**1.**

a. (1.5 pt.)

- Size of Each block $=4 \times 2^{10}$ Byte $= 8 \times 4 \times 2^{10}$ bits $= 2^{15}$ bits
- One block can keep = size of block/size of a block address $= 2^{15}$ bits / 64 bits $=2^{15} / 2^{6} = 2^{9} -1 = 511$ block information
- Total # of blocks in the secondary memory = size of secondary memory / block size
  = 2TB / 4KB blocks $=2 \times 2^{40} / 4 \times 2^{10}$
  $= 2^{41} / 2^{12} = 2^{29}$ blocks
- # of blocks need to keep track of free blocks $= 2^{29}$ blocks /511 = 1,050,628.007
  $\therefore$ 1,050,629 blocks

b. (1.5 pt.)

- Total # of blocks in the disk $= 2^{29}$ blocks
- Need $2^{29}$ bits for bit map$= 2^{29}$ bit $= 2^{29}/ 8$ Byte$= 2^{29} / 2^{3} = 2^{26}$ Byte
- # of blocks need for bitmap $= 2^{26} / (4 \times 2^{10}) = 2^{26} / 2^{12} = 2^{14}$ blocks

c. (1 pt.)

- Since this system use 64 bit disk block number, this system support $2^{64}$ blocks
- Maximum disk size = maximum # of block supported $\times$ one block size =
  $=2^{64} \times 4 \times 2^{10}$ Byte $=256 \times 2^{70}$ = 32 ZB (Zibi)

**2.** (1 pt.)

Sol) since 1 block is 2KB, and 16 Byte per block address, one block can save $2 \times 2^{10} / 16 = 2^{11}/2^{4} = 2^{7} = 128$ block information

Total = 10 + 128 = 138 block information.

Since a block size is 2KB, largest file will be 2KB × 138 =276 KB

**3.** (1 pt.)

a. Contiguous allocation – File name, first block number and number of blocks used

b. Linked allocation scheme – File name, First block number

c. I-node allocation scheme – File name, i-node number

**4.** (1 pt.)

a. Files are cached in the RAM when it is opened.

b.

- In LSF, each i-node is not at a fixed location; they are written to the log.
- LFS uses a data structure called an i-node map to maintain the current location of each i-node.
- Opening a file consists of using the map to locate the i-node for the file.

**5.** (2 pt.) The algorithm needs to maintain a bitmap with a size matching the number of i-nodes currently used by active files. The bitmap values are initialized in two phases:

- Phase one - For each modified file, its i-node is marked in the bitmap. Each directory is also marked and recursively inspected.
- Phase two - unmarking any directories that have no modified files or directories in them or under them.

**6.** (1 pt.)

Size of bit-map = $8 \times 2^{10} \times 2^{14}$ byte = $8 \times 2^{24}$ Byte = $8 \times 8 \times 2^{24}$ bit. = $2^{30}$ bits<br>
There are $2^{30}$ blocks<br>
Total disk size = # of block × one block size= $2^{30} \times 8 \times 2^{10} = 8 \times 2^{40}$ = 8 TB