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RIN - 48
FY CSE-A

EC Assignment - I

Q-1 Define soft water & hard water. what is the principle of EDTA method? Describe the estimation of hardness of water by EDTA method.

A: Hardness of water
it is a characteristic of water which prevents lathering of soap.

Soft water
water which forms good lather (foam) with soap or soap solution readily is known as ~~so~~ soft water.

Hard water
water which ~~so~~ does not form good lather with soap or soap solution but develops white scum (curd) is known as hard water.

Principle of EDTA Method :-
EDTA forms stable complexes with Ca^{++} & Mg^{++} ions present in water. Thus, in hard water sample, the total hardness can be determined by titrating known volume of hard water sample with std solution Na-EDTA using buffer solution.

Estimation of hardness by EDTA method.
① Standardization of EDTA solution
- pipette out 50 ml of the given solution
- Add 5ml of buffer solution to increase the pH to about 10.000
- Add 3-4 drops of EBT indicator. The solution turns wine red.
- Titrate the water sample slowly with 0.01 M EDTA until the colour changes to permanent blue (end point). Note down the volume of EDTA used up at endpoint (V_1 ml).

(b) Estimation of total hardness.

- 50 ml of hard water sample is titrated as above against EDTA solution (Volume of EDTA = V_2 ml)

(c) Estimation of ~~total hardness~~ permanent hardness.

- 50 ml of Hard water sample is boiled for about 15-20 mins, filtered, diluted, with distilled water to make 50 ml & titrated against EDTA solution (Volume of EDTA = V_3 ml)

Q-2 Describe ion-exchange process for demineralization of water. How is the exhausted resin regenerated in ion-exchange method.

A: Ion-Exchange process is the modern method in water softening methods. Ion-Exchange resins are insoluble, cross linked, long chain organic polymers with a microporus structure & "functional groups" attached to these chains are responsible for the ion-exchanging properties.

- Cation Exchange resin

These resins are made for exchanging cations by H^+ ions. They are represented as RH_2

$$RH_2 + Ca^{2+} \longrightarrow RCa + 2H^+$$

The exhausted cation Exchanger is regenerated by passing dilute acid solution through the Resin.

$$RCa + 2HCl \longrightarrow RH_2 + CaCl_2$$
$$RMg + 2HCl \longrightarrow RH_2 + MgCl_2$$

- Anion Exchange Resins

These resins are made of for exchanging rapidly anions by OH^- ions. These resins are represented as $R'(OH)_2$.

$$R'(OH)_2 + SO_4^{2-} \longrightarrow R'SO_4 + 2OH^-$$

The exhausted anion exchanger is regenerated by passing dilute alkali solution through the resin.

$$R'Cl_2 + 2NaOH \longrightarrow R'(OH)_2 + 2NaCl$$
$$R'SO_4 + 2NaOH \longrightarrow R'(OH)_2 + 1Na_2SO_4$$

Q-3: What is green chemistry? Explain the prevention of waste generation" principle in green chemistry with example

A: Green chemistry is a philosophy of chemical reasearch and engineering that encourages the design of products & processes that minimizes the use & regeneration of waste.

This term was coined by Paul Anastas & John C. Warner

P.T.O

Key developments in green chemistry

① Use of super critical CO_2 as green solvent.

② Use of Aqueous peroxide for clean oxidations.

③ Use of hydrogen in assymetric synthesis.

Principle of "Preventing waste ~~management~~ generation"

→ It is better to avoid generation of waste than to clean up the waste after it is formed.

→ Optimize processes to Reduce by-products & Hazardus ~~waste~~ products.

→ Control Reaction parameters to improve yield & reduce waste.

→ Prefer Renewables resources over non renewables.

Q-4: Write 12 principles of green chemistry. Give 4 applications of green chemistry.

A: The 12 principles of green chemistry are as follows.

① Prevention of waste generation

② Maximize atom Economy

③ Less hazardous Chemical synthesis

④ Designing safer chemicals & products.

⑤ Safer solvents & Auxilaries.

⑥ Design for energy efficiency.

⑦ Use of renewable feedstocks.

⑧ Reduce derivatives.

⑨ Use of catalysts.

⑩ Design for degradation.

⑪ Real-time analysis for pollution prevention.

⑫ Inherently safer chemistry for accident prevention.

Applications of green chemistry

① Pharmaceutical Manufacturing
Development of efficient & less wasteful drug synthesis

② Agricultural Chemicals
Creation of safer & more sustainable pesticides & fertilizers.

P.T.O

③ Material Science
Production of eco-friendly materials like biodegradable plastics &

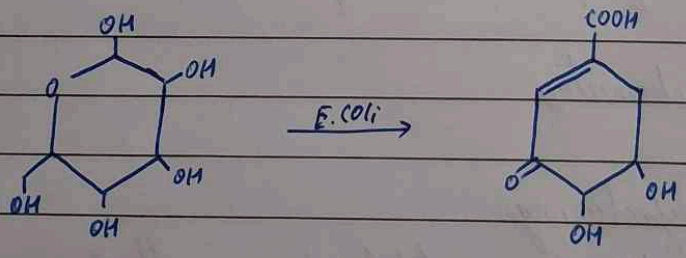
④ Cosmetic industry
Creating less hazardous better lasting products. like using natural occuring dyes rather than chemical colours in the products

Q5:

Q-5: Explain the green route of synthesis of Adipic acid. Highlight the green principle involved in the synthesis.

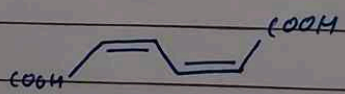
A: The green route of synthesizing Adipic acid involves removing benzene as feedstock & using d-glucose in its place.

This is done because benzene is a non renewable feedstock while also being carcinogenic which is against the principles of green chemistry.

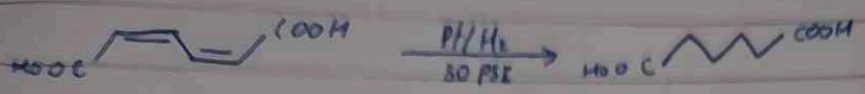


{ d-glucose } { 3-dehydroshikimate }

E.Coli



{ cis-cis-muconic acid }



or

$HOOC-(CH_2)_4-COOH$

{Adipic Acid}

Principles involved :-

① Renewable feedstock

② Less hazardous chemical synthesis