

# Ordinary Diff Eq's

$$\cdot \frac{dy}{dt} = 3y$$

$$\cdot \frac{dy}{dt} = \sin(t + y^2)$$

$$\cdot \frac{d^2y}{dt^2} + 3 \frac{dy}{dt} + 2y = 7 \cos t$$

$$\cdot \frac{d^2y}{dt^2} + y^3 = 0$$

unknown:  $y(t)$

# Partial Diff Eq's

$$\cdot \frac{\partial u}{\partial t} = k \frac{\partial^2 u}{\partial x^2}$$

$$\cdot \frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

$$\cdot \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = 0$$

$$\cdot \frac{\partial u}{\partial t} + 3u \frac{\partial u}{\partial x} = 0$$

unknown:  $u(x, t)$

unknown:  $u(x, t)$

unknown:  $V(x, y, z)$

unknown:  $u(x, t)$

# Order of a Diff Eq.

1st order diff eq's

$$\cdot y' + 2y = 0$$

$$\cdot y' + 2y = t^2$$

$$\cdot y' = y^2$$

$$\cdot \frac{dy}{dt} = e^y \sin t$$

$$\cdot \frac{dy}{dt} + ty = 0$$

$$\cdot \frac{dy}{dt} = \sin(t+y^2)$$

$$\cdot \frac{dy}{dx} + xy = x^3$$

2nd order diff eq's

$$\cdot y'' + 3y' + 2y = 0$$

$$\cdot y'' + (\cos t)y = 0$$

$$\cdot y'' + y' + y^3 = 0$$

$$\cdot y'' + 3y' + 2y = 7 \cos t$$

$$\cdot y'' + (\cos t)y = 5 \sin t$$

$$\cdot y'' + y' + y^3 = 7 \cos t$$

3rd order diff eq's

$$\cdot y''' - 2y'' + y' - 2y = 0$$

$$\cdot y''' + y' + \sin y = 0$$

$$\cdot y''' - 2y'' + y' - 2y = e^{-3t}$$

$$\cdot y''' + y' + (\sin y)(\cos t) = 0$$

# Systems of Diff Eqs

$$\begin{cases} \frac{dx}{dt} = 2x + y \\ \frac{dy}{dt} = -6x + 7y \end{cases} \quad \text{unknowns: } \begin{cases} x(t) \\ y(t) \end{cases}$$

$$\begin{cases} \frac{dx_1}{dt} = -x_2 + 2x_3 + \sin t \\ \frac{dx_2}{dt} = 2x_1 - 3x_2 + 2x_3 + e^{-2t} \\ \frac{dx_3}{dt} = 3x_1 - 3x_2 + x_3 \end{cases} \quad \text{unknowns } \begin{cases} x_1(t) \\ x_2(t) \\ x_3(t) \end{cases}$$

$$\begin{cases} \frac{dx}{dt} = x - 0.5xy \\ \frac{dy}{dt} = -0.75y + 0.25xy \end{cases} \quad \text{unknowns } \begin{cases} x(t) \\ y(t) \end{cases}$$

## Linear Diff Eq's

$$\cdot y' + 2y = 0$$

$$\cdot y' + 2y = t^2$$

$$\cdot y' + t^3 y = 0$$

$$\cdot y' + t^3 y = t^5$$

$$\cdot y'' + 3y' + 2y = 0$$

$$\cdot y'' + 3y' + 2y = 7 \cos t$$

$$\cdot y'' + 2y' + (3 \cos t) y = 0$$

$$\cdot y'' + 2y' + (3 \cos t) y = 5 \sin t$$

$$\cdot y''' - 2y'' + y' - 2y = 0$$

$$\cdot y''' - 2y'' + y' - 2y = e^{-3t}$$

$$\cdot t^2 y''' - (\cos t) y'' + y = 0$$

## Nonlinear Diff Eq's

$$\cdot y' + y^2 = 0$$

$$\cdot y' + y^2 = t^2$$

$$\cdot y' + t y^3 = 0$$

$$\cdot y' + t y^3 = t^5$$

$$\cdot y'' + 3y y' = 0$$

$$\cdot y'' + 3y y' = 7 \cos t$$