

[1.1절]

1.30 $\omega_n = 3 \text{ rad/s}$, $x_0 = 1.2 \text{ mm}$, $v_0 = 2.34 \text{ mm/s}$, $x(t) = ?$ Compute and plot.

$$x(t) = A \sin(\omega_n t + \phi) \quad \dot{x}(t) = \omega_n A \cos(\omega_n t + \phi)$$

$$x(0) = A \sin\phi = x_0 = 1.2 \text{ mm} > 0 \quad \dots \textcircled{1}$$

$$\dot{x}(0) = \omega_n A \cos\phi = v_0 \Rightarrow A \cos\phi = \frac{v_0}{\omega_n} = \frac{2.34 \text{ mm/s}}{3 \text{ rad/s}} = 0.78 \text{ mm} > 0 \quad \dots \textcircled{2}$$

$$\sin\phi > 0, \cos\phi > 0 \text{ 이므로, } 0 < \phi < \frac{\pi}{2}$$

$$\textcircled{1}^2 + \textcircled{2}^2 \Rightarrow A = \sqrt{(1.2 \text{ mm})^2 + (0.78 \text{ mm})^2} = 1.431 \text{ mm}$$

$$\textcircled{1} \div \textcircled{2} \Rightarrow \phi = \tan^{-1} \frac{(1.2 \text{ mm})}{(0.78 \text{ mm})} = \tan^{-1} 1.538 = 0.994 \text{ rad} (= 57.0^\circ)$$

$$\therefore x(t) = 1.431 \sin(3.00 t + 0.994) \text{ mm}$$

Plot

