An FM radio station has a frequency of 107.9 MHz and uses two identical antennas mounted at the same elevation, 12.0 m apart. The antennas radiate in phase. The resulting radiation pattern has a maximum intensity along a horizontal line perpendicular to the line joining the antennas and midway between them. Assume that the intensity is observed at distances from the antennas that are much greater than 12.0 m.
A) At which angles is the intensity maximum?
B) At which angles is it zero?

A) At large distances from the antennas the equation $d\sin\theta = m\lambda$, $m = 0, \pm1, \pm2, \cdots$ gives the angles where maximum intensity is observed and $d\sin\theta = (m+\frac{1}{2})\lambda$, $m = 0, \pm1, \pm2, \ldots$ gives the angles where minimum intensity is observed.

Given: $d = 12.0\text{ m}$. $\lambda = \frac{c}{f}$, $\lambda = \frac{c}{f} = \frac{3.00\times10^{8}\text{ m/s}}{107.9\times10^{6}\text{ Hz}} = 2.78\text{ m}$.

Maxima: $\sin\theta = \frac{m\lambda}{d} = m\left(\frac{2.78\text{ m}}{12.0\text{ m}}\right) = m(0.232)$.

$$\theta = \pm13.4°,\ \pm27.6°,\ \pm44.1°,\ \pm68.1°.$$

B) Minima: $\sin\theta = (m+\frac{1}{2})\frac{\lambda}{d} = (m+\frac{1}{2})(0.232)$.

$$\theta = \pm6.66°,\ \pm20.4°,\ \pm35.5°,\ \pm54.3°.$$

Observation: The angles for zero intensity are approximately midway between those for maximum intensity.