Harm. Schw. 2

A8:				
	(b)	$y_0 = 27\,cm$	$\omega = 2{,}7\,Hz$	$\delta = 0{,}73\,1/s$
	(a)	$38\,cm$	$4{,}3\,Hz$	$0{,}37\,1/s$

1) $f = \frac{\omega}{2\pi} = \frac{1}{2\pi}\sqrt{\frac{D}{m}} \qquad D = 4\pi^2 f^2 m = 4\pi^2 \cdot (4{,}6\,Hz)^2 \cdot 2{,}43\,kg = 2{,}0\,\frac{kN}{m}$

$F = m \cdot a = (-)\, D \cdot y_0 = (-) 4\pi^2 f^2 m \cdot y_0 = 4\pi^2 \cdot (4{,}6\,Hz)^2 \cdot 2{,}43\,kg \cdot 0{,}025\,m = 51\,N$

2) $4\pi^2 f^2 y_0 \leq g \qquad f \leq \sqrt{\frac{g}{4\pi^2 y_0}} = \frac{1}{2\pi}\sqrt{\frac{g}{y_0}} = \frac{1}{2\pi}\sqrt{\frac{9{,}81\,m/s^2}{1\cdot 10^{-3}\,m}} = 15{,}76\,Hz$

3) $f = \frac{25}{60\,s} \qquad \omega = \sqrt{\frac{D}{m}} \Rightarrow m = \frac{D}{\omega^2} = \frac{D}{4\pi^2 f^2} = \frac{25\,N/m}{4\pi^2 \cdot \left(\frac{25}{60\,s}\right)^2} = 3{,}65\,kg$

4) $E_K = \frac{1}{2} m \left[y_0 \omega \sin\left(\frac{2\pi}{T} \cdot \frac{1}{8} T\right)\right]^2 = \frac{m}{2} y_0^2 \frac{4\pi^2}{T^2} \sin^2\left(\frac{\pi}{4}\right) = \frac{0{,}5\,kg}{2} \cdot (0{,}1\,m)^2 \cdot \frac{4\pi^2}{4\,s} \sin^2\left(\frac{\pi}{4}\right) = 12{,}3\,mJ$

$E_{pot} = \frac{1}{2} D\, y\left(\frac{1}{8}T\right)^2 = \frac{m\omega^2}{2} \cdot \cos^2\left(\frac{2\pi}{T} \cdot \frac{1}{8} T\right) = \frac{m}{2} \cdot \frac{4\pi^2}{T^2} \cos^2\left(\frac{\pi}{4}\right) = 12{,}3\,mJ$

$E_{TOT} = E_K + E_p = 24{,}6\,mJ$

5) $E_K = \frac{1}{2} E_{pot} \Rightarrow E_{TOT} = \frac{1}{2} E_{pot} + E_{pot} = \frac{3}{2} E_{pot}$

$\frac{1}{2} D y_0^2 = \frac{3}{4} \cdot D \cdot y^2 \qquad y_0 = y \cdot \sqrt{\frac{3}{2}} = 30\,cm \cdot \sqrt{\frac{3}{2}} = 37\,cm$

6) $y = y_0/2 \qquad \frac{E_K}{E_{TOT}} = 1 - \frac{E_{pot}}{E_{TOT}} = 1 - \frac{\frac{1}{2} D y^2}{\frac{1}{2} D y_0^2} = 1 - \left(\frac{y}{y_0}\right)^2 = 1 - \frac{1}{4} = 75\%$

7) $\omega = \sqrt{\frac{g}{\ell}} = \sqrt{\frac{9{,}81\,m/s^2}{4{,}3\,m}} = 1{,}51\,Hz \qquad \delta = \frac{\ln 2}{T_{1/2}}$

$y(4{,}8s) = y_0\, e^{-\frac{\ln 2}{12s} \cdot 4{,}8s} \Rightarrow y_0 = y(4{,}8s) \cdot e^{\frac{\ln 2}{12s} \cdot 4{,}8s} = 32\,cm$

$y(4{,}8s) = 24\,cm$

$\frac{E_{TOT2}}{E_{TOT1}} = \frac{\frac{1}{2} D\, y(4{,}8s)^2}{\frac{1}{2} D\, y_0^2} = \left[\frac{y(4{,}8s)}{y(4{,}8s) \cdot e^{\frac{\ln 2}{12s} \cdot 4{,}8s}}\right]^2 = e^{-\frac{2 \ln 2 \cdot 4{,}8s}{12s}} = 57\%$

$\Rightarrow -43\%$