|  |  |  |
| --- | --- | --- |
| Experiment | Initial [HI] (mol L–1) | Initial rate of reaction (mol L–1 s–1) |
| 1 | 1.0 × 10–2 | 4.0 × 10–6 |
| 2 | 2.0 × 10–2 | 1.6 × 10–5 |
| 3 | 3.0 × 10–2 | 3.6 × 10–5 |

1) At a certain temperature the following data were collected for the decomposition of HI.

2HI → H2 + I2

Determine the rate law for the reaction.

What is the value of the rate constant for the decomposition of HI? *Include units in your answer.*

2) Nitrogen monoxide, a noxious pollutant, reacts with oxygen to produce nitrogen dioxide, another toxic gas: 2NO (g) + O2 (g) → 2NO2 (g) The rate data in the table was collected at 225oC.

|  |  |  |  |
| --- | --- | --- | --- |
| Exp | [NO]0  (M) | [O2]0  (M) | Initial Rate,  −∆[O2]/∆t  (M s−1) |
| 1 | 1.3 x 10−2 | 1.1 x 10−2 | 1.6 x 10−3 |
| 2 | 1.3 x 10−2 | 2.2 x 10−2 | 3.2 x 10−3 |
| 3 | 2.6 x 10−2 | 1.1 x 10−2 | 6.4 x 10−3 |

Determine the rate law for the reaction

Calculate the value of the rate constant at 225oC.

Calculate the rate of *appearance of NO2* when [NO] = [O2] = 6.5 x 10−3M.

Evaluate the following mechanism for the reaction. Which is the slow step? Does it match the rate law?

NO + NO ⇌ N2O2

N2O2 + O2 → 2NO2

3) Nitric oxide, a noxious pollutant, and hydrogen react to give nitrous oxide and water according to the reaction: 2NO (g) + H2 (g) → N2O (g) + H2O (g)

|  |  |  |  |
| --- | --- | --- | --- |
| Exp | [NO]0  (M) | [H2]0  (M) | Initial Rate,  −∆[NO]/∆t  (M s−1) |
| 1 | 6.4 x 10−3 | 2.2 x 10−3 | 2.6 x 10−5 |
| 2 | 1.3 x 10−2 | 2.2 x 10−3 | 1.0 x 10−4 |
| 3 | 6.4 x 10−3 | 4.4 x 10−3 | 5.1 x 10−5 |

The following rate data was collected at 225oC.

Determine the rate law for the reaction.

Calculate the value of the rate constant at 225 oC.

Calculate the rate of appearance of N2O when [NO] = [H2] = 6.6 x 10−3M.

Evaluate the following mechanism does it match the rate law. Which step is fast?

2NO ⇌ N2O2

N2O2 + H2 → N2O + H2O

4) The major pollutants NO (g), CO(g), NO2 (g) and CO2 (g) are emitted by cars and can react according to the following equation: NO2 (g) + CO (g) → NO (g) + CO2 (g) The rate data was collected at 225oC.

|  |  |  |  |
| --- | --- | --- | --- |
| Exp | [NO2]0  (M) | [CO]0  (M) | Initial Rate,  −∆[CO2]/∆t  (M s−1) |
| 1 | 0.263 | 0.826 | 1.44 x 10−5 |
| 2 | 0.263 | 0.413 | 1.44 x 10−5 |
| 3 | 0.526 | 0.413 | 5.76 x 10−5 |

Determine the rate law for the reaction.

Calculate the value of the rate constant at 225 oC.

Calculate the rate of appearance of CO2 when [NO2] = [CO] = 0.500 M.

Evaluate the following mechanism for the reaction based on the form of the rate law. Explain you answer.

NO2 + NO2 → NO + NO3

NO3 + CO → NO2 + CO2