1.

a)

Since page size is 100 bytes, virtual space of 780 byte program can be saved in 8 pages.
Page 0 ~ page 7

Sol) 7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1

b)

7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1

7	7	7	2		2		4	4	4	0			1		1		1		
	0	0	0		0		0	0	3	3			3		0		0		
		1	1		3		3	2	2	2			2		2		7		

12 page fault

c)

7 0 1 2 0 3 0 4 2 3 0 3 2 1 2 0 1 7 0 1

7	7	7	2		2		2			2			2				7		
	0	0	0		0		4			0			0				0		
		1	1		3		3			3			1				1		

9 page faults

2.

Size of bit-map = $2 \times 2^{10} \times 2^{12}$ byte = 8×2^{23} bit. = 2^{26} bit

There are 2^{26} block

Total disk size = $2^{26} \times 2 \times 2^{10} = 2^{37}$ =128 GB

3.

a.

$$Total\ Overhead(P) = Average\ page\ table\ size + the\ wasted\ memory\ in\ th\ last\ page\ of\ process$$
$$= \frac{S}{P} \times E + \frac{P}{2}$$

b.

$$Overhead'(P) = -\frac{SE}{P^2} + \frac{1}{2} = 0$$

$$P = \sqrt{2SE} : optimal \text{ page size}$$

4.

a.

- # of blocks = size of disk / size of a block = 128 GB = 128GB / 4KB blocks
  $= 128 \times 2^{30} / 4 \times 2^{10} = 2^7 \times 2^{30} / 2^2 \times 2^{10} = 2^{37} / 2^{12} = 2^{25}$ blocks
- Each block can save $4 \times 2^{10} \times 8 / 32 = 2^{10}-1 = 1023$ block information.
  # block need for saving free block info = 2^{25} blocks /1023 = 32800..03, need 32801 blocks

b.

- #of locks in 128 GB disk = 2^{25} blocks
- Size of bit map = 2^{25} bits= $2^{25} / 8 = 2^{25} / 2^3 = 2^{22}$ Byte
- # of block need for bit map = size of bit map / size of a block= $2^{22} / (4 \times 2^{10}) = 2^{10}$= 1024 blocks for saving free block information

c.

Since this system use 32 bit disk block number, this system support 2^{32} blocks
Maximum disk size = $2^{32} \times 2^{12}$ Byte = 2^{44} Byte = 16 Tera Byte
(2^{10}= Kilo, 2^{20}= Mega, 2^{30}= Giga, 2^{40}= Tera, 2^{50}= Peta, 2^{60}= Exa, 2^{70}= Zetta, 2^{80}= Yotta)

5.

Since 1 block is 4KB, and 64 bits per block address, it can save $(4 \times 2^{10} \times 8)/ 64 = 2^{15}/2^6 = 2^9$ = 512 block information
Total = 512 + 8 = 520 block information.
Since a block size is 4 KB, largest file will be $520 \times 4KB$ = 2080 KB

6.

- Physical Dump – Start at block 0 of the disk, writes all the disk blocks onto the output tape or disk in order, and stop when it has copied the last one.

- Logical Dump – Prepare bit map with the size of i-node assigned to files. Starts at one or more specified directories and recursively dumps all files and directories found there that have changed since some given base date
  - **Phase 1 :** begins at the starting directory and examines all the entries in it. For each modified file, its i-node is marked in the bitmap. Each directory is also marked and recursively inspected.
  - **Phase 2:** unmarking any directories that have no modified files or directories in them or under them.
  - **Phase 3:** all marked directory is dumped
  - **Phase 4:** all marked files is dumped