1st order

$$A \xrightarrow{k} P$$

$$-\frac{d[A]}{dt} = k[A]$$

Here is your DERIVED rate laws that we need to integrate

$$+\frac{d[A]}{[A]} = -k\,dt$$

Since we want the derivative in respect to [A] switch the sides of [A] + dt. Also switch the signs

Now to integrate
Finding the integral of both sides from initial values to the end points [A] + t

$\rightarrow \int \frac{1}{x}dx = \ln x$

$$\int_{[A]_0}^{[A]} \frac{d[A]}{[A]} = \int_0^t -k\,dt$$

Since we are integrating w/ respect to t, k is a constant so it can pop outside the integral so all you have is $\int_0^t dt = t\Big|_0^t$

$$\ln[A]\Big|_{[A]_0}^{[A]} = -kt\Big|_0^t$$

Now plug in initial + final values

(t=0 makes kt=0)

$$\ln[A] - \ln[A]_0 = -kt$$

or

$$\ln\frac{[A]}{[A]_0} = -kt$$

Properties of logs
→ Subtracting by same log base can be changed to dividing the logs as one

Comes from using def. of logs + rewriting previous line

$\rightarrow \ln_e \frac{a}{b} = x$

$\rightarrow e^x = \frac{a}{b}$

$\rightarrow b \cdot e^x = a$

or

$$[A] = [A]_0 e^{-kt}$$

or

$$\ln[A] = \ln[A]_0 - kt$$

$$y \qquad b \quad + \quad mx$$

Rewriting after the integration so that it is in y=mx+b form
→ ln[A] + ln [A]₀ constants, so is k, t is the variable

2nd order (simple)

$$A \xrightarrow{k} P$$

Start w/
2nd Derived LAW

$$-\frac{d[A]}{dt} = k[A]^2$$

$$-\frac{d[A]}{[A]^2} = k\,dt$$

Switch $[A]^2$ & k
as before

Pops out
(constant)

Constant again, pops out

Integrate

$$-\int_{[A]_0}^{[A]} \frac{d[A]}{[A]^2} = \int_0^t k\,dt$$

$\int dt = t$

$\int \frac{1}{x^2}\,dx = \frac{1}{x}$

$$\left.\frac{1}{[A]}\right|_{[A]_0}^{[A]} = \left.kt\right|_0^t$$

Initial & final
Points evaluated

$$\frac{1}{[A]} - \frac{1}{[A]_0} = kt$$

Bring to other
side

$$\frac{1}{[A]} = \frac{1}{[A]_0} + kt$$

$$y = b + mx$$

Now of form $y=mx+b$

→ $\frac{1}{[A]}$ & $\frac{1}{[A]_0}$ & k constants, t is variable