

Midterm Test

(200 points)

This exam has a total of 10 questions,
spread over 7 pages, including this cover
page.

Date: March 3, 2015

Student Name:

Student ID:.....

You are allocated a maximum amount of space to answer each question. (We have provided sufficient lines.) Adhere to those limitations when you formulate your answers. Do not use the backside of the pages; no additional pages are allowed. Make an effort to write in a readable fashion. We will skip over (and therefore not grade) non-readable portions.

"I have adhered to the Aggie Code of Honor."

Signature:

.....

1(33)

2(12)

3(15)

4(20)

5(15)

6(15)

7(20)

8(20)

9(30)

10(20)

T(200)

1. [33 points] Match each term in the left column to the definition/description in the right column that fits best. Do this by filling in the void entries on the left:

- | | |
|--|---|
| <input type="checkbox"/> Privacy | (A) System Call |
| <input type="checkbox"/> Throughput | (B) Information pertaining to permanent data storage |
| <input type="checkbox"/> Exception | (C) Lives in Kernel space and entries contain inode pointer among other attributes |
| <input type="checkbox"/> Context switching | (D) Files have unique inodes (one of the inodes only contains filename) |
| <input type="checkbox"/> inode table | (E) Integer number identifying a file connection |
| <input type="checkbox"/> Wait queue | (F) Data is available only to authorized users |
| <input type="checkbox"/> File table | (G) Number of operations completed per unit of time |
| <input type="checkbox"/> File descriptor | (H) Transfer of control to OS in response to an event |
| <input type="checkbox"/> vnode table | (I) Action performed by OS to remove a process from processor and replace it with another |
| <input type="checkbox"/> Trap | (J) Contains processes that are held up due to an IO operation |
| <input type="checkbox"/> Soft link | (K) Lives in Kernel space and entries contain offset and ref count among other attributes |

2. [12 points] Circle the following statements TRUE or FALSE

- T F The `exec()` system call creates a new process
- T F First Come First Served (FCFS) scheduling algorithm performance can never equal the performance of Shortest Job First (SJF) for average wait time
- T F Doubling the block size of a unix file system will double the max file size
- T F A `refcnt` of 2 in a `vnode` table implies a file of size 2 blocks

3. [15 points: 3 points for each item] Which of the following actions should be allowed only in kernel privileged mode? (circle correct answer)

- | | |
|-----------------------------------|--------|
| (a) Masking of an Interrupt | YES NO |
| (b) Exception Handling | YES NO |
| (c) String search in an open file | YES NO |
| (d) Creation of a file | YES NO |
| (e) Add instruction operation | YES NO |

4. [20 points] In the following code, what will the output at Lines X and Y? **Explain!**

```
#include <stdio.h>
#include <unistd.h>
#define SIZE 3
int nums[SIZE] = {2,4,6};
int main()
{
    int i;
    pid_t pid;
    pid = fork();
    if (pid == 0) {
        for (i = 0; i < SIZE; i++) {
            nums[i] *= -i;
            printf("CHILD: %d ",nums[i]); /* LINE X */
        }
    }
    else if (pid > 0) {
        wait(NULL);
        for (i = 0; i < SIZE; i++)
            printf("PARENT: %d ",nums[i]); /* LINE Y */
    }
    return 0;
}
```

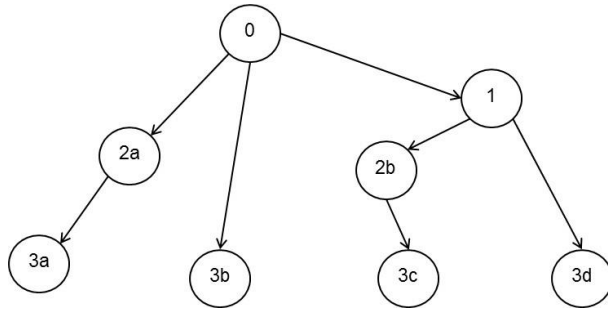
4a. [10 points] The output at Line (X) is _____

Note: Space provided for explanation

4b. [10 points] The output at Line (Y) is _____

Note: Space provided for explanation

5. [15 points] Write a pseudo code using fork to build the process tree shown below.



6. [15 points: 5 points for each part] Consider the program below:

```
#include <stdio.h>
#include <unistd.h>

int counter = 0;
int main()
{
    int i;
    for (i=0; i<2; i++) {
        fork();
        counter++;
        printf("counter = %d\n", counter);
    }
    printf("counter = %d\n", counter);
    return 0;
}
```

Please answer the questions below. No explanation is needed.

6a. How many times would the value of counter be printed: _____

6b. What is the value of counter printed in the first line? _____

6c. What is the value of counter printed in the last line? _____

7. [20 points] What would be the output of the program below that reads an input file with content: **HOWDY**

PLEASE EXPLAIN HOW YOU ARRIVED AT THE ANSWER.

Rubric: 10points for correct answer and 10 points for supporting explanation

```
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <fcntl.h>

int main(int argc, char *argv[])
{
    int fd1;
    int s = 0x1;
    char c1, c2;
    char *fname = argv[1];
    fd1 = open(fname, O_RDONLY, 0);
    read(fd1, &c1, 1);
    if (fork()) { /* Parent */
        sleep(s);
        read(fd1, &c2, 1);
        printf("Parent: c1 = %c, c2 = %c\n", c1, c2);
    } else { /* Child */
        sleep(1-s);
        read(fd1, &c2, 1);
        printf("Child: c1 = %c, c2 = %c\n", c1, c2);
    }
    return 0;
}
```

8. [20 points] Consider the following set of processes, with the length of the CPU burst time given in milliseconds:

Process	BurstTime	Priority
P1	2	3
P2	1	1
P3	4	4
P4	5	2
P5	8	3

The processes are assumed to have arrived in the order P1, P2, P3, P4, P5 all at time 0. We are going to schedule the execution of these processes using the following scheduling algorithms: First Come First Served (FCFS), Shortest Job First (SJF), Round Robin (RR), and a new type of scheduling algorithm called non-preemptive priority scheduling.

Assumptions and Clarifications:

- Assume the quantum (aka time slice) of 2 for RR algorithm
- Non-Preemptive means once scheduled, a process cannot be preempted (i.e. it runs to completion). Assume a larger priority number implies a higher priority.

8a. [10 points] What is the turnaround (completion) time of each process for each of the scheduling algorithms. Write the times in the table below.

	FCFS	SJF	Priority	RR
P1				
P2				
P3				
P4				
P5				

8b. [10 points] Which of the algorithms results in the longest average waiting time (over all processes)? Explain your answer with calculations.

9. [30 points] Consider a file system with 2K Byte blocks and 4 Byte pointers to those blocks. Each inode contains 12 direct pointers, 1 singly-indirect pointers, 1 doubly-indirect pointer, and 1 triply-indirect pointer. **Please show your calculations below:**

9a.[10 points] What total storage capacity can this file system support? Explain.

9b.[10 points] What is the maximum file size possible with this file system? Explain.

9c. [10 points] Make some reasonable assumptions and compute the number of inodes that can fit into a disk block.

10. [20 points] For each of the three mechanisms for supporting dual mode operation — privileged instructions, memory protection, and timer interrupts — explain briefly what might go wrong without that mechanism, assuming the system still had the other two.