1. $y'' - x^2 y' - xy = 0$
2. $y''' = y'' - x^2 (y')^2$
3. Aim to get this form: $\begin{cases} \dfrac{dx}{dt} = F(t, x, y), \\ \dfrac{dy}{dt} = G(t, x, y). \end{cases}$
4. The system $\begin{cases} \dfrac{dx}{dt} = 4x - y, \\ \dfrac{dy}{dt} = 2x + y \end{cases}$ has the independent solutions

$$\{x = e^{3t},\, y = e^{3t}\} \quad \text{and} \quad \{x = e^{2t},\, y = 2e^{2t}\}.$$

Will focus on the simple cases (Linear Systems):

5. Non-Homogeneous: $\begin{cases} \dfrac{dx}{dt} = a_1(t)x + b_1(t)y + f_1(t), \\ \dfrac{dy}{dt} = a_2(t)x + b_2(t)y + f_2(t) \end{cases}$
6. Homogeneous: $\begin{cases} \dfrac{dx}{dt} = a_1(t)x + b_1(t)y + f_1(t), \\ \dfrac{dy}{dt} = a_2(t)x + b_2(t)y + f_2(t) \end{cases}$