HW 1.3

$\omega = \dot{\theta} \qquad \dot{\omega} = \ddot{\theta}$

$$\begin{cases} \omega = \dot{\theta} & = \omega_0 \cdot y \\ \dot{\omega} = \ddot{\theta} = -\frac{g}{\ell}\sin(\theta) - \frac{\gamma}{m}\omega & = \omega_0 \cdot \frac{dy}{dt} \end{cases}$$

$\theta = \theta_0 \cdot x \qquad \frac{dx}{dt'} = y \qquad dt = t_0 \cdot dt'$

$\omega = \omega_0 \cdot y$

$t = t_0 \cdot t' \qquad \frac{dy}{dt'} = -\sin(x) - \theta y$

$$\begin{cases} \omega_0 \cdot y = \theta_0 \cdot \frac{dx}{dt} \\ \omega_0 \cdot \frac{dy}{dt} = -\frac{g}{\ell} \cdot \sin(\theta_0 \cdot x) - \frac{\gamma}{m} \cdot \omega_0 \cdot y \end{cases}$$

$\frac{dx}{dt} \rightarrow \frac{dx}{t_c \cdot dt'}$

$$\begin{cases} \omega_0 y = \theta_0 \cdot \frac{dx}{t_0 \cdot dt'} \\ \omega_0 \cdot \frac{dy}{t_c \cdot dt'} = -\frac{g}{\ell} \cdot \sin(\theta_0 x) - \frac{\gamma}{m}\omega_0 \cdot y \end{cases}$$

$$\begin{cases} \frac{dx}{dt'} = \frac{\omega_0 \cdot y \cdot t_0}{\theta_0} \qquad (I) \\ \frac{dy}{dt'} = \underbrace{-\frac{g}{\ell} \cdot \frac{t_c}{\omega_0}}_{=-1} \cdot \underbrace{\sin(\theta_0 x)}_{=1} - \frac{\gamma}{m} \cdot \frac{t_c}{\omega_0} \cdot \omega_0 \cdot y = -\frac{g}{\ell}\frac{t_c}{\omega_0}\sin(\theta_0 x) - \underbrace{\frac{\gamma}{m} t_0}_{=-\sigma} y \quad (II) \end{cases}$$

(I) $\theta_0, w_0, t_c, \sigma$

with $\frac{dx}{dt} = y$

$\Rightarrow \quad 1 = \frac{w_0 \cdot t_c}{\theta_0}$ V $\quad -1 = -\frac{g}{\ell} \cdot \frac{t_c}{w_0}$ VI $\quad -\sigma = -\frac{\gamma}{m} \cdot t_c$ VII

$\theta_0 = 1$ VIII

VI

$-1 = -\frac{g}{\ell} \cdot \frac{t_c}{w_0}$

from V $\quad w_0 = \frac{1}{t_0}$

$w_0 = \frac{g}{\ell} \cdot t_0$

$w_0^2 = \frac{g}{\ell}$

$w_0 = + \sqrt{g/\ell}$

$t_0 = \pm \sqrt{\frac{\ell}{g}}$

$\sigma = \frac{\gamma}{m} \cdot t_0 = \frac{\gamma}{m} \cdot \sqrt{\frac{\ell}{g}}$