M00E.2—Particle Above a Conducting Plane

Problem

A particle of mass m and charge q is released from rest from a distance z_0 above an infinite grounded conducting plane. Neglect relativistic effects and gravity.

a) How long will it take for the particle to hit the plane? (Neglect radiation loss.) You may leave your answer in terms of a *dimensionless* integral.

b) What is the power radiated as a function of z?

Now consider the conducting plane to be replaced by a semi-infinite dielectric ϵ. (That is, for $z > 0$, there is a vacuum, and for $z < 0$, space is filled with the dielectric.)

c) Calculate the force on the charge q when it is a distance z_0 above the plane.

Hint: an image solution exists where image charges are placed at either $+z_0$ or $-z_0$.