

1. A reaction (A + 2B → C) has the following rate data:

[A] ₀ /M	[B] ₀ /M	Rate ₀ /M s ⁻¹
0.1523	0.0115	1.45
0.3051	0.0115	3.00
0.3051	0.0232	5.99

- Calculate the rate law for this reaction.
- Find the rate constant with the units.
- What is the rate of this reaction if [A] = 0.1000 M and [B] = 0.0150 M?

$$\frac{R_2}{R_1} = \frac{3.00}{1.45} = 2.0689655 = \frac{k[A]_2^m [B]_2^n}{k[A]_1^m [B]_1^n} = \left(\frac{0.3051}{0.1523}\right)^m = 2.00328299^m$$

$$m = \frac{\log 2.0689655}{\log 2.00328299} = 1.04643 \approx 1$$

$$\frac{R_3}{R_2} = \frac{5.99}{3.00} = 1.9966667 = \frac{k[A]_3^m [B]_3^n}{k[A]_2^m [B]_2^n} = \left(\frac{0.0232}{0.0115}\right)^n = 2.017391304^n$$

$$n = \frac{\log 1.9966667}{\log 2.017391304} = 0.985286 \approx 1$$

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

$$k = \frac{\text{rate}}{[A][B]} = \frac{1.45 \text{ M s}^{-1}}{(0.1523 \text{ M})(0.0115 \text{ M})} = 827 \text{ M}^{-1} \text{ s}^{-1}$$

$$\text{Rate} = (827 \text{ M}^{-1} \text{ s}^{-1})(0.1000 \text{ M})(0.0150 \text{ M}) = 1.24 \text{ M s}^{-1}$$

2. The reaction



has the following data taken at 30.0 C.

Exp #	[A] (M)	[B] (M)	Initial Rate (M s ⁻¹)
1	0.1500	1.20	3.58×10 ⁻³
2	0.1963	1.20	4.09×10 ⁻³
3	0.1963	1.33	5.56×10 ⁻³

- Determine the form of the rate law (rate = k [A]^m[B]ⁿ).
- Determine the value of the rate constant (including units).

$$\frac{R_2}{R_1} = \frac{4.06 \times 10^{-3}}{3.58 \times 10^{-3}} = 1.134078212 = \frac{k [A]_2^m [B]_2^n}{k [A]_1^m [B]_1^n} = \left(\frac{0.1963}{0.1500} \right)^m = 1.30866667^m$$

$$m = \frac{\log 1.134078212}{\log 1.30866667} = 0.4677 \approx 0.5$$

$$\frac{R_3}{R_2} = \frac{5.56 \times 10^{-3}}{4.09 \times 10^{-3}} = 1.359413203 = \frac{k [A]_3^{0.5} [B]_3^n}{k [A]_2^{0.5} [B]_2^n} = \left(\frac{1.33}{1.20} \right)^n = 1.108333333^n$$

$$n = \frac{\log 1.359413203}{\log 1.108333333} = 2.98 \approx 3$$

$$\text{Rate} = k [A]^{0.5} [B]^3$$

$$k = \frac{\text{rate}}{[A]^{0.5} [B]^3} = \frac{3.58 \times 10^{-3} \text{ M s}^{-1}}{(0.1500 \text{ M})^{0.5} (1.20 \text{ M})^3} = 0.00496 \text{ M}^{-2.5} \text{ s}^{-1}$$

$$\text{Rate} = 0.00496 \text{ M}^{-2.5} \text{ s}^{-1} [A]^{0.5} [B]^3$$