4.1)
A) Number of pairs = 666
\[ f_R = 825 \text{ MHz} + n(30 \text{ kHz}) \quad 1 \leq n \leq 666 \]
B) \[ f_F = 870 \text{ MHz} + n(30 \text{ kHz}) \quad 1 \leq n \leq 666 \]
C) Total pairs = 832

D) The binary representations in the text are actually one's complement representations instead of two's complement representations, but that has no affect on the resulting answer.
\[ f_R = 825 \text{ MHz} + n(30 \text{ kHz}) \quad -32 \leq n \leq 0 \]
\[ f_F = 870 \text{ MHz} + n(30 \text{ kHz}) \quad -32 \leq n \leq 0 \]

The complete set (all channels) of center frequencies is given by:
\[ f_R = 825 \text{ MHz} + n(30 \text{ kHz}) \quad -32 \leq n \leq 799 \]
\[ f_F = 870 \text{ MHz} + n(30 \text{ kHz}) \quad -32 \leq n \leq 799 \]

4.2)
A) \( Q = 2k \)

B) \[ S/I = \frac{1}{(2k-1)^\nu + (2k+1)^\nu} \]

4.3)  
\( (S/I)_1 = 19.62 \text{ dB} \)  
\( (S/I)_2 = 19.12 \text{ dB}, \) Decrease of 0.46 dB

4.4)  
The number of channel sets is equal to the cluster size.  
\( K_{\text{cluster}} = 3, \) \( N_{\text{cell}} = N_{\text{chan}}/K_{\text{cluster}} = 222 \)

4.5)  
A) Adjacent channels should be placed in adjacent cells.

B) In the worst case the desired signal and the interferer are both at distance \( R \) even though they are in different cells: \( S/I = \alpha \)
4.6) In the worst case the desired signal and the two interferers are both at distance $R$:
\[
\frac{S}{I} = \alpha/2
\]

4.8)
\[
k_{\text{cluster}} = 19, \quad \hat{D} = \sqrt{k_{\text{cluster}}} = 4.359
\]
The resulting $Q$ and $S/I$ are: $Q = 7.55, \quad S/I = 20.31 \text{ dB}$

4.11)
\[
\rho = \frac{3 N_{\text{chan}}}{Q^2 A_{\text{cell}}}
\]

4.12)
\[
\begin{align*}
\text{A)} & \quad CT = \frac{\rho A_{\text{sys}} CBS (6 S/I)^{2/\nu}}{3 N_{\text{chan}}} \\
\text{B)} & \quad \text{CT is inversely proportional to } N_{\text{chan}}. \\
& \quad \text{CT is directly proportional to } \rho. \\
& \quad \text{CT is fractionally proportional to } S/I.
\end{align*}
\]
\[
\text{C)} \quad \text{As } \nu \text{ increases } \rho \text{ increases. From problem 4.11: } \quad \rho = \frac{3 N_{\text{chan}}}{(6 S/I)^{2/\nu} A_{\text{cell}}}
\]

4.13)
From Fig 4.14 the distance to the second-tier interferers is $D_2 = \sqrt{3}D$ where $D$ is the distance to the first-tier interferers. Let $(S/I)_2$ be the signal-to-interference ratio with second-tier interferers included.
\[
(S/I)_2 = \frac{1}{6} Q^4 \left( \frac{3^{\nu/2}}{3^{\nu/2} + 1} \right) = \frac{1}{6} Q^4 \cdot \frac{9}{10} = \frac{9}{10} (S/I)_1 = (S/I)_1 - 0.457 \text{ dB}
\]
The distance to third-tier interferers is $D_3 = 2D$.
\[
(S/I)_3 = \frac{1}{6} Q^4 \left( \frac{12^{\nu/2}}{12^{\nu/2} + 4^{\nu/2} + 3^{\nu/2}} \right) = \frac{1}{6} Q^4 \frac{144}{169} = \frac{144}{169} (S/I)_1
\]
\[
(S/I)_3 = (S/I)_1 - 0.695 \text{ dB} = (S/I)_2 - 0.238 \text{ dB}
\]
For $K_{cluster} = 1$ then the worst-case distance to the first and second-tier interferers is $D_1 = (\sqrt{3}/2) R$ and $D_2 = 2 R$. The signal-to-interference ratio is then -10.4 dB. To achieve a signal-to-interference ratio of 17 dB a processing gain of 27.4 dB is required.

With 30 dB attenuation for four of the six interferers, $(S/I)_1 = (1/2.004) Q^v = 23.425$ dB. For ideal sectoring, $(S/I)_1 = (1/2) Q^v = 23.434$ dB. For an omni-directional antenna (no sectoring), $(S/I)_1 = (1/6) Q^v = 18.663$ dB.