

Bryony Stanfield 2008682

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4) a) $m = 14.5 \text{ kg}$ $C = 200 \text{ N s/m}$ $K = 4 \text{ kN/m} = 4000 \text{ N/m}$

$$m \frac{d^2 \theta_o}{dt^2} + C \frac{d\theta_o}{dt} + K\theta_o = f$$

$\therefore$ dividing by m gives

$$\frac{d^2 \theta_o}{dt^2} + \frac{C}{m} \frac{d\theta_o}{dt} + \frac{K}{m} \theta_o = \frac{f}{m}$$

Comparing to $\frac{d^2 \theta_o}{dt^2} + 2\zeta \omega_n \frac{d\theta_o}{dt} + \omega_n^2 \theta_o = b_1 \omega_n \theta_i$

$$\omega_n^2 = \frac{h}{m} = \frac{4000}{14.5} = 275.862$$

$$\omega_n = \sqrt{275.862} = 16.609 \text{ Hz}$$

$$2\zeta \omega_n = \frac{C}{m}$$

$$\therefore \zeta = \frac{C}{2\omega_n m} = \frac{(200)}{2(16.609)(14.5)} = 0.415$$

$\zeta = 0.415$ which is < 1 so system is underdamped.