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<u>Problem 45.19 (RHK)</u>

Source A of *long-range radio waves leads source B by* 90^0. *The distance* r_A *to a detector is greater than the distance* r_B *by* 100 m. *We have to find the phase difference at the detector. Both sources have a wavelength of* 400 m.

<u>Source:</u>

It is given that the radio wave emitted by source *A* leads the wave of the same wavelength emitted by source *B* by $\pi/2$. The two waves can therefore be described by the functions

$$y_A = A\sin\left(\omega t - \frac{2\pi}{\lambda}r_A + \frac{\pi}{2}\right),$$

$$y_B = A\sin\left(\omega t - \frac{2\pi}{\lambda}r_B\right).$$

The phase difference at the detector will therefore be

$$\Delta\phi = -\frac{2\pi r_A}{\lambda} + \frac{\pi}{2} + \frac{2\pi r_B}{\lambda}$$

$$= \frac{\pi}{2} - \frac{2\pi\left(r_A - r_B\right)}{\lambda}.$$

It is given that the difference between the distances to the detector from the two sources is 400 m. That is

$r_A - r_B = 400 \text{ m}$.

The wavelength of the radio waves is 100 m. We thus find that the difference in phase between the two waves at the detector will be

$$\Delta\phi = \frac{\pi}{2} - \frac{2\pi\left(r_A - r_B\right)}{\lambda}$$

$$= \frac{\pi}{2} - \frac{2\pi \times 100}{400} = 0.$$