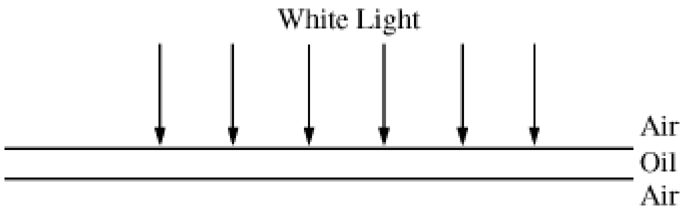
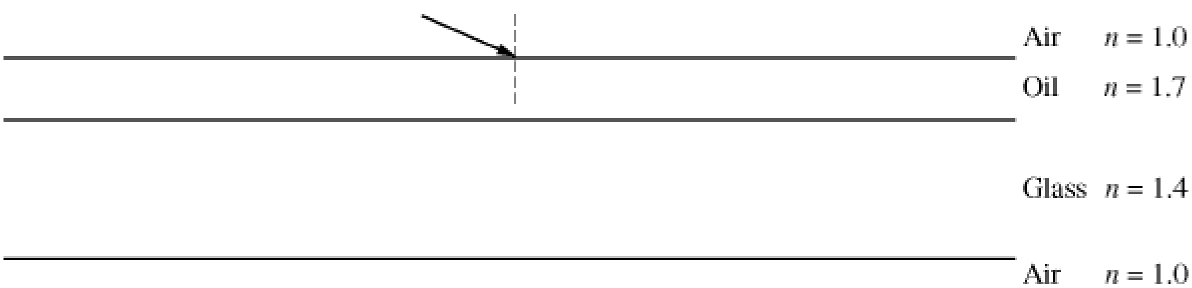


2009 B5:

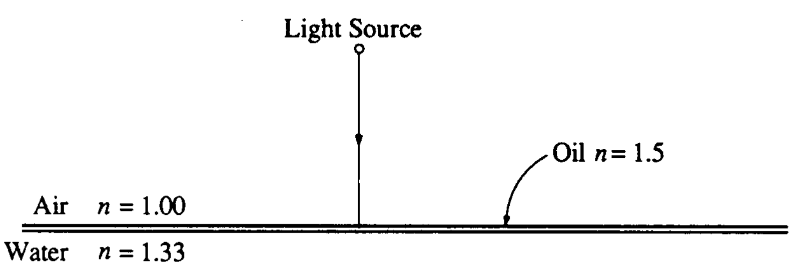
A wide beam of white light is incident normal to the surface of a uniform oil film. An observer looking down at the film sees green light that has maximum intensity at a wavelength of 5.2×10^{-7} m. The index of refraction of the oil is 1.7.

(a) Calculate the speed at which the light travels within the film.
(b) Calculate the wavelength of the green light within the film.
(c) Calculate the minimum possible thickness of the film.
(d) The oil film now rests on a thick slab of glass with index of refraction 1.4, as shown in the figure below. A light ray is incident on the film at the angle shown. On the figure, sketch the path of the refracted light ray that passes through the film and the glass slab and exits into the air. Clearly show any bending of the ray at each interface. You are NOT expected to calculate the sizes of any angles.



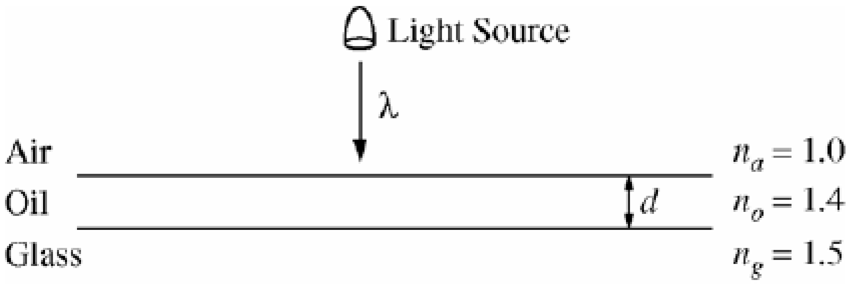
1990B6. A beam of light from a light source on the bottom of a swimming pool 3.0 meters deep strikes the surface of the water 2.0 meters to the left of the light source, as shown above. The index of refraction of the water in the pool is 1.33.

a. What angle does the reflected ray make with the normal to the surface?
b. What angle does the emerging ray make with the normal to the surface?
c. What is the minimum depth of water for which the light that strikes the surface of the water 2.0 meters to the left of the light source will be refracted into the air?



In one section of the pool, there is a thin film of oil on the surface of the water. The thickness of the film is 1.0×10^{-7} meter and the index of refraction of the oil is 1.5. The light source is now held in the air and illuminates the film at normal incidence, as shown above.

d. At which of the interfaces (air-oil and oil-water), if either, does the light undergo a 180° phase change upon reflection?
e. For what wavelengths in the visible spectrum will the intensity be a maximum in the reflected beam?



In a classroom demonstration of thin films, your physics teacher takes a glass plate and places a thin layer of transparent oil on top of it. The oil film is then illuminated by shining a narrow beam of white light perpendicularly onto the oil's surface, as shown above. The indices of refraction of air, the oil, and the glass plate are given in the diagram. Standing near the light source, you observe that the film appears green. This corresponds to a wavelength of 520 nm.

(a) Determine each of the following for the green light.

i. The frequency of the light in air

ii. The frequency of the light in the oil film

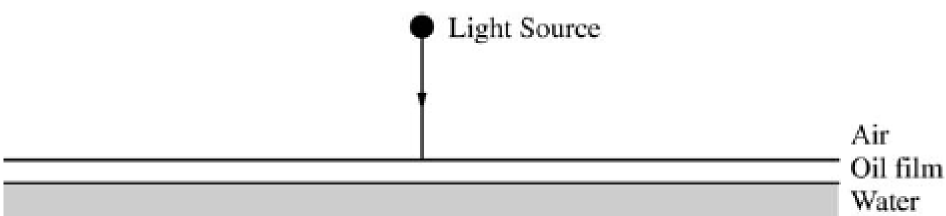
iii. The wavelength of the light in the oil film

(b) Calculate the minimum thickness of the oil film (other than zero) such that the observed green light is the most intense.

(c) As your teacher changes the angle of the light source, the light you observe from the film changes color. Give an explanation for this phenomenon.

2006 B4 (part b)

The student is also asked to determine the thickness of a film of oil (n = 1.43) on the surface of water (n = 1.33).



Light from a variable wavelength source is incident vertically onto the oil film as shown above. The student measures a maximum in the intensity of the reflected light when the incident light has a wavelength of 600 nm.

(d) At which of the two interfaces does the light undergo a 180º phase change on reflection?

___The air-oil interface only ___The oil-water interface only

___Both interfaces ___Neither interface

(e) Calculate the minimum possible thickness of the oil film.