Show your work and underline your final answer. Numeric answers must include units. Books, notes and calculators allowed. No other electronic devices allowed.

1. A code has codewords **0000000**, **0011001**, and **1010101**. What is the minimum distance of this code? How many errors is this code guaranteed to detect? How many errors is it guaranteed to correct?

distances:

	0000000	0011001	1010101
0000000	0	3	4
0011001	3	0	3
1010101	4	3	0

1010101
0011001
1001100 → 3

minimum distance $= d = \underline{3}$

can detect $d_{min}-1 = 3-1 = \underline{2}$ errors

can correct $\left\lfloor \dfrac{d_{min}-1}{2} \right\rfloor = \left\lfloor \dfrac{3-1}{2} \right\rfloor = \lfloor 1.5 \rfloor = \underline{1}$ errors

2. The codeword **1010111** is received. Was/were there errors? If so, in which bit(s)? Indicate any errored bit(s) unambiguously (e.g. circle it/them).

error

0000000   0011001   1010101
1010111   1010111   1010111
1010111   1001110   0000010
d=5   d=4   d=1

↖ Choose minimum-distance c/word.

yes, there were errors since the received c/w is not valid.

3. You create a maximum-length PRBS that has one run of 16 ones. How long will it take to transmit the complete sequence (one period) at 1 Mb/s?

maximum run length of 15 is m. ⟹ m=16

period $= 2^m - 1 = 2^{16} - 1 = 65535$

at 1 Mb/s : $\dfrac{65535 \text{ bits}}{1 \times 10^6 \text{ bits/s}} = \underline{65.5 \text{ ms}}$

4. An Ethernet frame contains, immediately following the preamble, the following bytes (in hexadecimal notation):

dest.   source   type
00 1d 60 9f 21 94 bc 83 85 f9 7d 7c 08 06

What is the source address? Give your answer as bytes in hexadecimal notation.

the source address is the second 6-byte address in the header (which immediately follows the preamble).

This is: <u>bc 83 85 f9 7d 7c</u>

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1. A code has codewords `0000000`, `0011001`, and `1010101`. What is the minimum distance of this code? How many errors is this code guaranteed to detect? How many errors is it guaranteed to correct?

   See   solution   on   previous page.

2. The codeword `0011000` is received. Was/were there errors? If so, in which bit(s)? Indicate any errored bit(s) unambiguously (e.g. circle it/them).

   errored bit

   ```
   0000000      0011001      1010101
   0011000      0011000      0011000
   ─────────    ─────────    ─────────
   0011000      0000001      1001101
   ```
   minimum distance

3. You create a maximum-length PRBS that has one run of 10 ones. How long will it take to transmit the complete sequence (one period) at 1 Mb/s?

   Maximum run length of 1s is m. ⟹ m = 10

   period $= 2^m - 1 = 2^{10} - 1 = 1023$

   at 1 Mb/s:　$\dfrac{1023 \text{ bits}}{1 \times 10^6 \text{ bits/s}} = 1 \text{ ms}$

4. An Ethernet frame contains, immediately following the preamble, the following bytes (in hexadecimal notation): ⟍ dest.　⟋ source　　　⟋ type

   `00 1d  60 9f 21 94` `bc 83 85 f9 7d 7c` `08 06`

   What is the source address? Give your answer as bytes in hexadecimal notation.

   the source address is the second 6-byte address in the header (which immediately follows the preamble).

   This is:　bc 83 85 f9 7d 7c