HW-I1. Alien Pupil Size.

Courtesy Evanna Lawrence Free Bulldog Clipart Pictures

An alien has a pupil than ranges in diameter from 1 mm to 11 mm. The alien has two kinds of vision: day vision and night vision. For this problem everything is bright enough so that the alien will use day vision and not need the night vision to kick in.

The alien is in a space ship and sees a bright space station 1 km away. The alien's pupil size is 1 mm looking at the space station. Then, the alien keeps watching the space station as the space craft recedes from the space station to 2 km, 3 km, and eventually to 8 km. The alien's pupil diameter enlarges during the trip so that the same total amount of light hits the alien's receptors at all times.

The focal length for the alien's eyes is f = 22 mm.

a) Independent of aliens, first give the f/# sequence from 1 to 22, but with two digits to the right of the decimal point for each element in the sequence, i.e., we want the f-numbers to the nearest hundredth.

#	1	1.4	2	2.8	4	5.6	8	11	16	22
To the nearest 0.01	1.00	1.41	2.00	2.83	4.00	5.66	8.00	11.31	16.00	22.63

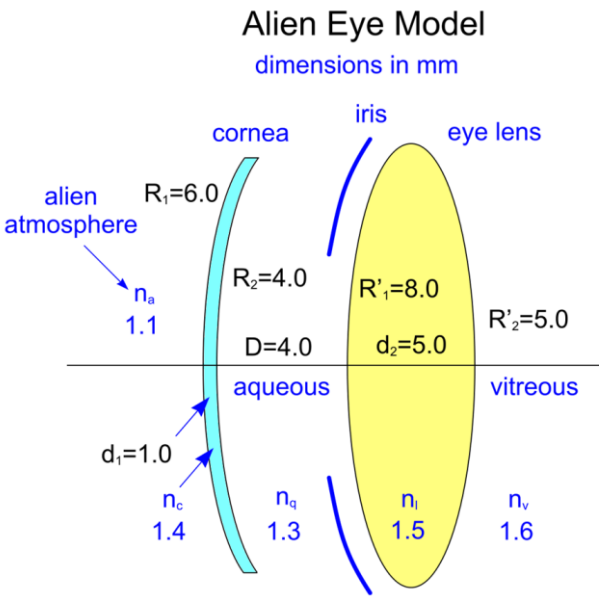
b) According to the inverse-square law, give the relative strength of the light at distances from the bright space station by completing the table below to two digits to the right of the decimal point.

Distance (km)	1	2	3	4	5	6	7	8
Percent of Light	100.00	25.00	11.11	6.25	4.00	2.78	2.04	1.56

c) To the nearest 0.01, give # as in f/# for the alien's aperture, viewing the space station at the indicated distances from the space station. Also, give the diameter of the alien's aperture for each case to one digit to the right of the decimal point, e.g. 2.4 mm, 4.0 mm, etc.

Distance (km)	1	2	3	4	5	6	7	8
Alien's # as in f/#	22.00	11.00	7.33	5.50	4.40	3.67	3.14	2.75
Alien's aperture d (mm)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0

HW-I2. Alien Dioptric Power.



An alien in the Andromeda galaxy is found to have a similar biological structure of the visual system to humans. Calculate the dioptric power of the alien eye shown below, when the alien is in the alien atmosphere with atmospheric index of refraction n_a = 1.1. For full credit, indicate the dioptric power for the a) cornea, b) eye lens, and c) total visual system, each finally rounded off to the nearest tenth of a diopter. You may approximate the separation distance between the secondary principal plane of the cornea to the first principal plane of the eye lens to be the same D = 4.0 mm that separates the surfaces.

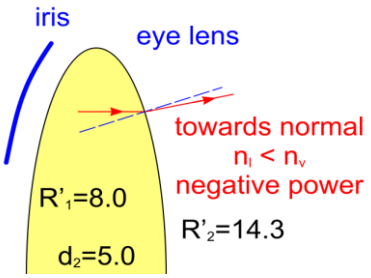
a) Cornea

$$P_{\text{front}} = P_1 = \frac{1}{f_1} = \frac{(n_c - n_a)}{R_1} = \frac{1.4 - 1.1}{0.006} = 50.00 \text{ D}$$

$$P_{back} = P_2 = \frac{1}{f_2} = \frac{(n_q - n_c)}{R_2} = \frac{1.3 - 1.4}{0.0040} = -25.00 \text{ D}$$

$$P_{cornea} = P_1 + P_2 - \frac{d}{n_c} P_1 P_2 = 50.00 - 25.00 - \frac{0.001}{1.4}(50.00)(-25.00) = 25.89 = 25.9 \text{ D}$$

b) Eye Lens



$$P_{\text{front}} = P_1 = \frac{1}{f_1} = \frac{(n_l - n_q)}{R_1'} = \frac{1.5 - 1.3}{0.008} = 25.00 \text{ D}$$

$$P_{back} = P_2 = \frac{1}{f_2} = \frac{(n_v - n_l)}{R_2'} = \frac{1.6 - 1.5}{-0.005} = -20.00 \text{ D}$$

$$P_{lens} = P_1 + P_2 - \frac{d}{n_l} P_1 P_2 = 25.00 - 20.00 - \frac{0.005}{1.5}(25.00)(-20.00) = 6.667 = 6.67 \text{ D}$$

c) Total System

$$P = P_{cornea} + P_{lens} - \frac{d}{n_q} P_{cornea} P_{lens} = 25.89 + 6.667 - \frac{0.004}{1.3}(25.89)(6.667) = 32.03 = 32.0 \text{ D}$$

HW-I3. Alien Eyeglasses. An alien in the large Magellanic Cloud that is able to see from 10 cm to infinity.

a) An alien eye has a far point of 80 cm. Prescribe $-\frac{100}{80} = -1.25 \text{ D}$.

b) An alien eye has a near point of 25 cm. Alien eye can do 100/25 = +4 D extra compared to infinity, but needs to do 100/10 = 10 D. Therefore, prescribe 10 D – 4 D = + 6 D.