

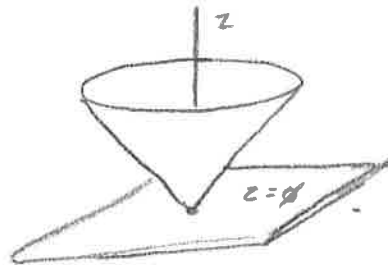
**PHYS542: Homework 8**

1. Consider time harmonic solutions to the Maxwell equations in vacuum where the fields are independent of the azimuthal angle  $\phi$  and the fields have no radial component to the fields  $E_r = B_r = 0$ .

(a) Show that the conditions stated above decouple the Maxwell curl equations into two subsets, each of which describes a different type of TEM wave

(b) Start with the Maxwell divergence equations and find general solutions for  $\mathbf{E}(r, \theta, t)$  and  $\mathbf{B}(r, \theta, t)$  for each of the two TEM wave types.

(c) The figure below shows the apex of an infinite solid conducting cone touching the conducting half-plane  $z < 0$ . Explain why this structure can be used to guide one of TEM wave types found above but not the other.



2. A perfectly conducting waveguide has cross-section in the shape of a quarter-circle with radius  $R$ .

(a) find the longitudinal field  $E_z$  and  $B_z$  for the TM and TE modes, respectively. Find also the cut-off frequency for these modes.

(b) Write explicit formulae for the transverse fields for the lowest cutoff frequency found in part (a)