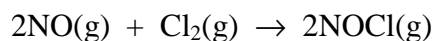


- The data given in the table below were obtained for the reaction between nitric oxide and chlorine at 1400 K.

Marks
4



Experiment number	INITIAL $[\text{Cl}_2]$ ($\text{mol}^{-1} \text{L}^{-1}$)	INITIAL $[\text{NO}]$ ($\text{mol}^{-1} \text{L}^{-1}$)	INITIAL REACTION RATE ($\text{mol}^{-1} \text{L}^{-1} \text{s}^{-1}$)
1	0.10	0.10	0.18
2	0.20	0.10	0.36
3	0.10	0.20	0.72

Deduce the rate law for this reaction and calculate the value of the rate constant.

<p>RATE LAW</p> <p>Between experiments (1) and (2), $[\text{NO}]$ is fixed and $[\text{Cl}_2]$ is doubled. This leads to the rate doubling: rate $\propto [\text{Cl}_2]^1$.</p> <p>Between experiments (1) and (3), $[\text{Cl}_2]$ is fixed and $[\text{NO}]$ is doubled. This leads to the rate increasing by a factor of 4: rate $\propto [\text{NO}]^2$.</p> <p>Overall, rate = $k[\text{NO}]^2[\text{Cl}_2]$.</p>	<p>RATE CONSTANT</p> <p>Using this rate law and the rate from experiment (1), $0.18 \text{ M s}^{-1} = k(0.10 \text{ M})^2(0.10 \text{ M})$</p> <p>Hence, $k = 180 \text{ M}^{-2} \text{ s}^{-1}$</p> <p>The units of k are such that the units of the left and right hand sides of the equation are the same: $\text{M s}^{-1} = (\text{units of } k)(\text{M}^2)(\text{M})$ units of $k = \text{M}^{-2} \text{ s}^{-1}$</p>
Answer: rate = $k[\text{NO}]^2[\text{Cl}_2]$	Answer: rate constant = $180 \text{ M}^{-2} \text{ s}^{-1}$