EE 434 Practice Test I (solutions)

1. a) Gain $= 0.9 \times 20 = 18 = \boxed{12.55\ dB}$ ←

b) $\theta = \lambda/dia$, $A_{eff} = A_{actual} = \frac{\pi\, dia^2}{4} = \frac{\pi}{4}\left(\frac{\lambda}{\theta}\right)^2 = D\left(\frac{\lambda^2}{4\pi}\right)$

$\therefore D = \frac{\pi}{4}\left(\frac{\lambda}{\theta}\right)^2 \times \frac{4\pi}{\lambda^2} = \left(\frac{\pi}{\theta}\right)^2$ ←

c) Real input impedance $\approx 73\ \Omega$, much better efficiency

d) Device that radiates or recieves energy from space

2. Noise Power $= kTB$ received power must be $10kTB$

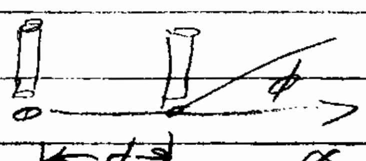
$10kTB = P_t G_r G_t \left(\frac{\lambda}{4\pi R}\right)^2$ for no path loss

For 60dB path loss P_t must be 10^6 times the above

$\therefore P_t = \frac{10 \times 1.38 \times 10^{-23} \times 4 \times 10^2 \times 10^7 \times 16 \times \pi^2 \times 9 \times 10^8}{10^3 \times 15.8 \times 0.85 \times 25 \times 10^{-4}} = 23.36 \times 10^{-4}\ W$

in the above $\lambda = \frac{3 \times 10^8}{6 \times 10^9} = 0.5 \times 10^{-1}$ and $D_{trans} = 10^{\frac{12}{10}} = 15.8$

so for no path loss $P_t = 2.336\ mW$
and for 60dB path loss $P_t = 2.336\ kW$ ←

3. 

$|AF| = \frac{\sin X}{\sin \frac{X}{2}}$ with $X = \frac{2\pi d}{\lambda}\cos\phi - \psi$

want maximum @ $\phi = 0$ so $\frac{2\pi d}{\lambda} = \psi$

zero @ $\phi = \pi$ or $X = -\frac{2\pi d}{\lambda} - \frac{2\pi d}{\lambda} = -\frac{4\pi d}{\lambda}$

1st zero for $|AF|$ @ $X = -\pi$

so $-\pi = \frac{-4\pi d}{\lambda}$ or $\boxed{\frac{d}{\lambda} = \frac{1}{4} \text{ and } \psi = \frac{\pi}{2}}$ ←

ANTENNA ARRAY RADIATION PATTERNS

The radiation pattern of a linear antenna array is given by the following:

$N := 2;\quad d := \frac{1}{4};\quad \psi := \frac{\pi}{2};\qquad j := \sqrt{-1};\quad \phi := 0, \frac{\pi}{100} .. 2\cdot\pi \qquad n := 0, 1 .. N-1;\quad F(\phi) := \left[\frac{1}{N}\cdot\left|\sum_{n} e^{-j\cdot n\cdot(2\cdot\pi\cdot d\cdot\cos(\phi)-\psi)}\right|\right]^2$

Where "N" is the number of array elements, "ψ" the progressive phase shift (element to element), and "d" the the element spacing in wavelengths.