Physics 160

Extra Credit #28

14.8 When $M_1 = 0.79\,kg$, $f_1 = 1.44\,Hz$

a) if $M_2 = 0.79kg + 0.2kg = 0.99kg$, $F_2 = ?$

$$\omega = \sqrt{\frac{k}{m}} \Rightarrow 2\pi f = \sqrt{\frac{k}{m}} \Rightarrow f\sqrt{m} = \frac{\sqrt{k}}{2\pi} = \text{Constant}$$

so $f_1\sqrt{m_1} = f_2\sqrt{m_2} \Rightarrow f_2 = f_1\frac{\sqrt{m_1}}{\sqrt{m_2}} = f_1\sqrt{\frac{m_1}{m_2}}$

$$\Rightarrow f_2 = 1.44Hz\sqrt{\frac{0.79}{0.99}} = 1.44Hz\,(0.893) = 1.29Hz$$

b) if $M_2 = 0.79kg - 0.2kg = 0.59kg$

$$\Rightarrow f_2 = 1.44Hz\sqrt{\frac{0.79}{0.59}} = 1.44Hz\,(1.157) = 1.67Hz$$

Notice that subtracting 0.2kg increased frequency by $1.67Hz - 1.44Hz = 0.23Hz$

but Adding 0.2kg decreased frequency by $1.44Hz - 1.29Hz = 0.15Hz$. Not An EQUAL CHANGE!

Pendulum Ranking

Rank by # of cycles per minute $\Rightarrow$ Rank by frequency

$$\omega = \sqrt{\frac{g}{L}} \Rightarrow 2\pi f = \sqrt{\frac{g}{L}} \Rightarrow f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$

So MASS is UNimportant. Simply RANK by inverse Length

$\Rightarrow$ shortest length gives highest frequency

Most

$L = 1m$ } $L = 2m$ { $L = 4m$ Least

there are two of each, so overlap