CS 376	**Operating Systems**	Test 3
Name:		Maximum Points: 52

Important: This is an open book test. You can use any books, notes, or paper. *Do not log into the computer during the test.* Any calculations and rough work can be done on the back side of the test pages.

1. [5 pt] Discuss how fragmentation manifests itself in each of the following types of virtual storage systems.

   (a) Segmentation

   (b) Paging

   (c) Combined Segmentation/Paging

2. [6 pt] Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

   What are the physical addresses for the following logical addresses?

   (a) 0, 430
   (b) 1, 10
   (c) 1, 11
   (d) 2, 500
   (e) 3, 400
   (f) 4, 112

3. [5 pt] If an instruction takes 1 μsec and a page fault takes an additional n μsec, give a formula for the effective instruction time if page faults occur every k instructions.

4. [6 pt] If FIFO page replacement is used with four frames and eight pages, how many page faults will occur with the reference string 0 1 7 2 3 2 7 1 0 3 if the four frames are initially empty? Now repeat this problem with LRU and OPT.

5. [10pt] Suppose the page table for the process currently executing on the processor looks like the following. All numbers are decimal, everything is numbered starting from zero, and all addresses are memory byte addresses. The page size is 1024 bytes.

Virtual Page #	Valid Bit	Reference Bit	Modify Bit	Frame #
0	1	1	0	4
1	1	1	1	7
2	0	0	0	-
3	1	0	0	2
4	0	0	0	-
5	1	0	1	0

(a) Describe exactly how, in general, a virtual address generated by the CPU is translated into a physical main memory address.

(b) What physical address, if any, would each of the following virtual addresses correspond to? (Do not try to handle any page faults, if any).

i. 1052

ii. 2221

iii. 5499

6. [6 pt] Disk requests come in to the disk driver for cylinders 10, 22, 20, 2, 40, 6, and 38, in that order. A seek takes 6 msec per cylinder moved. In all cases, the arm is initially at cylinder 20, and traveling towards cylinder 40. The disk has 48 cylinders. How much seek time is needed for

(a) First come, first served

(b) SSTF

(c) SCAN

(d) LOOK

7. [4 pt] Directories can be implemented either as "special files" that can only be accessed in limited ways, or as ordinary data files. What are the advantages and disadvantages of each approach?

8. [10pt] Execute the shell command script below. It creates a directory `junk` and creates five files in the directory. After doing some control `ls` commands, the `chmod` command turns off read permission for the directory. What happens when the various `ls` commands are executed now? What happens after changing directory into `junk`? After restoring read permission but removing execute (search) permission from `junk`, repeat the experiment. What happens?

```
mkdir junk
for i in 1 2 3 4 5
do
    echo hello > junk/$i
done
ls -ld junk
ls -l junk
chmod -r junk
ls -ld junk
ls junk
ls -l junk
cd junk
pwd
ls -l
echo *
cd ..
chmod +r junk
chmod -x junk
ls junk
ls -l junk
cd junk
chmod +x junk
```