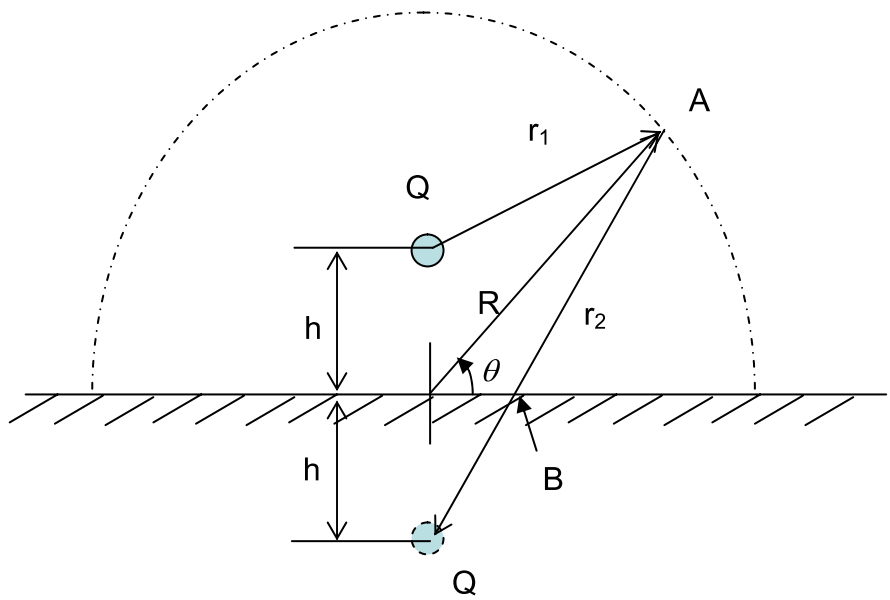
The figure shown below shows a typical sound power measurement setup in semi-anechoic chamber (all five surfaces of the room are anechoic, while the floor is rigid. In the figure, Q above the rigid surface is the actual sound source idealized as an acoustic monopole, Q below the rigid surface is the image source of the former.



(1) Show that the rigid surface condition (particle velocity normal to the surface = 0) is satisfied automatically by considering an image source as shown above.

(2) Using the monopole pressure equation, $p(r,t) = \frac{j\omega\rho_o Q}{4\pi r} e^{-jkr} e^{j\omega t}$, plot the pressure amplitude at points along the circle of radius R. Make plots of the amplitude ratios $\frac{P(\theta)}{P(\theta = 0^o)}$ when the frequency is 100Hz, 1,000 Hz and 2,000 Hz. Use R=1m, h=0.4m. Plotting in a polar form would be good. Because of the symmetry, plotting $0^o \le \theta \le \pi/2$ will be sufficient.

(3) Compare these three plots, and make discussions.