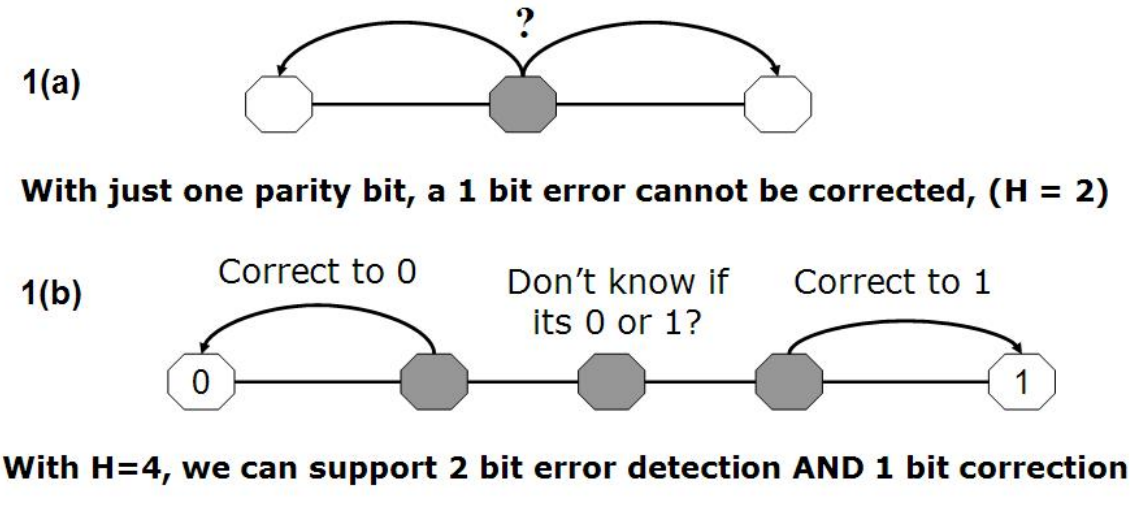
1. ECC

   (a) False. Parity only enables detection (Hamming distance of 2). See Figure 1(a).

   (b) 4. See Figure 1(b).

Figure 1. ECC



   (c) With k copies of every bit, $k-1$ errors per bit position can be detected. (since at least one copy will contain a different value. Similarly upto $\lfloor \frac{k-1}{2} \rfloor$ errors per bit position can be corrected. Corrected value of a bit will be the majority value among the k copies, provided that k is odd and there will be one equidistant point for even values of k where the codeword will cannot be corrected $\rightarrow$ *"I don't know which is the correct codeword"* .

2. I/O

   (a) Average rotational delay = 0.5 rotations / rotational speed = 0.5/7200 rpm = 4.167 milli sec.

   Transfer time (512 bytes) = 512 bytes/ 36 MB/sec = 14.22 μ sec
   Average rotational time = 4167 μ sec
   Controller Overhead = 300 μ sec
   Average seek time = 8500 μ sec
   Total time taken to read 512 bytes = 14.22 + 4167 + 300 + 8500 = 12981.22 μ sec

   Transfer time (4096 bytes) = 4096 bytes / 36 MB/sec = 113.78 μ sec
   Average rotational time = 4167 μ sec
   Controller Overhead = 300 μ sec
   Average seek time = 8500 μ sec
   Total time taken to read 4096 bytes = 113.78 + 4167 + 300 + 8500 = 13080.78 μ sec

   The 32 MB data file is to be read from the hard disk as 512 byte sectors. The number of sectors to be read from the hard drive is therefore 32×2^{20} bytes / $2^9 = 32 \times 2^{11}$ sectors.
   These sectors are scattered randomly around the disk since the file is heavily fragmented.

This means that for every sector to be read from the disk, we will have to take into account the average seek time, average rotational delay etc.
Thus the time taken for the file to be read is $= 32 \times 2^{11} \times 12981.22\ \mu$ sec $= 850.7$ sec

(b) The number of sectors to be read from the hard drive is $\frac{32 \times 2^{20} \text{bytes}}{4 \times 2^{10}} = 32 \times 2^8$
Again, the time taken will just be a multiple of the time taken for one sector to be read.

The time taken for the file to be read is $= 32 \times 28 \times 13080.78\ \mu$s $= 107.1$ sec

(c) A sector is the smallest amount of data that can be transferred from a disk. Thus, smaller blocks are preferable for storing small files. If your files are no more than 512 bytes long, then theres no benefit to 4 KB sectors! Not only would the transfer time be unnecessarily longer, but much of the 4 KB sector would actually be wasted space.