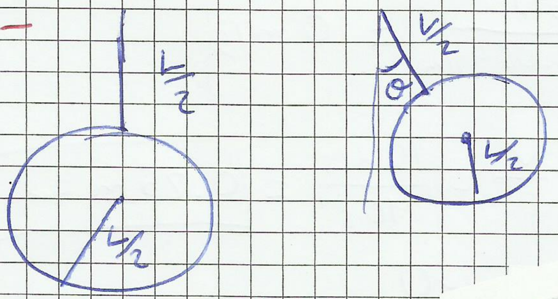
PHY 250 — 540000517

HW

1.-



$$T_1 = 2\pi \cdot \sqrt{\frac{I}{m \cdot g \cdot L}}$$

$$T_1 = 2\pi \cdot \sqrt{\frac{\frac{2}{5}\cancel{m}\left(\frac{L}{2}\right)^2 + \cancel{m}\cdot L^2}{\cancel{m}\, g\, \cancel{L}}}$$

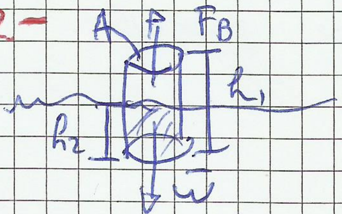
$$T_1 = 2\pi \cdot \sqrt{\frac{\frac{2}{5}\cdot\frac{L}{4} + L}{g}} = 2\pi \cdot \sqrt{\frac{L}{g}\cdot\left(\frac{2}{5}\cdot\frac{1}{4}+1\right)}$$

$$T_1 = 2\pi \cdot \sqrt{\frac{L}{g}\cdot\left(\frac{11}{10}\right)} > 2\pi \cdot \sqrt{\frac{L}{g}\left(\frac{11}{10}\right)} = \underbrace{2\pi \cdot \sqrt{\frac{L}{g}}}_{T_2} \cdot \sqrt{\frac{11}{10}}$$

$$T_2 = 2\pi \cdot \sqrt{\frac{L}{g}}$$

So, $T_1 \cdot \sqrt{\frac{11}{10}} = T_2$, with that we conclude that the larger ball takes longer.

2.-



$$\vec{F}_B = \vec{w} = \rho_w \cdot g \cdot V$$ displaced fluid volume

$$m \cdot \cancel{g} = \rho_w \cdot \cancel{g} \cdot h_2 \cdot A$$

a) $$\boxed{h_2 = \frac{m}{\rho_w \cdot A}}$$

$$\rho_w \cdot \cancel{g} \cdot (h_2+h_3)A = \overbrace{m \cdot \cancel{g}}^{\vec{w}} \cdot F \iff h_2 + h_3 = \frac{m \cdot F}{\rho_w \cdot A} \iff \boxed{h_3 = \frac{m \cdot F}{\rho \cdot A} - h_2}$$ (b)

$$\Sigma F = Mg - \rho \cdot A \cdot \frac{1}{m}(h_2+h_3) \implies k = \rho \cdot A \cdot \frac{1}{m}$$

$$\boxed{T = 2\pi \cdot \sqrt{\frac{m}{k}} = 2\pi \cdot \sqrt{\frac{m \cdot m}{\rho \cdot A}}}$$

3.- $y(x,t) = A \cdot \cos(kx - wt)$

a) $\boxed{v = \sqrt{\frac{F}{\mu}} = \sqrt{\frac{5N}{0.05\,kg/m}} = 10\ m/s}$

b) $v = f \cdot \lambda \Leftrightarrow \lambda = \frac{v}{f} = \frac{10\,m/s}{40\,s^{-1}} = \boxed{0.25\,m = \lambda}$

c) $y(x,t) = A \cdot \cos(kx - wt)$

$A = 0.03\,m$

$k = \frac{2\pi}{\lambda} = \frac{2\pi}{0.25}$

$w = \frac{2\pi}{T} = 2\pi \cdot f = 2\pi \cdot 40$

$y(x,t) = 0.03 \cdot \cos\left(\frac{2\pi}{0.25}x - 2\pi \cdot 40 \cdot t\right)$

d) $a = \frac{\partial^2 y(x,t)}{\partial t^2}\left(0.03 \cdot \cos\left(\frac{2\pi}{0.25}x - \frac{2\pi}{1} \cdot 40t\right)\right)$

$a = -0.03(2\pi \cdot 40)^2 \cos\left(\frac{2\pi}{0.25}x - 2\pi \cdot 40t\right)$

a_{max} when $\cos = 1$

$a_{max} = -0.03(2\pi \cdot 40)^2 \simeq 1895\,m/s^2$

e) Yes, it is a reasonable aproximation because the acceleration is much bigger than the one of the gravity, so this can be ignored.

4.-

a) $y_1(x,t) = A\cos(kx + wt)$

$y(x,t) = A \cdot \cos(kx + wt) + A \cdot \cos(kx + wt)$

$y(x,t) = 2A \cdot \cos(kx + wt) = 2A \cdot (\cos(kx) \cdot \cos(wt) - \cancel{\sin(kx)} \cdot \cancel{\sin(wt)})$

$y(x,t) = 2A \cdot \cos(kx) \cdot \cos(wt)$

b) at $x=0$ and $t=0$ $\rightarrow$ $y(x,t) = 2A \cdot \cos(0) \cdot \cos(0) = 2A$.

the amplitud is maximum at $x=0$, so it is an antinode.

$y_{max} = 2A$.

$\frac{\partial y(x,t)}{\partial t} = 2 \cdot A \cdot w \cdot \cos(\ldots)$ $\quad v_{max} = 2Aw$

$\frac{\partial^2 y(x,t)}{\partial t^2} = 2Aw^2 \cdot \cos(\ldots\ldots$ $\quad a_{max} = 2Aw^2$