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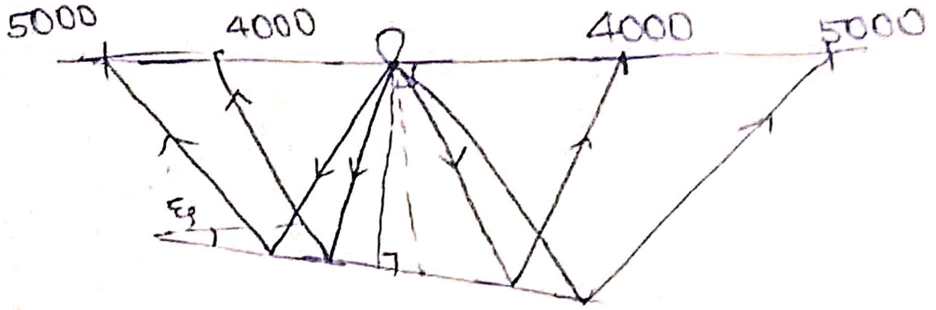
Lab Assignment 1

(1)



Given :- (i) $V = 7500$ ft/s

(ii) $\Delta t_R = 0.64$ s

(iii) $\Delta t_L' = 0.045$s.

Solution :- Right side

$$V^2 t_{4000}^2 = x^2 + 4h^2 - 4hx\cos\left(\frac{\pi}{2} + \xi_g\right)$$

$$\Rightarrow V^2 t_{4000}^2 = x^2 + 4h^2 + 2hx\sin\xi_g \quad \left(\because \cos\left(\frac{\pi}{2}+\theta\right) = -\sin\theta\right)$$

$$\Rightarrow t_{4000}^2 = \frac{x^2 + 4h^2 + 2hx\sin\xi_g}{V^2}$$

$$\Rightarrow t_{4000} = \frac{2h}{V}\left(1 + \frac{x^2 + 4hx\sin\xi_g}{8h^2}\right)$$

$$\Rightarrow t_{4000} = \frac{2h}{7500}\left(\frac{8h^2 + x^2 + 4hx\sin\xi_g}{8h^2}\right)$$

$$\Rightarrow t_{4000} = \frac{1}{30000h}\left(8h^2 + x^2 + 4hx\sin\xi_g\right) \quad \text{--- (1)}$$

$$t_{5000} = \frac{1}{30000h}\left(8h^2 + x^2 - 4hx\sin\xi_g\right) \quad \text{--- (2)}$$

From eq ①,

$$t_{4000} = \frac{1}{30000h}\left(8h^2 + (4000)^2 + 16000\,h \sin\xi\right) \quad \text{③}$$

From eq ②

$$t_{5000} = \frac{1}{30000\,h}\left(8h^2 + (5000)^2 + 20\,000\,h \sin\xi\right) \quad \text{④}$$

eq ④ − eq ③ we get,

$$t_{5000} - t_{4000} = \frac{1}{30000\,h}\left[9000000 + 4000h \sin\xi\right]$$

∵ Given $t_{5000} - t_{4000} = 0.064$

$$\Rightarrow \quad 0.064 = \frac{300}{h} + \frac{4}{30}\sin\xi \quad \text{⑤}$$

Left side

$$0.045 = \frac{300}{h} - \frac{4}{30}\sin\xi \quad \text{⑥}$$

Adding ⑤ and ⑥ we get,

$$0.109 = \frac{600}{h}$$

$$\Rightarrow \quad h = 5504.58\ \text{ft}$$

From eq ⑤,

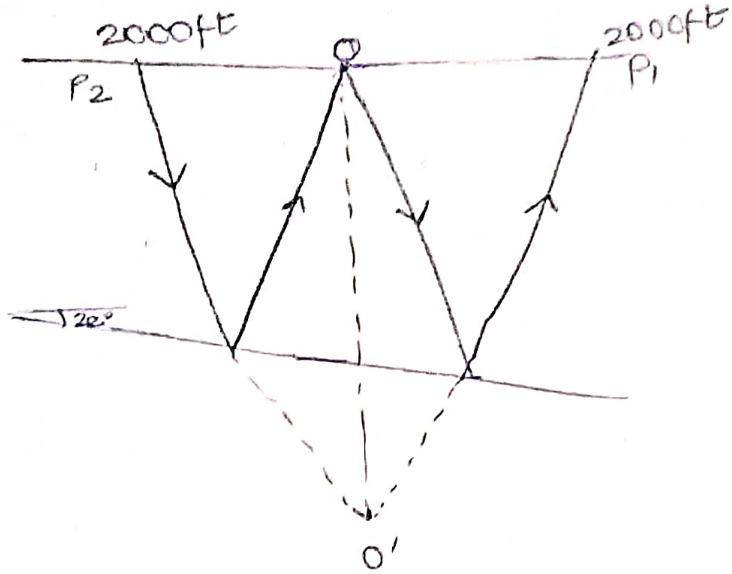
$$0.064 = \frac{300}{5504.58} + \frac{4}{30}\sin\xi$$

$$\Rightarrow \quad 0.064 = 0.0545 + 0.133\sin\xi$$

$$\Rightarrow \quad \sin\xi = \frac{9.5\times10^{-3}}{0.133}$$

$$\xi = 4.096^\circ$$

(2)



$\xi = 22°, \Rightarrow \sin\xi = \sin 22° = 0.375$

$h' = 7200 ft, \quad V = 8000 ft/s.$

$\therefore \sin\xi = \frac{V}{2}\left(\frac{\Delta t}{\Delta x}\right)$

$\Rightarrow \frac{\Delta t}{\Delta x} = \frac{2\sin\xi}{V}.$

$\Rightarrow \frac{\Delta t}{\Delta x} = \frac{2\times 0.375}{8000} = 9.375\times10^{-5} s/ft$

$x = 2000ft, \quad h = 7200\times\cos 22^0 = 6675.72ft.$

$t_{P_1}^2 = \frac{x^2 + 4h^2 + 4hx\sin\xi}{V^2} = \cancel{3} \ 3.1607 s^2$

$\therefore t_{P_1} = 1.778 s.$

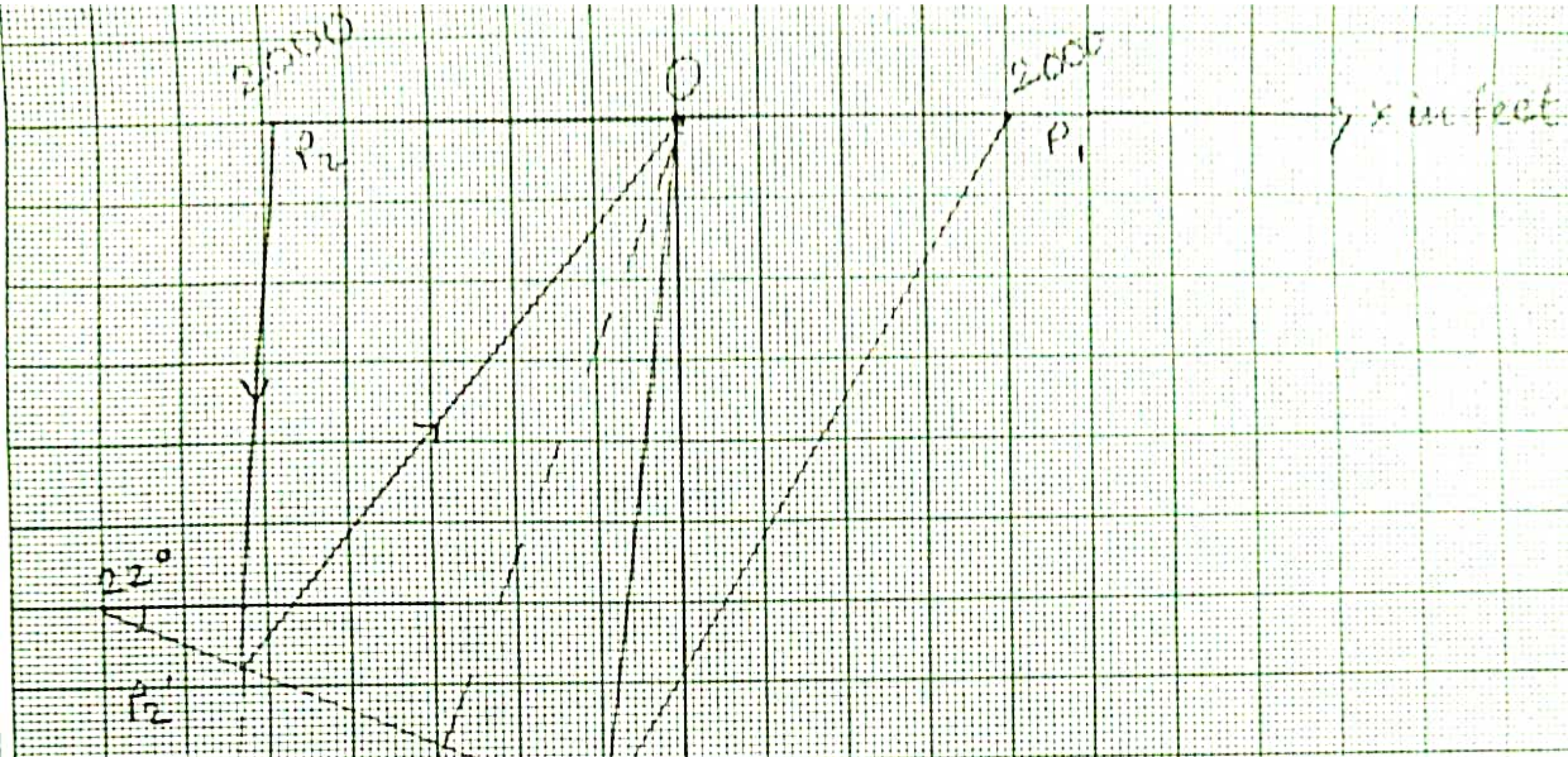
$t_{P_2}^2 = \frac{x^2 + 4h^2 - 4hx\sin\xi}{V^2} = 2.535 s^2$

$\therefore t_{P_2} = 1.592 s.$

$\Delta t = t_{P_1} - t_{P_2} = 0.186 s.$

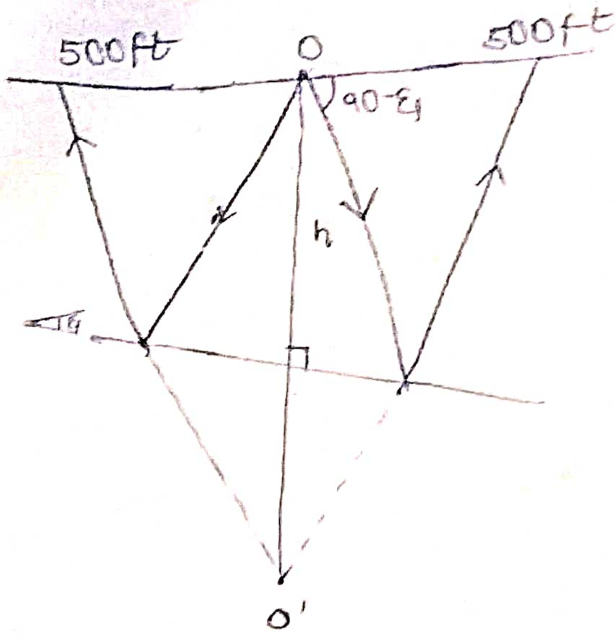
$\Delta x = 2000 ft$

$\therefore \frac{\Delta t}{\Delta x} = \cancel{9.93\times10} \ \frac{0.186}{2000} = 9.3\times10^{-5} s/ft$



2000
O
2000
x in feet
P_2
P_1
$22°$
P_2'
P_1'
O'

(3)



(a) $V = 8000 ft/s$

Δt for 1000ft in 0.047 s.

$t_0 = 1.669 s$

$\sin\xi = \frac{V}{2}\frac{\Delta t}{\Delta x} = \frac{8000}{2} \times \frac{0.047}{500}$

$\therefore$ $\xi = 22.1^\circ$

$\therefore$ Emergent angle $= 90^\circ - \xi = 67.9^\circ$

(b) $OO' = 2h = \frac{2 \times 1.669 \times 8000}{2}$ ft

$= 13352 ft$

(c) We observe that the reflected ray returns to point O, so we can conclude that it must be perpendicular to the reflecting surface, since the image must be at 'h' distance from surface, therefore "2h/2" is the mid-point (reflection point).

(d) Perpendicular bisector of OO' is perpendicular to mid-point hence it is a reflecting bed.