A student is fascinated by the idea that all electromagnetic waves work the same way, so she wants to do the famous Lloyd's mirror experiment with microwaves. She sets up a source, of 12 cm wavelength microwaves and a detector 2.84 m away. The source and detector are in a horizontal line, and just a small distance above a metal plate that will reflect the microwaves. The waves that bounce off the surface travel a distance of 3.44 m to get to the detector. However, she is uncertain whether waves reflecting from the metal plate have a phase shift of \pi or not. Explain, with a calculation, how she will know.

\[ x = 3.44 \text{ m} - 2.84 \text{ m} = 0.60 \text{ m} \]

\[ \Delta \phi = \frac{2\pi x}{\lambda} = \frac{2\pi \times 60 \text{ cm}}{12 \text{ cm}} = 5 \times 2\pi = 10\pi \]

This is the result if no phase shift will give a bright spot, or maximum.

If \pi phase shift you get

\[ \Delta \phi = 11\pi \]

Odd # of \pi \Rightarrow \text{ dark or minimum.} 

5 Points to know when max + min,

5 Points to find \Delta \phi

\[ \rightarrow 3 \text{ pts eq} \]

2 pts correct \( x \).

USEFUL INFORMATION

\[ n = \frac{c}{v} \quad \lambda = \frac{c}{v} \quad \Delta \phi = \frac{2\pi \Delta x}{\lambda} \]