QUESTÃO 3

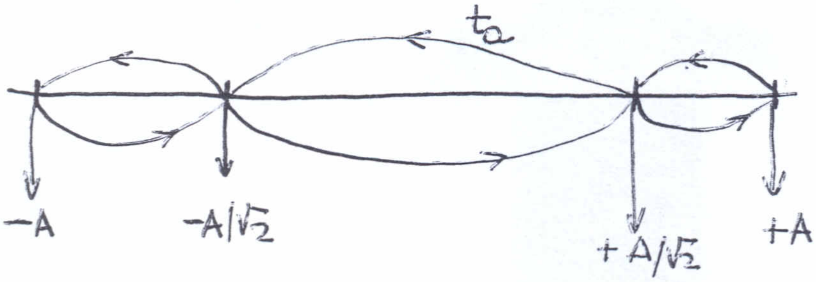
a) $x(t) = A\cos(\omega t + \phi)$; $E = T + U$; $T = \frac{1}{2} m v^2$; $U = \frac{1}{2} K x^2$

$$T = U \Rightarrow E = 2U = 2T$$

$$2U = E \Rightarrow 2\left(\tfrac{1}{2} K x^2\right) = \frac{1}{2} K A^2 \Rightarrow x = \pm A/\sqrt{2} \qquad \boxed{|x| = A/\sqrt{2}}$$

$$2T = E \Rightarrow 2\left(\tfrac{1}{2} m V_x^2\right) = \frac{1}{2} K A^2 \xRightarrow{\omega^2 = K/m} V_x = \pm \frac{\omega A}{\sqrt{2}} \qquad \boxed{|V_x| = \frac{\omega A}{\sqrt{2}}}$$

b) NUM CICLO x PERCORRE $+A \longrightarrow 0 \longrightarrow -A \longrightarrow 0 \longrightarrow +A$



DA FIGURA ACIMA VEMOS QUE $\boxed{T = U \text{ OCORRE 4 VEZES NUM CICLO}}$

CALCULO DE t_a (INTERVALO ENTRE DUAS OCORRÊNCIAS CONSECUTIVAS)

ESCOLHENDO $t = 0$ $x = +A \Rightarrow \phi = 0$ $\quad x = A\cos\omega t$

$x_1 = A/\sqrt{2} \Rightarrow A/\sqrt{2} = A\cos\omega t_1$; $\omega t_1 = \arccos(1/\sqrt{2}) = \frac{\pi}{4}$; $t_1 = \frac{\pi}{4\omega}$

$x_2 = -A/\sqrt{2} \Rightarrow -A/\sqrt{2} = A\cos\omega t_2$; $\omega t_2 = \arccos(-1/\sqrt{2}) = \frac{3\pi}{4}$; $t_2 = \frac{3\pi}{4\omega}$

$$\boxed{t_a = t_2 - t_1 = \frac{\pi}{2\omega}}$$

c) $x = A/2$ $\quad T = E - U = \frac{1}{2} K A^2 - \frac{1}{2} K x^2$

$$T = \tfrac{1}{2} K A^2 - \tfrac{1}{2} K (A/2)^2 = \frac{3}{8} K A^2$$

$$\frac{T}{E} = \frac{\frac{3}{8} K A^2}{\frac{1}{2} K A^2} = \boxed{\frac{3}{4}} \qquad \frac{U}{E} = \frac{\frac{1}{8} K A^2}{\frac{1}{2} K A^2} = \boxed{\frac{1}{4}}$$

QUESTÃO 4

$m = 100\,g \qquad \rho = 0.100\ Kg/s \qquad x(t) = A e^{-\gamma/2\, t} \cos(\omega t + \varphi)$

$A e^{-\gamma/2\, t} = \frac{A}{2}\ ; \quad \frac{t\gamma}{2} = \ln 2 \qquad t = \frac{2m}{\rho} \ln 2 = 2 \ln 2\ seg$

$\ln 2 = 0,693 \qquad \boxed{t = 1.386\ seg}$

) PODEMOS CALCULAR A ENERGIA EM SUCESSIVOS PONTOS DE RETORNO, ONDE $\cos(\omega t + \varphi) = \pm 1$

$\frac{1}{2} K x^2 = \frac{1}{2} K A^2 e^{-\gamma t}$

IMPOMOS QUE $\frac{1}{2} K A^2 e^{-\gamma t} = \frac{1}{2} \left(\frac{1}{2} K A^2 \right)$

$e^{\gamma t} = 2 \qquad t = \frac{\ln 2}{\gamma} = \frac{m}{\rho} \ln 2 = \ln 2$

$\boxed{t = 0,693\ seg}$

c) $\bar{E} = \frac{1}{2} K A^2$

$$\frac{d\bar{E}/dt}{\bar{E}} = \frac{\frac{d}{dt}\left[\frac{1}{2} K A^2 \right]}{\frac{1}{2} K A^2} = \frac{\frac{1}{2} K (2A) \frac{dA}{dt}}{\frac{1}{2} K A^2} = 2\, \frac{dA/dt}{A}$$

$$\frac{d\bar{E}/dt}{\bar{E}} = 2\, \frac{dA/dt}{A}$$