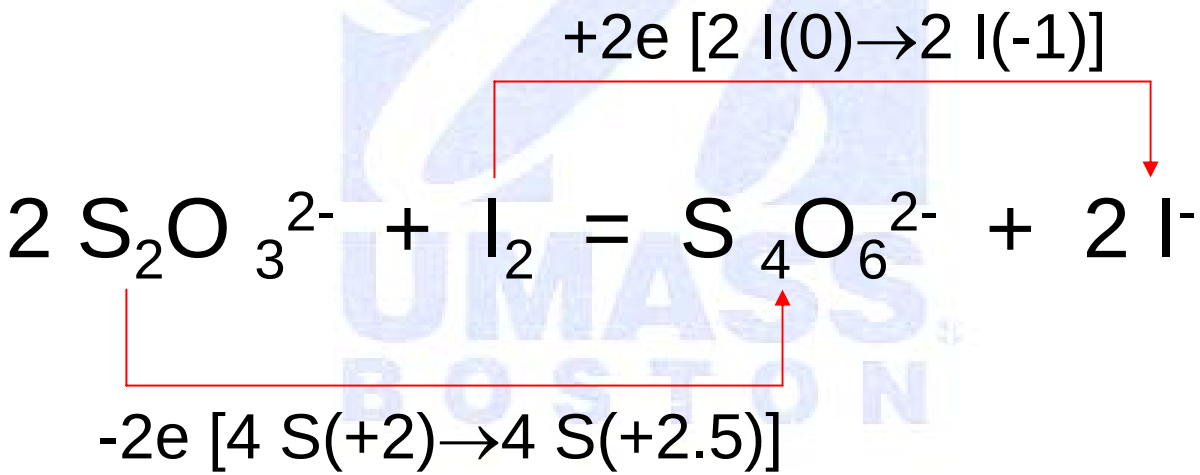
Assay for Phenol

Redox reaction

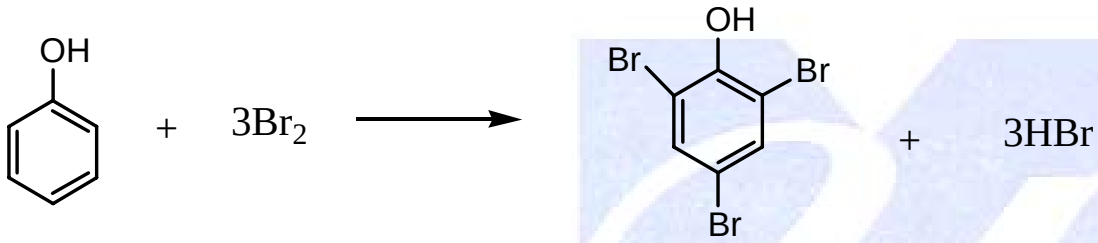
- Redox = reduction and oxidation
  - The reaction involves electron transfer from one reactant to another – the oxidation state of the elements has to be changed.
- $Cu^{2+} + Zn \rightarrow Cu + Zn^{2+}$
  - Cu^{2+} gaining two electrons is oxidizing agent, being reduced.
  - Zn losing two electrons is reducing agent, being oxidized.
- Faraday constant:
  - The unit of electric charge is coulombs (C).
  - One electron has 1.602×10^{-19} C
  - One mole of electron has 96500 C of charge F=96500C/mol

Redox Titration

- Redox titration is based on the redox reaction (oxidation-reduction) between analyte and titrant.



Calculation in Lab



$$BrO_3^- + 5\,Br^- + 6\,H^+ = 3\,Br_2 + 3\,H_2O$$

$$Br_2 + 2\,I^- = 2\,Br^- + I_2$$

$$2\,S_2O_3^{2-} + I_2 = S_4O_6^{2-} + 2\,I^-$$

- 3 mol $Br_2 \rightarrow$ 1mol Phenol
- 1 mol BrO_3^- (Primary standard, bromate)$\rightarrow$ 3 mol Br_2
- 1 mol $Br_2 \rightarrow$ 1 mol I_2
- 2 mol $S_2O_3^{2-}$ (thiosulfate) $\rightarrow$ 1 mol I_2

Titration of the blank

- The volume of $NaBrO_3$ is V_{BrO3}, the volume of thiosulfate standard used is V_1^*
- The mole amount of BrO_3^- is V_{BrO3} x $[BrO_3^-]$
- Br_2 produced is 3x V_{BrO3} x $[BrO_3^-]$ mmol
- I_2 produced is 3x V_{BrO3} x $[BrO_3^-]$ mmol
- Thiosulfate needed to titrate produced I_2 is 2x3x V_{BrO3} x $[BrO_3^-]$ mmol
- The concentration of thiosulfate solution is $6 \times V_{BrO3} \times [BrO_3^-] / V_1^*$ mmol

Titration of the sample

- The volume of thiosulfate standard used is V_2^*
- The mole amount of thiosulfate used is
  $[6 \times V_{BrO3} \times [BrO_3^-]/ V_1^*] \times V_2^*$ mmol
- The amount of I_2 is the solution is
  $0.5 \times [6 \times V_{BrO3} \times [BrO_3^-]/ V_1^*] \times V_2^* = [3 \times V_{BrO3} \times [BrO_3^-]/ V_1^*] \times V_2^*$ mmol
- The excess amount Br_2 remained is
  $[3 \times V_{BrO3} \times [BrO_3^-]/ V_1^*] \times V_2^*$ mmol
- Total amount of Br_2 produced is
  $3x\ V_{BrO3} \times [BrO_3^-]$ mmol
- The amount of Br_2 used to react with Phenol is
  $3x\ V_{BrO3} \times [BrO_3^-] - [3 \times V_{BrO3} \times [BrO_3^-]/ V_1^*] \times V_2^*$ mol
- The amount of Phenol titrated is
  $\{3x\ V_{BrO3} \times [BrO_3^-] - [3 \times V_{BrO3} \times [BrO_3^-]/ V_1^*] \times V_2^*\}/3 =$
  $V_{BrO3} \times [BrO_3^-] - [V_{BrO3} \times [BrO_3^-]/ V_1^*] \times V_2^*$ mmol