

EARTH FORCES
PROBLEM SET -- Seismology + Earth's Interior
DUE: Feb 13, 2008

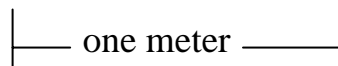
1. Rayleigh waves travel at a velocity of about 3.5 km/s. What is the wavelength of Rayleigh waves with a period of 10 s? How about 100s? 300 s ? Which period would have the greatest sensitivity to small scale lateral changes in seismic wave velocity? Which period would have the ability to resolve the seismic velocity at great depths?

2. A soldier in the trenches feels the ground vibrate, and 20 s later hears the artillery shell explode. Estimate how far away the shell exploded. What assumptions did you make?

3. a) Write the equation for a transverse wave travelling along a string with amplitude 0.01 meter, a frequency of 40 Hertz, and a velocity of 300 meter/sec.

b) What is the maximum transverse velocity of the string?

4. We set up the following experiment in the lab:



elastic wave source homogeneous rock seismometer

Find that the travel time for P waves through the rock is 1.85×10^{-4} seconds. The S wave travel time is found to be 3.03×10^{-4} seconds. From other measurements the density of the rock is known to be 3 gm/cm^3 . From this information find:

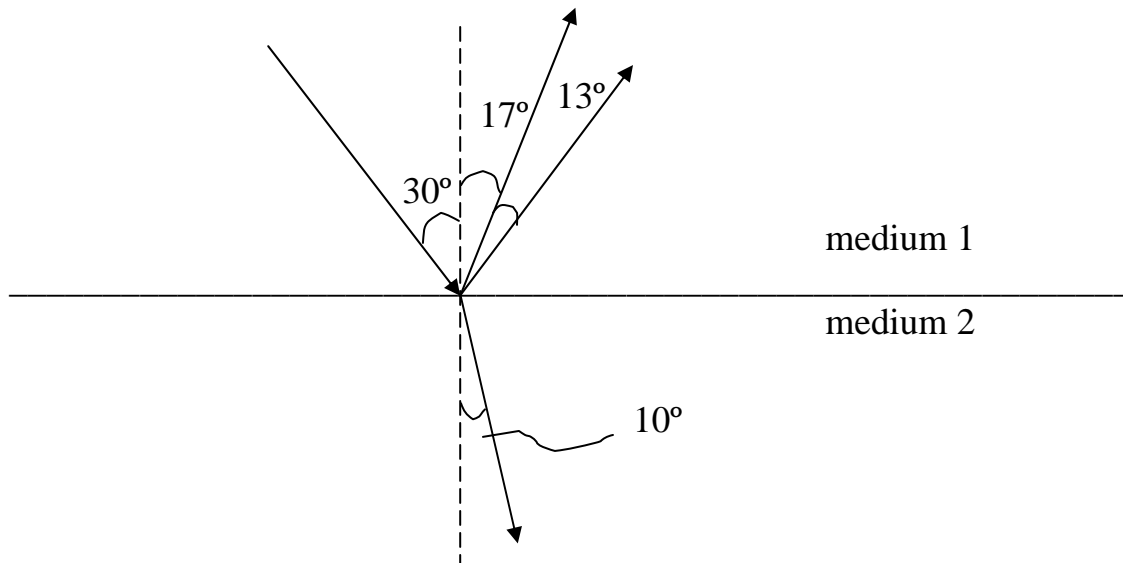
- a) The P wave velocity
- b) The S wave velocity
- c) λ and u , the elastic constants

d) It is often assumed that earth materials are a Poisson solid, which is characterized by $\lambda = \mu$. Is this a Poisson solid?

5. a) Given 3 layers with $\alpha = 6, 8, \text{ and } 10 \text{ km/sec}$, calculate the angle of a ray in the 10 km/sec layer if its incidence angle is 10° in the 6 km/sec layer.

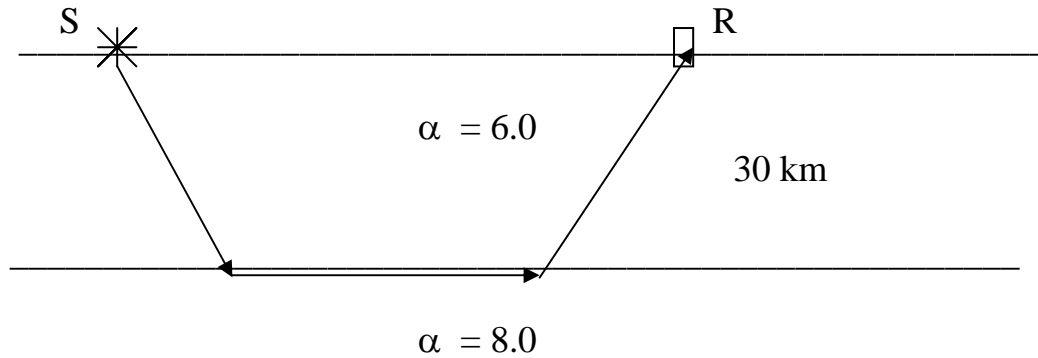
b) What incidence angle in the 6 km/sec layer causes total internal reflection at the 8 km/sec - 10 km/sec interface?

6. a) A ray incident on a surface results in 3 reflected and refracted rays. If the seismic velocities in medium 1 are $\alpha = 6.0 \text{ km/sec}$, $\beta = 3.5 \text{ km/sec}$, what are the seismic velocities in medium 2? What type of material is medium 2? Identify rays #1, #2, #3, #4 as P or S waves.



b) If the frequency of the incident wave is 2 Hertz, what is the frequency of the other rays? Give the wavelength of all rays.

7. You are designing a refraction survey of a region where the structure is



Since the refracted ray is only well recorded when it is the first arrival, how long must the line be to record the Moho refraction? At this distance what is the arrival time of the refracted ray? The direct ray? Reflected ray?

8. What would be the travel times and amplitudes of the reflected rays (back at the surface) from the following section (assume vertical incidence, plane waves, and neglect geometric spreading)

