6. WE ASSUME THAT

$$y = v(t)t^{-1}$$

$$\frac{dy}{dt} = \frac{dv}{dt}t^{-1} - v(t)t^{-2}$$

$$\frac{d^2y}{dt^2} = \frac{d^2v}{dt^2}t^{-1} - 2\frac{dv}{dt}t^{-2} + 2v(t)t^{-3}$$

THEN WE MUST HAVE

$$t^2\left[\frac{d^2v}{dt^2}t^{-1} - 2\frac{dv}{dt}t^{-2} + 2v(t)t^{-3}\right]$$
$$+3t\left[\frac{dv}{dt}t^{-1} - v(t)t^{-2}\right] + v(t)t^{-1} = 0$$

$$\frac{d^2v}{dt^2}t + \frac{dv}{dt} = 0 \qquad \text{LET } u = \frac{dv}{dt} \text{ SO } \frac{du}{dt} = \frac{d^2v}{dt^2}$$

$$\frac{du}{dt}t + u = 0$$

$$\frac{du}{dt}t = -u$$

$$\int \frac{1}{u}\,du = -\int \frac{1}{t}\,dt$$

$$\ln(u) = -\ln(t) + C_2$$

$$u = e^{-\ln(t)+C_2} = e^{C_2} \cdot e^{-\ln(t)} = C_2 e^{\ln(t^{-1})} = C_2 t^{-1}$$

$$\frac{dv}{dt} = C_2 t^{-1}$$

$$v = C_2 \int t^{-1}\,dt = C_2 \ln(t) + C_1$$

THE GENERAL SOLUTION IS

$$y = [C_2 \ln(t) + C_1]t^{-1}$$
$$= C_1 t^{-1} + C_2 t^{-1} \ln(t)$$