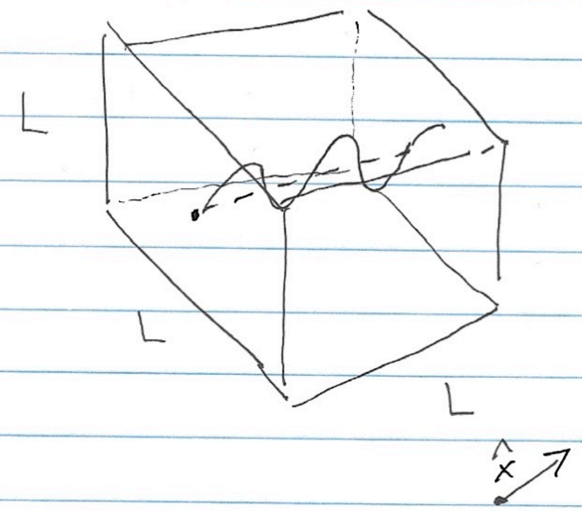
Jackson 6.11(a)

WLOG, consider screen of width L, consider box on the side of incident wave enclosing part of the wave



we consider momentum in $\hat{x}$ direction.

$$-dP_{left} = dP_{right} \quad \text{(conservation of momentum)}$$

$$\Rightarrow \quad -\frac{d}{dt}P_{left} = \frac{d}{dt}P_{right}$$

$$-\frac{d}{dt}\left[\frac{P_{left}}{L^2}\right]L^2 = \frac{d}{dt}\left[\frac{P_{right}}{L^3}\right]L^3$$

$\Rightarrow$

on the left, the momentum is of a screen, on the right, the momentum is of volume, so $\frac{P_{left}}{L^2}$ and $\frac{P_{right}}{L^3}$ makes sense.

$$-\left[\frac{\frac{d}{dt}P_{left}}{L^2}\right]L^2 = \frac{\frac{d}{dt}[P_{right}]L \quad L^2}{L^3}$$

$$\frac{F_\perp}{L^2} = \frac{FL}{L^3}$$

Taking L to be infinitesmal equates $\frac{F_1}{L^2}$ with Pressure,

and FL with work, so we have

$$\boxed{\begin{aligned} \text{Pressure} &= \frac{U}{L^3} \\ &= \text{energy volume density} \end{aligned}}$$

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