$$U(x) \quad = \quad mgh(x) \quad = \quad mgH\left[1 \; - \; \cos(\frac{2\pi x}{L})\right]$$

$$\begin{aligned}\cos(\theta) \quad &= \quad \cos(0) \; + \; \frac{\theta^1}{1!}(-\sin(0)) \; + \; \frac{\theta^2}{2!}(-\cos(0)) \; + \; \frac{\theta^3}{3!}(\sin(0)) \; + \; \frac{\theta^4}{4!}(\cos(0)) \; + \; ... \\ &= \quad 1 \quad + \quad 0 \quad - \quad \frac{\theta^2}{2!} \quad - \quad 0 \quad + \quad \frac{\theta^4}{4!} \quad + \quad ...\end{aligned}$$

$$\begin{aligned}\sin(\theta) \quad &= \quad \sin(0) \; + \; \frac{\theta^1}{1!}(\cos(0)) \; + \; \frac{\theta^2}{2!}(-\sin(0)) \; + \; \frac{\theta^3}{3!}(-\cos(0)) \; + \; \frac{\theta^4}{4!}(\sin(0)) \; + ... \\ &= \quad 0 \quad + \quad \frac{\theta^1}{1!} \quad - \quad 0 \quad - \quad \frac{\theta^3}{3!} \quad + \quad 0 \quad + \quad \frac{\theta^5}{5!} \quad + \quad ...\end{aligned}$$

$$\begin{aligned}e^{i\theta} \quad &= \quad e^0 \; + \; \frac{i\theta^1}{1!}(e^0) \; + \; \frac{i^2\theta^2}{2!}(e^0) \; + \; \frac{i^3\theta^3}{3!}(e^0) \; + \; \frac{i^4\theta^4}{4!}(e^0) \; + ... \\ &= \quad 1 \quad + \quad \frac{i\theta^1}{1!} \quad - \quad \frac{\theta^2}{2!} \quad - \quad \frac{i\theta^3}{3!} \quad + \quad \frac{\theta^4}{4!} \quad + \quad \frac{i\theta^5}{5!} \quad + \quad ...\end{aligned}$$

$$\frac{d^2y}{dt^2} \quad = \quad -\left(\frac{k}{m}\right) y \quad = \quad -\omega^2 y$$

$$\omega \quad \equiv \quad \sqrt{\frac{k}{m}}$$

$$y(t) \quad = \quad A\cos(\omega t + \phi)$$

$$y(t) \quad = \quad B\cos(\omega t) \; + \; C\sin(\omega t)$$

$$y(0) \quad = \quad 0 \text{ m}$$

$$\frac{dy}{dt}|_{t=0} \; = \; v_y(0) \quad = \quad 0.12 \text{ m/s}$$

$$y(t) \quad = \quad (-0.04 \text{ m})\cos(\omega t + \frac{\pi}{2})$$

$$y(t) \quad = \quad (0) \; \cos(\omega t) \; + \; (0.04 \text{ m}) \; \sin(\omega t)$$

$$y(t) \quad = \quad Ae^{i(\omega t + \phi)}$$

$$e^{i\theta} \quad = \quad \cos(\theta) \; + \; i \, \sin(\theta)$$

$$y(t) \quad = \quad Ae^{i(\omega t+\phi)} \quad = \quad A\cos(\omega t+\phi) \; + \; i\, A\sin(\omega t+\phi)$$

$$\frac{dy}{dt} \quad = \quad v_y(t) \quad = \quad i\omega A e^{i(\omega t+\phi)} \quad = \quad i\omega y(t)$$

$$\frac{d^2y}{dt^2} \quad = \quad a_y(t) \quad = \quad -\omega^2 A e^{i(\omega t+\phi)} \quad = \quad -\omega^2 y(t)$$

$$y(t) \quad = \quad Ae^{-i(\omega t+\phi)} \quad = \quad A\cos(\omega t+\phi) \; - \; i\, A\sin(\omega t+\phi)$$

$$y(t) \quad = \quad Ae^{i(\omega t+\phi)}$$

$$y(t) \quad = \quad Be^{i(\omega t)} \; + \; Ce^{-i(\omega t)}$$