Chem F110

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2020A3PS121

pH curve

Equivalence point when $[\cancel{OH^-}] = [H_3O^+]$
$pH = \log_{10}[H_3O^+]$
Henderson-Hasselbach equation:

$$pH = pK_a + \log_{10}\left(\frac{[A^-]}{[HA]}\right)$$

$pH = pK_a$ at half equivalence point
Procedure:

- Standardize $NaOH$ $(N_1V_1 = N_2V_2)$
- Titrate weak acid with $NaOH$
- Equivalence point: Peak of $\frac{\Delta pH}{\Delta V}$

Hardness of water

Secondary standard : $EDTA$ Indicator used : **Erichrome Black T** (EBT)
Initial color : **Red wine** due to cations in the analyte
Intermediate color : **Purple**
Final color : **Bright blue** due to *free* EBT, Ca^{2+} chelated with $EDTA$
Procedure:

- Standardize $EDTA$
- Titrate $EDTA$ with $CaCO_3$

Hardness in $ppm = \left(\frac{0.1 \cdot x \cdot y}{m}\right) \cdot 10^6$
$x =$ Volume of $EDTA$; $y =$ Molarity(M) of $EDTA$
$m =$ Mass of water sample (gm)

Iodometry

$2Cu^{2+} + 4I^- \rightleftharpoons Cu_2I_2 + I_2$
Forward shifted rxn. due to continuous removal of Cu_2I_2 (insol. complex)
I_2 liberated titrated against **hypo** with starch as indicator Sources of error:

- Aerial oxidation: $4I^- + 4H^+ + O_2 \rightleftharpoons 2I_2 + 2H_2O$
  Minimized by addition of Na_2CO_3 to remove O_2.
- Volatility of I_2 : $I^- + I_2 \rightleftharpoons I_3^-$
  Solved by adding excess I^-

Dibenzalacetone

Final product: $\beta-$hydroxy aldehyde/ketone (aldol)
Dehydration is usually exothermic
Benzaldehyde: Best reagent for cross aldol rxn (no $\alpha-$hydrogens $\therefore$ single product)
Procedure:

- Synthesis of dibenzalacetone
- Recrystallization

Simple stoichiometry/aldol mechanism problems.

Schiff's base ligand

Aldehydes + Amines = Schiff's base (mild conditons)
Schiff's base ligand formed: **Salen's ligand** (Mol. wt = 268.31gm/mol)
The above ligand is further grinded with $Cu(OAc)_2 \cdot 2H_2O$ to obtain a **Cu(II)** comple
Color of grinded product : **Bright Yellow**

Kinetics

Pseudo 1^{st} order reaction (rate constant = k')
$-\frac{d[I_2]}{dt} = k'[I_2]^x$
$k' = k[CH_3COCH_3]^y[H^+]^z$ where the concentration terms are approximately constant
$T = \frac{I}{I_0}$ where T is the transmittance and I, I_0 are the intensities of reflected and transmitted lights respectively
$A = -\log_{10} T = \log_{10}\left(\frac{I_0}{I}\right)$, where A is the absorbance of the sample
Beer-Lambert law : $A = \epsilon cl$ where ϵ is the molar absorption coefficient(characteristic of absorbing species) and l is the length of sample through which light passes
Optical density : ϵc
I_3^- : Brownish red species I_2, I_3^- : Iodinating agents

Equilibrium constant

$K_c = \frac{[CH_3COOC_2H_5][H_2O]}{[CH_3COOH][C_2H_5OH]}$
Acid catalyzed reaction
Procedure:

- Standardize $NaOH$ solution $(N_1V_1 = N_2V_2)$; (Phenolphthalein indicator)
- Standardize HCl solution (Phenolphthalein indicator)

Conductometry

Resistance $R = \rho\frac{l}{A}$, where l = distance b/w electrodes and A = area of electrodes
Conductance $\Lambda = \frac{1}{R}$
specific conductance $\kappa = \frac{1}{\rho} = \frac{1}{R} \cdot \frac{l}{A}$
Cell constant $= \frac{l}{A}$
AC current should be used, because a DC current applied to an electrolyte produces a **back EMF**, opposing current flow
Equivalent conductance $(\Lambda_c) = \frac{1000\kappa}{C}$
Degree of dissociation $(\alpha) = \frac{\Lambda_c}{\Lambda_0}$
Dissociation constant $(K_a) = \frac{C\alpha^2}{1-\alpha}$
Where C = concentration of solution, Λ_0 = conductance at infinite dilution

Saponification

Saponification : Triglycerides + $[OH^-] \rightarrow$ Glycerol + Soap
Saponification value : Number of mg of KOH required to neutralize fatty acids resulting from **complete** hydrolysis of $1g$ of fat
Used for studying **length of fatty acid chain**
Saponification value $\propto \frac{1}{\text{Av. molecular weight}}$
Saponification value $\propto \frac{1}{\text{Length of fatty acid chain}}$
Reaction:

$$\text{Triglyceride} + 3KOH \rightarrow \text{Glycerol} + 3RCOOK$$

$RCOOK$ = Soap molecule