

ACIDS, BASES AND SALTS

Important Points in Chapter:

1. Acids turn blue litmus to red and bases turn red litmus to blue.
2. Acids are formed when metallic oxides are dissolved in water.
3. Bases are formed when non-metallic oxides are dissolved in water.
4. Low volatile acids are prepared from high volatile acids.
5. Hydrogen is released When acids react with metals.
6. Water and salt are formed when acids react with bases.
7. According to Arrhenius theory acids produce H^+ ions, and bases produce OH^- ions in aqueous media.
8. Combination of H^+ and OH^- ions is called neutralisation.
9. All acids and bases are not falling under Arrhenius theory of Acids and bases.
10. $[H^+] \times [OH^-]$ is called ionic product of water.
11. pH scale was introduced by Sorenson. $pH = -\log[H^+]$
12. pH value of acids is between '0' and '7' and that of bases is between 7 and 14.
13. Neutral solution has a pH of 7.
14. For a reaction between strong acid and strong base the heat neutralisation is 13.7 K.Cal mol^{-1} .
15. For a reaction involving weak acid and weak base, the heat of neutralization is less than 13.7 K.Cal.

4 Marks Questions.

1. Define strong acid, strong base, weak acid and weak base. Give one example for each.

A. Strong acids: Acids which ionize completely are called strong acids.

Eg: HCl , H_2SO_4 , HNO_3 etc.

Weak acids: Acids which incompletely ionize are called weak acids.

Eg: CH_3COOH , H_2CO_3 , H_3PO_4 etc.

Strong Base: Bases which completely ionize are called strong bases.

Eg: $NaOH$, KOH , $LiOH$ etc.

Weak Base: Bases which incompletely ionize are called weak bases.

Eg: NH_4OH , $Mg(OH)_2$, $Al(OH)_3$ etc.

2. Write short notes on

a) Limitations of Arrhenius theory of Acid and Bases.

b) Heat of Neutralization. **(June-2000)**

A. a) Limitations of Arrhenius theory of Acid and Bases:

(1) Arrhenius theory explains the nature of substances which are soluble in water only. It doesn't explain the nature of substances which are insoluble in water and also the nature of substances in other solvents.

(2) **For Example:** HCl acts as an acid, when it is dissolved in water. But when . But when it is dissolved in Benzene it doesn't produce H^+ ions and it doesn't show any acidic properties.

(3) SiO_2 is insoluble in water but it has acidic in nature.

- (4) CaCO_3 is soluble in water but basic in nature.
- (5) Though substances like CO_2 , SO_2 , SO_3 and P_2O_5 don't contain H^+ ions of their own, they possess acid nature. In the same manner MgO , CaO , NH_3 and Na_2O behave as bases without possessing OH^- ions.

b) Heat of neutralisation:

The amount of heat liberated when one mole of acid reacts with one mole of base is called heat of neutralization.

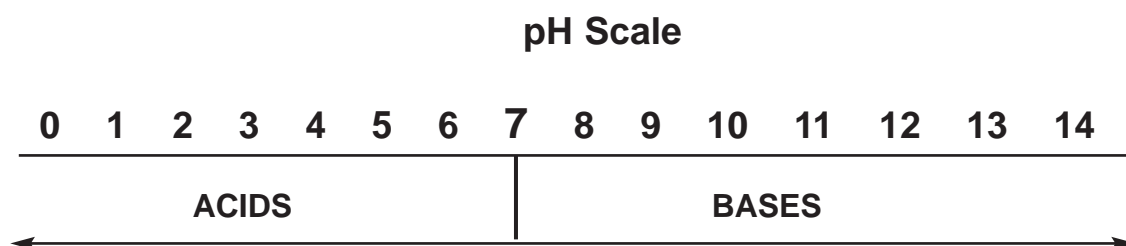
The heat of neutralization for a reaction between a strong acid and strong base is 13.7 K.Cal /mole. If acid or base is weak this value is less than 13.7 K.Cal/mole.

3. Write a short notes on the following.

a) pH

b) The strengths of acids and bases. (June-2001)

- A.
- (1) Sorensen introduced the term pH.
 - (2) The negative logarithm of H^+ ion concentration is called pH. $\text{pH} = -\log [\text{H}^+]$.
 - (3) Relation between pH and concentration of H^+ ions.
 $[\text{H}^+] = 10^{-1} 10^{-2} 10^{-3} 10^{-4} 10^{-5} 10^{-6} 10^{-7} 10^{-8} 10^{-9} 10^{-10} 10^{-11} 10^{-12} 10^{-13} 10^{-14}$
pH = 1 2 3 4 5 6 7 8 9 10 11 12 13 14
 - (4) If the pH value of a solution is 7 it indicates neutral. As the pH value moves from 7 to 1 the strength of the acid increases. As the pH value moves from 7 to 14 base character increases.



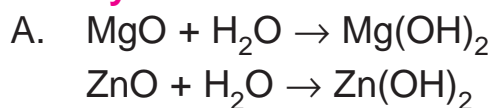
Short Answer type Questions:

1. Define a strong acid? (June-2010)

A. An acid which is completely ionized in aqueous solution is called a strong acid.



2. Give the equation for the preparation of magnesium hydroxide and zinc hydroxide from their oxides of magnesium and zinc. (June-2004)

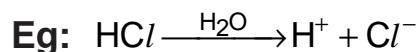


3. Write any two chemical properties of bases with equations? (June-2004)

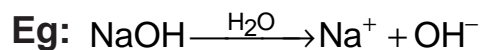
- A.
- (1) On heating bases decompose into metallic oxide and water.
 $\text{Cu}(\text{OH})_2 \rightarrow \text{CuO} + \text{H}_2\text{O}$
 - (2) Bases react with acids to form salt and water.
 $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

4. Write the Arrhenius theory of acids and bases? (March-06, June-02)

A. According to Arrhenius theory, Acid is a substance which contain hydrogen group and gives H^+ ions on aqueous solution.



Base is a substance which contain hydroxyl group and gives OH^- ions in aqueous solution.



5. What is ionic product of water? Give its value at 25°C?

(March-07, 02, 01, 99 June-08, 2000)

A. The product of concentration of H^+ and OH^- ions in one mole of water is known as ionic product of water. It is denoted by the symbol K_w . $K_w = [H^+] [OH^-]$

At 25°C K_w value is 1.0×10^{-14} mole²/litre²

6. Calculate the pH of 0.002M HCl.? (March-1999)

$$[H^+] = 0.002M = 2 \times 10^{-3}M$$

$$pH = -\log[H^+] = -\log(2 \times 10^{-3})$$

$$pH = -[\log 2 + \log 10^{-3}] = -[0.3010 + (-3) \log 10]$$

$$= -\{0.3010 - 3\} = 2.699$$

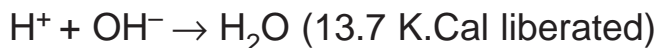
7. Distinguish between an Acid and Base?

S.NO.	ACID	BASE
1.	Acid gives H^+ ions in water solution.	Base gives OH^- ions in water solution.
2.	Sour to taste.	Bitter to taste and soapy touch.
3.	It turns blue litmus to red.	It turn red litmus to blue.
4.	pH value is less than 7.	pH value is more than 7.
5.	Methyl orange indicator changes to red in acid medium.	Methyl orange solution changes to yellow in basic medium.

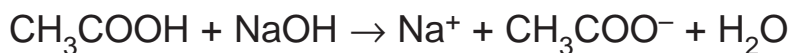
8. Why the heat of neutralization is less than 13.7 K.Cal/mole. When a weak acid and weak base involves in neutralisation.

A. The heat of neutralisation for a reaction between NaOH and CH_3COOH is 13.4 K.Cal/mole. Because in a net reaction 0.3 K.Cal/mole of heat is used to ionize the weak acetic acid.





Net reaction



(13.7 K.Cal – 0.3 K.Cal = 13.4 K.Cal/mole)

9. Find out the pH value of 0.001M of NaOH?

A. $[\text{OH}^-] = 0.001\text{M} = 10^{-3}$

But $[\text{H}^+][\text{OH}^-] = K_w = 1.0 \times 10^{-14} \text{ moles}^2/\text{litre}^2$

$$[\text{H}^+] = \frac{1.0 \times 10^{-14} \text{ moles}^2 / \text{litre}^2}{10^{-3} \text{ mole / litre}} = 10^{-11} \text{ moles / litres}$$

$$[\text{H}^+] = 10^{-11} \text{ moles/litre}$$

$$\text{pH} = -\log 10^{-11} = 11$$

Very Short Answer Questions (1 Mark Each)

1. Arrange the following acids in the increasing order of volatility. HCl, H₂SO₄, CH₃COOH? (June-2010)

A. $\text{CH}_3\text{COOH} > \text{HCl} > \text{H}_2\text{SO}_4$

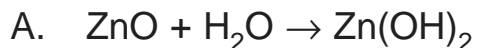
2. Define pH? (June-05, 01, March-05, 99)

A. The negative logarithm of Hydrogen ion concentration is called pH.

3. Distinguish between H⁺ and [H⁺]?

A. H⁺ represent hydrogen ion or a proton. Where as [H⁺] represents the concentration of Hydrogen ions.

4. Write down the balanced equation showing the preparation of zinc hydroxide from zinc oxide? (June-2002)



5. What is heat of neutralisation for a strong acid and strong base? (March-2003)

A. 13.7 K.Cal/mole.

6. What is the nature of a solution whose pH value is 1.

A. Strong acid.

Fill in the Blanks (1/2 Mark Questions)

1. If the pH of a solution is 10, its [H⁺] is _____ (March-04, June-02)

2. pH of water is _____ (June-2003)

3. CaO is _____ (March-2000)

4. Weak acid ionize up to _____

5. The value of K_w changes with changing _____

6. If the pH of a solution is 8, its [H⁺] is _____

7. The colour of Phenolphthalein indicator in basic solution is _____ (March-01)

8. The colour of methyl orange indicator in acid medium is _____
9. _____ amount of heat is used to ionize the acetic acid.
10. The body fluid where pH is greater than 7 is _____ **(June-01, 04, March-2000)**
11. Formula of acetic acid is _____ **(March-2000)**
12. Ionic product of water at 25°C is _____
13. If pH of a solution is 8, then $[\text{OH}^-] =$ _____

Answers

1. 10^{-10} moles/litre
2. 7
3. base
4. less than 100%
5. temperature
6. 10^{-8} moles/litre
7. pink
8. red
9. 0.3 K.Cal
10. blood
11. CH_3COOH
12. 1.0×10^{-14} moles²/litre²
13. 10^{-6} moles/litres

$$[\text{H}^+] = \frac{1.0 \times 10^{-14} \text{ moles}^2 / \text{litre}^2}{10^{-3} \text{ mole} / \text{litre}} = 10^{-11} \text{ moles} / \text{litres}$$