

## Can't see it?

**Then you need to memorize it or actually do the math in your calculator ☹️**

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**Change factor to Rate = [Change factor for Concentration]<sup>x</sup>**

| Examples of determining the orders by actually plugging in |             |                                 |          |
|--|-------------|---------------------------------|----------|
| <i>rate doesn't change</i>                                 | $1 = 2^x$   | <i>concentration doubles</i>    | $x = 0$  |
| <i>rate doubles</i>  | $2 = 2^x$   | <i>concentration doubles</i>    | $x = 1$  |
| <i>rate quadruples</i>                                     | $4 = 2^x$   | <i>concentration doubles</i>    | $x = 2$  |
| <i>rate increases x8</i>                                   | $8 = 2^x$   | <i>concentration doubles</i>    | $x = 3$  |
| <i>rate is cut in half</i>                                 | $1/2 = 2^x$ | <i>concentration doubles</i>    | $x = -1$ |
| <i>rate doesn't change</i>                                 | $1 = 3^x$   | <i>concentration triples</i>    | $x = 0$  |
| <i>rate triples</i>  | $3 = 3^x$   | <i>concentration triples</i>    | $x = 1$  |
| <i>rate increases by x9</i>                                | $9 = 3^x$   | <i>concentration triples</i>    | $x = 2$  |
| <i>rate is cut in thirds</i>                               | $1/3 = 3^x$ | <i>concentration triples</i>    | $x = -1$ |
| <i>rate quadruples</i>                                     | $4 = 4^x$   | <i>concentration quadruples</i> | $x = 1$  |
| Etc...etc...etc...   |             |                                 |          |

## Finding Units for k

Remember:

$$\text{rate} = k[A]^x[B]^y \text{ etc ...}$$

Rearrange:

$$k = \frac{\text{rate}}{[A]^x[B]^y \text{ etc...}}$$

Remember:

$$\text{rate units} = \frac{M}{s}$$

$$\text{Concentration units} = M$$

$$\text{Overall Order} = (x + y + \text{etc ...})$$

Substitute in your units and rewrite:

$$k = \frac{M/s}{M^{(x+y+\text{etc...})}} \rightarrow k = \frac{M}{M^{(x+y+\text{etc...})} \cdot s} \rightarrow \text{then cancel out units}$$

| Units for k based on overall order of reaction  |  |  |
|---|--|--|
| $k = \frac{M}{M^{(x+y+\text{etc...})} \cdot s}$ |  |  |
| Overall Order                                   | Example of Units Plugged In  | Final Units for k                      |
| 0   | $k = \frac{M}{M^{(0)} \cdot s} = \frac{M}{1 \cdot s}$  | $\frac{M}{s} = Ms^{-1}$                |
| 1   | $k = \frac{M}{M^{(1)} \cdot s} = \frac{\cancel{M}}{\cancel{M} \cdot s}$  | $\frac{1}{s} = s^{-1}$                 |
| 2   | $k = \frac{M}{M^{(2)} \cdot s} = \frac{\cancel{M}}{\cancel{M} \cdot \cancel{M} \cdot s}$                                   | $\frac{1}{M \cdot s} = M^{-1}s^{-1}$   |
| 3   | $k = \frac{M}{M^{(3)} \cdot s} = \frac{\cancel{M}}{\cancel{M} \cdot \cancel{M} \cdot \cancel{M} \cdot s}$                  | $\frac{1}{M^2 \cdot s} = M^{-2}s^{-1}$ |
| 4   | $k = \frac{M}{M^{(4)} \cdot s} = \frac{\cancel{M}}{\cancel{M} \cdot \cancel{M} \cdot \cancel{M} \cdot \cancel{M} \cdot s}$ | $\frac{1}{M^3 \cdot s} = M^{-3}s^{-1}$ |
| Etc...etc...etc...                              |  |  |

$$\text{Remember: } M = \frac{\text{mol}}{L} \quad \frac{1}{M} = M^{-1} = \frac{L}{\text{mol}}$$



You may see this substituted into k units.

$$\text{For example: } M^{-1}s^{-1} = \frac{L}{\text{mol} \cdot s}$$