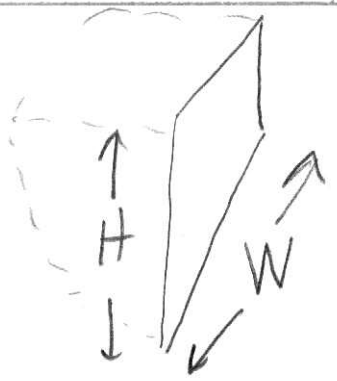
1.

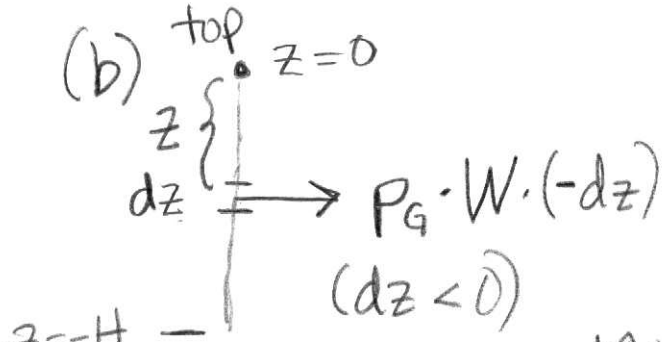


(a) $\boxed{P_G = \rho g H}$ symbolic

$= 10^3 \cdot 10 \cdot 10$

$\boxed{P_G = 10^5 \text{ Pa} \approx 1 \text{ atm}}$ numerical

(b)



Torque will be out of page

$d\tau = -z P_G W dz$

$d\tau = -\rho g W z^2 dz$

$$\tau = \int d\tau = -\rho g W \int_{-H}^{0} z^2 dz$$

$\boxed{\tau = \rho g W \left(\frac{1}{3} H^3\right)}$ symbolic

$\tau = 10^3 \cdot 10 \cdot 30 \cdot \frac{1}{3} \cdot 10^3$

$\boxed{\tau = 10^8 \text{ N-m}}$

(c) $\boxed{P_G \propto H, \text{ doubles}}$

(d) $\boxed{\tau \propto H^3, \text{ up by a factor of 8}}$

2. Pain: $\beta_{Pain} = 120\,dB$, $I_{Pain} = 1\ W/m^2$

$\beta_{Threshold} = 0\,dB$, $I_{thresh} = I_0 = 10^{-12}\ W/m^2$

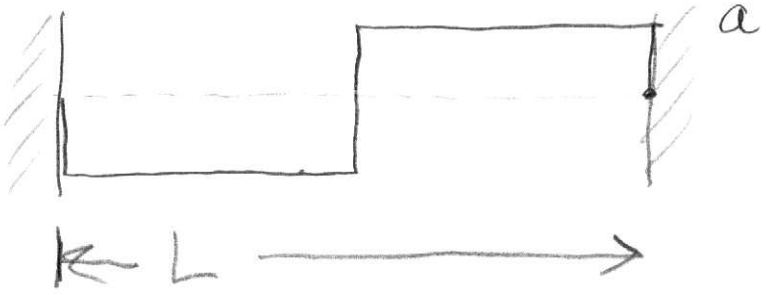
$$\left(\frac{I_p}{I_t}\right) = \left(\frac{r_t}{r_p}\right)^2$$

$$r_t = r_p\sqrt{I_p/I_t}$$

$$= 1\sqrt{1/10^{-12}}\ m$$

$$\boxed{r_t = 10^6\,m = 10^3\,km}$$

3. (a)



(b) $y(x,0)$ is an <u>odd</u> function when flipped about $x = L/2$.

B_n that correspond to <u>even</u> functions when flipped about $x = L/2$ will be 0. These are

$$\boxed{B_n = 0\ ,\ n = \underset{\text{odd}}{1,3,5,7,\ldots}}$$

(c) $B_n = \frac{2}{L}\int_0^L dy\, y(x,0)\sin\left(\frac{n\pi}{L}x\right)$

$$= \frac{2}{L}\left(-\int_0^{L/2} dy\, a\sin\left(\frac{n\pi}{L}x\right) + \int_{L/2}^{L} dy\, a\sin\left(\frac{n\pi}{L}x\right)\right)$$

$$= \frac{2a}{L}\left(+\frac{L}{n\pi}\cos\left(\frac{n\pi}{L}x\right)\Big|_0^{L/2} - \frac{L}{n\pi}\cos\left(\frac{n\pi}{L}x\right)\Big|_{L/2}^{L}\right)$$

$$B_n = \frac{2a}{n\pi}\left(\cos\left(\frac{n\pi}{2}\right) - \cos(0) - \cos(n\pi) + \cos\left(\frac{n\pi}{2}\right)\right)$$

$\cos(0) = 1$, $\cos(n\pi) = (-1)^n$

$$\boxed{B_n = \frac{2a}{n\pi}\left(2\cos\left(\frac{n\pi}{2}\right) - 1 - (-1)^n\right)}$$

Check: n = odd $(1, 3, 5, 7, \ldots)$

$$\cos\left(\frac{\text{odd}\,\pi}{2}\right) = 0$$

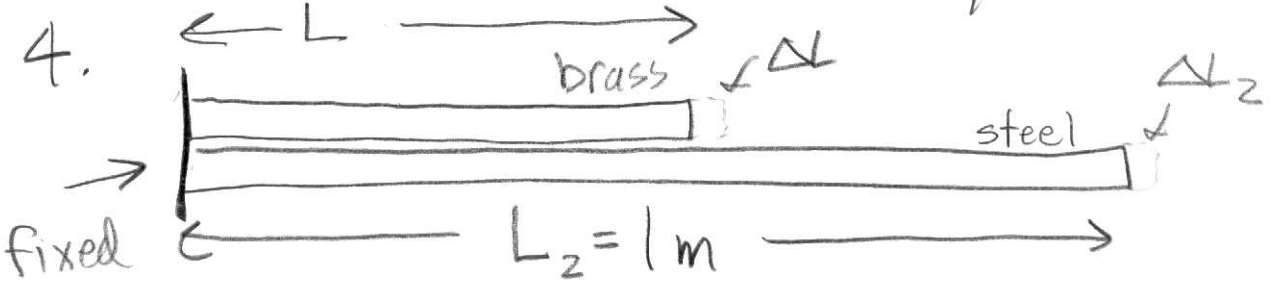
$$(-1)^n = -1$$

$$\boxed{B_n = \frac{2a}{n\pi}\left(0 - 1 - (-1)\right) = 0 \quad n \text{ odd}}$$

n = even: $\cos\left(\frac{n}{2}\pi\right) = (-1)^{n/2}$ $\quad (-1)^n = 1$

$$\boxed{B_n = \frac{2a}{n\pi}\left(2(-1)^{n/2} - 2\right) = \frac{4a}{n\pi}\left((-1)^{n/2} - 1\right) \quad n \text{ even}}$$

4.



want $\Delta L = \Delta L_2$

$$\alpha L \Delta T = \alpha_2 L_2 \Delta T$$

$$L = \left(\frac{\alpha_2}{\alpha}\right) L_2$$

$$= \left(\frac{1.2 \cdot 10^{-5}}{2.0 \cdot 10^{-5}}\right) 1\ m$$

$$\boxed{L = 0.6\ m,\ \text{Brass}}$$