

unit of rate constant k

0th order: $r = -\frac{d[A]}{dt} = k$

↑
unit for r
is always $M s^{-1}$ $\Rightarrow \therefore r = k \therefore$ the unit of k is $M s^{-1}$

1st order: $r = k[A]^1$

↑ ↑
 $M s^{-1}$ $M \Rightarrow \cancel{M s^{-1}} = k \cdot \cancel{M} \therefore$ the unit of k is s^{-1}

2nd order:

$r = k[A]^2$

↑ ↑
 $M s^{-1}$ $M^2 \Rightarrow \cancel{M s^{-1}} = k \cdot \cancel{M^2} \therefore$ the unit of k is $s^{-1} M^{-1}$

3rd order: $k (s^{-1} M^{-2});$ 4th order: $k (s^{-1} M^{-3});$ 5th: $k (s^{-1} M^{-4})$