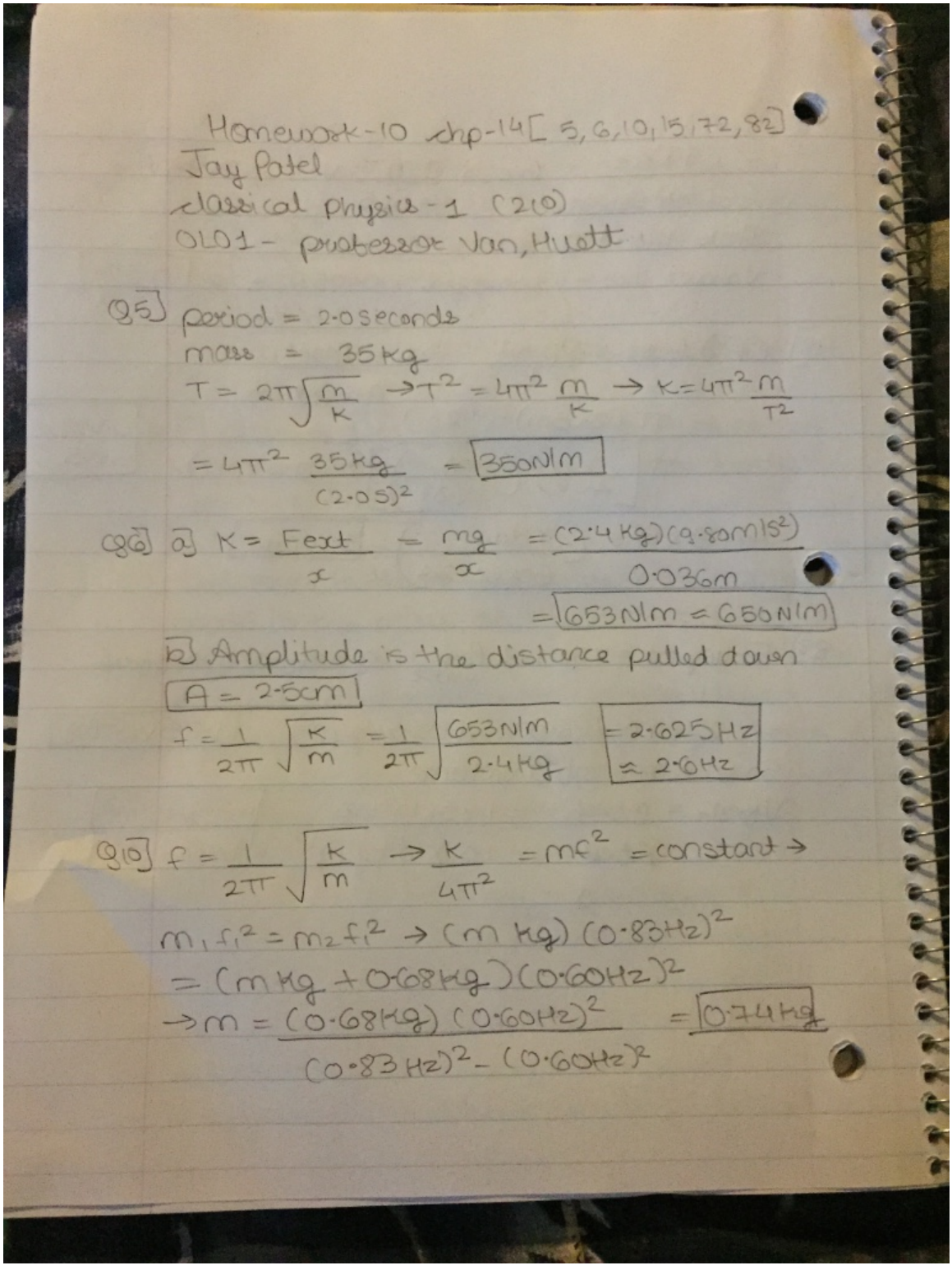
Homework 10 Chapter 14



Homework-10 chp-14[5, 6, 10, 15, 72, 82]
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Q5] period = 2.0 seconds
mass = 35 kg
$T = 2\pi\sqrt{\frac{m}{K}} \rightarrow T^2 = 4\pi^2 \frac{m}{K} \rightarrow K = 4\pi^2 \frac{m}{T^2}$

$= 4\pi^2 \frac{35\,kg}{(2.05)^2} = \boxed{350\,N/m}$

Q6] a] $K = \frac{F_{ext}}{x} = \frac{mg}{x} = \frac{(2.4\,kg)(9.80\,m/s^2)}{0.036\,m}$

$= \boxed{653\,N/m = 650\,N/m}$

b] Amplitude is the distance pulled down
$\boxed{A = 2.5\,cm}$

$f = \frac{1}{2\pi}\sqrt{\frac{K}{m}} = \frac{1}{2\pi}\sqrt{\frac{653\,N/m}{2.4\,kg}}$ $\boxed{= 2.625\,Hz \approx 2.6\,Hz}$

Q10] $f = \frac{1}{2\pi}\sqrt{\frac{K}{m}} \rightarrow \frac{K}{4\pi^2} = mf^2 = \text{constant} \rightarrow$

$m_1 f_1^2 = m_2 f_2^2 \rightarrow (m\,kg)(0.83\,Hz)^2$
$= (m\,kg + 0.68\,kg)(0.60\,Hz)^2$
$\rightarrow m = \frac{(0.68\,kg)(0.60\,Hz)^2}{(0.83\,Hz)^2 - (0.60\,Hz)^2} = \boxed{0.74\,kg}$

15] $K = 305 N/m$ $m = 0.260 kg$

$A = 0.280 m$ $\omega = \sqrt{K/m} = 34.250 rad/s$

a] m has zero displacement and positive velocity at $t = 0$

$y(t) = (0.280m) \sin[(34.3 rad/s)t]$

b] period of oscillation is, $T = \frac{2\pi}{\omega} = \frac{2\pi}{34.25 rad/s}$

$= 0.18345s$.

$t_{max} = \frac{T}{4} + nT = \boxed{4.59 \times 10^{-2} s + n(0.183s), n = 0, 1, 2.}$

$t_{min} = \frac{3T}{4} + nT = \boxed{1.38 \times 10^{-1} s + n(0.183s), n = 0, 1, 2,}$

72] a] $f = \frac{1}{2\pi}\sqrt{\frac{g}{l}} = \frac{1}{2\pi}\sqrt{\frac{9.80 m/s^2}{0.63m}}$ $\boxed{= 0.6277 Hz \approx 0.63 Hz}$

b] $E_{top} = E_{bottom} \rightarrow KE_{top} + PE_{top}$

$= KE_{bottom} + PE_{bottom}$

$0 + mg(L - L\cos\theta) = \frac{1}{2}mv^2_{bottom} + 0$

$v_{bottom} = \sqrt{2gL(1 - \cos\theta)}$

$= \sqrt{2(9.80 m/s^2)(0.63m)(1 - \cos 15°)}$

$= \boxed{0.6487 m/s \approx 0.65 m/s}$

c] $E_{total} = \frac{1}{2}mv^2_{bottom} = \frac{1}{2}(0.295 kg)(0.6487 m/s^2)$

$= \boxed{6.2 \times 10^{-2} J}$

82] a] $E_1 = E_2 \rightarrow \frac{1}{2}mv_1^2 + \frac{1}{2}kx_1^2 = \frac{1}{2}mv_2^2 + \frac{1}{2}kx_2^2$

$\rightarrow \frac{1}{2}mv_1^2 = \frac{1}{2}kx_2^2 \rightarrow k = \frac{mv_1^2}{x_1^2}$

$= (950\,kg)\frac{(25\,m/s)^2}{(5.0\,m)^2} = 2.375 \times 10^4\,N/m \approx 2.4 \times 10^4\,N/m$

b] $\frac{1}{2}T = \frac{1}{2}2\pi\sqrt{\frac{m}{k}}$

$= \pi\sqrt{\frac{(950\,kg)}{2.375 \times 10^4\,N/m}}$

$= 0.63\,s$

Homework 10 Chapter 15

Homework-10 chapter 15 [6, 48, 49, 50]
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(Q6) $v = \sqrt{F_T/\mu}$

$v = \frac{\Delta x}{\Delta t} = \sqrt{\frac{f_T}{\mu}} \rightarrow \Delta t = \frac{\Delta x}{\sqrt{\frac{F_T}{\mu}}} = \frac{8.0m}{\sqrt{\frac{140N}{(0.65kg)(8.0m)}}}$

$= \boxed{0.19s}$

(Q48) $\lambda = \frac{v}{f} \rightarrow \Delta x \text{ node} = \frac{1}{2}\lambda = \frac{v}{2f} = \frac{96m/s}{2(445Hz)}$

$= \boxed{0.11m}$

(Q49) $f_n = nf_1$ two successive overtones differ by the fundamental frequency

$\Delta f = f_{n+1} - f_n = (n+1)f_1 - nf_1 = f_1 = 320Hz - 240Hz$

$= \boxed{80Hz}$

(Q50) Speed of waves = $v = \sqrt{f_T/\mu}$

$f_n = \frac{nv}{2\ell_{vib}}$ where ℓ_{vib} is the length of the portion that is actually vibrating

$$f_n = \frac{n}{2l_{vib}}\sqrt{\frac{f_t}{\mu}} \qquad f_1 = \frac{1}{2(0.600m)}\sqrt{\frac{520N}{(3.16\times10^{-3}kg)/(0.900m)}}$$

$= 320.7Hz$

$f_2 = 2f_1 = 641.4Hz \quad f_3 = 3f_1 = 962.1Hz$

So the three frequencies are,

320Hz, 640Hz, 960Hz to 2 significant figures