13.811
Advanced Structural Dynamics and Acoustics
Quiz - Acoustics
April 21, 2004

Question 1.

$$p_\omega(x,y;0) = \frac{1}{4\pi^2}\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} e^{-ik_z h} p_\omega(k_x,k_y,h) e^{ik_x x} e^{ik_y y} dk_x dk_y \tag{4}$$

Question 2.

$$p_\omega(x,y,h) = \sin(\frac{\omega x}{2c}) = \frac{e^{ik_{x0}x} - e^{-ik_{x0}x}}{2i} \tag{5}$$

where $k_{x0} = k/2 = \omega/2c$. Insert into eq. 1 and use EGW eqn. 1.5

$$p_\omega(k_x,k_y;h) = \frac{4\pi^2}{2i}[\delta(k_x - k_{x0}) - \delta(k_x + k_{x0})]\delta(k_y) \tag{6}$$

Insert into Eq. (4)

$$\begin{aligned} p_\omega(x,y;0) &= \frac{1}{2i}[e^{-ik_{z0}h}e^{ik_{x0}x} - e^{-ik_{z0}h}e^{-ik_{x0}x}] \\ &= e^{-ik_{z0}h}\sin(\frac{\omega x}{2c}) \end{aligned} \tag{7}$$

with $k_{z0} = \sqrt{k^2 - k_{x0}^2} = k\sqrt{1-0.25} = k\sqrt{3}/2$

Question 3.

Surface of radiater has a standing wavefield with crests parallel to the y-axis, generating two plane waves propagating at grazing angle $\cos^{-1}(1/2) = 60°$, interfering at all distances h to produce a standing wavefield in the horizontal plane, but propagating vertically