

- 1a. In demand-paging memory management, give two reasons for why an application program need not be entirely loaded into main memory before it is executed. (5%)
- 1b. What does *thrashing* mean? Give one method to prevent *thrashing* from occurring. (5%)
- 1c. When a page-fault occurs, the OS will execute the steps below. But the steps are not in correct order. List the steps in a correct order. (5%)

(a) Allocate the CPU to another process.	(d) Save the user process's registers.
(b) Check that the page reference was legal.	(e) Determine that the interrupt was a page fault.
(c) Put the user process into wait state and issue a read from the disk to a free frame.	

2. Consider the following page-reference string: 2, 4, 3, 4, 1, 2, 5, 4, 2, 3, 5, 2, 1, 2, 3, 4. Assume only three memory frames are available and they are initially empty.
- (a) How many page faults will occur if LRU replacement algorithm is used? (6%)
- (b) How many page faults will occur if optimal page replacement algorithm is used? (6%)
- 3a. What does "race condition" mean, and what causes "race condition" to occur? (6%)
- 3b. A solution to the critical-section problem must satisfy three requirements. Give two of the requirements that must always be satisfied. (4%)
- 4a. The two system calls, *wait(S)* and *signal(S)*, are for semaphore processing. How can the OS execute these system calls atomically? (5%)
- 4b. Write a pseudo-code segment to implement *wait(S)* in the style of suspend lock. (5%)

5. The program segment in Fig. 1 is for the reader process of a reader-writer synchronization problem. Write out the lost statements near the exit-section part. (8%)

```
wait(mutex);
readcount++;
if( readcount == 1 ) wait(wrt);
signal(mutex);
...
//reading is performed here;
...
x
x
x
x
x
```

Fig. 1

- 6a. When a dead lock occurs, four necessary conditions can be observed. What do "no preemption" and "hold and wait" mean? (5%)
- 6b. A cycle found in a resource allocation graph (RAG) may not mean that a deadlock occurs. Why? (You may draw a RAG to explain it) (5%)

7. Consider the snapshot of a system as shown in the table below. Determine if the system is in a safe state by executing the safety-checking algorithm. (8%)

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	0	6	3	2	0	6	5	2	1	5	2	0
P1	0	0	1	4	0	6	5	6				
P2	0	0	1	2	0	0	1	2				
P3	1	0	0	0	1	7	5	0				
P4	1	3	5	4	2	3	5	6				

- 8a. What information is stored in a file control block (FCB)? Give at least 3 items. (6%)
- 8b. The in-memory information is used for both file-system management and performance improvement. Besides mount table, give two more items of such information. (4%)
- 9a. Linked allocation is a method for disk space allocation. What disadvantages of linked allocation are improved by the variant method, FAT (file allocation table)? (5%)
- 9b. Draw an example of an i-node that is used in the indexed disk space allocation method with the combined scheme. (4%)
- 10a. In the Unix file system, the i-nodes are pre-allocated across the entire disk partition. What is the purpose for such pre-allocation? (5%)
- 10b. If a disk partition is of 80 Gigabytes and each of its data blocks is of 2,048 bytes, how many bytes should be reserved for the bit vector in order to manage the data blocks in this partition? (4%)