Mathematics 309 — Spring 2004 — First homework

Due Wednesday, January 14.

1. Draw red light rays coming from above a flat water surface at incident angles of $0°$, $\pm 10°$, $\ldots$, $90°$ and converging onto a point 1 meter below the surface. Label the refraction angles. Draw very, very carefully, at a scale of 1 meter = 5 centimeters, with the water surface halfway up a page.

2. Draw the path of several light rays leaving the plane at $x = -2$, intersecting a glass hemi-sphere of unit radius centred at $(0, 0)$ ($n = 1.5$), and then exiting at the back to intersect a plane at $x = 2$. List carefully in some way the points of interest. Do the pairs $(y, \theta) = (0, 0)$, $(\pm 1, 0)$, $(0, \pm 5°)$. Exhibit (y, θ) at $x = 2$.

3. Place a unit sphere at centre $(0, 0)$; assume it filled with water. Trace a light ray starting far to the left, height $y = 0.5$, moving to the right horizontally, entering the sphere, reflecting off the back, and coming out the front. Label data carefully.