Antennas PHYS 501 Homework 5

NAME:_____ Due:

1. A vertical wire antenna has a nearly isotropic pattern in azimuth, plus its pattern is slightly downward, so it is best for broadcasting. What is the polarization of the wave that it transmits? (vertical, horizontal, circular)? _____
(so, how would you orient your receiving antenna?) _____

2. Sketch a 4-element Yagi antenna. Which is the driven element? Which direction will the antenna's radiation pattern will be a maximum? (in other words, which direction will the wave prefer to go?) Sketch which direction the polarization (electric field direction) of the wave will be.

3. An unpolarized signal, when bounding off a reflecting surface, becomes polarized. That is because the electric field component into the boundary must vanish but the electric field along the surface is preserved. That is why a pure vertical antenna doesn't bounce back well off the ionosphere directly above you. It is best for long-range propagation to use a horizontal polarization. So, if I want to use my Yagi to bounce off the ionosphere to a receiver in Europe, which way should I orient it? (make a sketch).

4. Antenna efficiency is measured in dB (decibels), where x (dB) = 10 log (Y), where Y is the ratio of power with direction over the isotropic power (sometimes it's given as a ratio to dipole power dB). Sometimes the power of a signal is also given in dBm, but now the power in dB is given as 10 log (P/ 1mW). So, 1mW of power is 0 dBm; 1W is 30 dBm. Since power falls off as distance squared, a 10 dB antenna gain gives you a factor of 10 in power in a given direction, which means a factor of 3 more distance you can hear a signal (or send a signal efficiently).

   A 6 dB antenna gain is almost exactly a factor of _____ in power or a factor of _____ in distance.

5. 789 rule: A good rule of thumb for dB is, if the **ratio Y** lies in the range from 7 to 10, the value of the ratio X in dB is approximately 0.5Y + 5. Given that rule of thumb, if an antenna has a power ratio of 9, what is its gain in dB? _____

   Working backwards, if the **gain** is in the range of 8 to 10 dB, then the ratio Y is approximately 2 (X-5). So, for a gain of 9 dB, what is its approximate power ratio? _____

6. If an antenna has a gain of 28 dB, what is its approximate power ratio in the favored direction over an isotropic antenna? (show your work)