Solución Auxiliar 11.

P1

a)

$$L = 0\,dB = 10\lg\left(\frac{I_1}{I_0}\right) \Rightarrow \lg\left(\frac{I_1}{I_0}\right) = 0$$

$$\Rightarrow I_1 = I_0$$

$$L = 0\,dB \Rightarrow 10\lg\left(\frac{I_2}{I_0}\right) = 0 \Rightarrow I_2 = I_0$$

$$L_{1+2} = 10\lg\left(\frac{I_1 + I_2}{I_0}\right) = 10\lg\left(\frac{I_0 + I_0}{I_0}\right)$$

$$= 10\lg(2) = 3{,}01\,dB$$

b)

$$40 = 10\lg\left(\frac{I_1}{I_0}\right) \Rightarrow I_1 = 10^4 I_0$$

$$70 = 10\lg\left(\frac{I_2}{I_0}\right) \Rightarrow I_2 = 10^7 I_0$$

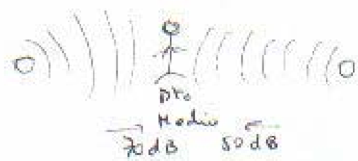
$$80 = 10\lg\left(\frac{I_3}{I_0}\right) \Rightarrow I_3 = 10^8 I_0$$

$$\Rightarrow L_{1+2+3} = 10\lg\left(\frac{(10^4 + 10^7 + 10^8) I_0}{I_0}\right)$$

$$L_{1+2+3} = 80{,}41\,dB$$

P2

a) $I = \frac{P}{4\pi R^2}$ $\quad$ $R = 2$



$$L_1 = 70\,dB = 10\lg\left(\frac{I_1}{I_0}\right) = 10\lg\left(\frac{P_1}{4\pi R^2}\cdot\frac{1}{I_0}\right) \Rightarrow P_1 = 10^7 4\pi R^2 I_0$$

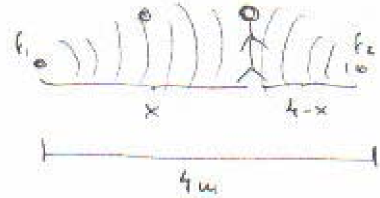
$$L_2 = 50\,dB = 10\lg\left(\frac{I_2}{I_0}\right) = 10\lg\left(\frac{P_2}{4\pi R^2}\cdot\frac{1}{I_0}\right) \Rightarrow P_2 = 10^5 4\pi R^2 I_0$$

$$\Rightarrow I_1 = 10^7 I_0$$

$$I_2 = 10^5 I_0$$

Luego $\quad L_{1+2} = 10\lg\left(\frac{10^7 I_0 + 10^5 I_0}{I_0}\right) \Rightarrow \boxed{L_{1+2} = 70{,}043\,dB}$

b)



$$I_1 = \frac{P_1}{4\pi x^2} \qquad I_2 = \frac{P_2}{4\pi(4-x)^2}$$

$$I_1 = I_2$$

$$\Rightarrow \frac{P_1}{4\pi x^2} = \frac{P_2}{4\pi(4-x)^2}$$

$$P_1 = 10^7\, 4\pi R^2 I_0$$

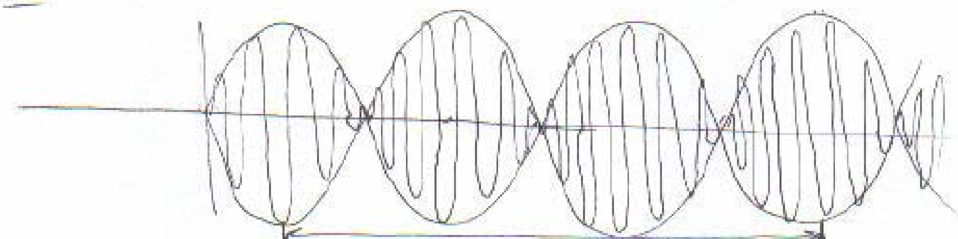
$$P_2 = 10^5\, 4\pi R^2 I_0$$

$$\frac{10^7 \cancel{4\pi R^2 I_0}}{\cancel{4\pi} x^2} = \frac{10^5\, 4\pi R^2 I_0}{4\pi(4-x)^2}$$

$$\frac{10^7}{x^2} = \frac{10^5}{(4-x)^2} \Rightarrow x = 4,4$$

$$\boxed{x = 3,63}$$

P3



$f_1 = 500\,Hz$

$f_2 = ?$

$P_1 = P_0 \operatorname{sen}(\omega_1 t)$

$P_2 = P_0 \operatorname{sen}(\omega_2 t)$

$$P = P_1 + P_2 = P_0 \operatorname{sen}(\omega_1 t) + P_0 \operatorname{sen}(\omega_2 t)$$

$$P = 2P_0 \cos\tfrac{1}{2}(\omega_1 - \omega_2)t \; \operatorname{sen}\tfrac{1}{2}(\omega_1 + \omega_2)t$$

$$P = 2P_0 \cos\left(\tfrac{1}{2}\Delta\omega t\right) \operatorname{sen}(\bar{\omega} t)$$

$$\omega = \frac{1}{2}\Delta\omega \Rightarrow 2\omega = \Delta\omega$$

$$2f = \Delta f$$
$$\downarrow$$
$$2$$
$$\Delta f = 4$$

$f_1 - f_2 = 4$ ó
$f_2 - f_1 = 4$

si $f_1 = 500\ Hz$

$\Rightarrow 500 - 496 = 4 \Rightarrow \boxed{f_2 = 496}$

si $f_2 = 500\ Hz$

$\Rightarrow 504 - 500 = 4 \Rightarrow \boxed{f_1 = 504}$

b) si se coloca cera en el diapasón de mayor frecuencia entonces esta disminuye ligeramente y se pierde el efecto que producen ambos diapasones y se escucharía un solo sonido sin abatimiento.

Si se coloca cera en el diapasón que emite a menor frecuencia, esta frecuencia disminuye, esto provocaría que que se escuchen más batidos por segundo.

De esta manera puede identificarse cual es la frecuencia del segundo diapasón de la parte a)

P4

$$m\ddot{x} + c\dot{x} + kx = F_0\cos(\omega_0 t)$$

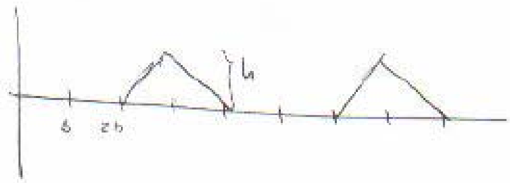
cuya solución es:

$$x(t) = \underbrace{e^{-\frac{c}{m}t}\left(K_1\cos\frac{k}{m}t + K_2\operatorname{sen}\frac{k}{m}t\right)}_{\text{reg. transciente}} + \underbrace{A\cos(\omega_0 t + \phi)}_{\text{reg permanente}}$$

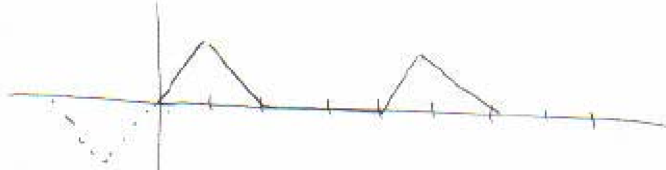
para $t \to \infty$ esta solución desaparece

P5

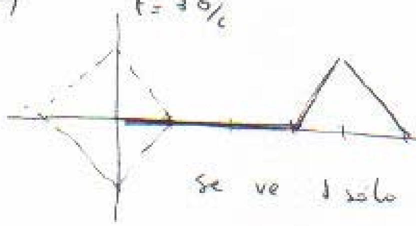
$t=0$



a) $t = 2b/c$

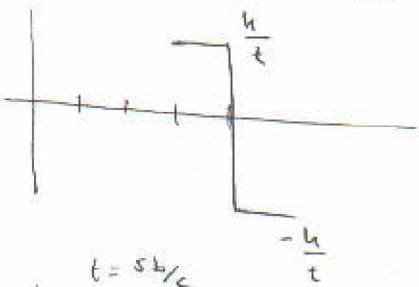


a) $t = 3b/c$

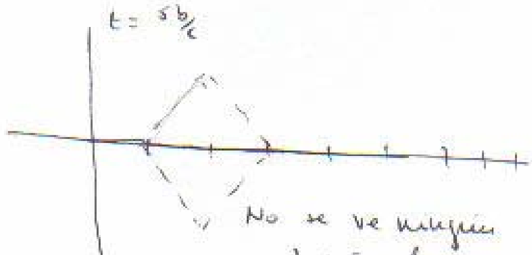


se ve 1 solo triángulo

b) velocidad $v = \frac{dx}{dt}$



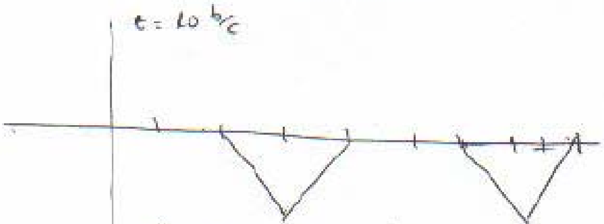
$t = 5b/c$



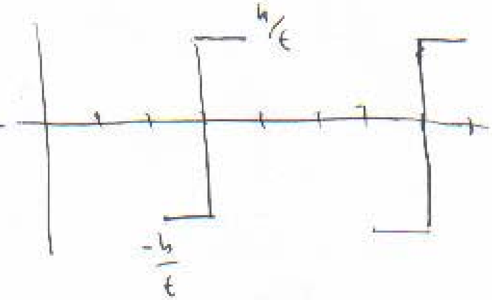
No se ve ningún triángulo

$t = 5b/c$

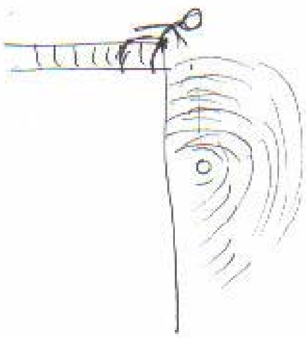
$t = 10\,b/c$



se ven los 2 triángulos invertidos.



P6



$v(t) = g t$

velocidad con que cae la fuente

V_S = velocidad del sonido

f_0 = frecuencia con que emite la radio

$$f = f_0 \frac{1}{1 + \frac{v(t)}{V_s}}$$

$$\boxed{f = \frac{f_0 \cdot V_s}{V_s + v(t)}}$$