

29.)

$$m = 10 \text{ kg} \quad F_1(x=1) = 20 \text{ N} \quad F_2 = -b\dot{x} \quad v_0 = 0$$

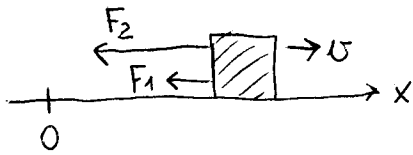
$$F_1 = -Dx$$

$$D = 20 \frac{\text{N}}{\text{m}}$$

$$\boxed{\vec{a} = \frac{\vec{F}_e}{m}}$$

$$x(t=3T) = \frac{x(0)}{10}$$

$$T = ?$$



$$m\ddot{x} = -Dx - b\dot{x}$$

$$\omega^2 = \frac{D}{m} \quad \frac{b}{m} = 2\alpha$$

$$\ddot{x} + \frac{b}{m}\dot{x} + \frac{D}{m}x = 0$$

$$\ddot{x} + 2\alpha\dot{x} + \omega^2x = 0$$

$$x(t) = Ae^{-\alpha t} \cos(\gamma t + \delta) \quad \gamma = \sqrt{\omega^2 - \alpha^2}$$

$$x(0) = A \cos \delta$$

$$x(3T) = Ae^{-3\alpha T} \cos(3T\gamma + \delta) = Ae^{-3\alpha T} \cos \delta$$

$$\frac{x(0)}{x(3T)} = 10 = \frac{A \cos \delta}{Ae^{-3\alpha T} \cos \delta} = e^{3\alpha T} \quad \longrightarrow \quad \ln 10 = 3\alpha T$$

$$\frac{\ln 10}{3T} = \alpha$$

$$\gamma^2 = \omega^2 - \alpha^2 \quad \gamma = \frac{2\pi}{T}$$

$$\hookrightarrow \omega^2 - \alpha^2 = \frac{4\pi^2}{T^2}$$

$$\omega^2 - \left(\frac{\ln 10}{3T}\right)^2 = \frac{4\pi^2}{T^2}$$

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