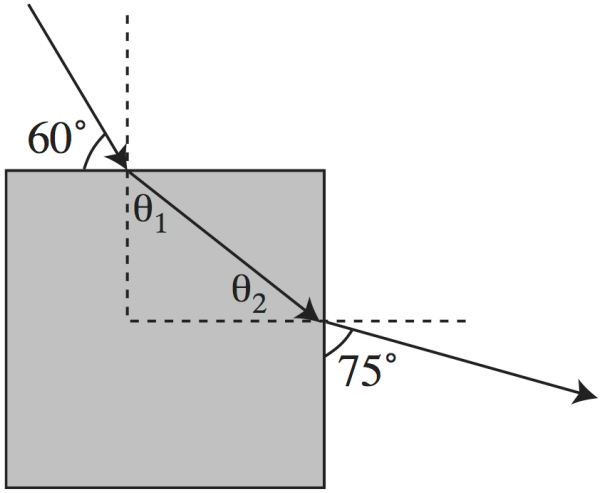
Homework 3 (EAS 4803: Planetary Sound - SPRING SEMESTER 2020)
Total points: 100; Due 01/31/2020

1. [20] Please write down a tentative title and a brief description of your final term paper project (you can email it to me by please do it before next Friday before the class). Please describe how you would access the data (either by recording them by yourself or download them from online data centers). Finally, please list your teammate. The answers could be the same between you and your teammate.

ANS: Up to each team.

2. [20] A downgoing P wave in a medium with a P velocity of 6 km/s travels through this "corner" shaped structure (Right). If the incident ray is at an angle of 60° from the horizontal and the final ray is at an angle of 75° from the vertical, what is the P velocity within the corner shaped medium?



Let u be the slowness of the cube. From Snell's law we then have

$$\begin{aligned}(1/6)\sin 30^\circ &= u\sin\theta_1 \\ (1/6)\sin 15^\circ &= u\sin\theta_2 = u\cos\theta_1\end{aligned}$$

or

$$\frac{\sin 30^\circ}{\sin 15^\circ} = \frac{\sin\theta_1}{\cos\theta_1} = \tan\theta_1$$

which gives us $\theta_1 = 62.6^\circ$. We can then solve for $u = 0.094$ s/km and obtain that the velocity of the cube is 10.65 km/s.

3. [30] For a medium composed of upper, middle and lower layers with velocities of 6, 8, and 10 km/s, calculate the angle of incidence in the 8 and 10 km/s layers for a ray with an incident angle of 10o in the 6 km/s layer. What is the smallest angle of incidence in the 6 km/s layer that causes total internal reflection at the 8 km/s-10 km/s interface?

$\alpha_u = 6$ km/s, $\alpha_m = 8$ km/s, $\alpha_l = 10$ km/s, $i_u = 10°$.

Snell's law: $\dfrac{\alpha_u}{\sin i_u} = \dfrac{\alpha_m}{\sin i_m} = \dfrac{\alpha_l}{\sin i_l}$.

Middle layer: $\sin i_m = \dfrac{\alpha_m \sin i_u}{\alpha_u} \approx 0.2315$ so $i_m \approx 13°$.

Lower layer: $\sin i_l = \dfrac{\alpha_l \sin i_m}{\alpha_m} \approx 0.2894$ so $i_l \approx 17°$.

Critical angle: $\sin i_c = \dfrac{\alpha_u}{\alpha_l} = 0.6$ so $i_c \approx 37°$.

4. [30] For the two cases of an incident wave hitting a plate boundary between two medias shown below,
a. Determine which waves are P waves and which are S waves.
b. Determine which media are liquid and which are solid.
c. For the two media in each case, determine which has the higher P-wave velocity.

ANS:

a) For the first diagram, A, B and C are *P* waves, while D is an *S* wave. For the second diagram C and D are *P* waves, while A, B and E are *S* waves.

b) For the first diagram the top is a liquid, while the bottc media are solid.

c) For the first diagram, the bottom medium has the higl gram, the top medium has the higher *P*-wave velocity.