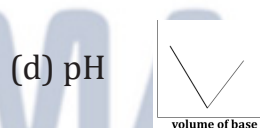


# TITRATION

**1. As per Bronsted-Lowry concept, acid is defined as: [GPAT-2024]**

- (a) Electron pair donor
- (b) Any substance/molecule that can donate a proton
- (c) Electron pair acceptor
- (d) Any substance/molecule that can accept a proton

**2. The titration of a strong acid with a strong base is represented by plot [GPAT-2022]**



**3. Match List I with List II [GPAT-2022]**

**LIST I (BUFFERS)**

1. HCl and KCl
2. HCl and Potassium Hydrogen Phthalate
3. NaOH and Potassium Hydrogen Phthalate
4.  $H_3BO_4$ , NaOH, and KCl

**LIST II (pH VALUE)**

- [P] 8 to 10
- [R] 0.2 to 4.0
- [Q] 1.2 to 2.2
- [S] 4.2 to 5.8

**Choose the correct answer from the options given below**

- (a) 1-[Q], 2-(R), 3-[S], 4-[P]
- (b) 1 (R), 2-[Q], 3-[S], 4-[P]
- (c) 1-(Q), 2-[S], 3-[P], 4-[Q]
- (d) 1-(R), 2-[S], 3-(Q), 4-[P]

**4. In Universal indicators, a pH of 7 is shown with [GPAT- 2018]**

- (a) Yellow color
- (b) Green color
- (c) Blue color
- (d) Pink color

5. Methyl orange have acidic colour

- (a) Red                      (b) Orange                      (c) Yellow                      (d) Blue

6. Boric acid is a weak acid ( $pK_a$  9.19) which cannot be titrated with a standard solution of sodium hydroxide using phenolphthalein as indicator. This titration becomes possible on addition of glycerol due to one of the following reactions. Choose the correct reaction [GPAT-2011]

- (a) Boric acid becomes boric acid on reaction with glycerol  
(b) Boric acid gives a monoprotic tetra-alkyl boron ester with glycerol  
(c) Boric acid gives a tribasic acid on reaction with glycerol  
(d) Two boric acid molecules combine to give an anhydride in presence of glycerol

7. Identification test prescribed in LP is for Chlorambucil 6.4g of the drug is extracted with 10 ml quantities of 2 M hydrochloric acid three times. To 10 ml quantity of extract, 0.5 ml potassium mercuric iodide solution is added, which yields [GPAT-2007]

- (a) Yellow coloured precipitate                      (b) Yellow coloured solution  
(c) Buff coloured precipitate                      (d) Red coloured precipitate

8. Chlorambucil is assayed as per IP by titrating a dilute acetone solution of the drug with [GPAT-2007]

- (a) 0.1 M sodium hydroxide                      (b) 0.1 M hydrochloric acid  
(c) 0.2 M perchloric acid                      (d) 0.1 M silver nitrate

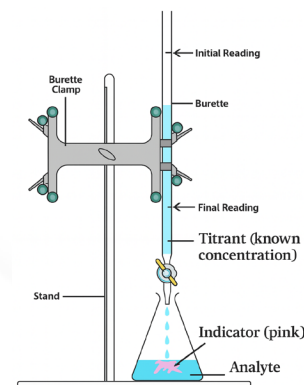
# ACID BASE TITRATION

## Acid - base concepts

- An acid-base titration (or neutralization titration) is based upon the chemical reaction between an acid and a base.
- Several acid-base theories have been proposed to explain or classify acidity and basicity properties of substances.

## Acid-Base Theories

Theory	Acid	Base
Arrhenius theory	Hydrogen ion donor	Hydroxide ion donor
Bronsted-Lowry theory	Proton donor	Proton acceptor
Lewis theory	Electron pair acceptor	Electron pair donor



## Types of Acid-Base Titration

Types	Examples
Strong acid-strong base	Hydrochloric acid and sodium hydroxide
Weak acid-strong base	Ethanoic acid and sodium hydroxide
Strong acid-weak base	Hydrochloric acid and ammonia
Weak acid-weak base	Ethanoic acid and ammonia

## Example:

Calculate the equivalent weight of  $\text{H}_2\text{SO}_4$  (molar mass = 98 g/mol) in an acid-base reaction.

- a) 49 g/equiv      b) 100 g/equiv      c) 196 g/equiv      d) 24.5 g/equiv

## Solution

The **equivalent weight (E)** of an acid in an acid-base reaction is given by the formula:

$$E = \text{Molar mass} / \text{Basicity}$$

where **basicity** = number of replaceable hydrogen ions ( $\text{H}^+$ ) per molecule of the acid.

### For Sulfuric acid ( $\text{H}_2\text{SO}_4$ ):

- Molar mass** = 98 g/mol
  - Basicity** = 2 (since it can donate 2  $\text{H}^+$  ions)
- $$E = 98 / 2 = 49 \text{ g/equiv}$$

## COMMON ION EFFECT

Point	Short Definition / Explanation	Example
<b>Concept</b>	Suppression of ionization of a weak electrolyte by adding a strong electrolyte having a common ion	$\text{CH}_3\text{COOH} + \text{NaOH}/\text{NaAc}$
<b>Weak Electrolyte</b>	Poorly dissociated in water	$\text{CH}_3\text{COOH} \rightleftharpoons \text{H}^+ + \text{CH}_3\text{COO}^-$
<b>Strong Electrolyte</b>	Fully dissociated, contributes common ion	$\text{NaCH}_3\text{COO} \rightleftharpoons \text{Na}^+ + \text{CH}_3\text{COO}^-$
<b>Effect</b>	Added common ion shifts equilibrium backward $\rightarrow$ decreases dissociation of weak electrolyte	Addition of $\text{NaCH}_3\text{COO}$ reduces ionization of $\text{CH}_3\text{COOH}$
<b>Law Applied</b>	Law of Mass Action (Le Chatelier's Principle)	$\uparrow [\text{CH}_3\text{COO}^-] \rightarrow$ suppresses $\text{CH}_3\text{COOH}$ dissociation

## pH

Term	Definition / Explanation	Formula / Range	Example
<b>pH</b>	Measure of hydrogen ion concentration $\rightarrow$ indicates acidity or alkalinity of a solution	$\text{pH} = -\log_{10} [\text{H}^+]$	If $[\text{H}^+] = 1 \times 10^{-3} \rightarrow \text{pH} = 3$
<b>Scale Range</b>	Usually 0 - 14	pH < 7 = Acidic pH = 7 = Neutral pH > 7 = Basic	HCl (pH $\approx$ 1), Pure water (pH = 7), NaOH (pH $\approx$ 13)

Indicator	pH range	Acid	Alkaline
Methyl Orange	3.1 - 4.4	Red	Orange
Thymol Blue	1.2 - 2.8	Blue	Yellow
Bromophenol blue	3.0 - 4.6	Yellow	Blue
Bromocresol Green	3.8 - 5.4	Yellow	Blue
Methyl Red (920 indicator)	4.2 - 6.3	Red	Yellow
Phenol Red	6.8 - 8.4	Yellow	Red
Phenolphthalein	8.3 - 11.0	Colorless	Pink/Red

### Indicators Used In Various Titrations

**1. Strong acid strong base titrations.** Eg: Methyl orange, Methyl red, Phenolphthalein Bromothymol Blue, Phenol Red.

**2. Weak acid strong base titrations.** Eg: Phenolphthalein, Thymolphthalin, Thymol Blue.

**3. Strong acid weak base titrations** Eg: Methyl orange, Methyl red, bromophenol, Bromocresol green.

**4. Weak acid weak base titrations** Eg: Mixed Indicators.

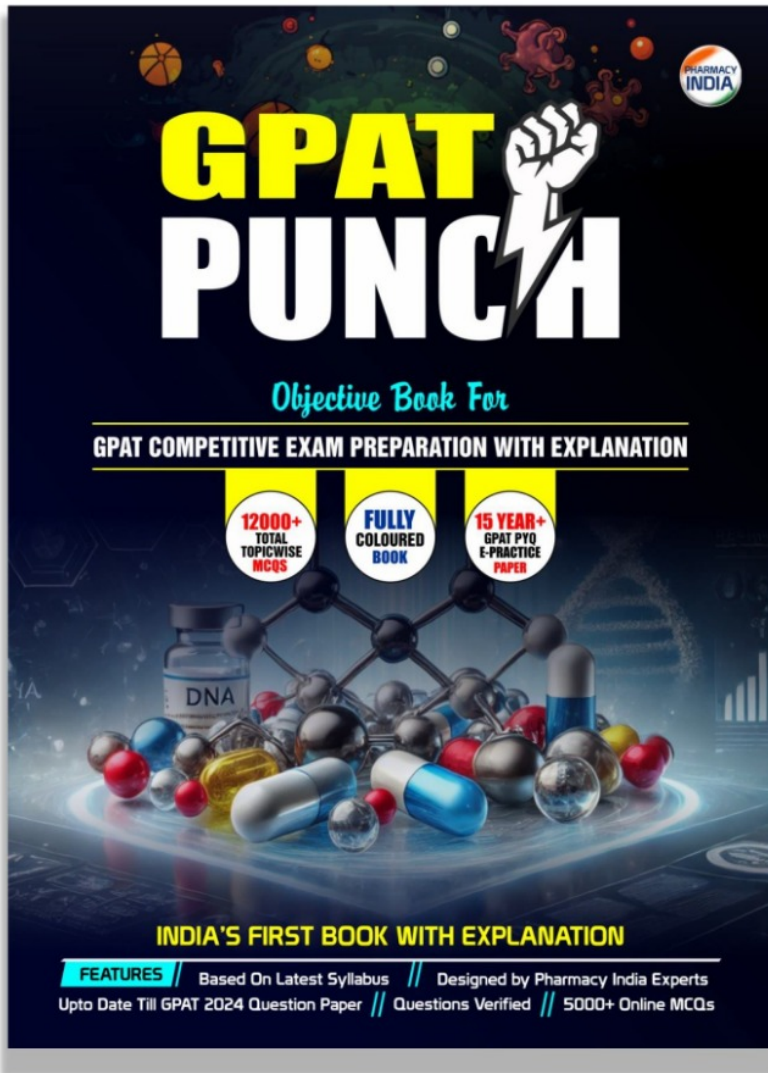
#### Exam Punch

- **Acid-base catalysis** involves donation/acceptance of protons by the catalyst.
- **Boric acid** is assayed officially by titrimetry.
- In the assay of boric acid, glycerine is added to boric acid to **increase basicity**.
- Assay of boric acid is carried out in the presence of **phenolphthalein**.
- In universal indicators a pH of 7 is shows **green colour**.
- Sodium methoxide is standardized by **benzoic acid**.
- The color of Phenolphthalein in 0.01 N NaOH Solution is **pink**.





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