

## Rate Laws

### Example One

The initial rate of a reaction  $\text{CH}_3\text{Cl (g)} + \text{H}_2\text{O (g)} \rightarrow \text{CH}_3\text{OH (g)} + \text{HCl (g)}$  was measured for several different starting concentrations of A and B, and the results are as follows:

Experiment Number	Initial $\text{CH}_3\text{Cl}$ Concentration (M)	Initial $\text{H}_2\text{O}$ Concentration (M)	Observed Initial Rate (M/s)
1	0.10	0.20	0.50
2	0.20	0.20	1.0
3	0.10	0.40	2.0

Using this data, determine

(a) the rate law for the reaction,

(b) the rate constant,

(c) the rate of the reaction when  $[\text{CH}_3\text{Cl}] = 0.050 \text{ M}$  and  $[\text{H}_2\text{O}] = 0.100 \text{ M}$

### Example Two

The initial rate of a reaction  $A + B \rightarrow C$  was measured for different starting concentrations of A and B, as shown in the table below.

Experiment Number	Initial [A] (M)	Initial [B] (M)	Initial Rate (M/s)
1	0.10	0.10	$2.0 \times 10^{-5}$
2	0.10	0.20	$2.0 \times 10^{-5}$
3	0.20	0.10	$8.0 \times 10^{-5}$

Using this data, determine

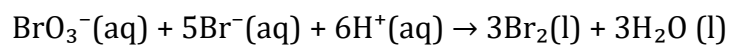
(a) the rate law for the reaction,

(b) the rate constant,

(c) the rate of the reaction when  $[A]=0.050$  M and  $[B]=0.100$  M

### Example Three

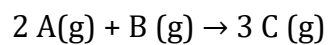
Given the reaction and experimental data below, determine the general rate law for the reaction and the specific rate constant, k.



Experiment Number	Initial $[\text{BrO}_3^-]$ (M)	Initial $[\text{Br}^-]$ (M)	Initial $[\text{H}^+]$ (M)	Initial Rate (M/s)
1	0.10	0.10	0.10	$1.6 \times 10^{-3}$
2	0.20	0.20	0.10	$6.4 \times 10^{-3}$
3	0.20	0.10	0.10	$3.2 \times 10^{-3}$
4	0.10	0.10	0.20	$6.4 \times 10^{-3}$

### Example Four

The rate data for the reaction between A and B was attained at 25°C as shown below. What is the rate law for the reaction and the specific rate constant for this reaction.

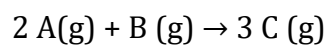


Experiment Number	Initial [A] (M)	Initial [B] (M)	Initial Rate (M/s)
1	0.10	0.10	$1.0 \times 10^{-5}$
2	0.20	0.30	$2.0 \times 10^{-5}$
3	0.10	0.20	$1.0 \times 10^{-5}$

### Example Five

The following rate data was attained at 25°C for the reaction between generic chemicals A and B.

What is the rate law and the specific rate constant for this reaction?



Experiment Number	Initial [A] (M)	Initial [B] (M)	Initial Rate (M/s)
1	0.24	0.060	0.360
2	0.24	0.24	1.44
3	0.12	0.12	0.090

### Example Six

The following rate data was attained at 25°C for the reaction between C<sub>2</sub>H<sub>4</sub> and O<sub>3</sub>.  
What is the rate law for this reaction.

Experiment Number	Initial [C <sub>2</sub> H <sub>4</sub> ] (M)	Initial [O <sub>3</sub> ] (M)	Initial Rate (M/s)
1	0.50	1.00	1.00
2	1.50	1.00	3.00
3	1.00	2.00	8.00

### Example Seven

The following rate data was attained at 25°C for the reaction between C<sub>2</sub>H<sub>4</sub> and O<sub>3</sub>.  
What is the rate law for this reaction.

Experiment Number	Initial [C <sub>2</sub> H <sub>4</sub> ] (M)	Initial [O <sub>3</sub> ] (M)	Initial Rate (M/s)
1	0.50	1.00	1.00
2	1.50	1.00	3.00
3	1.00	2.00	2.00