1) The observer in the figure is positioned so that the far edge of the bottom of the empty glass is just visible. When the glass is filled with water (n=1.33), the center of the bottom of the glass is just visible to the observer. Find the height, H, of the glass, given that its width is W=6.2cm.

![Diagram of glass and observer](image1)

2) A glass paperweight with an index of refraction n rests on a desk, as shown. An incident ray of light enters the horizontal top surface of the paperweight at an angle $\theta=77^\circ$ to the vertical. Find the minimum value of n so that there is total internal reflection on the left side, as shown.

![Diagram of paperweight and incident ray](image2)

3) An air wedge is formed by placing a human hair between two glass plates on one end, and allowing them to touch on the other end. When this wedge is illuminated with red light ($\lambda=771nm$), it is observed to have 179 dark fringes. How thick is the hair?

![Diagram of air wedge](image3)
4) The diffraction pattern shown in the figure is produced by passing He-Ne laser light ($\lambda=632.8\text{nm}$) through a single slit and viewing the pattern on a screen 1.5m behind the slit.
   a) What is the width of the slit?
   b) If monochromatic yellow light of wavelength 591nm is used with this slit instead, will the distance in the figure be greater or less than 15.2cm?

5) Experiments show that the ground spider *Drassodes cupreus* uses one of its several pairs of eyes as a polarization detector. In fact, the two eyes in this pair have polarization directions that are at right angles to one another. Suppose linearly polarized light with an intensity of 825 W/m$^2$ shines from the sky onto the spider, and that the intensity transmitted by one of the polarizing eyes is 212 W/m$^2$.
   a) For this eye, what is the angle between the polarization direction of the eye and the polarization direction of the incident light?
   b) What is the intensity transmitted by the other polarizing eye?

6) The asteroid Ida is orbited by its own small “moon” called Dactyl. If the separation between these two asteroids is 2.5km, what is the maximum distance at which the Hubble Space Telescope (aperture diameter 2.4m) can still resolve them with 550nm light?