Question 1

$$L(d) = \frac{P_{rx}(d)}{P_{tx}} = \frac{P_{rx}(d_0)(\frac{d_0}{d})^{\gamma}}{P_{tx}} = \frac{P_{tx}G_{rx}G_{tx}(\frac{\lambda}{4\pi d_0})^2(\frac{d_0}{d})^{\gamma}}{P_{tx}} = G_{rx}G_{tx}(\frac{\lambda}{4\pi d_0})^2(\frac{\lambda}{4\pi d_0})^{\gamma}$$

$$L(d)[dB] = G_{rx}[dBm] + G_{tx}[dBm] + 20log_{10}\frac{\lambda}{4\pi d_0} + 10\gamma log_{10}\frac{d_0}{d} = 20log_{10}\frac{c}{4\pi f} + 10\gamma log_{10}\frac{1}{d}$$

$$L(d)[dB] = 20log_{10}\frac{c}{4\pi f} - 10\gamma log_{10}d = 20log_{10}\frac{299792458m/s}{4\pi \times 900MHz} - 32log_{10}d$$

```
c = physconst('LightSpeed');
f = 900 * 1e6;
Gamma = 3.2;
L_d = @(d) 20 * log10(c/(4*pi*f)) - 10 * Gamma * log10(d);
d = 1:0.1:100;
L = L_d(d);
plot(d, L);
ylabel('Path Loss [dB]');
xlabel('Distance [m]');
```