# Unit 2: How seismic waves bend in the ground

## Multiple choice questions

What type of ground movement is caused by ‘p-waves,’ the fastest seismic wave?

1. Side-to-side
2. Up-and-down
3. Compressional
4. Rolling

The critically refracted ray is important because:

1. It bends the waves at an interface back towards the surface where we can measure them
2. It provides a direct two-way travel time to calculate velocity from
3. It is the first wave to arrive at the surface sensors
4. It goes the deepest underground

Diagrams of the subsurface are most likely to be:

1. Highly detailed, based on extensive excavation and digging
2. Simple, based on basic observations we can make from the surface
3. In three dimensions, and include information about groundwater movement
4. Entirely based on guesses

\_\_\_\_\_ is an example of a seismically FAST materials and \_\_\_\_\_\_ is an example of a seismically SLOW material

1. Soil; Bedrock
2. Sedimentary Rock; Air
3. Water; Sand
4. Water; Granite

Snell’s Law predicts that waves should bend back towards the ground surface when there is a 2-layered system:

1. Where the upper layer is sand and the lower layer is bedrock
2. Where the upper layer is sandstone and the lower layer is soil
3. Where the upper layer is saturated and the lower layer is dry
4. Where the upper layer is less porous and the lower layer is more porous

The t-intercept or “T1” may be obtained from:

1. The first sensor of the ground surface next to the hammer seismic source
2. Back-projecting the slope of V2 on the travel-time/offset plot
3. Finding the first time at which the headwave displays a refraction velocity
4. The first sensor that records a reflection event

## Short Answer Questions

1. *Explain the steps that would be used to calculate the velocity of the lower layer using a travel-time/offset plot.*
2. *If V1 = 500 m/s and V2 = 1000 m/s and the thickness of the top layer is 5 meters, would a signal measured at 5 meters from the seismic source be a ground wave or a refraction? At 20 m?*
3. *Calculate a plausible incident angle when the ray is critically refracted for a subsurface where layer 1 material is soil and the layer 2 material is bedrock.*
4. *Draw a diagram of a two-layer subsurface and assign thickness and velocities to each layer. Then, draw the following ray paths: reflected ray, critically refracted ray, ground wave, and transmitted ray.*
5. *Explain why a refracted ray can arrive at a sensor before the direct ground wave even though the total distance that the refracted ray traveled in the subsurface is longer.*