

16. At the location of the detector, the phase difference between the wave which traveled straight down the tube and the other one which took the semi-circular detour is

$$\Delta\phi = k\Delta d = \frac{2\pi}{\lambda}(\pi r - 2r) .$$

For $r = r_{\min}$ we have $\Delta\phi = \pi$, which is the smallest phase difference for a destructive interference to occur. Thus

$$r_{\min} = \frac{\lambda}{2(\pi - 2)} = \frac{40.0 \text{ cm}}{2(\pi - 2)} = 17.5 \text{ cm} .$$