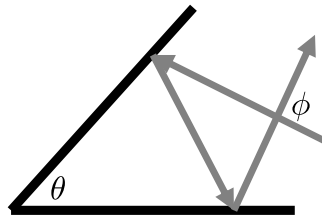


- (4 pts) If a ray of light travels from one medium to the other, under what conditions will the light bend toward the normal? Under what conditions will it bend away from the normal?
- (3 pts) When light goes from one medium to the other, which of the following changes: (a) the speed that the wave travels at, (b) the frequency of the light wave, (c) the wavelength of the light wave?
- (6 pts) A beam of light from a sodium lamp has a wavelength of 589 nm in air. The beam travels through the air and then strikes the surface of a bucket of water at an angle of 44.2 degrees from the normal. (a) What is the angle of the light in the water (measured from the normal of the water)? (b) What is the wavelength of the light when it is in the water? Assume that the index of refraction is 1.333 at this wavelength.
- (8 pts) A diver under water looks up through the surface of the water at an airplane flying overhead. The airplane appears to her to be at an angle of 38.2 degrees from the vertical. What is the actual angle to the airplane from the vertical? Assume that the airplane is flying very high compared to the depth of the diver.
- (9 pts) In my research we use several prisms which deflect light by a given angle by reflecting it off of two surfaces which have a fixed angle relative to one another, as shown in the figure below. Find the angle between the incoming and outgoing beams of light, ϕ , in terms of the angle between the mirrors, θ . Hint: what do you get when you add all three angles of a triangle?



Extra problems I recommend you work (not to be turned in)

- Why does a mirage occur?
- Use the principle of refraction to explain how a lens can focus light.
- Two mirrors are each 10 cm wide and are placed 1 cm apart parallel to one another. A beam of light just misses the edge of one mirror, and strikes the other at an angle of 10° from the normal. (a) How many times will the beam of light reflect off of the two mirrors? (b) How far will the light travel between the first and last reflection off of the mirrors?
- The speed of sound in air is 343 m/s. In water it is 1480 m/s. If a sound wave in air strikes the surface of a lake at an angle of 23 degrees from the normal, at what angle from the normal will the transmitted wave travel in the water?