Q- A riverside warehouse has two open doors and its walls are lined with sound absorbing material. A boat on the river sounds its horn. To a person A on the perpendicular bisector of the doors, at a distance D = 150 m from the doors, sound is loud and clear while to a person B, x = 30 m from A sideways, sound is barely audible. Assuming the person B is at the position of the first minimum, determine the distance between the doors, center to center, if the principle wavelength of the sound wave is 3.00 m.

Let the distance between the doors be 'd'. The central maximum is at A and the first minima is at position of B hence the path difference between the two waves at B must be $\lambda/2$.

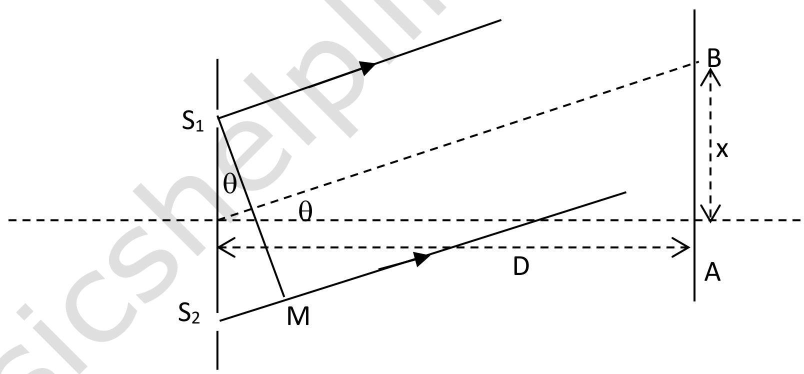
Now for D >> d, the path difference S_2M between the waves is given by

$$\delta = d * \sin\theta$$

Or $$\frac{\lambda}{2} = d * \sin\theta$$

and as the angle θ is small then we can write $\sin\theta = \tan\theta$ and it the distance of the point from the bisector be x and from the source is D, then we can write

$$\sin\theta = x/D$$



and the path difference at a point distance x from the bisector will be

$$\frac{\lambda}{2} = d * \frac{x}{D}$$

$$d = \frac{D\lambda}{2x}$$

or $$d = \frac{150*3}{2*30} = 7.5\ m$$