The proportion of dissociation is large as it completely dissolves in water due to formation of hydrogen bonding.

5. Dissociation of acetic acid in water



The proportion of dissociation is small.

6. Dissociation of magnesium chloride in water



The proportion of dissociation is large as magnesium chloride is highly soluble in water.

7. Dissociation of copper sulphate in water



The proportion of dissociation is medium.

Q. 6 A. Write down the concentration of each of the following solutions in g/L and mol/L.

7.3g HCl in 100ml solution

Answer : Given:

Weight in grams = 7.3g

Volume in liters = 100 mL = 0.1L (1mL = 1/1000L)

Molecular mass of HCl = 1 + 35.4 = 36.4 g/mol

$$\text{No. of moles (n)} = \frac{\text{weight}}{\text{molecular mass}} = \frac{7.3 \text{ g}}{36.4 \text{ g/mol}} = 0.2 \text{ mol}$$

$$\text{Concentration in } \frac{\text{g}}{\text{L}} = \frac{7.3 \text{ g}}{0.1 \text{ L}}$$

Concentration in g/L = 73g/L

$$\text{Concentration in } \frac{\text{mol}}{\text{L}} = \frac{\text{no. of moles}}{\text{Volume in L}}$$

$$\text{Concentration in } \frac{\text{mol}}{\text{L}} = \frac{0.2 \text{ mole}}{0.1 \text{ L}}$$

Concentration in mol/L = 2 mol/L

Thus, concentration in g/L is 73g/L and concentration in mol/L is 2mol/L.

Q. 6 B. Write down the concentration of each of the following solutions in g/L and mol/L.

2g NaOH in 50ml solution

Answer : Given:

Weight in grams= 2g

Volume in liters = 50 mL = 0.05L (1mL= 1/1000L)

Molecular mass of NaOH = 23+16+1 = 40 g/mol

$$\text{No. of moles (n)} = \frac{\text{weight}}{\text{molecular mass}} = \frac{2 \text{ g}}{40 \text{ g/mol}} = 0.05 \text{ mol}$$

$$\text{Concentration in } \frac{\text{g}}{\text{L}} = \frac{2 \text{ g}}{0.05 \text{ L}}$$

Concentration in g/L = 40g/L

$$\text{Concentration in } \frac{\text{mol}}{\text{L}} = \frac{\text{no. of moles}}{\text{Volume in L}}$$

$$\text{Concentration in } \frac{\text{mol}}{\text{L}} = \frac{0.05 \text{ mole}}{0.05 \text{ L}}$$

Concentration in mol/L = 1 mol/L

Thus, concentration in g/L is 40g/L and concentration in mol/L is 1mol/L.

Q. 6 C. Write down the concentration of each of the following solutions in g/L and mol/L.

3g CH₃COOH in 100ml solution

Answer : Given:

Weight in g= 3g

Volume in L = 100 mL = 0.1L (1mL= 1/1000L)

Molecular mass of CH₃COOH = 12+3×1+12+16+16+1

= 60 g/mol

$$\text{No. of moles (n)} = \frac{\text{weight}}{\text{molecular mass}} = \frac{3 \text{ g}}{60 \text{ g/mol}} = 0.05 \text{ mol}$$

$$\text{Concentration in } \frac{\text{g}}{\text{L}} = \frac{3 \text{ g}}{0.1 \text{ L}}$$

Concentration in g/L = 30g/L

$$\text{Concentration in } \frac{\text{mol}}{\text{L}} = \frac{\text{no. of moles}}{\text{Volume in L}}$$

$$\text{Concentration in } \frac{\text{mol}}{\text{L}} = \frac{0.05 \text{ mole}}{0.1 \text{ L}}$$

Concentration in mol/L = 0.5 mol/L

Thus, concentration in g/L is 30g/L and concentration in mol/L is 0.5mol/L.

Q. 6 D. Write down the concentration of each of the following solutions in g/L and mol/L.

4.9g H₂SO₄ in 200ml solution

Answer : Given:

Weight in grams= 4.9g

Volume in liters = 200 mL = 0.2L (1mL= 1/1000L)

Molecular mass of H₂SO₄ = 2×1+32+4×16 = 98 g/mol

$$\text{No. of moles (n)} = \frac{\text{weight}}{\text{molecular mass}} = \frac{4.9 \text{ g}}{98 \text{ g/mol}} = 0.05 \text{ mol}$$

$$\text{Concentration in } \frac{\text{g}}{\text{L}} = \frac{4.9 \text{ g}}{0.2 \text{ L}}$$

Concentration in g/L = 24.5g/L

$$\text{Concentration in } \frac{\text{mol}}{\text{L}} = \frac{\text{no. of moles}}{\text{Volume in L}}$$

$$\text{Concentration in } \frac{\text{mol}}{\text{L}} = \frac{0.05 \text{ mole}}{0.2 \text{ L}}$$

Concentration in mol/L = 0.25 mol/L

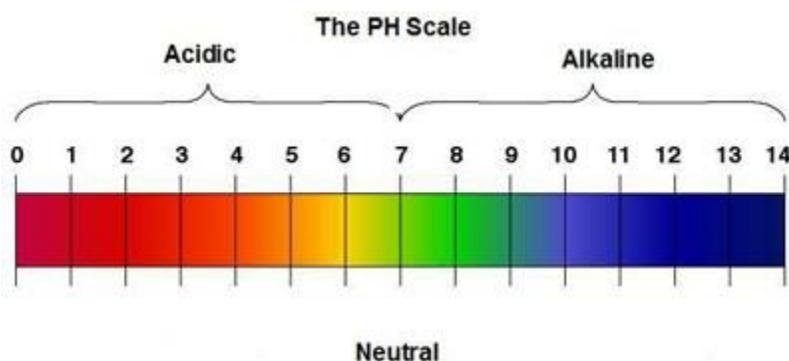
Thus, concentration in g/L is 24.5g/L and concentration in mol/L is 0.25mol/L.

Q. 7. Obtain a sample of rainwater. Add to it a few drops of universal indicator. Measure its pH. Describe the nature of the sample of rainwater and explain the effect if it has on the living world.

Answer : If the pH of rainwater is less than 7, it means its nature is acidic.

If the pH of rainwater is above 7, it means its nature is basic.

If the pH of rainwater is 7, it means its nature is neutral.



Natural rainwater has a pH around 5.6 and is slightly acidic. If value of pH is below pH, then it is considered as “acid rain”. Acid rain particularly damages:

- i. Lakes, rivers, streams
- ii. Forests
- iii. Plants and animals
- iv. Human beings (especially damages the skin)

Q. 8 A. answer the following questions.

Classify the acids according to their basicity and give one example of each type.

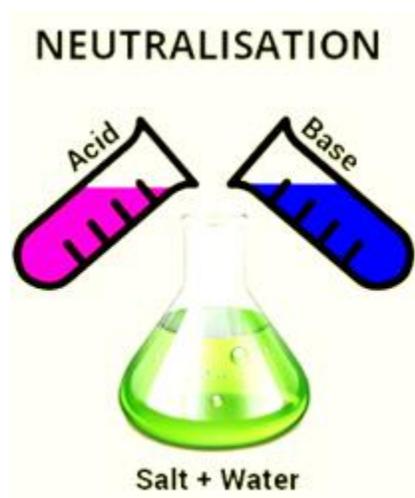
Answer : Basicity of acids: The number of H⁺ ions obtainable by the dissociation of one molecule of an acid is called its basicity.

Acid	Basicity
$\text{HCl} = \text{H}^+ + \text{Cl}^-$	Monobasic (one hydrogen ion is present)
$\text{CH}_3\text{COOH} = \text{CH}_3\text{COO}^- + \text{H}^+$	Monobasic (one hydrogen ion is present)
$\text{H}_2\text{SO}_4 = 2\text{H}^+ + \text{SO}_4^{2-}$	Dibasic (two hydrogen ions are present)
$\text{H}_3\text{PO}_4 = 3\text{H}^+ + \text{PO}_4^{2-}$	Tribasic (three hydrogen ions are present)

Q. 8 B. Answer the following questions.

What is meant by neutralization? Give two examples from everyday life of the neutralization reaction.

Answer : In the neutralization reaction, an acid reacts with a base to form a salt and water.



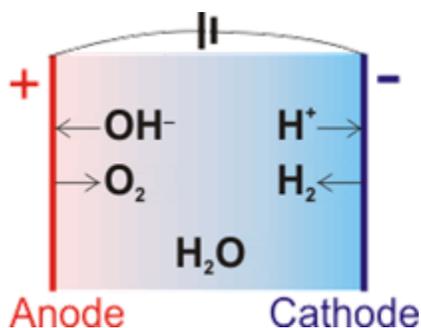
Everyday examples:

- i. Toothpastes help in neutralizing the effect of acid because they are alkaline in nature and neutralize the effect of acid present in our mouth.
- ii. Use of baking soda in cooking.
- iii. To reduce acidity in the stomach, we take milk of magnesia ($\text{Mg}(\text{OH})_2$).

Q. 8 C. Answer the following questions.

Explain what is meant by electrolysis of water. Write the electrode reactions and explain them.

Answer : Electrolysis of water: It is defined as the process of decomposition of water into hydrogen and oxygen gas by the passage of electricity through its aqueous solution (water).



i. At the cathode (negative electrode), reduction takes place and evolves hydrogen gas:



ii. At the anode (positive electrode), oxidation takes place and evolves oxygen gas:



iii. Overall cell reaction: $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$

Q. 9. Give reason for the following.

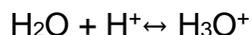
A. Hydronium ions are always in the form H_3O^+

B. Buttermilk spoils if kept in a copper or brass container.

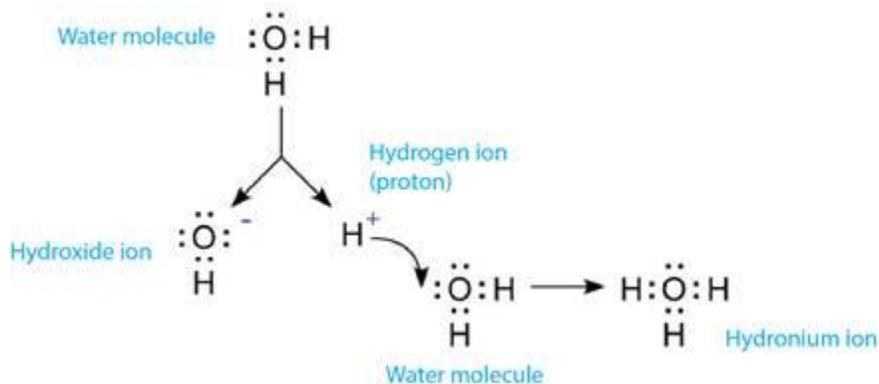
Answer : A. Dissociation of water molecule



As soon as the H^+ ions are formed, they make bond with water molecules in the solution to form hydronium ion (H_3O^+). This is because hydrogen cannot exist independently (alone) in the aqueous solutions, and hence take the form of the hydronium ion.



Water has ability to attract H^+ because it is a polar molecule



B. Buttermilk spoils if kept in a copper or brass container because

- i. Butter milk contains lactic acid.
- ii. The lactic acid present in the buttermilk reacts completely with copper or brass container.
- iii. Due to the chemical reaction taking place, the buttermilk becomes unfit for consumption and spoils the buttermilk.

Q. 10. Write the chemical equations for the following activities.

A. NaOH solution was added to HCl solution.

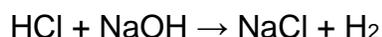
B. Zinc dust was added to dilute H₂SO₄.

C. Dilute nitric acid was added to calcium oxide.

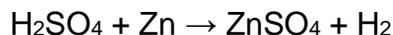
D. Carbon dioxide gas was passed through KOH solution.

E. Dilute HCl was poured on baking soda.

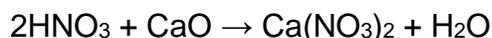
Answer : **A.** When NaOH solution was added to HCl solution, it forms sodium chloride and liberated hydrogen gas.



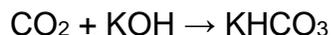
B. When zinc dust was added to dilute H₂SO₄, it forms zinc sulphate and liberated hydrogen gas.



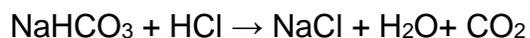
C. When dilute nitric acid was added to calcium oxide, it forms calcium nitrate and water.



D. When carbon dioxide gas was passed through KOH solution; it was completely absorbed by KOH.



E. When dilute HCl was poured on baking soda (NaHCO_3), it forms a salt NaCl, water and releases bubbles of carbon dioxide.



The above reaction is an example of neutralization reaction.

Q. 11 A. State the differences.

Acids and bases

Answer : Difference between acids and bases:

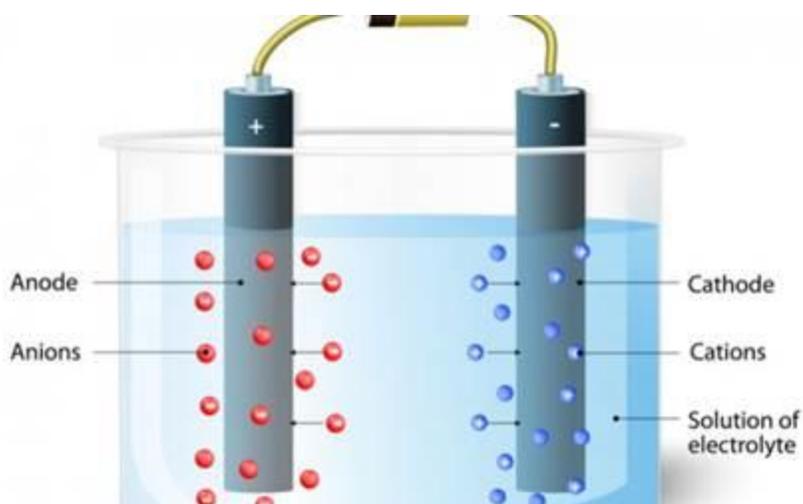
Acids	Bases
1. An acid is a substance which gives H^+ ion when dissolved in water.	A base is a substance which gives OH^- ion when dissolved in water.
2. For example: $\text{HCl} \rightarrow \text{H}^+ + \text{Cl}^-$ HCl releases H^+ ion, hence it is an acid.	For example: $\text{NaOH} \rightarrow \text{Na}^+ + \text{OH}^-$ NaOH releases OH^- ion, hence it is a base.

Q. 11 B. State the differences.

Cation and anion

Answer : Difference between cation and anion:

Cation	Anion
1. Positively charged ions are called cations.	Negatively charged ions are called anions.
2. For example: In NaCl, Na^+ is the cation.	For example: In NaCl, Cl^- is the anion.



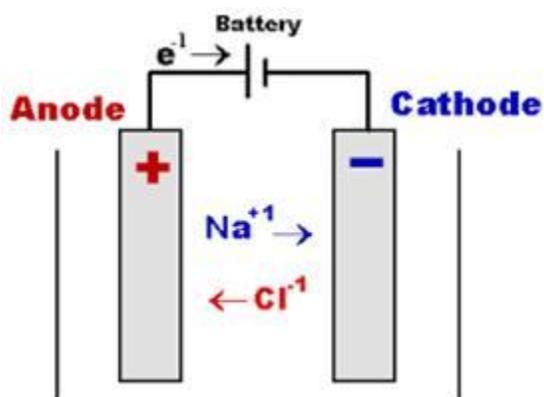
Representation of cation and anions

Q. 11 C. State the differences.

Negative electrode and positive electrode.

Answer : Difference between Negative electrode and positive electrode:

Negative electrode	Positive electrode
1. The electrode connected to the negative terminal of a battery by means of a conducting wire is called a negative electrode.	The electrode connected to the positive terminal of a battery by means of a conducting wire is called positive electrode.
2. Negative electrode is called <u>cathode</u> .	Positive electrode is called <u>anode</u> .



Representation of anode and cathode

Q. 12. Classify aqueous solutions of the following substances according to their pH into three groups : 7, more than 7, less than 7.

Common salt, sodium acetate, hydrochloric acid, carbon dioxide, potassium bromide, calcium hydroxide, ammonium chloride, vinegar, sodium carbonate, ammonia, sulphur dioxide.

Answer :

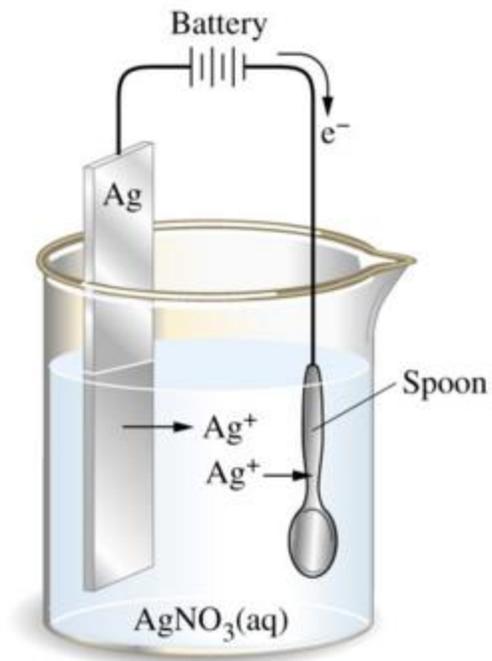
pH = 7 (neutral)	pH>7 (basic)	pH<7 (acidic)
NaCl	Calcium hydroxide (12.8)	Sodium acetate (4-6)
Potassium bromide	Sodium carbonate (11.7)	Hydrochloric acid (1.5-3.5)
	Ammonia (11.6)	Carbon dioxide (5-6)
		Ammonium chloride (4.6-6)
		Vinegar (3)
		Sulphur dioxide (5-6)

Q. 13. Collect information about electroplating. Make a list of articles in day-to-day life, where this technique is used.

Answer : Electroplating: In this process, electric current is passed through electrolyte.

- i.** Two electrodes are dipped in the solution.
- ii.** Connecting with a circuit and a battery.
- iii.** The electrodes and electrolyte are made from chosen elements.
- iv.** On passing electric current, splitting of electrolyte takes place and some of its parts deposits to one of the electrode at the top
- v.** As a result, one of the electrode becomes electroplated.

Basically, the electroplating is the coating one metals with another metal.



Electroplating of silver onto spoon

List of articles in day to day life where electroplating is used:

- i. Gold and silver coating is done in ornaments.
- ii. Iron is coated with tin to make fresh containers.
- iii. In machine parts, zinc coating is done.
- iv. In cars, nickel coating is done.
- v. In handle of cycles and wheels, chromium coating is done to give an extra shine.