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(01) a) $i = \dot{q}$

$$5 = 10^4 \dot{q} + 10^6 q$$

$$5 \cdot 10^{-4} = \dot{q} + 10^2 q$$

$$5\, 10^{-4} e^{10^2 t} = \dot{q} e^{10^2 t} + 10^2 q e^{10^2 t}$$

$$\frac{d}{dt}\left(5 \cdot 10^{-6} e^{10^2 t}\right) = \frac{d}{dt}\left(q e^{10^2 t}\right)$$

$$C + 5 \cdot 10^{-6} e^{10^2 t} = q e^{10^2 t}$$

$$q = 5 \cdot 10^{-6} + C e^{-10^2 t}$$

$$\tau = 0{,}01\ s$$

b) $q(0) = 0$

$$0 = 5\, 10^{-6} + C$$

$$C = -5 \cdot 10^{-6}$$

$$q(t) = 5 \cdot 10^{-6}\left(1 - e^{-10^2 t}\right)$$

$$q(0{,}02) = 5 \cdot 10^{-6}\left(1 - e^{-2}\right) = 4{,}32 \cdot 10^{-6}$$

(02) a) $V = Ri + V_b$

$J\dot{w} = T_m - bw = k_t i - bw$

$\dot{w} + \frac{b}{J} w = \frac{k_t i}{J}$

$\dot{w} e^{\frac{b}{J}t} + \frac{b}{J} w e^{\frac{b}{J}t} = \frac{k_t i}{J} e^{\frac{b}{J}t}$

$w \cancel{e^{\frac{b}{J}t}} = \frac{k_t i}{b} \cancel{e^{\frac{b}{J}t}} + C e^{-\frac{b}{J}t}$ *

$\tau = J/b$

b) $V_b i = T_m w = k_t i w$

$V_b = k_t \cdot w$

$V = Ri + K_t \cdot w$

$14{,}8 = 8{,}3 i + 10{,}7 w$

de *: $w(t \to \infty) = \frac{k_t \cdot i(t \to \infty)}{b}$

$8{,}87 \cdot 10^{-8} w = \frac{10{,}7}{8{,}3}(14{,}8 - 10{,}7 w)$

$8{,}3 \cdot 8{,}87 \cdot 10^{-8} w = 10{,}7 \cdot 14{,}8 - 10{,}7 \cdot 10{,}7 w$

$w = \frac{10{,}7 \cdot 14{,}8}{10{,}7 \cdot 10{,}7 + 8{,}3 \cdot 8{,}87 \cdot 10^{-8}} = 1{,}38$ rad/s

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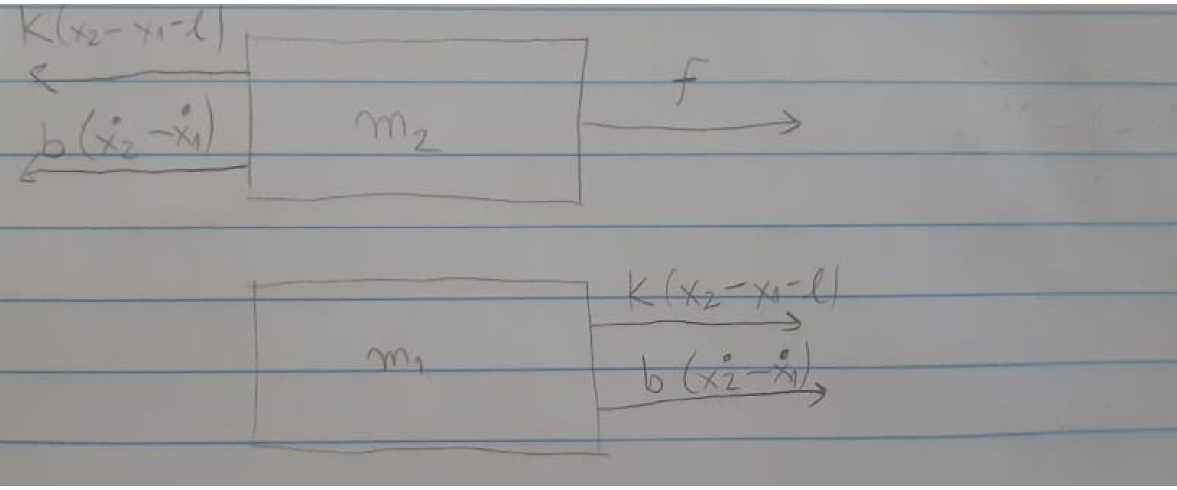

$$\begin{cases} m_2 \ddot{x}_2 = f - k(x_2 - x_1) - b(\dot{x}_2 - \dot{x}_1) \\ m_1 \ddot{x}_1 = k(x_2 - x_1) + b(\dot{x}_2 - \dot{x}_1) \end{cases}$$

$$\begin{cases} \ddot{x}_1 = \frac{k}{m_1} x_2 - \frac{k}{m_1} x_1 + \frac{b}{m_1} \dot{x}_2 - \frac{b}{m_1} \dot{x}_1 \\ \ddot{x}_2 = \frac{f}{m_2} - \frac{k}{m_2} x_2 + \frac{k}{m_2} x_1 - \frac{b}{m_2} \dot{x}_2 + \frac{b}{m_2} \dot{x}_1 \\ \dot{x}_1 = \dot{x}_1 \\ \dot{x}_2 = \dot{x}_2 \end{cases}$$

$$\frac{d}{dt} \begin{bmatrix} x_1 \\ \dot{x}_1 \\ x_2 \\ \dot{x}_2 \end{bmatrix} = \underbrace{\begin{bmatrix} 0 & 1 & 0 & 0 \\ -\frac{k}{m_1} & -\frac{b}{m_1} & \frac{k}{m_1} & \frac{b}{m_1} \\ 0 & 0 & 0 & 1 \\ \frac{k}{m_2} & \frac{b}{m_2} & -\frac{k}{m_2} & -\frac{b}{m_2} \end{bmatrix}}_{A} \begin{bmatrix} x_1 \\ \dot{x}_1 \\ x_2 \\ \dot{x}_2 \end{bmatrix} + \underbrace{\begin{bmatrix} 0 \\ 0 \\ 0 \\ \frac{1}{m_2} \end{bmatrix}}_{B} f$$

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \underbrace{\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}}_{C} \begin{bmatrix} x_1 \\ \dot{x}_1 \\ x_2 \\ \dot{x}_2 \end{bmatrix} + \underbrace{\begin{bmatrix} 0 \\ 0 \end{bmatrix}}_{D} F$$