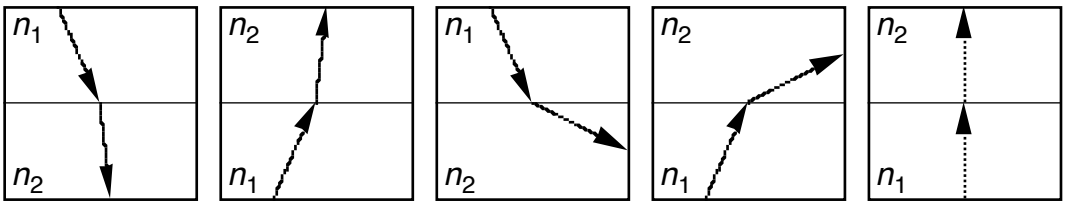
Exercises

1. A ray of light traveling in air strikes the surface of water at an angle of 25° from the normal. At what angles are the reflected and refracted rays?

2. A ray of light traveling in air strikes the surface of diamond at an angle of 25° from the normal. At what angles are the reflected and refracted rays?

3. Here are light rays being refracted at the boundary between two materials. Shade in the material that has the higher index of refraction in each case.



How would you answers change if the directions of the light rays were reversed?

4. On each sketch in #3, draw a normal line and label the angle you would use in applying the Law of Refraction.

5. A ray of light traveling in air strikes the surface of water at an angle of 30 degrees above the surface.
(a) Draw a picture showing the incident light ray, the surface, the 30 degrees angle, and the normal line.
(b) Determine the angle of the reflected ray
(c) Determine the angle of the refracted ray.

6. What is the velocity of light in zircon (n=1.923)?

7. What will the critical angle be for a light ray trying to go from ice (n=1.31) to air?

Exercise Solutions

1. The reflected angle will be 25°. You can find the refracted angle by using $n_1 \sin\theta_1 = n_2 \sin\theta_2$; which gives us an angle of 18.53°.

2. The reflected angle will be 25°. You can find the refracted angle by using $n_1 \sin\theta_1 = n_2 \sin\theta_2$; which gives us an angle of 10.07°.

3. The medium with the higher index of refraction are, respectively: n_2, n_2,n_1, n_1, and undetermined. Nothing changes if the light rays were reversed.

4. The normal line in these cases is vertical. The angle ***must*** be measured from normal!

5. (a) If the angle is 30 degrees above the surface, it is 60 degrees from the normal line. Make sure your sketch is correct.
(b) Reflection: $\theta_{incident}=\theta_{reflected}$. Angle is 60 degrees from normal.
(c) Refraction: $n_1 \sin\theta_1 = n_2 \sin\theta_2$

6. Using the equation, $c = nv$ we find that $v= 1.56 \times 10^8$ m/s.

7. Using the equation, $n_1 \sin\theta_c = n_2 \sin 90°$ we find that the critical angle is 49.76°.