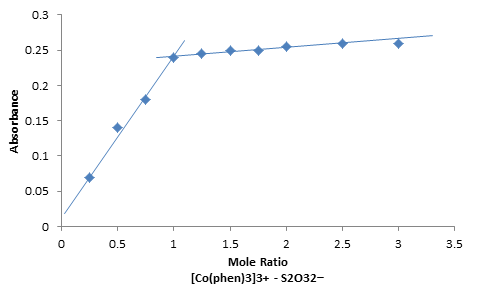
**REDUCTION OF [Co(phen)3]3+ BY SODIUM THIOSULPHATE (Na2S2O3) IN AQUEOUS HYDROCHLORIC ACID MEDIUM**

**RESULT**

1. **Stoichiometric Determination**



**Variation of absorbance with mole ratio for the [Co(phen)3]3+- [S2O32−] reaction**

From above, the mole ratio of [Co(phen)3]3+- [S2O32−] reaction is 1:1. Thus;

**[Co(phen)3]3+ + S2O32− →** **[Co(phen)3]2+ + S2O3−**

**2[Co(phen)3]3+ + 2S2O32− →** **2[Co(phen)3]2+ + S4O62−**

1. **Order of Reaction**

**Pseudo - first order plot for the [Co(phen)3]3+- [S2O32−] reaction.**

**Fig 2: Plot of (A∞ − At) against time**

**Pseudo-first order and third order rate constants for the reaction of [Co(phen)3]3+- [S2O32−] at [Co(phen)3]3+ = 2.0 × 10-3 mol dm-3, [H+] = 0.02 mol dm-3, I = 0.4 mol dm−3 (NaCl), T = 28˚C and λmax = 495 nm.**

|  |  |  |
| --- | --- | --- |
| **[S2O32−], mol dm−3** | **103 k1, s-1** | **k3, dm6 mol- 2s-1** |
| 0.03  0.04  0.05  0.06  0.07  0.08  0.09  0.10  0.11 | 2.59  4.90  7.37  11.22  15.72  19.96  26.20  32.74  34.73 | 3.05  3.06  3.25  3.12  3.21  3.12  3.23  3.27  3.03 |

**Plot of log k1 versus log [S2O32−]**

1. **Effect of [H+]**

**Pseudo-first order and acid dependent rate constants for the reaction of [Co(phen)3]3+-[S2O32−] at [Co(phen)3]3+ = 2.0 × 10-3 mol dm-3, [S2O32−] = 0.07 mol dm-3, I = 0.4 mol dm−3 (NaCl), T = 28˚C and λmax = 495 nm.**

|  |  |  |
| --- | --- | --- |
| **[H+]**  **mol dm−3** | **102 k1,**  **s−1** | **k3,**  **dm6 mol− 2 s−1** |
| 0.70  0.90  1.00  2.00  3.00  4.00  5.00 | 3.69  5.25  6.63  12.28  18.39  24.69  31.27 | 0.75  1.07  1.35  2.51  3.75  5.04  6.38 |

**The plot of k3 versus [H+]for the [Co(phen)3]3+- [S2O32−] reaction**

1. **Test for Ionic Strength and Dielectric Constant**

**Pseudo - first order and Ionic strength dependent rate constants for the reaction of [Co(phen)3]3+-[S2O32−] at [Co(phen)3]3+ = 2.0 × 10-3 mol dm-3, [S2O32−] = 0.07 mol dm-3, [H+] = 0.02 mol dm−3, T = 28˚C and λmax = 495 nm.**

|  |  |  |
| --- | --- | --- |
| **[I]**  **mol dm−3** | **102 k1,**  **s−1** | **k3,**  **dm6 mol− 2 s−1** |
| 0.20  0.30  0.40  0.50  0.60  0.70  0.80 | 0.66  1.16  1.58  2.28  3.22  4.07  5.53 | 1.35  2.36  3.22  4.65  6.57  8.31  11.28 |

**The plot of log k3 versus √μ for the [Co(phen)3]3+- [S2O32−] reaction**

**Effect of changes in total dielectric constant for [Co(phen)3]3+-[S2O32−] at [Co(phen) 3]3+ = 2.0 × 10-3 mol dm-3, [S2O32−] = 0.07 mol dm-3, [H+] = 0.02 mol dm−3, I = 0.4 mol dm−3 (NaCl), T = 28˚C and λmax = 495 nm.**

|  |  |  |
| --- | --- | --- |
| D | 102 kobs,  s−1 | k2,  dm3 mol− 1 s−1 |
| 80.1  78.7  77.2  75.8  74.4  72.9  71.5  70.1 | 1.47  1.55  1.64  1.74  1.82  1.90  2.00  2.08 | 3.01  3.16  3.34  3.56  3.72  3.89  4.09  4.25 |

**Plot of log k3 versus 1/D for the Reaction of [Co(phen)3]3+ and Thiosulphate ion (S2O32−)**

1. **Test for Added Ions**

**Table 4.18: Effect of Added Cations to Reaction Medium for the Reaction of [Co(phen)3]3+ and Thiosulphate ion (S2O32−) at** [Co(phen)3]3+ = 2.0 × 10−3 mol dm−3, [S2O32−] = 7.0 × 10−2 mol dm−3, [H+] = 2.0 × 10−2 mol dm−3, I = 0.4 mol dm−3 (NaCl), T = 28˚C and λmax = 495 nm.

|  |  |  |  |
| --- | --- | --- | --- |
| **Ion** | **103 [ion]**  **mol dm−3** | **102 kobs,**  **s−1** | **k2,**  **dm3 mol− 1 s−1** |
| Mg2+  NH3+ | 1.00  10.00  30.00  50.00  70.00  100.00  140.00  1.00  10.00  30.00  50.00  70.00  100.00  140.00 | 1.73  1.81  1.84  1.87  1.92  1.96  1.98  1.65  1.70  1.73  1.81  1.91  1.99  2.12 | 3.71  3.76  3.82  3.89  3.98  4.05  4.18  3.36  3.48  3.62  3.70  3.90  4.06  4.32 |

**Effect of Added Anions to Reaction Medium for the Reaction of [Co(phen)3]3+ and Thiosulphate ion (S2O32−) at** [Co(phen)3]3+ = 2.0 × 10−3 mol dm−3, [S2O32−] = 7.0 × 10−2 mol dm−3, [H+] = 2.0 × 10−2 mol dm−3, I = 0.4 mol dm−3 (NaCl), T = 28˚C and λmax = 495 nm.

|  |  |  |  |
| --- | --- | --- | --- |
| **Ion** | **103 [ion]**  **mol dm−3** | **102 kobs,**  **s−1** | **k2,**  **dm3 mol− 1 s−1** |
| CH3COO−  HCOO− | 0.00  1.00  3.00  5.00  7.00  10.00  15.00  1.00  10.00  30.00  50.00  70.00  100.00  140.00 | 1.97  1.66  1.45  1.11  1.01  0.68  0.24  1.97  1.63  1.33  1.18  0.96  0.72  0.37 | 4.02  3.39  2.95  2.27  2.07  1.38  0.48  4.02  3.32  2.72  2.41  1.97  1.48  0.77 |

1. **Test for Intermediates**

**Spectra of the electron transfer reaction mixture of [Co(phen)3]3+ and S2O32− after 3 minutes of reaction**

There was a shift in wavelength from the cobalt(III) to the cobalt(II) complex, 495nm to 600nm respectively.

**Michaelis-Menten plot for the [Co(phen)3]3**+- **[S2O32−] reaction.**.

1. **Test for Free Radicals**

There was no gel formation when excess methanol was added to the acrylamide-oxidant-reductant mixture**.**

1. **Temperature dependence studies**

**Temperature dependence plot for [Co(phen)3]3+-[S2O32−] reaction.**

**Temperature-dependent rate constants for [Co(phen)3]3+-[S2O32−] at [Co(phen) 3]3+ = 2.0 × 10-3 mol dm-3, [S2O32−] = 0.03 mol dm-3, [H+] = 0.02 mol dm−3, I = 0.4 mol dm−3 (NaCl), T = 28˚C and λmax = 495 nm.**

|  |  |  |
| --- | --- | --- |
| **Temp, K** | **104 k1, s-1** | **k3, dm6 mol- 2s-1** |
| 311  321  326  336  341 | 9.42  23.10  85.57  297.99  517.49 | 0.19  0.47  1.75  6.08  10.56 |