Modern Optics, Prof. Ruiz, UNCA
Chapter K Homework. Aberrations.

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Violet	~ 425 nm	
Blue	~ 475 nm	
Green	~ 525 nm	
Yellow	~ 575 nm	
Orange	~ 625 nm	
Red	~ 675 nm	

HW-K1. Dispersion in Water. When Professor Booker and I taught astronomy years ago, we found many schools simplifying the spectrum by assigning 50 nm for each of the basic 6 color regions. So we used that scheme for our UNCA astronomy lab. Though some color regions are narrower and some larger, if you start with 425 nm and keep adding 50 nm you do get sample colors in all 6 regions. The index of refraction for water at these wavelengths appear in the table below

color	Violet	Blue	Green	Yellow	Orange	Red
λ (nm)	425	475	525	575	625	675
n (water)	1.338	1.336	1.334	1.333	1.332	1.331

a) Find a general formula $x = x(\theta,d,n)$ for the dispersion shown in the pool below.
b) For $\theta = 45.00°$ and d = 4.000 meters, give x_v, x_b, x_g, x_y, x_o, and x_r in cm to 4 significant figures using the corresponding refractive indexes in the above table. Give $\Delta = x_r - x_v$ to the nearest mm.
c) What does your general formula reduce to for small angles?
d) For $\theta = 5.000°$ and d = 4.000 m, give x_v, x_r, and $\Delta = x_r - x_v$ with your exact and approximate formulas, where x_v and x_r are reported to 4 significant figures and Δ is reported to the nearest mm.

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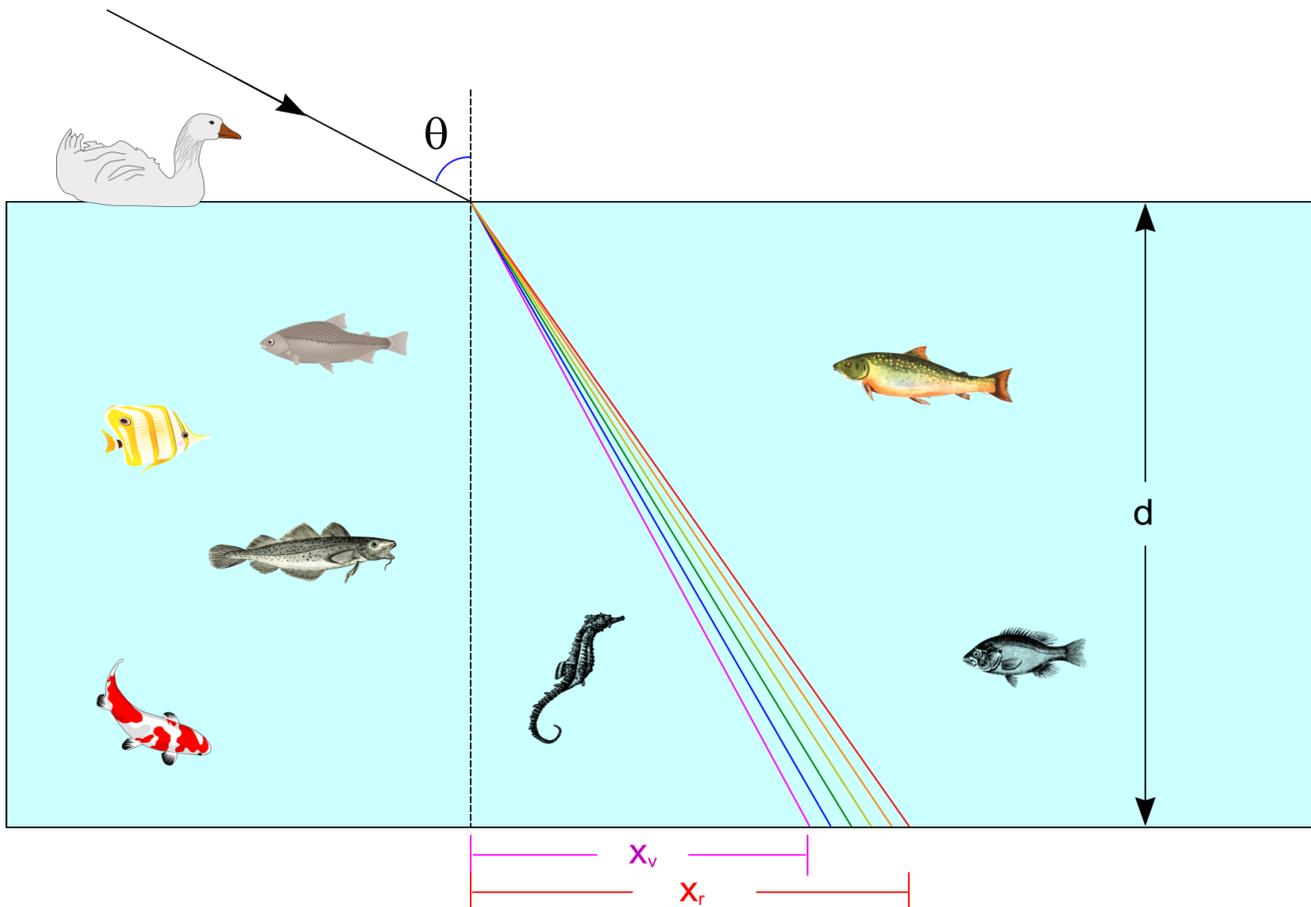
Design an achromatic doublet shown below that has an effective focal length of f = 50.0 mm. Note that the decimal and following zero in 50.0 indicate 3 significant figures. Calculate R and R'_2 to three significant figures. Is the rear surface convex or concave? Then give the focal lengths for the components f_1 and f_2 to three significant figures. Chemists will be happy with us since our f and the Abbe numbers are to 3 significant figures, while the refractive indexes are to 4 significant figures. Since the least number of significant figures for the input parameters is 3, we should report final answers to 3 significant figures. Chemists keep physicists on the ball when it comes to significant figures. During intermediate steps keep at least 4 significant figures and round off last.

Crown Glass K5: n_D = 1.523 and V_D = 59.5

Dense Flint SF5:
n_D = 1.673 and V_D = 32.3

$|R_1| = R$

$|R'_1| = R$

$|R_2| = R$

$|R'_2| = ?$

1   2