Practice Exam

Warning: May be easier than real exam

Part I: Short Questions

1. The THE system is organized in a strict hierarchy, virtualizing aspects of the machine one at a time, with higher-level abstractions built on top of the earlier layers. The lowest level of virtualization ("level 0") is of:
   (a) the processor
   (b) core memory
   (c) the drum
   (d) the keyboard console
2. In Nucleus, assume a server process implements a user-level file system. What prevents a malicious process from sending a "fake" response from the file system to a client waiting for a response?
   (a) Mutual trust among processes
   (b) The client waits for a particular buffer from the server
   (c) Only the server can send send a message to waiting clients
   (d) The Nucleus kernel makes sure no fake messages are ever sent
3. In Hydra, if a process has a reference to an object, it can for certain
   (a) modify the object's entire representation
   (b) modify only the object's data part
   (c) destroy the object
   (d) perform operations in accordance with the access rights of the reference
4. In the original Unix system, the i-number (or "index number") of a file can be used to locate the file's inode
   (a) by scanning the free list
   (b) by checking the bit map
   (c) by performing a simple "base + offset" calculation
   (d) not at all (the i-number can't be used to directly find the inode)
5. In Pilot, a program can give advice to the operating system in order to tailor the OS's behavior to the program's liking. The Space.Activate() call on a region of a mapped file results in
   (a) the OS immediately fetching those pages
   (b) the OS knowing that those pages should be fetched soon
   (c) in-kernel data structures related to the space getting marked as "hot"
   (d) the pages of the space are all moved back on the global replacement list
6. A TLB miss occurs in an application running on Irix running on top of Disco. Which of the following represents a legal control flow? **(Circle all that apply)**
   (a) Irix TLB miss handler → resume application
   (b) Disco → resume application
   (c) Disco → Irix TLB miss handler → Disco → resume application
   (d) Disco → Irix TLB miss handler → Irix page fault handler → Disco → resume application
7. In which situations will the Gray-box file-cache content detector work poorly? **(Circle all that apply)**
   (a) A program accesses only "small" files sequentially (whole file)
   (b) A program accesses only "small" files randomly (1KB at a time)
   (c) A program accesses large files sequentially (whole file)
   (d) A program accesses large files randomly (1KB at a time)
8. From the "impact of structure on memory-system performance" paper, which of the following are true: **(Circle all that apply)**
   (a) Virtual-to-physical mappings can affect performance noticeably
   (b) User programs and the OS interfere with each other noticeably in the cache
   (c) Mach performance is poor because of extra communication overhead
   (d) Ultrix runs nearly all applications faster than Mach
9. Unix FFS used which of the following techniques to reduce the ill effects of *disk seeks* that were prevalent in the old Unix file system? **(Circle all that apply)**
   (a) Bit maps

(b) Sub-blocks

(c) Cylinder groups

(d) Rotational layout tables

10. When calling read() from an application to read a single data block from an open file in LFS, how many disk reads could occur? **(Circle all that apply)**

    (a) Zero

    (b) One

    (c) Two

    (d) More than two

11. Which of the following is true for RAID-5 as compared to RAID-4? **(Circle all that apply)**

    (a) RAID-5 has potentially higher read bandwidth

    (b) RAID-5 has potentially higher write bandwidth

    (c) RAID-5 has potentially lower read bandwidth under a single failure

    (d) RAID-5 potentially uses more capacity

12. AutoRAID does which of the following automatically? **(Circle all that apply)**

    (a) Moves active data into mirrored storage

    (b) Moves inactive data into RAID-0 storage

    (c) Adds new disks until workload runs smoothly

    (d) Takes advantage of idle time to power down gracefully

Part II: Longer Questions

1. **Be Very Af-RAID.**

   Assume you have a RAID-5 system with D data disks and 1 parity disk. Each disk has B blocks of capacity, and all disks are of identical make, model, and performance. Unfortunately, one of your data disks fails, and you replace it with a brand new disk. The system must then carry out the task of updating the new disk so that the RAID-5 returns to its normal "working" status (*i.e.*, all the data disks have all their data and the parity disk has all its necessary parity information), a process known as *reconstruction*.

   a): Describe how the process of reconstruction would work for RAID-5.

   b): During this reconstruction, how many blocks must be read from the RAID-5 storage system, and how many written?

   c): Now assume that we had instead created a storage system with mirroring instead of RAID-5, with a total of 2D disks for the system. Describe how reconstruction would work in the mirrored system.

   d): Which is faster - reconstruction in RAID-5 or reconstruction in the mirrored system? (justify)