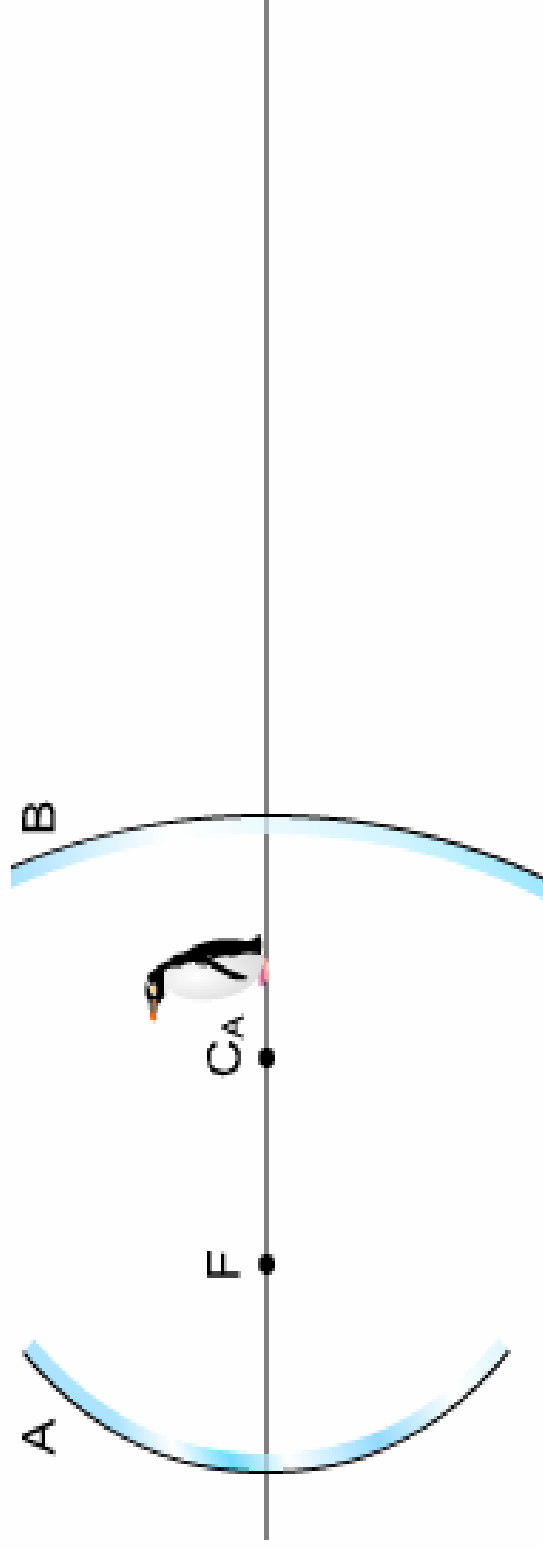
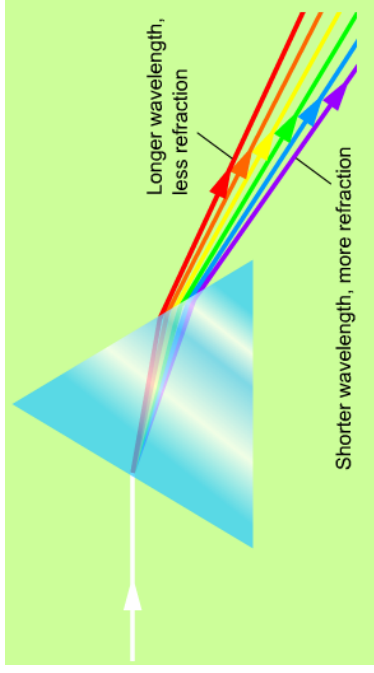


1. Why you need a planar mirror at least half of your height to view your full image in it?
2. Two parallel planar mirrors facing each other are separated by a distance d . An object is placed between them. Prove that the distance between the "second-order" images in both mirrors is $4d$.
3. Use the mirror equation to show that for a planar mirror, the magnitude of the image distance equals the magnitude of the object distance.
4. You wish to use a concave mirror to produce a virtual image that is three times the size of an object. (a) Which will be closer to the mirror, the image or the object? (b) If the object is 22.0 cm from the mirror at this magnification, what is the radius of curvature of the mirror?

5. Two concave mirrors are arranged as shown in the illustration. Their focal points coincide at point F , and the center of curvature of mirror A is indicated. An object is placed between the mirrors as shown. Consider the image created by mirror B of an image created by mirror A of the object. In other words, first imagine that mirror A creates an image of the object. The image created by A is then used as the object for mirror B to create the "final" image. Ignore all other images created by the mirrors. (a) Is the final image upright or inverted compared to the object? It may help to draw a ray diagram. (b) Is the final image real or virtual? (c) If the focal length of mirror A is 6.00 cm, the focal length of mirror B is 13.0 cm, and the object is 14.0 cm from mirror A , how far is the final image from the object (give a positive answer)?



6. Light of wavelength X travels more slowly in glass than light of wavelength Y . (a) Which light refracts (bends) more as it travels from air to glass? (b) Which wavelength is longer?



7. If a fish in a still river tries to look up out of the water at an angle (measured from the vertical) that is greater than the critical angle, will he be able to see the world of air? If not, what will he see?
8. A glass of water ($n = 1.33$) has a layer of vegetable oil ($n = 1.47$) floating on top. A beam of light enters the oil from above the glass with an incident angle of 57.0° . What is the refraction angle of the light leaving the oil-water interface?

9. Two thin lenses with focal lengths f_1 and f_2 are placed back to back sharing the same principal axis. What is the effective focal length of this lens combination?
10. A diverging lens is placed 50.0 cm to the right of a concave mirror. An object is placed between the two, 30.0 cm from the mirror. The lens has a focal length of -30.0 cm and the mirror has a radius of curvature of 44.0 cm. Use only the light that leaves the object and hits the mirror first to answer the following questions. (a) Is the final image to the left or right of the mirror? (b) Is the final image real or virtual? (c) Is the final image upright or inverted compared to the original object? (d) How far is the final image from the mirror? Give the absolute value of this distance if it is negative. (e) What is the overall magnification of the system?

