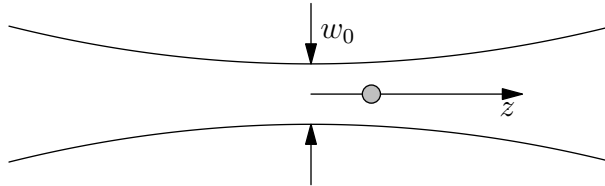# J05E.3 - Dielectric Sphere in a Laser Beam

Problem

A laser beam can be used to trap a dielectric object. Let the dielectric object have a radius a and be immersed in an electric field, $\vec{E}$. The induced dipole moment is $\vec{p} = -\alpha a^3 \vec{E}$, where α is the polarizability of the material.

a)   The sphere is placed in a *uniform* static electric field. What is the net force, $\vec{F_0}$, on the sphere?

b)   Now the sphere is placed in a collimated (zero divergence) laser beam of power I, diameter w_0, and wavelength λ. Assume $w_0, \lambda \gg a$. What is the net force, $\vec{F_s}$ on the sphere?

c)   Now the sphere is placed in a focused laser beam, so that the intensity as a function of longitudinal distance $I(z)$, is

$$I(z) = \left[\frac{P}{\pi w_0^2} \right] \frac{1}{1 + (\frac{z}{w_0})^2}$$

What is the stable position, z_s, of a particle in this beam? Assume $z_s \ll w_0$.