

This exam is **closed book**. You can have **one** page of notes.

1. Complete the following sentences: (6×5 points)

- (a) `__fork()` is one of the *most expensive* system calls.
- (b) A system whose users edit, compile and run their programs from terminals is an `__interactive__` system.
- (c) The sole disadvantage of *non-blocking writes* is that `__data can be lost if the system crashes before the write completes__`.
- (d) To speed up disk accesses, most modern disk controllers have `__direct memory access (DMA)_____`
- (e) A process that *shares* the address space of its parent is called a `__TWO ANSWERS: lightweight process OR thread _____`.
- (f) The only way for the CPU to switch from user mode to supervisor mode is through `__a context switch__`.

2. Consider a modification of the Unix operating system where child processes would not inherit opened file descriptors from their parent. Which Unix system call would then become absolutely useless and why? (10 points)

The pipe(...) system call would become totally useless because two processes could not share the same pipe.

3. How many lines of output will the following program print out? (5 points)?

```
main(){
    if (fork()== 0) fork();
    printf("Hi!\n");
}
```

The program will print `__three__` lines.

4. Why is the ready state normally organized as a priority queue? (10points)

Because it contains all the processes waiting for the CPU and these processes are ranked by (a) priority and (b) order of arrival in the queue.

5. What is the default action that a Unix process takes when it receives a signal from another process? (5 points)

It terminates.

6. Advantage and disadvantages: you will get **no credit** if you answer **mentions a disadvantage when an advantage is asked and vice versa**. (5×5 points)

- (a) What is the major disadvantage of **microkernels** over **monolithic kernels**?

A system call involving a server process outside the kernel requires two additional context switches.

- (b) What is the major advantage of the **symmetric** organization in multiprocessor architectures?

Since multiple copies of the kernel can run in parallel, system calls and other kernel activities never cause a bottleneck

- (c) What is the major advantage of **swapping out** processes that have been for too long in the waiting state?

It frees space in the main memory for other processes.

- (d) What is the major disadvantage of **user-level threads**?

When one of the threads does a blocking system call, none of the other threads sharing the same address space can run.

- (e) What is the major advantage of **dual-mode CPUs**?

Dual-mode CPUs prevents user from directly accessing the disk for this would allow them to bypass all file access control rules set up by the file system.

7. Explain in a few words each of the three transitions leaving the **running state** and give examples of events that can cause them.. (15 points)

- (a) Process returns to the ready state after a timer interrupt *(or the arrival of another process)

- (b) Process goes to the waiting state while waiting for the outcome of a system call

- (c) Process terminates.