NAME / Section #: _____ / _____	Exam II Problem #2 Phys270

2. [25 pts] A deep sea diver wearing a spherical plastic helmet of diameter 0.50 m looks directly at a fish, and the fish looks directly back. The fish is 2.00 m from the helmet, and the the diver's eye is 0.20 m from the helmet. Ignore any refraction effects from the plastic helmet itself (that is, assume that the plastic helmet is infinitely thin). The index of refraction of water is 1.33.

a) [12 pts] How far does the fish appear to be from the surface of the helmet as observed by the diver?
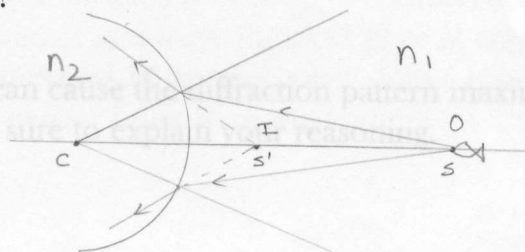
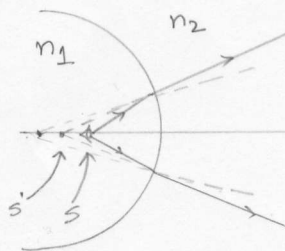$$n_1 = \frac{4}{3} = 1.33$$
$$n_2 = 1$$
$$s = 200\,cm$$
$$R = +25\,cm$$

$$\frac{n_1}{s} + \frac{n_2}{s'} = \frac{n_2 - n_1}{R}$$

$$\frac{\frac{4}{3}}{200} + \frac{n_2}{s'} = \frac{1 - \frac{4}{3}}{+25}$$

$$\therefore \quad \frac{1}{s'} = -\frac{1}{150} - \frac{1}{75} = -\frac{1}{50}$$

$$s' = -50\,cm$$

b) [13 pts] How far does the diver's eye appear to be from the surface of the helmet as observed by the fish?

$$n_1 = 1.00$$
$$n_2 = \frac{4}{3} = 1.33$$
$$R = -25\,cm$$
$$s = 20\,cm$$

$$\frac{n_1}{s} + \frac{n_2}{s'} = \frac{n_2 - n_1}{R}$$

$$\Rightarrow \quad \frac{1}{20} + \frac{\frac{4}{3}}{s'} = \frac{\frac{1}{3}}{-25} = -\frac{1}{75}$$

$$\Rightarrow \quad \frac{4}{3s'} = -\frac{1}{75} - \frac{1}{20}$$

$$\Rightarrow \quad \frac{1}{s'} = -\frac{1}{100} - \frac{3}{80} = -\frac{19}{400}$$

$$\therefore \quad s' = -\frac{400}{19} \approx -21\,cm$$