ODE's

- $\frac{dx}{dt} = f(t) \Rightarrow$ direct integration
- $\frac{d^2x}{dt^2} = f(t) \Rightarrow$ " "
- $\frac{dx}{dt} = f(t)g(x) \Rightarrow$ separable variables (1st order only!)

COMMON ODEs

$\frac{dx}{dt} = \alpha x \Rightarrow x \sim e^{\alpha t}$

$\frac{d^2x}{dt^2} = \alpha^2 x \Rightarrow x \sim \left\{ \begin{matrix} e^{\alpha t} \\ e^{-\alpha t} \end{matrix} \right\} \sim \left\{ \begin{matrix} \sinh(\alpha t) \\ \cosh(\alpha t) \end{matrix} \right\}$

H.O. $\rightarrow$ $\frac{d^2x}{dt^2} = -\alpha^2 x \Rightarrow x \sim \left\{ \begin{matrix} \cos(\alpha t) \\ \sin(\alpha t) \end{matrix} \right\} \sim \left\{ \begin{matrix} e^{i\alpha t} \\ e^{-i\alpha t} \end{matrix} \right\}$

Also, $\cos(\alpha t + \phi)$

- n^{th} order, linear ODE, const coeffs, eg

$\dddot{x} + a\ddot{x} + b\dot{x} + cx = 0 \Rightarrow$ Try $x \sim e^{\alpha t}$

- n^{th} order, linear ODE, inhomogeneous

$\Rightarrow x(t) = \{\text{homogeneous solns}\} + \{\text{particular solution}\}$