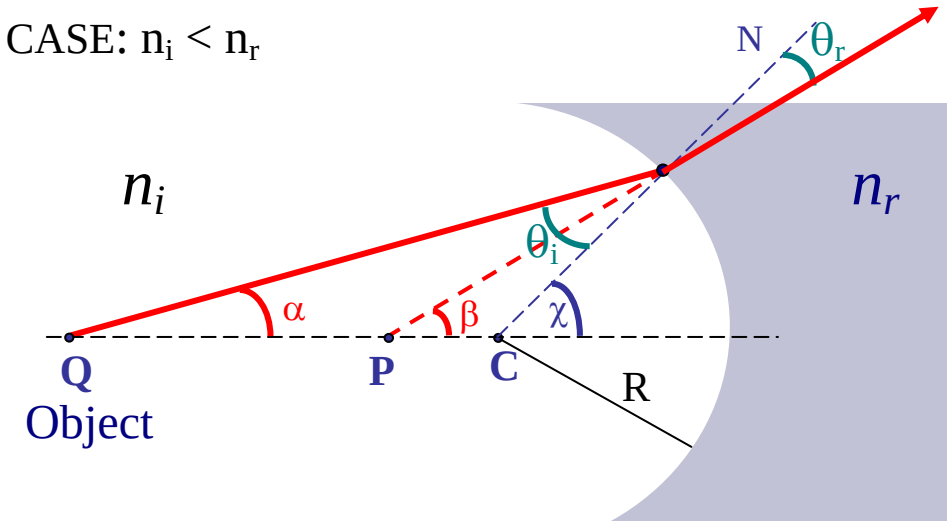
Physics 464/564

Homework #6 Due May 26th, 2009

CONJUGATED POINTS for SPHERICAL LENSES

1. In the figure shown below, n_i and n_r stand for the indices of refraction of two materials separated by a spherical surface interface of radius R. Assume $n_i < n_r$.



1.A Assuming that n_i, n_r, and R are given quantities, let Q be a point (along the optical axis) located at a distance qR from the center of the sphere. Find the position of the point Q (*i.e.* find the value of q) such that it is perfectly imaged by the spherical interface. Find the position of the image point P in terms of R.

1.B For n_i=1, n_r =1.5 and *R=10 cm* draw to scale a glass meniscus that can be used to image perfectly a given axial point Q. Indicate the corresponding positions of the corresponding object point Q and its image.

STOPS, ENTRANCE PUPIL, EXIT PUPIL

2. For the given optical system,

2A Use ray tracing to located the image of the object AB

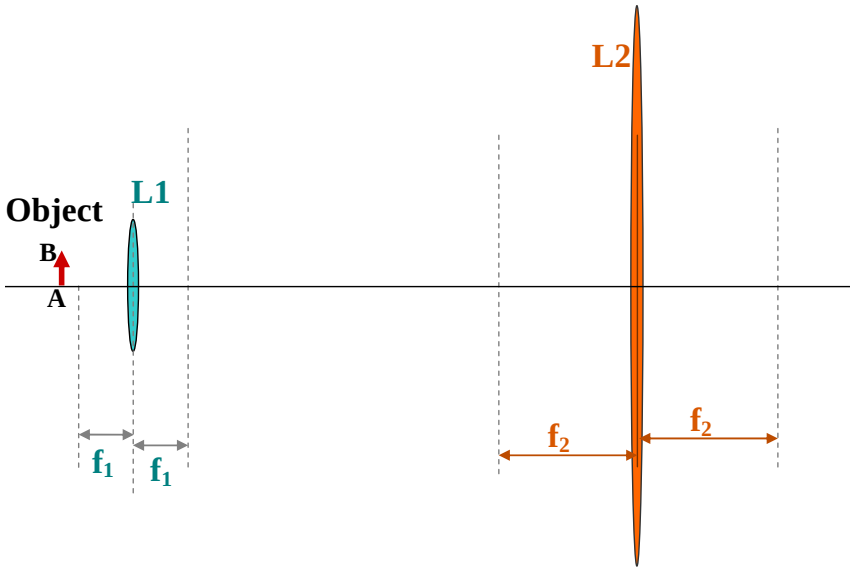
Locate the entrance pupil EP, aperture stop AS, and the exit pupil EP

For **the point B**, highlight the space subtended by the corresponding illumination-cone of light, which starts from B and end up in the corresponding image point B'.

2B Using the AS, entrance pupil, and exit pupil (determined in the questions above), highlight the cone of light that start **at an arbitrary object point P** (between A and B) and traces down to the corresponding image P'

Trace the corresponding chief ray.

<u>At your own discretion, uou may use separate graphs for answering some of the several questions above</u>.



THE WAVE EQUATION

3. 3A Show that the following waves satisfy the wave equation

$E_1(x,t) = A\ tan(x - ct)$ where A is an arbitrary constant

$E_2(x,t) = (x - ct)^3$

Show that, I general, the wave $E(x,t) = f(x - ct)$ satisfy the wave equation, regardless of the specific function *f*.

3B Show $E(x,t) = A\ Cos(x - ct)$ satisfies the wave equation

Assuming ω is given, find out the value for *k* so that the wave $E(x,t) = A\ Cos(kx - \omega t)$ satisfies the wave equation

3C Express the wave equation in complex-variable.
Then, demonstrate that $E(x,t) = e^{i(kx-wt)}$ is a solution.