CSCI.4210 Operating Systems
Exam 2
October 31, 2002

Name: _______________________________ RCS login ____________________

You will have 90 minutes to complete this test. Each question has a suggested time. These
total 90 minutes. The weight of each question will be proportional to this suggested time.

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48.

Total Raw Score _____  Scaled Score _____
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True/False (30 seconds each)

1. _____ A disk drive is a block device
2. _____ A printer is a block device
3. _____ The DMA controller has access to the main system bus
4. _____ The DMA controller copies data directly to the user process memory without CPU intervention
5. _____ The DMA controller only issues one interrupt per successful IO request, at the completion of the operation.
6. _____ Programmed I/O is the fastest method of I/O
7. _____ A device driver is a software component that acts as an interface between the kernel I/O systems and the device controller
8. _____ With the MPEG standard every frame in a particular file is the same size (excluding header information)
9. _____ With the MPEG standard most frames only encode the difference between the current frame and the previous frame
10. _____ With the MPEG standard, frames are not compressed because it takes too long to decompress a frame in real time
11. _____ In a virtual memory system, the page size and the page frame size must be the same
12. _____ In a virtual memory system performance is usually enhanced if adjacent logical pages are stored in adjacent page frames
13. _____ A virtual memory system can be enhanced by having each logical page map to two or more physical page frames.
14. _____ If a system is dispensing videos, caching recently used frame information boosts performance.

15. _____ X Windows and Microsoft Windows are both examples of event driven programming

16. _____ The Unix Inode contains the size of the file

17. _____ The Unix Inode contains the name of the file

18. _____ The Unix Inode contains the complete path of the file

19. _____ The Unix Inode contains the user id of the file owner

20. _____ In Unix, a call to open creates a new entry in the process file descriptor table

21. _____ In Unix, a call to open creates a new entry in the kernel open file table

22. _____ In Unix, a call to open loads the Inode of the file into memory

23. _____ Most file systems assign logical blocks of a file to contiguous blocks on a disk.

24. _____ With the XWindow system, the user sits at an X server.

End of True False

Multiple Choice (1 minutes each):

25. _____ If a disk drive is running the elevator algorithm, which component would be most likely to implement it
   a. The device controller
   b. The device driver
   c. The kernel IO system
   d. The user process which makes the IO request
   e. The interrupt handler

26. _____ A user program issues the following command
   
   printf("The value is %f\n",f) /* the %f flag in the format string signifies that its argument is of type float */
   
   Where would the conversion of a value in memory to the outputted string be done?
   a. In user space
   b. In the kernel
   c. In the device driver
   d. In the device controller
   e. In the interrupt handler
27. _____ A disk drive uses the elevator algorithm. It just read data from cylinder 50, and before that it read data from cylinder 65. There are four requests for data, on cylinders 20, 30, 55, and 65. Which request would it perform first?
   a. 20
   b. 30
   c. 55
   d. 65

28. _____ The most time consuming factor in a typical disk read operation is
   a. The time required to wait for the data to spin around under the read/write head
   b. The time required to copy the data from the disk to a buffer in memory
   c. The time required to move the read/write head over the appropriate cylinder
   d. The time required to compute the sector(s) to read from the file offset value.

29. _____ Which best describes the role of the disk device controller?
   a. It converts a file offset value to sector and track values
   b. It reads one byte at a time from the disk and copies the value to main memory
   c. It calculates which sector to read next
   d. It reads a bit stream from a sector, performs error detection with a check sum, and copies the bytes to main memory

30. _____ A distributor of videos on the web noticed that demand for videos followed Zipf’s Law. His most popular video in a given period was Titanic, which had 1000 requests during a particular week. How many requests would you estimate for the second most popular video that week?
   a. 900
   b. 750
   c. 666
   d. 500

31. _____ According to the text, the best way to implement the fast forward function for an MPEG file is
   a. Run the video at ten times normal speed
   b. Display every tenth frame.
   c. Display frames which are separated by a constant distance in the file, but this is not necessarily every nth frame.
   d. To build a special file containing, say, every tenth frame, and encode this using the normal MPEG algorithm

32. _____ In Unix there is one Inode
   a. for each file
   b. for each link to a file
   c. for each open file
   d. for each block of the file
   e. for every ten blocks of a file
   f. for each directory
33. _______ An entry in a FAT table
   a. is a pointer to a block or cluster of data
   b. is a pointer to a block which contains pointers to blocks of data
   c. contains flags, such as whether the file is open for reading or writing
   d. contains the name of the file

34. _______ The MS/DOS file system allowed file names of only 8 characters plus a three char suffix, while the NT file system allows much longer file names. This introduced potential problems of backward compatibility. Which of the following is true?
   a. Many of the programs and utilities written for MS/DOS cannot handle long file names, and as a result had to be replaced.
   b. There were essentially no problems with backward compatibility because MS/DOS file names are legal in an NT file system
   c. Windows NT actually has two file names for each file, a potentially long name and a DOS style name
   d. NT solved the problem by converting all file names to unicode

35. _______ A page table entry in a typical paging system contains
   a. Only the page frame number or address
   b. The page frame number and address, and offset within the page frame
   c. The page frame number or address, and other information, such as the referenced bit and protection bits.
   d. The address of the page frame on the disk

36. _______ The dirty bit in a page table entry is set when
   a. the page has been referenced since the last clock tick
   b. the page can be replaced
   c. the contents have been modified
   d. the page is not in the cache

37. _______ Swapping
   a. refers to replacing a page in virtual memory by another page
   b. refers to copying entire processes onto disk after they have been loaded and started.
   c. refers to a situation in which a system generates so many page faults that little real work gets done
   d. refers to a memory compaction process in which two or more small holes in memory are consolidated into one large hole.

End of Multiple choice
38. (4 minutes) Your text distinguishes two types of file system backup, logical and physical. Briefly list the advantages and disadvantages of each.

39. (2 minutes) What problem does a multilevel page table solve?

40. (4 minutes) What is the principle of locality? Why is it fundamental to modern operating system design. What are the two types of locality?
41. (9 minutes) A number of independent processes interact with a database. When a process wants to access a record, it obtains a lock on it, and if another process already has a lock on that record, the requesting process blocks until the process with the lock releases the record.

Here are some situations. For each, draw the resource allocation graph and decide whether a deadlock situation exists.

**Situation A.**
Process 1 has been granted record 56
Process 2 has been granted record 97
Process 3 has been granted record 42
Process 1 has requested record 97
Process 2 has requested record 42
Process 1 has requested record 42

**Situation B.**
Process 1 has been granted record 56
Process 2 has been granted record 97
Process 3 has been granted record 42
Process 4 has been granted record 50
Process 1 has requested record 97
Process 2 has requested record 50
Process 3 has requested record 97
Process 4 has requested record 42

**Situation C**
Process 1 has been granted record 56
Process 2 has been granted record 97
Process 3 has been granted record 42
Process 4 has been granted record 50
Process 1 has requested record 50
Process 2 has requested record 50
Process 3 has requested record 50
Process 1 has requested record 97
42. (6 minutes) A real time file system has three processes running, each of which has a highly periodic deadline.

Process A has a period of 50 msec and uses 15 msec of cpu time per cycle
Process B has a period of 75 msec and uses 20 msec of cpu time per cycle
Process A has a period of 30 msec and uses 10 msec of cpu time per cycle

List the times that each of these cycles is loaded into memory and is completed (they may be preempted) for two scheduling algorithms Rate Monotonic Scheduling and Earliest Deadline First, by filling in the chart below.

<table>
<thead>
<tr>
<th>Time in Msec.</th>
<th>A</th>
<th>B</th>
<th>C</th>
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<tr>
<td>0</td>
<td>A1</td>
<td>B1</td>
<td>C1</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td>B2</td>
<td>C2</td>
</tr>
<tr>
<td>40</td>
<td>A2</td>
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<tr>
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<td></td>
<td>B2</td>
<td>C4</td>
</tr>
<tr>
<td>80</td>
<td>A3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
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<td>120</td>
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43. (6 minutes) A user on a unix system types `cp a.txt /usr/students/suzy/a.txt`

The `cp` command copies a file, just like your first assignment. List all of the disk accesses needed to do this. Assume that the current directory is in cache memory, but no other files are.

44. (4 minutes) P 194 of your text states "Multiprogramming introduces two essential problems that must be solved – relocation and protection."

Define the relocation problem and discuss ways to solve it.
45. (6 minutes) What is a Translation Lookaside Buffer? What problem does it solve and how does it work?

46. (6 minutes) What is an inverted page table? What problem does it solve? How does it work?

47. (6 minutes) Suppose you had to write the interrupt handler for a page fault. List everything that it should do.
48. (12 minutes) A computer system with virtual memory has a memory cache, and a Translation Lookaside Buffer in the MMU. List all of the steps which the system has to do to locate a memory address. There will be several decisions, and in each case, indicate what would happen in both cases.

For example, your steps might include something like this?

Is the contents of the address in the cache?

if Yes ...
if No ...