(1) A loudspeaker aperture 12 in. in diameter is putting out 5 W of acoustic power at a frequency around 500 cps. Estimate the amplitude of vibration of the air at the aperture.

The area of the aperture is 0.07 m^2; the power density in the outgoing wave is 70 W/m^2. For air of density ρ oscillating with amplitude A at frequency ω the kinetic energy in unit volume, averaged over one cycle, is $\rho A^2\omega^2/4$. Doubling that to get the total energy density in the wave and multiplying by the speed of sound V to get the power we have $70\ W/m = \rho A^2\omega^2 V/2$. Solving for A with $\rho = 1\ kg/m^3$, $\omega^2 = 10^7 s^{-2}$, and $V = 330$ m/s, we find $A = 0.2$ mm.