

Inorganic Chemistry (Sp - 1)

P-P # 2023

Solved S.Qs

Redd's Laboratory

1) Solubility of EDTA in Water :-

EDTA is sparingly soluble in water. However, its disodium and tetrasodium salts are highly soluble in water. This is because the sodium salts dissociate easily, increasing the availability of EDTA in solution for complex formation with metal ions. EDTA salts are more soluble in water at higher pH.

2) Role of organic reagents as masking agent :-

Organic reagents can be used as masking agents for interfering. They form complexes with certain metal ions thus main desired metal ion can be determined. By masking the certain

metal, we can prevent them from reacting with main analyte.

The common masking agents used in complexometric titrations are tartaric acid, citric acid, triethanol amine, triphenyl amine or ascorbic acid.

3) Buffer used in EDTA titration

In EDTA titrations, a pH buffer is used to maintain a suitable pH for metal complex formation. The choice of buffer depends on metal ion being titrated.

→ For Ca^{2+} and Mg^{2+} , ammonia-ammonium chloride ($\text{NH}_3/\text{NH}_4\text{Cl}$) buffer is used to maintain pH 10.

→ For transition metals ions (Cu^{2+} , Zn^{2+} , etc), acetate buffer ($\text{CH}_3\text{COOH}/\text{CH}_3\text{COO}^-$) at pH 4-5 or ammonium buffer at pH 9-10 is used.

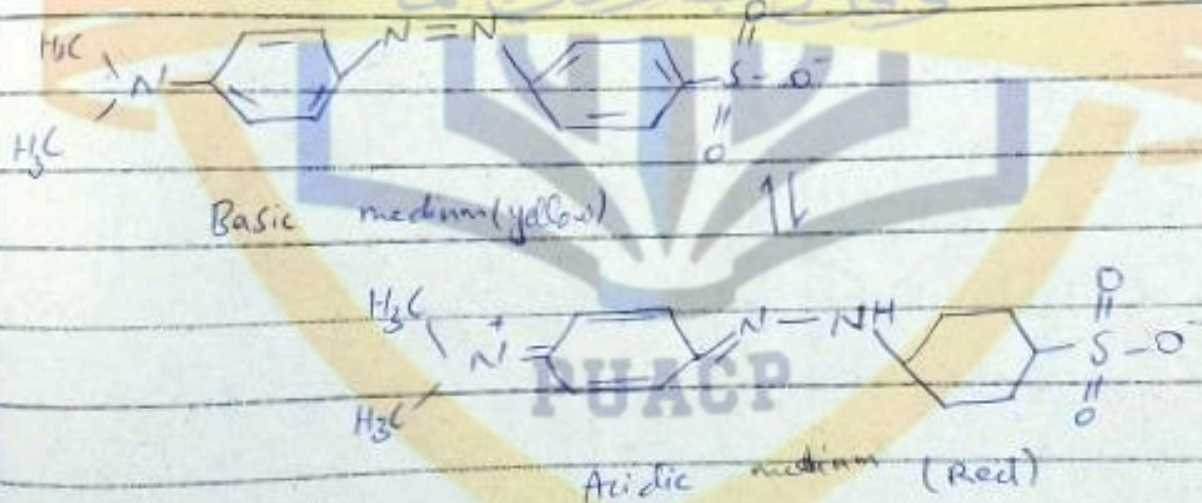
* Buffers ensure that metal ions remain in correct oxidation state and form stable complex with EDTA.

4) Acid - Base indicators

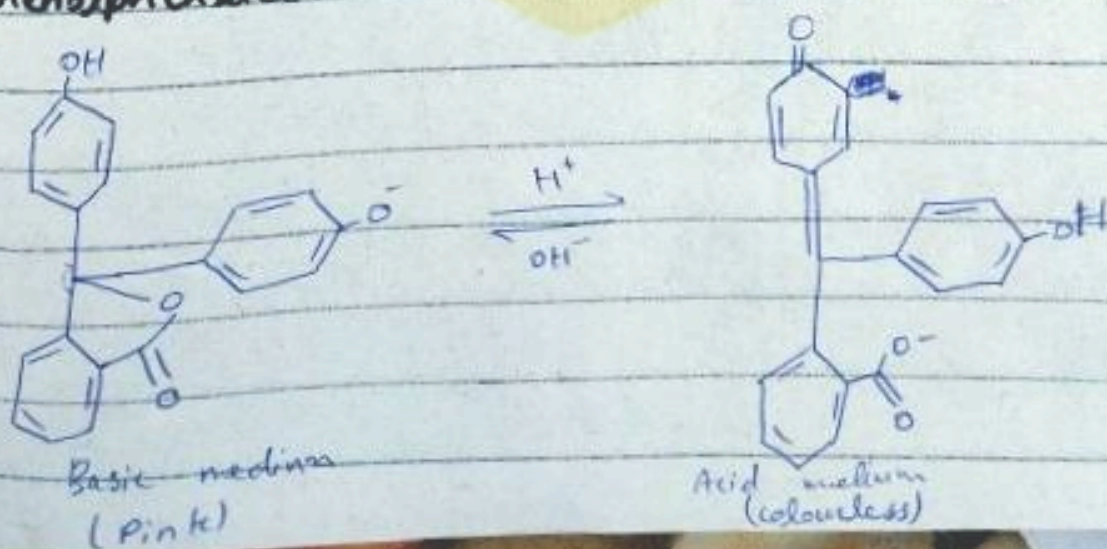
They are weak acids or bases that change color depending on the pH of solution. They help to determine endpoint of acid-base titrations by visually signaling pH changes.

→ Example

Methyl orange → Colour changes takes place at $\text{pH} = 3.1 - 4$. Red in acidic, yellow in basic solutions.



Phenolphthalein



∴ colour changes at 8.3 - 10 -
Bromothymol blue → yellow in acid,
blue in base. pH transition 6 - 7.6

5) Uses of 8-hydroxyquinoline

inorganic analysis.

It is universal organic reagent,
widely used in inorganic analysis
due to its ability to form
stable complexes with metal ions.

→ It is used for gravimetric
analysis of Al^{3+} , Cu^{2+} , Bi^{3+} , Cd^{2+} , Co^{3+} ,
 Zn^{2+} , U^{6+} & VO^{2+} .

→ It is used for solvent
extraction and gravimetric
determination of Cu^{2+} and VO^{2+}
in $CHCl_3$ (chloroform) solution.

→ It is used for fluorimetric
determination of Al^{3+} , Co^{3+} , La^{3+} &
 Zn^{2+} which forms fluorescent metal
acacates in $CHCl_3$.

6) Structural formula of titrant

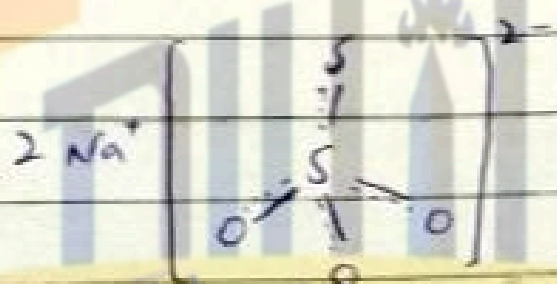
other than EDTA

One common titrant other than

EDTA is sodium thiosulfate

($\text{Na}_2\text{S}_2\text{O}_3$) which is used in

redox titrations, such as for determination of iodine concentration



7) What is $p\pi - p\pi$ bonding

It is a type of covalent bonding that occurs when the p -orbitals of two atoms overlap sideways or parallel p -orbitals on adjacent atoms overlap.

⇒ The resulting bond is π -bond.

Examples

→ In O_2 , each oxygen atom has an unpaired e^- in its $2p$ orbital, which overlaps with other $2p$ -orbital of other O-atom.

8) $3c - 4e$ bond :-

It is a type of chemical bond that involves three atoms sharing four electrons.

This bond is common in electron deficient compound where there are not enough valence electrons to form $2c - 2e$ bonds.

e.g. \rightarrow In boron hydrides (BH_3 , diborane) the two H-atoms form $3c - 2e$ bonds with B-atom.

9) Why fluorine show peculiar behavior in group VIIA

Fluorine exhibits unique properties in group VIIA halogens due to its small atomic size, high electronegativity and absence of d-orbitals.

\rightarrow It has highest electronegativity (3.98), making it strong oxidizing agent.

\rightarrow Unlike other halogens, F does not form multiple oxidation states because it lacks

available d-orbitals.

→ It has low bond dissociation energy due to lone-pair repulsions in E_2 , making it more reactive.

→ F - forms H-bonds (e.g. in HF) unlike other halogens.

10) **S** - inert pair effect
It refers to the reluctance of resistance of ns^2 electrons to participate in bonding, especially in heavier elements of groups 13, 14, and 15.

Example

• Lead (Pb) prefers +2 oxidation state over +4 due to inert pair effect.

• Bi favors +3 over +5.

⇒ This effect arises due to poor shielding by inner d and f electrons, leading to increased effective nuclear charge, which holds the ns^2 electrons tightly.

11) Why NF_5 not exist
 NF_5 does not exist because
Nitrogen lacks d-orbitals, preventing
nitrogen from expanding its
octet to accommodate five
F-atoms.

Reasons

- Nitrogen has only s and p orbitals, limiting its maximum valency to 4 (e.g. in NF_3)
- Strong lone pair repulsions on nitrogen make NF_5 highly unstable
- Steric hindrance : Five F-atoms around a small nitrogen atom would create excessive repulsion.

12) Similarity b/w VBT & MOT

The common features or similarities b/w VBT and MOT -

- 1) Both explain the formation of covalent bond.
- 2) In both theories, a covalent bond is formed by overlapping of atomic orbitals having appropriate symmetry about molecular axis.
- 3) According to both, the electronic charge resides in region between the atomic nuclei.
- 4) Both methods lead to formation of two types of bonds viz σ and π bonds.
- 5) In both the methods, the atomic & molecular orbitals are filled up according to same principles.

13) What is range of UV & visible radiation

→ UV light range

10nm - 400nm → Wavelength

• Near UV

• Far UV

→ UV light is not visible to human eye.

→ Have high frequency than visible

Visible light range

⇒ Wavelength 400 - 700 nm

⇒ The part of electromagnetic spectrum that human can see

⇒ The colors of visible spectrum are

Violet → 400 - 450 nm

Blue → 450 - 500 nm

Green → 500 - 570 nm

Yellow → 570 - 590 nm

Orange → 590 - 620 nm

Red → 620 - 700 nm

14) Diagonal

Relationship:-

It refers to similarities between elements diagonally adjacent in the periodic table.

→ Diagonally related elements have similar atomic radii, which leads to similar ionic radii & analogous chemical properties.

→ Electronegativity of these elements is also similar, resulting in comparable bonding patterns and reactivity.

Examples

1) Li & Mg

→ Both form stable carbonates

(Li_2CO_3) & (MgCO_3)

→ Both form strongly covalent

compounds

→ Both show low reactivity compared to their group members.

2) Be & Al

3) B & Si

15) Experimental evidence for $d\pi - p\pi$ bonding.

One experimental evidence for $d\pi - p\pi$ bonding is the shorter than the expected bond lengths in compounds like SO_2 and POCl_3 . X-ray crystallography studies show that the $\text{S}=\text{O}$ bond in SO_2 is shorter than a single $\text{S}-\text{O}$ bond, indicating partial double-bond character due to $d\pi - p\pi$ overlap. Similarly, the spectroscopic data (UV-Visible and IR) reveal delocalization of π -density between d-orbitals of transition metals and p-orbitals of ligands.