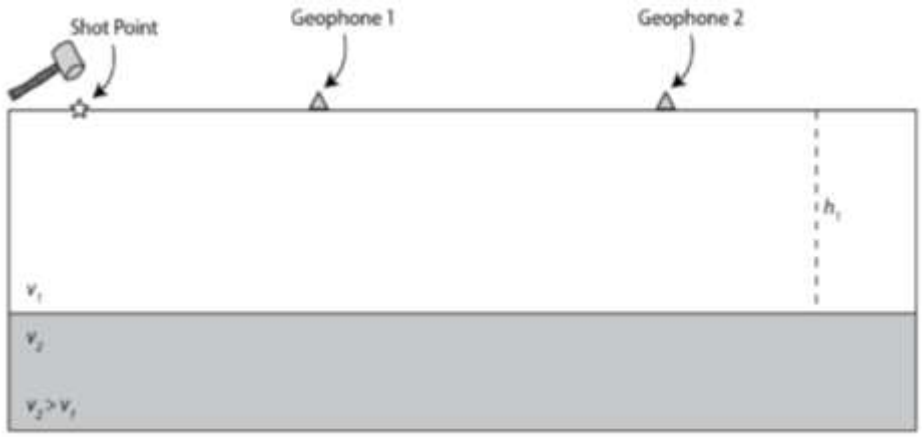
## Seismic refraction exercises

### Exercise 1: seismic refraction

(a) On the picture below, draw and label the paths of the direct ray, the reflected ray, and the refracted ray to both geophones.
Note that geophone 1 is at the critical distance and geophone 2 is at the crossover distance.
You don't have to make your drawing perfectly to scale, but use a straight edge and label the critical angle ($i_c$) everywhere that it occurs.
Only draw and label the rays that are recorded at these two geophones




(b) Which ray is the first arrival at distances less than geophone 1's location?

(c) What ray arrives first between geophone 1 & 2? Why?

(d) What ray arrives first between geophone 2? Why?

(e) Which ray is never the first arrival? Why?

(f) What are the equations for the arrival times of the direct ray and the first refracted ray given the layer thicknesses and the layer velocities?

### Exercise 2: seismic refraction

(a) Construct a t-x diagram using the data below.

(b) How many layers did you detect?

(c) What are the velocities of each layer?

(d) How many layer thicknesses can you determine from this data?

| Distance (m) | Travel Time (milliseconds) |
|---|---|
| 5 | 7.1 |
| 10 | 14.3 |
| 15 | 21.4 |
| 20 | 28.6 |
| 25 | 35.7 |
| 30 | 42.9 |
| 35 | 48.5 |
| 40 | 51.0 |
| 45 | 53.5 |
| 50 | 56.0 |
| 55 | 58.4 |
| 60 | 60.9 |
| 65 | 63.4 |
| 70 | 65.9 |
| 75 | 68.4 |
| 80 | 70.8 |
| 85 | 73.3 |
| 90 | 75.8 |
| 95 | 77.5 |
| 100 | 78.3 |
| 105 | 79.1 |
| 110 | 80.0 |
| 115 | 80.8 |
| 120 | 81.6 |

## Exercise 3: seismic refraction

(a) Construct a t-x diagram using the data below.

(b) What does this data tell you about the interface(s) geometry at depth? It is horizontal, dipping, and/or undulating?

| Distance (m) | Forward Time (msec) | Reverse Time (msec) |
|---|---|---|
| 10 | 33.3 | 33.3 |
| 20 | 66.7 | 66.7 |
| 30 | 100.0 | 100.0 |
| 40 | 111.4 | 119.8 |
| 50 | 114.3 | 125.1 |
| 60 | 117.3 | 134.1 |
| 70 | 120.2 | 137.0 |
| 80 | 123.1 | 140.0 |
| 90 | 133.6 | 142.9 |
| 100 | 138.9 | 145.8 |
| 110 | 144.1 | 148.8 |
| 120 | 149.4 | 151.7 |

## Exercise 4: seismic reflection

Interpret the seismic profile in term of interfaces and interface and faults.