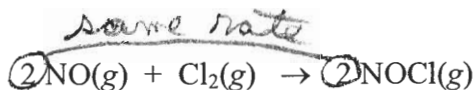


1. (4 Pts) Nitrogen monoxide reacts with chlorine at high temperature according to the equation,



In a certain reaction mixture the rate of formation of NOCl(g) was found to be $4.50 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$.
 What is the rate of consumption of NO(g)?

$$\frac{\Delta[\text{NOCl}]}{2\Delta t} = -\frac{\Delta[\text{NO}]}{2\Delta t}$$

∴ They would have the same rate.

2. (4 Pts) The reaction, $2\text{NO}(g) + \text{O}_2(g) \rightarrow 2\text{NO}_2(g)$, was found to be first order in each of the two reactants and second order overall. What is the rate law?

$$\text{rate} = k[\text{NO}]^1[\text{O}_2]^1$$

3. For the reaction, $\text{A} + 2\text{B} \rightarrow \text{C} + 2\text{D}$, the following data were obtained

Experiment	[A]	[B]	Rate ($\text{mol L}^{-1} \text{ s}^{-1}$)
1	0.100	0.200	0.000360
2	0.200	0.200	0.000720
3	0.100	0.400	0.000720

a. (8 Pts) Determine the rate law:

1st general rate law: rate = k [A]^x [B]^y

for A: use Exp. $\frac{2}{1}$: $\frac{0.000720}{0.000360} = \frac{k [0.200]^x [0.200]^y}{k [0.100]^x [0.200]^y}$ $2 = 2^x$ $x = 1$

for B: use Exp $\frac{3}{1}$: $\frac{0.000720}{0.000360} = \left(\frac{0.400}{0.200}\right)^y$ $2 = 2^y$ $y = 1$

$$\text{rate} = k[\text{A}][\text{B}]$$

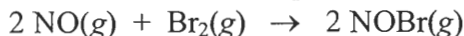
b. (5 Pts) Determine the value of the rate constant

Use data from any experiment: i.e. # 1

$$0.000360 \text{ M}\cdot\text{s}^{-1} = k [0.100][0.200]$$

$$0.018 \text{ M}^{-1}\cdot\text{s}^{-1} = k$$

4. (4 Pts) Nitric oxide reacts with bromine at elevated temperatures according to the equation

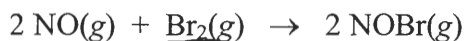


The experimental rate law is $\text{rate} = k[\text{NO}][\text{Br}_2]$. In a certain reaction mixture the rate of formation of NOBr(g) was found to be $4.50 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$. What are the correct units for the rate constant in this case?

$$\frac{\text{M}}{\text{s}} = k \text{ M M}$$

$$k = \text{s}^{-1} \cdot \text{M}^{-1} \text{ or } \text{L} \cdot \text{mol}^{-1} \cdot \text{s}^{-1}$$

1. (4 Pts) Nitrogen monoxide reacts with bromine at elevated temperatures according to the equation



In a certain reaction mixture the rate of formation of NOBr(g) was found to be $4.50 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$.

What is the rate of consumption of Br₂(g)?

$$-\frac{\Delta [\text{Br}_2]}{\Delta t} = \frac{\Delta [\text{NOBr}]}{2 \Delta t} = \frac{4.50 \times 10^{-4}}{2} = 2.25 \times 10^{-4} \text{ mol} \cdot \text{L}^{-1} \cdot \text{s}^{-1}$$

2. (4 Pts) The reaction, $2 \text{NO}(g) + \text{O}_2(g) \rightarrow 2 \text{NO}_2(g)$, was found to be first order in each of the two reactants and second order overall. What is the rate law?

$$\text{rate} = k [\text{NO}]^1 [\text{O}_2]^1$$

3. For the reaction, $2 \text{XO} + \text{O}_2 \rightarrow 2 \text{XO}_2$, data obtained from measurement of the initial rate of reaction at varying concentrations are given below.

Experiment	[XO]	[O ₂]	Rate (mmol L ⁻¹ s ⁻¹)
1	0.010	0.010	2.5
2	0.010	0.020	5.0
3	0.030	0.020	45.0

a. (8 Pts) Determine the rate law:

1st general rate law: $\text{rate} = k [\text{XO}]^x [\text{O}_2]^y$

for [XO] use exp. $\frac{3}{2}$ $\frac{45.0}{5.0} = \frac{k [0.030]^x [0.020]^y}{k [0.010]^x [0.020]^y} \Rightarrow 9 = 3^x \Rightarrow x = 2$

for [O₂] use exp. $\frac{2}{1}$ $\frac{5.0}{2.5} = \frac{k [0.010]^x [0.020]^y}{k [0.010]^x [0.010]^y} \Rightarrow 2 = 2^y \Rightarrow y = 1$

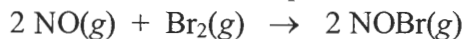
$$\text{rate} = k [\text{XO}]^2 [\text{O}_2]^1$$

b. (5 Pts) Determine the value of the rate constant and its units.

Use data from any experiment: i.e. #1

$$2.5 = k [0.010]^2 [0.010] = 2.5 \times 10^6 \text{ M}^{-2} \cdot \text{s}^{-1}$$

4. (4 Pts) Nitric oxide reacts with bromine at elevated temperatures according to the equation



The experimental rate law is $\text{rate} = k[\text{NO}][\text{Br}_2]$. In a certain reaction mixture the rate of formation of NOBr(g) was found to be $4.50 \times 10^{-4} \text{ mol L}^{-1} \text{ s}^{-1}$. What are the correct units for the rate constant in this case?

$$\text{rate} = k [\text{NO}] [\text{Br}_2]$$

$$\frac{\text{M}}{\text{s}} = k \text{ M M}$$

$$k = \text{s}^{-1} \cdot \text{M}^{-1} \text{ or } \text{L} \cdot \text{mol}^{-1} \cdot \text{s}^{-1}$$