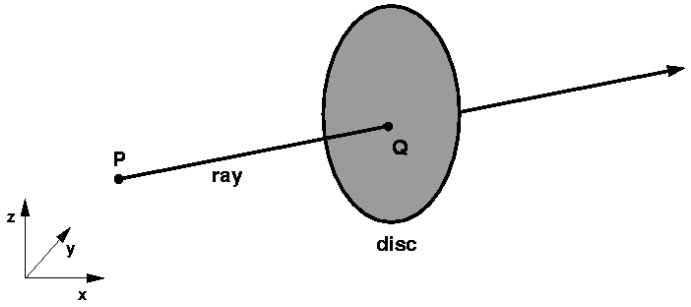
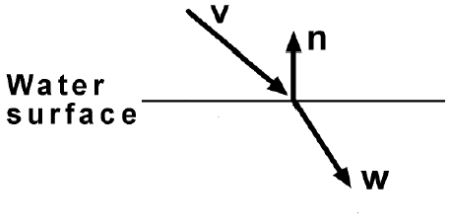
G-V Exercises

1. **Ray Tracing**

   (a) A disc is a planar face with a circular boundary. Describe an algorithm to find the intersection point Q of an arbitrary light ray from the camera position P with an arbitrary disc in 3D. Clearly state suitable input parameters to define both the ray and the disc.

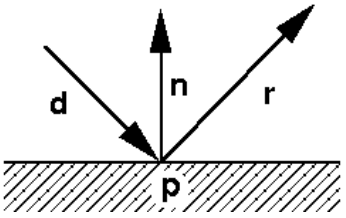


   (b) A light vector v passing from air into water is refracted on the water surface (see figure). Given v, and the *unit* normal n of the water surface, compute the resulting vector w. Assume that the projections of v and w onto n have the same length and that the projection of w onto the water surface has half the length of the projection of v onto the surface.



2. **Inverse Reflection**

   Let r be the direction vector of the perfect reflection of a light ray at a point p on a surface with normal n. Give the equations to compute the direction vector d of the original light ray (see figure below).



3. **Extended Light Sources**

   An extended light source is a light source which emits light from a surface, e.g. a sphere, rather than from a single point. With the help of a simple diagram explain how extended light sources create soft shadows. Briefly describe how you might extend the basic ray tracing algorithm to handle extended light sources to give soft shadows.

4. **Radiosity**

   Explain the radiosity equation and list all major steps required for the radiosity rendering technique.