

1. Jackson 8.3
2. A waveguide consists of a vacuum enclosed by a cylindrical conductor of radius “a” and infinite extent along z . Assume that the conductivity of the metal wall is infinite. The guide is excited with an antenna of frequency ω . The following questions relate to the lowest order TM ($B_z = 0$) mode of the guide.
 - (a) Sketch the electric and magnetic field lines for this mode. What are the non-zero components of \mathbf{E} and \mathbf{B} ?
 - (b) Starting with Maxwell’s equations derive an equation for the mode. What boundary conditions must be applied at the conducting surface?
 - (c) Solve the equation derived in (b) and calculate the velocity at which energy propagates down the guide. What is the limiting form of the velocity when ω is large? Small? Interpret both of these limits. What is the lowest frequency for which energy propagates down the waveguide?
3. A resonance cavity consists of the hollow space between two metallic cylinders of radius a, b with $b > a$ and length L . The cylinders are capped on either end.
 - (a) Find the resonance frequency of the lowest order TE mode.
 - (b) Sketch the fields.
 - (c) Find the Q of this mode.