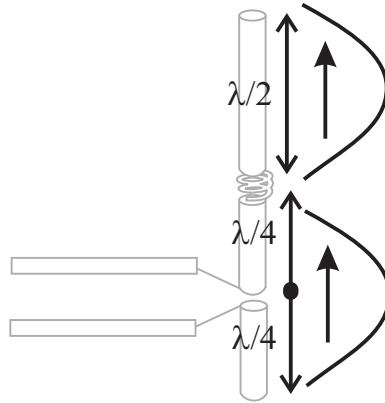# ECE 4370: Antenna Engineering
Solutions to TEST 1 (Fall 2011)

1. **Wire Antenna:**

   (a) The current follows this distribution:

   $$I(z) = I_0 |\cos(kz)| \text{ for } -\frac{\lambda}{4} \le z \le \frac{3\lambda}{4}$$

   (b) Smaller, since HPBW decreases as the size of an antenna increases.

   (c) When fed from the center, the full-wave dipole has infinite input impedance; impossible to couple power into the device.

2. **Antenna Pattern:**

   (a) $\theta = 90°$

   (b) $\theta = 0°, 180°$

   (c) Condition must hold:

   $$\int_0^\pi d\theta \int_0^{2\pi} d\phi \, \sin\theta \, D(\phi, \theta) = 4\pi \text{ steradians}$$

   $$\int_0^\pi d\theta \int_0^{2\pi} d\phi \, D_0 \, \sin^4\theta = \frac{3\pi^2 D_0}{4} = 4\pi \text{ steradians}$$

   This implies $D_0 = \frac{16}{3\pi}$.

   (d) $\theta_{hp} = 52.5°$, $127.5°$, $\theta_{hpbw} = 74.9°$

3. **Small Scale Fading:** -77.1 dBm

4. **Voltages on Antennas:** 141 mV

5. **Link Budget:** -27.0 dBm