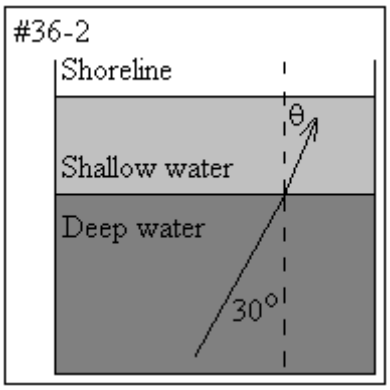
**Phsx 2220 - Homework #10**

36-1. The wavelength of yellow sodium light in air is 589 nm. (a) What is its frequency? (b) What is its wavelength in glass whose index of refraction is 1.52? (c) From the results of (a) and (b) find its speed in this glass.

36-2. Ocean waves moving at a speed of 4.0 m/s are approaching a beach at an angle of 30° to the normal, as shown at right. Suppose the water depth changes abruptly at a certain distance from the beach and the wave speed there drops to 3.0 m/s. Close to the beach, what is the angle θ between the direction of wave motion and the normal? (Assume the same law of refraction as for light.) Explain why most waves come in normal to a shore even though at large distances they approach at a variety of angles.




36-3. Monochromatic green light, of wavelength 550 nm, illuminates two parallel narrow slits 7.70 μm apart. Calculate the angular deviation θ of the third-order (for m = 3) bright fringes (a) in radians and (b) in degrees.

36-4. In a double-slit experiment, λ = 546 nm, the distance between the slits is d = 0.10 mm, and the distance from the slits to the viewing screen is D = 20 cm. On the screen, what is the distance between the fifth maximum and the seventh minimum from the central maximum?

36-5. Light of wavelength 624 nm is incident perpendicularly on a soap film (n = 1.33) of thickness 1.21 μm, suspended in air. What are the smallest two thicknesses of the film for which the reflections from the film undergo fully constructive interference?

36-6. A lens with index of refraction greater than 1.30 is coated with a thin transparent film of index of refraction 1.30 to eliminate by interference the reflection of red light at wavelength 680 nm that is incident perpendicularly on the lens. What minimum film thickness is needed?

37-7. Monochromatic light of wavelength 441 nm is incident on a narrow slit. On a screen 2.00 m away, the distance between the second diffraction minimum and the central maximum is 1.50 cm.
(a) Calculate the angle of diffraction θ of the second minimum.
(b) Find the width of the slit.

37-8. The distance between the first and fifth minima of a single-slit diffraction pattern is 0.35 mm with the screen 40 cm away from the slit, using light of wavelength 550 nm. (a) Find the slit width. (b) Calculate the angle $\theta$ of the first diffraction minimum.

37-9. Under ideal conditions, estimate the linear separation of two objects on the planet Mars that can just be resolved by an observer on Earth (a) using the naked eye and (b) using the 200 inch (= 5.1 m) Mount Palomar telescope. Use the following data: distance to Mars = $8.0 \times 10^7$ km; diameter of pupil = 5.0 mm; wavelength of light = 550 nm.

37-10. A diffraction grating 1.0 cm wide has 10,000 parallel slits. Monochromatic light that is incident normally is deviated through $30^\circ$ in the first order. What is the wavelength of the light?

37-11. (a) How many rulings must a 4.00-cm-wide diffraction grating have to resolve the wavelengths of 415.496 and 415.487 nm in the second order? (b) At what angle are the maxima found?

37-12. X rays of wavelength 0.12 nm are found to undergo second-order reflection at a Bragg angle of $28^\circ$ from a lithium fluoride crystal. What is the interplanar spacing of the reflecting planes in the crystal?