1) a)

B -> number of blocks
F -> number of free blocks
D ->size of disk address

A bitmap would need B bits.
Free list would track every individual free spot and need F*D bits.
If there are few free spots such that F*D<B, then the free list would use less space.

b)

An i-node shows the blocks in use by a file at a given period. A free list is the opposite of this, tracking all free blocks. If the free list is destroyed, we can build it back from the i-node by considering what blocks are not in the i-node and adding those blocks to the free list.

The FAT is similar the free-list as it stores the addresses of blocks not in use by a file. Therefore, FAT can be restored in the same way.

c)

A Journaling File System keeps track of operations not yet committed. After the operation is completed, the log is erased. This ensures that if the system was to crash, it knows what job was not completed.

d)

Contiguous file allocation would not be appropriate as the file size is not static and allocation would depend on the availability of contiguous memory at a given instance. Therefore, this can lead to the file not being able to fit or, if a large portion of space is allocated to the file, wasted space.

Linked list allocation would be appropriate as memory can be allocated as needed. However, it does not allow for random access.

FAT would also be appropriate as it also allows for growing and shrinking file size. Additionally, it allows for random access.

e)

A write-through cache would be better as USB hard drive is a removable piece of hardware. Write-through ensures that blocks are updated in both cache and the disk at the same time. Therefore, if the USB is removed unexpectedly, there would be less chance of files being lost or corrupted. With a non-write-through cache, there is less instances of accessing the disk. Changes to cache are updated at some later time. Therefore, if the USB is unexpectedly removed, files may become corrupted or be lost.

f)

Average Memory Access Time = Hit Rate*Cache Time + Miss Rate*Miss Penalty

=(h*1ms) + ((1-h) *75ms)

=h+75(1-h) ms

(where h is expressed as a decimal)

2) a)

In Windows, different file systems are each identified with a different drive. When a process opens a file, the drive letter indicated which file system is used. In Unix systems, a Virtual File Systems allows for use of multiple file systems. The part of the file system that is common to all file systems is abstracted out. That code is put in a layer that will call to functions in a different layer that implement the concrete file system.

b)

A precise interrupt leaves the machine in a well-defined state. The PC is in a known place and the state of the instruction it is pointed to is known. Instructions before where the PC is pointed have been executed and those after have not. An imprecise interrupt does not leave the machine in a defined state. It is an interrupt that occurs during the execution of an instruction that should be atomic.

3)

200 cylinders from 0 to 199
Current position: 30
Pending: 109, 190, 48, 123, 21, 135, 75, 77, 29

Scheduling Algorithm	Order	Calculation
FCFS	109 190 48 123 21 135 75 77 29	(109-30) + (190-109) + (190-48) + (123-48) + (123-21) + (135-21) + (135-75) + (77-75) + (77-29) **= 703**
SSTF	29 21 48 75 77 109 123 135 190	(30-29) + (29-21) + (48-21) +(75-48) + (77-75) + (109-77) + (123-109) + (135-123) + (190-135) **= 178**
C-SCAN	48 75 77 109 123 135 190 199 0 21 48	(48-30) + (75-48) + (77-75) + (109-77) + (123-109) + (135-123) + (190-135) + (199-190) + (199-0) + (21-0) + (29-21) = **397**

C-LOOK	48 75 77 109 123 135 190 21 29	(48-30) + (75-48) + (77-75) + (109-77) + (123-109) + (135-123) + (190-135) + (190-21) + (29-21) = **337**