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HW# 3 Sol.

(a) From $y(x) = A\sin(kx+\varphi_0)$

At $t=0$, $x=x_0$ $\rightarrow$ $y(x_0) = A\sin(kx_0+\varphi_0) = A$ for maximum displacement.

$\therefore \sin(kx_0+\varphi_0) = 1$

$\rightarrow kx_0+\varphi_0 = \frac{(4n+1)\pi}{2}$, $n=0,1,2,\dots$

$\rightarrow \frac{2\pi x_0}{\lambda}+\varphi_0 = \frac{(4n+1)}{2}\pi$

$\therefore \varphi_0 = \left(\frac{4n+1}{2}\right)\pi - \frac{2\pi}{\lambda}x_0$

$= \left[\frac{4n+1}{2} - \frac{2x_0}{\lambda}\right]\pi$

For $n=0$, $\varphi_0 = \frac{\pi}{2} - \frac{2\pi}{\lambda}x_0$

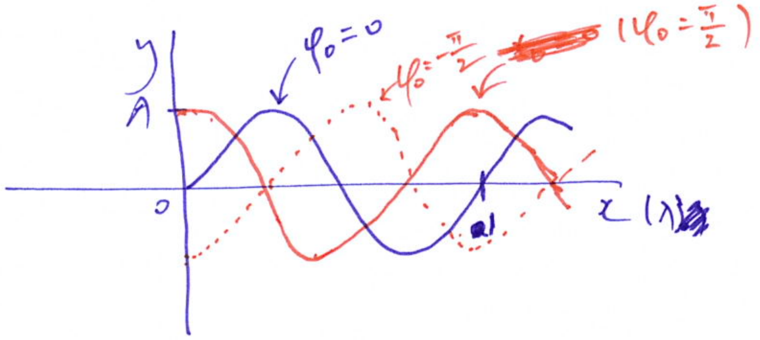
(b) For $\lambda = 10\,cm$, $x_0 = 0, \frac{5}{6}, \frac{5}{2}, 5$, and $-\frac{1}{2}$ cm.

$\varphi_0 = \frac{\pi}{2} - \frac{2\pi}{10}\left(0; \frac{5}{6}; \frac{5}{2}; 5; -\frac{1}{2}\right) = \frac{\pi}{2} - \frac{\pi}{10}\left(0; \frac{5}{3}; \frac{5}{1}; 10; -1\right)$

$= \frac{\pi}{10}\left[5 - \left(0; \frac{5}{3}; 5; 10; -1\right)\right]$

$= \frac{\pi}{10}\left[5; \frac{10}{3}; 0; -5; 6\right]$

$= \frac{\pi}{2}; \frac{\pi}{3}; 0; -\frac{\pi}{2}; \frac{3}{5}\pi$



• $y = A\sin(kx+\varphi_0)$

(c) $-\frac{\pi}{2}$ phase shifted.

$\cos x = \sin\left(x+\frac{\pi}{2}\right)$