a) Find Huffman code

\[ \bar{B} = 0.35(1) + 0.3(2) + 0.2(3) + 0.15(3) = 2 \text{ bits} \]  
(Could use simple binary code).

Data rate: 2 bits/sample × 10⁴ samples/s = 2 × 10⁴ bits/s

b) Energy in signal set 1: \( \frac{A^2T}{2} \) for each signal.
Energy in signal set 2: \( \frac{A^2T}{4} \) for each signal.

\[ \int_{0}^{T} s(t) s^*(t) dt = 0 \]

Pick the set for which \( \int_{0}^{T} |s(t) - s(t)|^2 dt \) is largest.

Signal set 1: \[ \int_{0}^{T} |s(t) - s(t)|^2 dt = \int_{0}^{T} s(t) s(t) dt + \int_{0}^{T} s^*(t) s(t) dt - 2 \int_{0}^{T} s(t) s^*(t) dt \]

\[ = \frac{A^2T}{2} + \frac{A^2T}{2} - 0 = A^2T \]

Signal set 2: \[ \int_{0}^{T} |s(t) - s(t)|^2 dt = \frac{A^2T}{4} + \frac{A^2T}{4} - 2 \left( -\frac{A^2T}{4} \right) = A^2T \]

Each yields same performance.

c) For BPSK: \( P_e = Q \left( \sqrt{\frac{2\alpha^2 A^2 T}{N_0}} \right) \leq 10^{-3} \)

From plot on figure 6.10 (199), \( \frac{\alpha^2 E_b}{N_0} \geq 6.5 \text{ dB} \)

\[ \frac{\alpha^2 E_b}{N_0} \geq 6.5 \text{ dB} \]

d) \( \alpha \) proportional to \( \frac{1}{d} \) \( \Rightarrow \alpha^2 \) proportional to \( \frac{1}{d^2} \). Moving twice as far away reduces \( \alpha^2 \) by a factor of 4 \((-6 \text{ dB})\)

\[ \frac{\alpha^2 E_b}{N_0} \text{ now about } 0.5 \text{ dB} \Rightarrow P_e \approx 8 \times 10^{-2}. \text{(Not very good)} \]