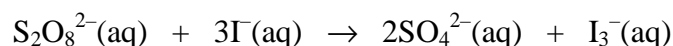


Marks
3

- Peroxydisulfate and iodide ions react according to the following equation.



The following rate data were collected at room temperature.

Experiment	$[\text{S}_2\text{O}_8^{2-}(\text{aq})]_0$ (M)	$[\text{I}^-(\text{aq})]_0$ (M)	Initial rate ($\text{mol L}^{-1} \text{s}^{-1}$)
1	0.080	0.034	2.2×10^{-4}
2	0.080	0.017	1.1×10^{-4}
3	0.160	0.017	2.2×10^{-4}

Determine the rate law for the reaction.

Between experiments (1) and (2), $[\text{S}_2\text{O}_8^{2-}(\text{aq})]_0$ is constant and $[\text{I}^-(\text{aq})]_0$ is halved from 0.034 M to 0.017 M. This halves the initial rate. The rate is directly proportional to $[\text{I}^-(\text{aq})]$: the reaction is first order with respect to $[\text{I}^-(\text{aq})]$.

Between experiments (2) and (3), $[\text{I}^-(\text{aq})]_0$ is constant and $[\text{S}_2\text{O}_8^{2-}(\text{aq})]_0$ is doubled from 0.080 M to 0.160 M. This doubles the initial rate. The rate is directly proportional to $[\text{S}_2\text{O}_8^{2-}(\text{aq})]$: the reaction is first order with respect to $[\text{S}_2\text{O}_8^{2-}(\text{aq})]$.

Hence:

$$\text{rate} = k[\text{S}_2\text{O}_8^{2-}(\text{aq})][\text{I}^-(\text{aq})]$$

Calculate the value of the rate constant at room temperature.

From experiment (1), the rate = $2.2 \times 10^{-4} \text{ M s}^{-1}$ when $[\text{S}_2\text{O}_8^{2-}(\text{aq})] = 0.080 \text{ M}$ and $[\text{I}^-(\text{aq})] = 0.034 \text{ M}$. Hence:

$$2.2 \times 10^{-4} \text{ M s}^{-1} = k(0.080 \text{ M})(0.034 \text{ M})$$

$$k = 0.081 \text{ M}^{-1} \text{ s}^{-1}$$

(Note that the units are worked out by requiring that the units on the two sides of the rate law are the same.)

Answer: $0.081 \text{ M}^{-1} \text{ s}^{-1}$