2.2abcd

$$\ddot{\theta} = -\frac{g}{l}\sin\theta - \frac{\gamma}{m}\dot{\theta}$$

$$\omega = \dot{\theta} \qquad\qquad g = \left[\frac{m}{s^2}\right]$$

$$\Longrightarrow \quad \dot{\omega} = -\frac{g}{l}\sin\theta - \frac{\gamma}{m}\omega$$

$$\theta = \theta_0 x, \quad \omega = \omega_0 y, \quad t = t_0 t'$$

where θ_0, ω_0, t_0 are positive constants

$$\frac{dx}{dt'} = y \qquad \frac{dy}{dt'} = -\sin(x) - \sigma y \qquad (1)$$

Substitute x, y, t'

$$\frac{\theta_0}{t_0}\frac{dx}{dt} = \omega_0 y$$

$$\frac{\omega_0}{t_0}\frac{dy}{dt} = -\frac{g}{l}\sin(\theta_0 x) - \frac{\gamma}{m}\omega_0 y$$

Choose $t_0 = \sqrt{\frac{l}{g}}$ in order for t_0 to have s units

since $g = \left[\frac{m}{s^2}\right]$

$$\frac{dx}{dt} = \sqrt{\frac{l}{g}}\,\frac{\omega_0}{\theta_0}\,y \qquad \frac{dy}{dt} = -\frac{g}{l}\sqrt{\frac{l}{g}}\,\frac{\sin(\theta_0 x)}{\omega_0} - \frac{\gamma}{m}\sqrt{\frac{l}{g}}$$

with (1)

$$\sqrt{\frac{l}{g}}\,\frac{\omega_0}{\theta_0} = 1 \qquad \theta_0 = 1.$$

$$\sigma = \frac{\gamma}{m}\sqrt{\frac{l}{g}}$$

$$\theta_0 = 1 \implies \omega_0 = \sqrt{\frac{g}{l}}$$