

Problem 2 (a)

$$\frac{d^2 x(t)}{dt^2} = -\omega^2 x(t)$$

$$\text{let } \tau = \omega t$$

$$\left(\frac{d^2 x(\tau)}{d\tau^2} \right) \left(\frac{d\tau}{dt} \right)^2 = -\omega^2 x(\tau)$$

$$\frac{d\tau}{dt} = \omega$$

$$\Rightarrow \frac{d^2 x(\tau)}{d\tau^2} \cancel{\omega^2} = -\cancel{\omega^2} x(\tau)$$

$$\Rightarrow \boxed{\frac{d^2 x(\tau)}{d\tau^2} = -x(\tau)}$$