a) $k_x = mg$

$k = \frac{mg}{x} \Rightarrow k = \frac{0,2 \cdot 9,81}{0,2}$

$\boxed{k = 9,81 \frac{N}{m}}$

b) $E_0 = \frac{k x_0^2}{2} \Rightarrow \frac{9,81 \cdot (0,05)^2}{2} = 0,012226\ J$

$\boxed{E_0 = 1,23 \cdot 10^{-2}\ J}$

c)

$A_n = A_0 e^{-n\gamma t}$

$\frac{1}{5} A_0 = A_0 e^{-5\gamma t}$

$\ln\left(\frac{1}{5}\right) = -5\gamma t$

$\gamma t = \frac{\ln(1/5)}{-5}$

$\gamma t = 0,322$

$\gamma = \frac{0,322}{0,9}$

$\gamma = 0,358$

$\omega_0 = \sqrt{\frac{k}{m}}$

$\omega_0 = \sqrt{\frac{9,81}{0,2}}$

$\omega_0 = \sqrt{49,05}$

$\omega_0 = 7,00$

$\omega = \sqrt{\omega_0^2 - \gamma^2}$

$\omega = \sqrt{(7,00)^2 - (0,358)^2}$

$\omega = \sqrt{48,92}$

$\omega = 6,99$

c-) $X(t) = A e^{-\gamma t} \operatorname{sen}(\omega t + \theta_0)$

$X(0) = A \operatorname{sen}(\theta_0)$

$0,05 = A \operatorname{sen}(\theta_0)$

$A = \frac{0,05}{\operatorname{sen}\theta_0} = \frac{0,05}{\operatorname{sen}(1,52)} = 5,01 \cdot 10^{-2}\ m$

$V(t) = A e^{-0t}[-\gamma \operatorname{sen}(\theta_0) + \omega \cos(\theta_0)]$

$V(0) = A[-\gamma \operatorname{sen}(\theta_0) + \omega \cos(\theta_0)]$

$0 = A[-\gamma \operatorname{sen}(\theta_0) + \omega \cos(\theta_0)]$

$\hookleftarrow A \neq 0$

$\gamma \operatorname{sen}(\theta_0) = \omega \cos(\theta_0)$

$\frac{\operatorname{sen}(\theta_0)}{\cos(\theta_0)} = \frac{\omega}{\gamma}$ ▷ $\theta = 1,52\ rad$

$\operatorname{tg}\theta_0 = \frac{\omega}{\gamma}$

$\operatorname{Arctg}\theta = \frac{6,99}{0,358}$

$\operatorname{Arctg}\theta = 19,52$

$$X(t) = 5,01 \cdot 10^{-2} e^{-0,358t} \operatorname{sen}(6,99t + 1,52)$$

(d) $\epsilon_n = \epsilon_0 e^{-2n\beta t}$

$\epsilon_2 = \epsilon_0 e^{-2.(2).0,358.0,9}$

$\epsilon_2 = 1,23.10^{-2}.\ e^{-1,288}$

$\epsilon_2 = 1,23.10^{-2}.\ 2.76.10^{-1}$

$$\boxed{\epsilon_2 = 3,39.10^{-3}\ J}$$ //

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