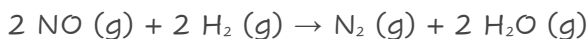


Initial Rates

Consider the following chemical reaction:



Use the data below to answer the following questions.

Experiment	H ₂ , atm	NO, atm	Rate, atm/s
1	0.263	0.100	1.84 × 10 ⁻⁴
2	0.263	0.200	7.11 × 10 ⁻⁴
3	0.263	0.240	1.03 × 10 ⁻³
4	0.197	0.267	9.47 × 10 ⁻⁴
5	0.191	0.267	9.21 × 10 ⁻⁴
6	0.136	0.267	6.45 × 10 ⁻⁴

a) Determine the order with respect to H₂.

$$\frac{\text{rate}_5}{\text{rate}_6} = \frac{k \times 0.191^m \times 0.267^n}{k \times 0.136^m \times 0.267^n} = \frac{9.21 \times 10^{-4} \text{ atm/s}}{6.45 \times 10^{-4} \text{ atm/s}} \quad \frac{0.191^m}{0.136^m} = 1.43$$
$$1.40^m = 1.43 \quad m = 1$$

b) Determine the order with respect to NO.

$$\frac{\text{rate}_2}{\text{rate}_1} = \frac{k \times 0.263^m \times 0.200^n}{k \times 0.263^m \times 0.100^n} = \frac{7.11 \times 10^{-4} \text{ atm/s}}{1.84 \times 10^{-4} \text{ atm/s}} \quad \frac{0.200^n}{0.100^n} = 3.86$$
$$2^n = 3.9 \quad n = 2$$

c) What is the overall order of the reaction?

3rd order overall

d) Write the rate law for the reaction.

$$\text{Rate} = k[\text{H}_2][\text{NO}]^2$$

e) What is the value of the rate constant, k?

Solve rate law for k. Use info from any experiment. From

$$\text{Exp. 1: } k = \frac{\text{rate}}{[\text{H}_2][\text{NO}]^2} = \frac{1.84 \times 10^{-4} \text{ atm/s}}{(0.263 \text{ atm}) \times (0.100 \text{ atm})^2} = \mathbf{0.0700 \text{ atm}^{-2}\text{s}^{-1}}$$

f) What is the rate, in atm/s if the H₂ pressure is 0.155 atm and NO is 0.240 atm?

$$\text{Rate} = 0.0700 \text{ atm}^{-2}\text{s}^{-1} \times (0.155 \text{ atm})(0.240 \text{ atm})^2 = \mathbf{6.25 \times 10^{-4} \text{ atm/s}}$$