**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 | 2.594.907.3711.2215.7219.9626.2032.7434.73 | 3.053.063.253.123.213.123.233.273.03 |

**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** |
| 0.700.901.002.003.004.005.00 | 3.695.256.6312.2818.3924.6931.27 | 0.751.071.352.513.755.046.38 |

**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** |
| 0.200.300.400.500.600.700.80 | 0.661.161.582.283.224.075.53 | 1.352.363.224.656.578.3111.28 |

**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 |
| 80.178.777.275.874.472.971.570.1 | 1.471.551.641.741.821.902.002.08 | 3.013.163.343.563.723.894.094.25 |

**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+ | 1.0010.0030.0050.0070.00100.00140.001.0010.0030.0050.0070.00100.00140.00 | 1.731.811.841.871.921.961.981.651.701.731.811.911.992.12 | 3.713.763.823.893.984.054.183.363.483.623.703.904.064.32 |

**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− | 0.001.003.005.007.0010.0015.001.0010.0030.0050.0070.00100.00140.00 | 1.971.661.451.111.010.680.241.971.631.331.180.960.720.37 | 4.023.392.952.272.071.380.484.023.322.722.411.971.480.77 |

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 | 9.4223.1085.57297.99517.49 | 0.190.471.756.0810.56  |