

Geometrical Optics

Problems for Week 1

1. Two mirrors are set in the corner perpendicular to each other. A light ray, which travels in the plane perpendicular to both mirrors, hits one of the mirrors. Draw all resulting rays. Choose your own angle of incidence for the first ray (you don't need necessarily to choose a numerical value, you can choose a graphical representation) and find angles of travel for all other rays.
2. A layer of water is on the top of a horizontal rectangular slab of glass. There is no wind or other perturbances on the surface of water. A light ray hits the water at some non-zero angle with the normal to the water surface. Draw all resulting rays. Choose your own angle of incidence for the first ray (you don't need necessarily to choose a numerical value, you can choose a graphical representation) and find angles of travel for all other rays. The indexes of refraction of air, water and glass are: n_1 , n_2 , and n_3 correspondingly.
3. In the setup of the problem 2, light shines from the bottom of glass slab. Find critical angles of total internal reflection at the water-glass interface and the water-air interface. The glass is a crown glass (see the table in the lecture notes).
4. In a middle of the floor of a large 2 m deep swimming pool, there is an electric light. You are swimming in the middle lane (which goes directly above the light source). Will you always see the light looking from the air? Support your answer with the numerical calculations and ignore any waves in the swimming pool.