

$$\frac{d^2 y}{dx^2} + 2 \frac{dy}{dx} + 3y = \cos x \quad (3)$$

(4).

$$y^{(4)} - y = 0$$

$$\left(\text{Here } y^{(4)} = \frac{d^4 y}{dx^4} \right)$$

(2) - non-homogeneous linear ODE of order one with variable coefficients

(3) - non-homogeneous linear ODE of order two with constant coefficients

(4) - homogeneous linear ODE of order 4 with constant coefficients.

Remark 1: The term linear refers to the fact that each expression in ~~the~~ the differential equation is of degree one or degree zero in the variables $y, y', y'', \dots, y^{(n)}$.

The following are non-linear ODE's

$$y'' + y^2 = \sin x \quad (5)$$

$$y''' + yy' = x \quad (6)$$

$$y'' + \sin y = 0 \quad (7)$$

Q: Identify why each one is non-linear.