You may use your text book, notes, and a calculator.

Two loud speakers A,B are a distance L= 2.00 m apart. They each emit pure tones of frequency f= 206 Hz. The speed of sound in air is 344 m/s.

1) Along the line joining the speakers and between them, the ratio of the number of constructive interference positions to the number of destructive ones is

a) < 1  b) 1  c) > 1

\[ \lambda = \frac{v}{f} = \frac{344}{206} = 1.67 \text{ m}. \] Thus > 1\( \lambda \), but < 1.5\( \lambda \) can fit between the speakers.

Take a point \( P \) on the line between the speakers with distance from \( A = AP \) and distance from \( B = BP \). For constructive interference on the line connecting the speakers and between them, \( AP - BP = 0, \pm \lambda \) (3 places), while for destructive interference, \( AP - BP = \pm \lambda/2 \) (2 places). The ratio is > 1, (c)

2) The number of constructive interference positions between speakers is

a) 0  b) 1  c) 2  d) 3  e) none of these

The answer is 3 (given above), (d).

3) Consider a line through speaker B that is perpendicular to the line between the speakers. The ratio of the minimum distance along the former line for destructive interference to that of constructive interference is

a) < 1  b) 1  c) > 1

Note \( PAB \) form a right triangle. \( BP, AB \) are the sides and \( AP \) the hypotenuse. So
\( AP > BP, AP = \sqrt{4 + (BP)^2} \). For the minimum constructive interference value of
\( BP, AP - BP = \lambda \), while for destructive interference \( AP - BP = \lambda/2 \). Thus for con-
stuctive interference \( BP/AP \) is less than for destructive interference (just draw the right
triangles). Thus the ratio you want is \( > 1 \), (c). Below is the full calculation.

\[
AP = \sqrt{2.00^2 + (BP)^2}.
\]

For destructive interference the minimum \( BP \) is obtained from,
\[
\sqrt{2.00^2 + (BP)^2} - BP = \lambda/2.
\]
Thus, \( 2.00^2 + (BP)^2 = (BP)^2 + \lambda BP + \lambda^2/4 \) or \( BP = 4/\lambda - \lambda/4 = 1.98 \) m. For constructive interference, \( \sqrt{2.00^2 + (BP)^2} - BP = \lambda \), so \( BP = 2/\lambda - \lambda/2 = 0.363 \) m and the ratio is \( > 1 \), (c).