



# Kinetics

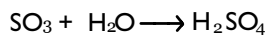
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### Example 1 : Finding the rate law

Using the table, find the rate law and rate constant.



Trial	[ SO <sub>3</sub> ], M	[ H <sub>2</sub> O ], M	Rate M/s
1	0.35	0.35	0.150
2	0.70	0.35	0.600
3	0.35	0.70	0.300
4	0.70	0.70	1.20

**Step 1** Pick two different trials where one reactant's concentration stays the same and the other changes. Plug values into formula.

Trial	[ SO <sub>3</sub> ], M	[ H <sub>2</sub> O ], M	Rate M/s
1	0.35	0.35	0.150
2	0.70	0.35	0.600
3	0.35	0.70	0.300
4	0.70	0.70	1.20

$$\frac{\text{Rate 2}}{\text{Rate 1}} = \frac{k [\text{SO}_3]^x [\text{H}_2\text{O}]^y}{k [\text{SO}_3]^x [\text{H}_2\text{O}]^y}$$

$$\frac{0.600}{0.150} = \frac{k [0.70]^x [0.35]^y}{k [0.35]^x [0.35]^y}$$

**Step 4** Plug in each value from the two chosen trials. Cancel like terms and divide remaining terms.

$$\frac{\text{Rate 4}}{\text{Rate 2}} = \frac{k [\text{SO}_3]^x [\text{H}_2\text{O}]^y}{k [\text{SO}_3]^x [\text{H}_2\text{O}]^y}$$

$$\frac{1.20}{0.600} = \frac{k [0.70]^x [0.70]^y}{k [0.70]^x [0.35]^y}$$

To solve for y pick the trials where the concentration of the first reactant is the same.

Divide      Cancel like terms

$$2 = 2^y$$

$$y = 1$$

**Step 2** Solve for x by cancelling like terms and dividing the remaining values.

$$\frac{0.600}{0.150} = \frac{k [0.70]^x [0.35]^y}{k [0.35]^x [0.35]^y}$$

Divide      Cancel like terms

$$4 = 2^x$$

$$x = 2$$

To solve for x pick the trials where the concentration of the second reactant is the same.

**Step 5** Plug x and y values into rate law formula.

$$x = 2 \quad y = 1$$

$$\text{Rate} = k [\text{SO}_3]^x [\text{H}_2\text{O}]^y$$

$$\text{Rate} = k [\text{SO}_3]^2 [\text{H}_2\text{O}]^1$$

**Step 3** Repeat step one with two other trials but solve for y now.

Trial	[ SO <sub>3</sub> ], M	[ H <sub>2</sub> O ], M	Rate M/s
1	0.35	0.35	0.150
2	0.70	0.35	0.600
3	0.35	0.70	0.300
4	0.70	0.70	1.20

**Answer :** Rate = k [ SO<sub>3</sub> ]<sup>2</sup> [ H<sub>2</sub>O ]<sup>1</sup>