

Chapter	16 Labs Safety and Practical Skills	Class	1 st Year	Subject	Chemistry
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Give Short Answers of the Following Questions

1. For which type of titration, methyl orange is used as an indicator?

Ans. Methyl orange is used as an indicator in strong acid-weak base titrations.

Methyl orange changes colour in the pH range of 3.1 to 4.4, making it ideal for titrations where the equivalence point is acidic, as is the case when a strong acid (e.g., HCl) is titrated against a weak base (e.g., NH_4OH).

2. Explain why phenolphthalein is a suitable indicator for the titration of a weak acid with a strong base but not for the titration of a strong acid with a weak base.

Ans. Phenolphthalein is suitable for weak acid-strong base titrations because the equivalence point ($\text{pH} \approx 8.5$), which falls within phenolphthalein's colour change range ($\text{pH } 8.2-10$).

It is not suitable for strong acid-weak base titrations because the equivalence point is acidic ($\text{pH} < 7$), outside phenolphthalein's range, so it would not show a clear endpoint.

3. Explain why different indicators change colour over different pH ranges.

Ans. Different indicators change colour over different pH ranges because each has a unique acid-base equilibrium and changes structure (and thus colour) at a specific pH range where its conjugate acid and base forms are present in comparable amounts.

Examples:

1. Phenolphthalein:

- Colour change range: $\text{pH } 8.2 - 10$
- Colour: Colourless in acid, pink in base

2. Methyl Orange:

- Colour change range: $\text{pH } 8.2 - 10$
- Colour: Red in acid, yellow in base

4. It is always advisable to use dilute solutions while performing experiments in volumetric analysis? Give a reason.

Ans. Yes, it is advisable to use dilute solutions in volumetric analysis because they reduce the risk of large heat changes and allow for more precise volume measurements, minimizing errors and improving the accuracy of the titration results.

5. White precipitates are formed when Ca^{2+} , Al^{3+} and Zn^{2+} all react separately with NaOH solution. How will you detect which basic radical is present?

Ans. To distinguish between Ca^{2+} , Al^{3+} and Zn^{2+} ions when all form white precipitates with NaOH, excess can be used:

1. Add excess NaOH to each white precipitate formed:

- $\text{Ca}(\text{OH})_2$: Insoluble in excess NaOH $\rightarrow$ White ppt remains
- $\text{Al}(\text{OH})_3$: Dissolves in excess NaOH forming a colorless solution
- $\text{Zn}(\text{OH})_2$: Dissolves in excess NaOH forming a colorless solution

2. Differentiate Al^{3+} and Zn^{2+} using ammonium hydroxide (NH_4OH):

- $\text{Al}(\text{OH})_3$: Insoluble in excess $\text{NH}_4\text{OH} \rightarrow$ White ppt remains
- $\text{Zn}(\text{OH})_2$: Soluble in excess NH_4OH - Colorless solution forms

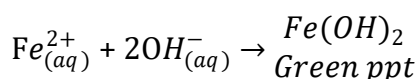
6. How Fe^{2+} can be distinguish from Fe^{3+} chemically?

Ans. Identification of Iron (II) radical (Fe^{2+})

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Take 4 g sample in a clean test tube. Dissolve it in 10 cm³ of distilled water. Make two portions of the solution for further tests.

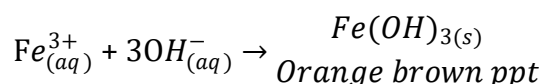
Experiment	Observation	Inference
To one portion, add NaOH solution.	A green precipitate is formed which is turned into orange brown precipitate after some time.	Fe ²⁺ ions are indicated.
To the second portion of the above, add aqueous ammonia.	A while gelatinous precipitate of Fe(OH) ₂ is formed which quickly oxidizes to form red brown precipitate of Fe(OH) ₃ .	Fe ²⁺ ions are indicated.



Identification of Fe (III) radical (Fe²⁺)

Take 2 g FeCl₃ in a clean test tube. Dissolve it in 10 cm³ of distilled water. Make two portions of the solution for further tests.

Experiment	Observation	Inference
To one portion, add NaOH solution.	Orange brown precipitate is formed.	Fe ³⁺ ions are indicated.
To the second portion of the above, add aqueous ammonia.	Orange brown precipitate is formed.	Fe ³⁺ ions are indicated.



7. Why does Ca²⁺ not give precipitate with aqueous ammonia?

Ans. Ca²⁺ does not give a precipitate with aqueous ammonia because calcium hydroxide (Ca(OH)₂), formed by the reaction of Ca²⁺ with ammonia, is sparingly soluble in water. The amount of hydroxide formed is insufficient to exceed the solubility product (K_{sp}) and produce a visible precipitate under normal conditions.

In contrast, other metal ions like Al³⁺ and Zn²⁺ form insoluble hydroxides that precipitate in the presence of ammonia.

8. How will you find out the concentration of acetic acid in vinegar solution?

Ans. To find the concentration of acetic acid (CH₃COOH) in a vinegar solution, we can perform a titration using a strong base (such as NaOH) and an appropriate indicator (such as phenolphthalein).

Procedure:

- 1. Prepare a Sample of Vinegar:** Measure a known volume (e.g., 10 cm³) of the vinegar solution.
- 2. Titration Setup:**

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- Titrant: Prepare a standard solution of NaOH of known concentration (e.g., 0.1 M).
- Indicator: Add a few drops of phenolphthalein (which changes from colorless to pink as the solution goes from acidic to slightly basic).

3. Perform the Titration:

- Slowly add the NaOH solution from the burette to the vinegar solution while stirring.
- End point: The titration is complete when the solution turns light pink (indicating neutralization).

4. Calculate the Concentration of Acetic Acid:

- Use the formula:

$$C_1V_1 = C_2V_2$$

Where:

- C_1 = concentration of acetic acid (required).
- V_1 volume of vinegar used,
- C_2 concentration of NaOH,
- V_2 volume of NaOH used to reach the endpoint.

5. Final Calculation: Solve for C_1 the concentration of acetic acid in vinegar.

Example Calculation:

- If 25 cm³ of NaOH (0.1 M) neutralizes 10 cm³ of vinegar, the calculation would be:

$$C_1 \times 10.0 \text{ cm}^3 = 0.1 \text{ M} \times 25 \text{ cm}^3$$

$$C_1 = 0.1 \times 25.0 / 10 = 0.25 \text{ M}$$

So, the concentration of acetic acid is 0.25 M.

This gives the molarity of acetic acid in the vinegar.

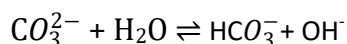
9. What precautions you need to observe while diluting a concentrated acid?

Ans. Precautions to Observe while Diluting a Concentrated Acid:

- Always add acid to water, never water to acid - this prevents splashing due to the exothermic reaction.
- Use protective gear-wear gloves, goggles, and a lab coat to prevent burns and injuries.
- Perform the dilution slowly, while stirring continuously, to control heat release.
- Use heat-resistant glassware - to prevent breakage from the heat generated.
- Work in a well-ventilated area or fume hood- to avoid inhaling harmful vapours.
- Keep neutralizing agents (like baking soda) nearby in case of spills.

10. Why does an aqueous solution of Na₂CO₃ behave like a base?

Ans. An aqueous solution of Na₂CO₃ (sodium carbonate) behaves like a base because the carbonate ion (CO_3^{2-}) undergoes hydrolysis in water:



This reaction produces hydroxide ions (OH^-), which increase the pH of the solution, making it basic in nature. Na₂CO₃ is a salt of a strong base (NaOH) and a weak acid (H₂CO₃), so its solution is basic due to the weak conjugate acid (HCO_3^-) not fully neutralizing OH^- formation.

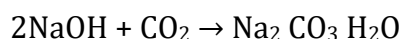
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11. If an aqueous solution of NaOH is kept in an open container, what changes do you expect to take place with the passage of time?

Ans. If an aqueous solution of NaOH is kept in an open container, the following changes occur over time:

1. Absorption of CO₂ from the air:

NaOH reacts with carbon dioxide in the atmosphere:



This reaction forms sodium carbonate Na₂CO₃ and water.

2. Decrease in alkalinity:

As NaOH is gradually converted into Na₂CO₃, the concentration of OH⁻ ions decreases, reducing the solution's basic strength (pH).

3. Formation of precipitates (if concentration is high):

If the solution becomes saturated, precipitates of sodium carbonate hydrate may form. So, by the passage of time the NaOH solution becomes less basic and transforms into a carbonate solution.