NCERT 11.15. Q10

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Question: For the travelling harmonic wave $y(x,t) = 2.0\cos 2\pi(10t - 0.0080x + 0.35)$ where x and y are in cm and t in s. Calculate the phase difference between oscillatory motion of two points separated by a distance of

 (a) $4m$
 (b) $0.5m$
 (c) $\lambda/2$
 (d) $3\lambda/4$

Solution:

Parameter	Description	Value
$y(x_i,t)$	equation of harmonic wave	$A\cos(2\pi ft - kx_i + \phi)$
k	angular wave number	$2\pi(0.008)$
$\lambda = \dfrac{2\pi}{k}$	wavelength	$125\,cm$
f	frequency	10
A	amplitude	2.0
ϕ	phase constant	$2\pi(0.35)$
θ_i	phase of ith harmonic wave	$(2\pi ft - kx + \phi)$
x_i	position of ith harmonic wave	
t	time	
$x_2 - x_1$	path difference	$400\,cm$
		$50\,cm$
		$\dfrac{\lambda}{2}$
		$\dfrac{3\lambda}{4}$

TABLE 1
Given parameters

$$\text{Phase difference}\,(\Delta\theta) = (2\pi ft - kx_1 + \phi)$$
$$- (2\pi ft - kx_2 + \phi) \quad (1)$$
$$= k(x_2 - x_1) \quad (2)$$

Parameter	Description	subquestion	Value
$\Delta\theta$	$\theta_1 - \theta_2$	(a)	6.4π radians
		(b)	0.8π radians
		(c)	π radians
		(d)	$\dfrac{3\pi}{2}$ radians

TABLE 2
Phase differences