1. $m = 0.5 g$ $\quad L = 0.5 m$ $\quad \nu_0 = 440 Hz$ (fundamental)
$= 0.0005 kg$

a) $v = \sqrt{\frac{T}{\mu}} \Rightarrow T = v^2 \mu$

$$\mu = \frac{0.0005 kg}{0.5 m} = 0.001 kg/m$$

$v = \lambda_0 \nu_0$ where $\lambda_0 = 2L = 1m$

$v = (1m)(440 Hz) = 440 m/s$

$\Rightarrow T = (440 m/s)^2 (0.001 kg/m) = 193.6 N$

b) C is the fundamental for a string of length:

$L = \frac{\lambda_0}{2}$ where $\lambda_0 = \frac{v}{\nu_0} = \frac{440 m/s}{528 Hz} = 0.833 m$

$\therefore L = \frac{0.833 m}{2} = 0.417 m$

so you must put your finger
$0.5m - 0.417m = 0.083m$
or 8.3cm from the end

#1) (6.4)

$C_s = 340 \text{ m/s}$

$\lambda = 4L$, $L = 20 \text{ m}$

$\Rightarrow \nu_f = \frac{C_s}{4L} = \frac{340}{4(20)} = \underline{\underline{4.25 \text{ Hz}}}$

$\nu_1 = \frac{C_s}{4L/3} = \frac{3C_s}{4L} = 3(4.25) = \underline{\underline{12.75 \text{ Hz}}}$

$\nu_2 = \frac{5C_s}{4L} = 5(4.25) = \underline{\underline{21.25 \text{ Hz}}}$

#3) 6.6) density $= 50\,g/m$ in medium ①

density $= 20\,g/m$ " ②

$\Rightarrow$

(a) It is a Soft boundary since we are moving from higher densed medium, ①, to less dense medium, which is ②.

(b) $C_1 = \sqrt{T/50}$, $C_2 = \sqrt{T/20}$

reflected amplitude is $= \dfrac{\sqrt{\rho_1 T} - \sqrt{\rho_2 T}}{\sqrt{\rho_1 T} + \sqrt{\rho_2 T}} A_0$

A_0 : initial amp.

$\Rightarrow$ reflected amp. is $= \dfrac{\sqrt{50} - \sqrt{20}}{\sqrt{50} + \sqrt{20}}(1\,cm) = \underline{\underline{0.225\,cm}}$

(c) $A_{Trans} = \dfrac{2\sqrt{\rho_1 T}}{\sqrt{\rho_1 T} + \sqrt{\rho_2 T}} = \dfrac{2\sqrt{50}}{\sqrt{50} + \sqrt{20}} = \underline{\underline{1.225\,cm}}$

(d) Energy Conservation is given by

$$\rho_1 C_1 (A_1^2 - A_r^2) = \rho_2 C_2 A_2^2$$

$$\Rightarrow \rho_1 C_1 A_1^2 - \rho_1 C_1 A_r^2 = \rho_2 C_2 A_2^2$$

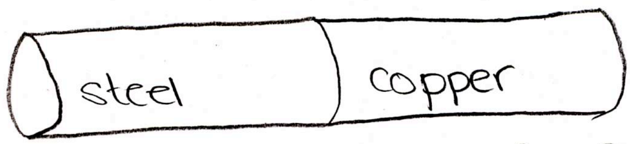
$$\Rightarrow \frac{\rho_1 C_1}{\rho_2 C_2} = \frac{A_2^2}{A_1^2 - A_r^2} = \frac{1.225^2\ cm^2}{1\ cm^2 - (0.225^2\ cm^2)} = 1.58$$

but fraction of energy reflected is:

$1/1.58 = .6326 \Rightarrow \underline{\underline{63.2\%}}$ of wave energy is reflected

* Note: A's here are the same ξ's in the book.

10.



steel: $\rho_v = 7800\,\text{kg/m}^3$
$Y = 2.0\times10^{11}\,\text{N/m}^2$

copper: $\rho_v = 8900\,\text{kg/m}^3$
$Y = 1.1\times10^{11}\,\text{N/m}^2$

a) the mechanical impedance of a solid is $Z_m = \sqrt{\rho_v Y}$

$$Z_{steele} = \sqrt{(7800\,\text{kg/m}^3)(2.0\times10^{11}\,\text{N/m}^2)} = 3.95\times10^{7}\,\text{kg/m}^2\cdot\text{s}$$

$$Z_{copper} = \sqrt{(8900\,\text{kg/m}^3)(1.1\times10^{11}\,\text{N/m}^2)} = 3.13\times10^{7}\,\text{kg/m}^2\cdot\text{s}$$

$$\text{fraction of energy reflected} = \left(\frac{Z_{steele} - Z_{copper}}{Z_{steele} + Z_{copper}}\right)^2 = (0.116)^2 = \left(\frac{\mathcal{E}_r}{\mathcal{E}_i}\right)^2$$

$$= 0.0134$$
$$= 1.34\%$$

Thus the amount of energy transmitted is
$100\% - 1.34\% = 98.7\%$

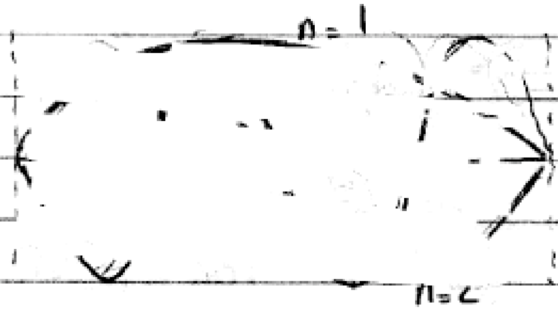
b) from a) $\dfrac{\mathcal{E}_r}{\mathcal{E}_i} = 0.116$

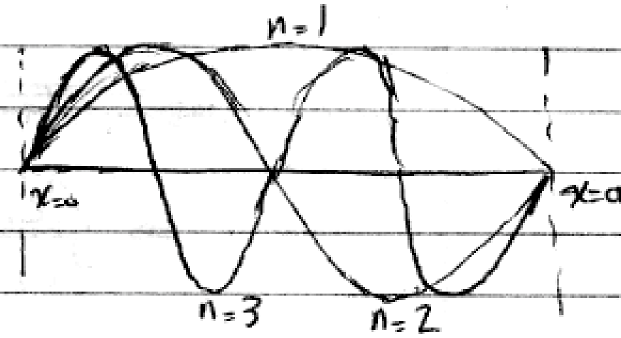
$$\mathcal{E}_t = \mathcal{E}_r + \mathcal{E}_i \Rightarrow \frac{\mathcal{E}_t}{\mathcal{E}_i} = \frac{\mathcal{E}_r}{\mathcal{E}_i} + 1 = 1.116$$

c) I calculated this in part a)

#5)

(a)





Amp. = 0 when $x=0$ & $x=a$

$Ka = n\pi \Rightarrow \boxed{K = \frac{n\pi}{a}}$ for $n = 1, 2, 3, \ldots$

(b) $p = \hbar K$, $E = p^2/2m$

$$\Rightarrow E_n = \frac{(\hbar k_n)^2}{2m} = \boxed{\frac{(\hbar n\pi)^2}{2ma^2}}$$ for $n = 1, 2, 3, \ldots$

(c) for $n=1$ $\Rightarrow E_1 = \frac{\pi^2\hbar^2}{2ma^2}$ ← Energy of ground state

$$\Rightarrow \frac{E_n}{E_1} = \frac{\frac{\cancel{\hbar^2} n^2 \cancel{\pi^2}}{\cancel{2ma^2}}}{\frac{\cancel{\hbar^2}\cancel{\pi^2}}{\cancel{2ma^2}}} = n^2 \Rightarrow \boxed{E_n = n^2 E_1}$$