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) $\epsilon_0 = \frac{k x_0^2}{2} \Rightarrow \frac{9,81 \cdot (0,05)^2}{2} = 0,012256 \ J$

$$\boxed{\epsilon_0 = 1,23 \cdot 10^{-2} \ J}$$

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

(d) $E_n = E_0 e^{-2n\beta t}$

$E_2 = E_0 e^{-2 \cdot (2) \cdot 0{,}358 \cdot 0{,}9}$

$E_2 = 1{,}23 \cdot 10^{-2} \cdot e^{-1{,}288}$

$E_2 = 1{,}23 \cdot 10^{-2} \cdot 2{,}76 \cdot 10^{-1}$

$$E_2 = 3{,}39 \cdot 10^{-3} \text{ J}$$

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

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

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

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

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

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

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

$\hookrightarrow A \neq 0$

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

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

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

$\theta = 1,52\ rad$

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

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

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

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

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

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

$$\gamma t = 0,322$$

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

$$\gamma = 0,358$$

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

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

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

$$\omega_0 = 7,00$$

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

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

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

$$\omega = 6,99$$