This exam is closed book. You can have one page of notes. UH expels cheaters.

1. Match each of the following features with the single sentence that describes it best: (10×3 points) (Hint: Several of the choices offered are plain wrong.)

<table>
<thead>
<tr>
<th>Function</th>
<th>(a)</th>
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</table>

(a) Allows the CPU to execute input/output instructions.
(b) Contains all processes that are waiting for the completion of a system request.
(c) Contains all the processes waiting for the CPU. (answer for the ready state)
(d) Creates a duplicate of a given file descriptor.
(e) Creates a new process.
(f) Define interrupt priorities. (answer for vectorized interrupts)
(g) Delegate most of their duties to user-level servers.
(h) Gives real-time processes faster access to the disk controller. (plain wrong)
(i) Identifies a superuser process. (plain wrong)
(j) Loads in memory the program to be executed by a given process.
(k) Sends a signal to another process.
(l) Share the address space of their parent.
(m) Specifies what a process should do when it receives a signal.
(n) Specifies which files cannot be accessed by the user processes. (plain wrong)
(o) Terminates the process making that system call. (answer for _exit())
(p) Used to send the standard output of a process to the standard input of another one.
2. **Advantage and disadvantages:** you will get no credit if you answer mentions a disadvantage when an advantage is asked and vice versa. (6×5 points)

(a) What is the major disadvantage of modular kernels?

*Modular kernels are much less reliable than other kernels because they allow users to load possibly unsafe extensions into the kernel.*

(b) What is the major advantage of having timer interrupts?

*They will prevent CPU-bound processes from monopolizing the CPU.*

(c) What is the major advantage of not allowing processes to catch SIGKIL signals?

*It provides a sure way to terminate any process no matter what.*

(d) What is the major advantage of DMA controllers?

*They speed up data transfers between the disks and the memory.*

(e) What is the major disadvantage of delayed writes?

*Data waiting to be written on disk will be lost if the writing process or the kernel crashes.*

(f) What is the major advantage of copy-on-write implementations of the fork() system call?

*They reduce the cost of the fork() system call by letting parent and child share the same address space and only copy the pages that either of them has modified.*

T: ___
3. Add the two system calls that will ensure that the program will print exactly once Hello World! and Goodbye! in that order. (2×5 points)

```c
int main(){
    if (fork() == 0) {
        printf("Hello World!\n");
        _exit(0); // do not forget the underscore
    }

    wait(0);
    printf("Goodbye!\n")
} // main
```

4. Which of the following statements apply to (a) kernel-supported threads, (b) user-level threads and (c) all threads? (5 points per correct line)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Kernel-supported</th>
<th>User-level</th>
<th>All threads</th>
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<tbody>
<tr>
<td>They can be ported to different architectures.</td>
<td>____</td>
<td>✓</td>
<td>____</td>
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<tr>
<td>They may require the use of non-blocking system calls.</td>
<td>____</td>
<td>✓</td>
<td>____</td>
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<tr>
<td>They allow the kernel to allocate several processors to the threads sharing the same address space.</td>
<td>✓</td>
<td>____</td>
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</table>

5. Which are the three states a running process can go and when? (3×5 points)

(a) To the ready__________ state when the process gets preempted.__________________________________________

(b) To the waiting________ state when the process issues a (blocking) system request.________________________

(c) To the terminated________ state when the process terminates.__________________________________________