Part 1 - Synchronization

Answer 7 of the 10 questions below. The remaining 3 can be answered for extra credit. Please clearly mark which are which, otherwise it will be assumed 1-7 count and 8-10 are the extra credit.

1. Describe a critical region.

2. Why is synchronization of processes necessary?

3. Describe deadlock.

4. There were 4 conditions that must be met for deadlock to occur. Name 2 of them.
5. What algorithm is used when dealing with deadlock in modern systems?

6. The Linux kernel has a specific programming methodology in order to avoid even possible resource deadlock. Describe it.

7. What does it mean for an operation to be atomic?

8. We discussed the difference between atomicity and ordering. Please summarize this discussion.

9. There is a method that can be used to ensure ordering in the Linux kernel. Please describe it.
10. How do you decide which of spin locks, semaphores, and Mutexes to use?

Part 2 - Kernel Time

Answer 4 of the 6 questions below. The remaining 2 can be answered for extra credit. Please clearly mark which are which, otherwise it will be assumed 1-4 count and 5-6 are the extra credit.

1. For the kernel, what is the tick rate, and what is it used for?

2. Describe the concept of a tickless operating system, and what advantages it would have.

3. Where is the total ticks since system boot stored?

4. How does the system deal with the above variable wrapping around?
5. Describe the difference between absolute and relative time.

6. What are BogoMIPS, and what are they used for?

**Part 3 - VFS**

1. The VFS is very important to everyday operation. What does it do for us?

2. Draw the path of the flow of data from user space to physical media.

3. There are 4 object types associated with VFS. What are they?
4. Describe each of the 4 object types from the previous question.

5. There are 3 main data structures associated with a process at the VFS layer. These are the `files_struct`, the `fs_struct`, and the `mnt_namespace`. Describe the purpose of each and how they relate to one another.

Part 4 - Page cache and writeback

*Answer 4 of the 6 questions below. The remaining 2 can be answered for extra credit. Please clearly mark which are which, otherwise it will be assumed 1-4 count and 5-6 are the extra credit.*

1. What is caching, and why is it important?

2. Please describe the two different types of locality, and how they can be used to inform caching decisions.
3. Reads and writes are cached in different ways, with multiple possible strategies. For both, describe how data ends up in the cache, and the strategies that could be used to keep it in sync with the canonical copy.

4. What strategy does Linux use for cache eviction? Please be very specific.

5. The Linux page cache uses a specific object to index entries in the cache, which is distinctly misnamed. Please name and describe its usage.

6. Describe laptop mode, as it relates to the page cache.