(Total time 180 minutes, Total Points = 100 points)
from noon – 3:00 pm

Name: (please print) _____

This examination allows **only one page A4 cheat sheet, absolutely no notes and close book**. You may not collaborate in any manner in the exam. You are not allowed to use any means to copy the exam book/question(s). In recognition of and in the sprit of the Oakland University Honor Code, I certify that I will neither give nor receive aid during the exam.

Signature: _____

Hints:

1. Put your name on the exam books NOW!
2. Read the questions clearly and think it through before you are answering.
3. You have 180 minutes to complete the exam. Be a smart exam taker! Remember not all the points born equal. So, if you get stuck on one problem go on to another problem.
4. If you think your answer is not provided as a choice (it will rarely happen), put your answer along with the question.
5. Put your final answers in the answer sheet on the second page.

Answer sheet

Question 1 (Total 30 points: 3 points for each correct answer)					
1	2	3	4	5	6
7	8	9	10		
Earned:_____					
Question 2 (Total 50 points: 4 points for each correct answer)					
1	2	3	4	5	6
7	8	9	10	11	12
13					
Earned:_____					
Question 3 (Total 20 points: 3 points for each correct answer)					
1	2	3	4	5	6
7					
Earned:_____					

Total: _____

Question 1. (30 points) [**Disk Scheduling]** Disk requests come into the disk driver for cylinders 10, 22, 20, 2, 40, 6, and 38 in that order. Assume that the disk has 100 cylinders, from 1 to 100. The disk heads are along the up travel direction In all the cases, the arm is **initially at cylinder 29**.

1) Suppose the disk head scheduling policy is First-come, First-served (FCFS), then what is the cylinder the disk head would be visiting first?

   A. 10 B. 22 C. 20 D. 2 E. 40 F. 6 G. 38

   Answer: _____

2) Suppose the disk head scheduling policy is First-come, First-served (FCFS), then what is the cylinder the disk head would be visiting last?

   A. 10 B. 22 C. 20 D. 2 E. 40 F. 6 G. 38

   Answer: _____

3) Suppose the disk head scheduling policy is Shortest Seek Time First (SSTF), then what is the cylinder the disk head would be visiting first?

   A. 10 B. 22 C. 20 D. 2 E. 40 F. 6 G. 38

   Answer: _____

4) Suppose the disk head scheduling policy is Shortest Seek Time First (SSTF), then what is the cylinder the disk head would be visiting last?

   A. 10 B. 22 C. 20 D. 2 E. 40 F. 6 G. 38

   Answer: _____

5) Suppose the disk head scheduling policy is SCAN, then what is the cylinder the disk head would be visiting first?

   A. 10 B. 22 C. 20 D. 2 E. 40 F. 6 G. 38

   Answer: _____

6) Suppose the disk head scheduling policy is SCAN, then what is the cylinder the disk head would be visiting last?

   A. 10 B. 22 C. 20 D. 2 E. 40 F. 6 G. 38

Answer: _____

7) Suppose the disk head scheduling policy is C-SCAN, then what is the cylinder the disk head would be visiting first?

A. 10 B. 22 C. 20 D. 2 E. 40 F. 6 G. 38

Answer: _____

8) Suppose the disk head scheduling policy is C-SCAN, then what is the cylinder the disk head would be visiting last?

A. 10 B. 22 C. 20 D. 2 E. 40 F. 6 G. 38

Answer: _____

9) Suppose the disk head scheduling policy is C-LOOK, then what is the cylinder the disk head would be visiting first?

A. 10 B. 22 C. 20 D. 2 E. 40 F. 6 G. 38

Answer: _____

10) Suppose the disk head scheduling policy is C-LOOK, then what is the cylinder the disk head would be visiting last?

A. 10 B. 22 C. 20 D. 2 E. 40 F. 6 G. 38

Answer: _____

Question 2. (50 points) [Memory Management: each correct answer earns 4 points]

In this section, questions 1) – 5) are about the following table showing the core map of a virtual memory system at time **t**, which has a page size of 1000 bytes. In this table, column "Timer" indicates the reference time on the corresponding page (earlier access has smaller value).

Frame number	Process ID	Page number	Timer
0	1	2	3
1	1	1	2
2	2	1	1
3	3	0	4
4	1	3	5
5	2	2	6

1) To which physical address does virtual address 1300 of process 1 map?

A) 1300 B) 300 C) 2300 D) 3300 E) does not map

Answer: _____

2) To which physical address does virtual address 17 of process 2 map?

A) 17 B) 1700 C) 2700 D) 3700 E) does not map

Answer: _____

3) Which virtual address of which process maps to physical address 500?

   A) process 1, virtual address 2500

   B) process 1, virtual address 1500

   C) process 2, virtual address 2500

   D) process 2, virtual address 1500

   E) does not map

   Answer: _____

4) Let's assume the given system has memory of 6000 bytes. Right now (@time **t**), **process 1** issues a reference to its logical address 4500, there will be a page fault. If the system deploys LRU algorithm for page replacement with global replacement policy, what is the corresponding physical address being referenced?

   A. 500 B. 1500 C. 2500 D.3500 E. 4500 F. 5500

   Answer: _____

5) Let's assume the given system has memory of 6000 bytes. The system page table is shown as above, right now (@time **t**), **process 1** issues a reference to its logical address 4500, there will be a page fault. If the system deploys LRU algorithm for page replacement with local replacement policy, what is the corresponding physical address being referenced?

   A. 500 B. 1500 C. 2500 D.3500 E. 4500 F. 5500

   Answer: _____

6) What is the primary reason that a translation lookaside buffer (TLB) is used?

   A. A TLB ensures that a process does not access memory outside of its address space

   B. A TLB makes translating virtual addresses to physical addresses faster

   C. A TLB allows multiple processes to share the L1 cache

   D. A TLB makes translating virtual addresses to physical addresses possible

   Answer: _____

7) Which of the following is not a solution to thrashing?

   A. Running fewer processes
   B. Increasing the speed of the CPU
   C. Rewriting programs to have better locality
   D. Increasing the size of physical memory
   E. These all solve the problem of thrashing

   Answer: _____

8) Which of the following is (are) true about base and bounds registers?

   I. They offer protection between processes
   II. They lead to internal fragmentation of physical memory
   III. Once a process has been started at a given memory location, it cannot be moved to another location

   A. I
   B. II
   C. I & II
   D. I, II, & III
   E. None of the above

   Answer: _____

9) If a process has allocated every 1024^{th} virtual page (e.g. it has allocated virtual pages 0, 1024, 2048, 3072, 4096, 5120 ... 1024000), which one of the following page table schemes will use the LEAST amount of memory?
   A. A flat page table
   B. A two-level page table with 1024 first level entries
   C. A two-level page table with 2048 first level entries
   D. An inverted page table
   E. Each of the above page table will use exactly the same amount of memory

   Answer: _____

10) A smaller page size leads to smaller page tables.

True [ ] False [ ]

11) A smaller page size leads to more TLB misses.

True [ ] False [ ]

12) A smaller page size reduces paging I/O throughput.

True [ ] False [ ]

13) A smaller page size leads to fewer page faults.

True [ ] False [ ]

Question 3. (20 points) [**File System**] Suppose that you have a UNIX file system where the disk block size is 1000 bytes. Disk addresses and file block pointers take 32 bits (4 bytes), and the i-node contains 10 direct pointers, one single-indirect pointer and one double-indirect pointer. Assume an index block is the same size as a disk block [Hint : it may help if you sketch a picture of how i-node is used to locate the blocks making up a file.]

1) What is the maximum number of data blocks a file will be supported by this i-node structure?

   A. 62,760
   B. 251,010
   C. 30
   D. 1,001,010
   E. 350

   Answer: _____ or _____ blocks

2) If a user wants to store 5,000 bytes into a file, how many disk blocks the file would need from the hard disk not including the i-node?

   A. 50 B. 100 C. 5 D. 6 E. 51 F. 101

   Answer: _____ or _____ blocks

3) If a user wants to store 50,000 bytes into a file, how many disk blocks the file would need from the hard disk not including the i-node?

   A. 50 B. 100 C. 5 D. 6 E. 51 F. 101

   Answer: _____ or _____ blocks

4) If a file has 50,000 bytes of data and it is never been accessed, we only assume the i-node is in memory, none of the rest of the file the user wants to access to 400 bytes of data from address 8,500, how many I/O operations would be needed?

   A. 1 B. 2 C. 3 D. 4 E. 5 F. 6

   Answer: _____

5) If a file has 50,000 bytes of data and it is never been accessed, we only assume the i-node is in memory, none of the rest of the file the user wants to access to 600 bytes of data from address 8,500, how many I/O operations would be needed?

A. 1 B. 2 C. 3 D. 4 E. 5 F.6

Answer: _____

6) If a file has 50,000 bytes of data and it is never been accessed, we only assume the i-node is in memory, none of the rest of the file the user wants to access to 1600 bytes of data from address 8,500, how many I/O operations would be needed?

A. 1 B. 2 C. 3 D. 4 E. 5 F.6

Answer: _____

7) If a file has 50,000 bytes of data and it is never been accessed, we only assume the i-node is in memory, none of the rest of the file the user wants to access to 2600 bytes of data from address 8,500, how many I/O operations would be needed?

A. 1 B. 2 C. 3 D. 4 E. 5 F.6

Answer: _____