6.10

a. \( \Pr[\text{single bit not in error}] = 1 - 10^{-3} = 0.999 \)

Probability of at least one error in frame = 1 – probability of all 8 bit not in error

\[
\Pr[\text{at least one error in frame}] = 1 - (0.999)^8 = 0.008
\]

b. Adding a parity bit to each character makes the frame size 10 bit

\[
\Pr[\text{at least one error in frame}] = 1 - (0.999)^{10} = 0.01
\]

6.13 CRC = 11010

6.14 a. Don’t worry about this problem

\[
\begin{align*}
& C_3 & + & \rightarrow & C_2 & \rightarrow & C_1 & \rightarrow & C_0 \\
\end{align*}
\]

b. Code = 001010011011100

c. Change one of the bit and show nonzero remainder.

6.15

a. The string to send: 100100110111100

b. The remainder is nonzero in this case, i.e., the error is detected

c. The remainder is zero, i.e., the error is not detected

7.8 Say you are using a 2-bit sequence number instead of 3-bit

1. A sends frames, 0, 1, 2 to B

2. B receives all three frames and cumulatively acknowledges with RR3

3. RR3 is lost in transit
4. A times out and retransmits frame 0

5. B has already advanced its receive window to accept frames 3, 0, 1, 2. Thus it assumes that frame 3 has been lost and that this is a new frame 0, which it accepts. B sends SREJ 3.

7.10 a  \[
\begin{array}{ccccccccc}
& & & & & & & & & & \\
0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & \text{0} & 1 & 2
\end{array}
\]

b. \[
\begin{array}{ccccccccc}
& & & & & & & & & & \\
0 & 1 & 2 & 3 & \text{4} & 5 & 6 & 7 & 0 & 1 & 2
\end{array}
\]

c. \[
\begin{array}{ccccccccc}
& & & & & & & & & & \\
0 & 1 & 2 & 3 & 4 & 5 & 7 & 0 & \text{1} & 2
\end{array}
\]

7.11 A lost SREJ frame can cause problems. The sender never knows that the frame was not received, unless the receiver times out and retransmits the SREJ.

7.12 From the standard: “A SREJ frame shall not be transmitted if an earlier REJ exception condition has not been cleared (to do so would request retransmission of a data frame that would be retransmitted by the REJ operation.)” In other words, since the REJ requires the station receiving the REJ to retransmit the rejected frame and all subsequent frames, it is redundant to perform a SREJ on a frame that is already scheduled for retransmission.

Also from the standard: “Likewise, a REJ frame shall not be transmitted if one or more earlier SREJ exception conditions have not been cleared. “The REJ frame indicates the acceptance of all frames prior to the frame rejected by the REJ frame. This would contradict the intent of the SREJ frame or frames.”