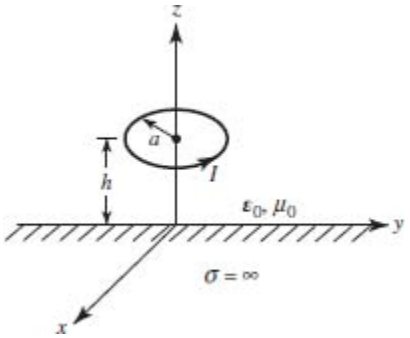
HW2

1. A common 860 MHz cellular antenna is a 3-element dipole array (on the z-axis) with each element being λ/2 long. The array is placed on top of a cellular tower. (The dipole is actually a folded dipole which has a wider impedance bandwidth). Calculate and plot the radiation pattern of this array for a spacing of $0.6\lambda_0$. (The plot should be in polar format and linear scale for power). Determine the HPBW. Why do you think that the designers chose a 3-element array and not a single antenna or a 5-element array? **10 Extra points** to calculate the directivity (you need to do numerical integration). In future homework, you will need to do numerical integration as well but not for extra points.
2. Assume that you are living on UCF campus and need an antenna for your TV to receive the over-the-air TV channels. Will you buy a rabbit ear antenna or an expensive Yagi-Uda/log-periodic antenna (with a gain of 13)? Just provide your justifications by reasoning.
3. A very small loop antenna ($a << \lambda/30$) of constant current is placed a height *h* above a flat, perfectly conducting ground plane of infinite extent. The area plane of the loop is parallel to the interface (x-y plane). For far-field observations:
    a. find the total electric field radiated by the loop in the presence of the ground plane
    b. all the angles (in degrees) from the vertical to the interface where the total field will vanish when the height is λ
    c. the nonzero heights (in λ) such that the total far-zone field exhibits a null at an angle of 60° from the vertical



4. Calculate the series resistance and radiation resistance of a 1 MHz AM loop antenna of 100 turns wound around a Sandust core of $\mu_r = 100$ and having a diameter of 1 cm. The wire diameter is 200 μm and the conductivity of copper is 5.8×10^7 S/m. What is the efficiency of this receiving antenna? Compare with a typical λ/4 long and 2-mm diameter FM Monopole (center frequency of 98 MHz) if this monopole is used at 1 MHz for AM reception. (Do not forget the take into account the skin depth effect)
5. A low-cost antenna for HF and VHF communications is a dual λ/2 folded dipole backed by a ground plane. Consider an array of two dipoles spaced 0.5λ from each other and fed in phase (dipoles are z-oriented at y= λ/4, x=±λ/4; the ground plane is the x-z plane). The ground plane is at h= λ/4 away from the dipoles. Calculate the radiation patterns in the E and H planes (radial, dB plot down to -30 dB). (you can assume the element pattern is proportional to sin(θ)).