

## E&M II - set 7 :: Exact scattering

PHSX 520 - Fall 2015

### Problem 1

Exactly solvable scattering/diffraction problems are rare, since they require exact integration of Maxwell equations with corresponding boundary conditions, and usually involve special functions.

#### Exact scattering on a cylinder.

Consider a plane wave incident on a perfectly conducting, infinite cylinder, perpendicular to the cylinder's axis (cylinder axis is along  $z$ , the wave is coming from  $x = -\infty$ ). The polarization of the wave is along  $z$ . Find the exact expressions for the electric and magnetic fields in this scattering problem. Find the currents and charges induced on the surface of the cylinder, and the scattering cross section. Analyze the answer in short- and long-wavelength limits. Hints:

- (a) The perfect conductor assumes  $\mathbf{E} = \mathbf{B} = 0$  inside so one doesn't have to deal with the internal region, and one can easily write the boundary conditions for the external fields
- (b) One can solve the wave equation for fields exactly in cylindrical coordinates (some special functions appear!). You might want to expand the incoming plane wave in the basis of appropriate orthogonal functions as well.