Sonic Doppler effect

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Solution: *a. First speaker (distance r_1):*

$$I_1 = \frac{P}{4\pi r_1^2} = 19.9\ \mu W/m^2\ .$$

Second speaker (distance r_2):

$$I_2 = \frac{P}{4\pi r_2^2} = 8.849\ \mu W/m^2\ .$$

b. Knowing that the frequency is constant, and that the intensity I is proportional to the square of the amplitude A, it is possible to calculate the intensity when the interference is fully constructive (intensity is maximum) by: $A = C\sqrt{I}$. Since the frequency is constant, C will be the same value at any given point. Adding the amplitudes, we get,

$$\sqrt{I_{max}} = A/C = \sqrt{I_1} + \sqrt{I_2}$$
$$I_{max} = (\sqrt{I_1} + \sqrt{I_2})^2 = 55.3\ \mu W/m^2\ .$$

c. Same as for the previous item, however, knowing that in totally destructive interference, the intensity is minimal and its amplitudes are subtracted, we get,

$$\sqrt{I_{min}} = A/C = \sqrt{I_1} - \sqrt{I_2}$$
$$I_{min} = (\sqrt{I_1} - \sqrt{I_2})^2 = 2.21\ \mu W/m^2\ .$$

d. Knowing that these are incoherent waves, we just add the intensities:

$$I = I_1 + I_2 = 19.9\ \mu W/m^2 + 8.849\ \mu W/m^2 = 28.7\ \mu W/m^2\ .$$