Rate Laws

Example One

The initial rate of a reaction CH_3Cl (g) + H_2O (g) → CH_3OH (g) + HCl (g) was measured for several different starting concentrations of A and B, and the results are as follows:

Experiment Number	Initial CH_3Cl Concentration (M)	Initial H_2O 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 $[CH_3Cl]$=0.050 M and $[H_2O]$=0.100 M

Example Two

The initial rate of a reaction A + B → 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	2.0×10^{-5}
2	0.10	0.20	2.0×10^{-5}
3	0.20	0.10	8.0×10^{-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.

$$BrO_3^-(aq) + 5Br^-(aq) + 6H^+(aq) \rightarrow 3Br_2(l) + 3H_2O\ (l)$$

Experiment Number	Initial $[BrO_3^{-1}]$ (M)	Initial $[Br^{-1}]$ (M)	Initial $[H^{+1}]$ (M)	Initial Rate (M/s)
1	0.10	0.10	0.10	1.6×10^{-3}
2	0.20	0.20	0.10	6.4×10^{-3}
3	0.20	0.10	0.10	3.2×10^{-3}
4	0.10	0.10	0.20	6.4×10^{-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.

$$2\ A(g) + B\ (g) \rightarrow 3\ C\ (g)$$

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

$$2\ A(g) + B\ (g) \rightarrow 3\ C\ (g)$$

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_2H_4 and O_3.
What is the rate law for this reaction.

Experiment Number	Initial $[C_2H_4]$ (M)	Initial $[O_3]$ (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_2H_4 and O_3.
What is the rate law for this reaction.

Experiment Number	Initial $[C_2H_4]$ (M)	Initial $[O_3]$ (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