

科目：作業系統

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請“✓”明 ☒不可看書 可看書

* 請將答案依題號順序寫入答冊

1. (8% in total) (4%) Explain and illustrate how synchronous I/O system calls and asynchronous I/O system calls work. (4%) What are their respective advantages and disadvantages?
2. (8% in total) (4%) In an UNIX operating system, all I/O instructions are defined to be privileged instructions and users cannot issue I/O instructions directly. Why? (4%) Explain the design of the I/O protection mechanism used in UNIX to allow users to perform legal I/O instructions.
3. (8% in total) (4%) Explain how the microkernel approach structures the kernel to provide services. (4%) Explain the advantages and disadvantages of the microkernel approach.
4. (8% in total) (8%) On UNIX, a process (parent) can call the `fork()` system call to create a new process (child) and then each of them executes their own different piece of code. Write a C program to illustrate how to use `fork()` to do this job.
5. (4%) When using FCFS to schedule processes, there may be a convey effect. Explain clearly what this problem is and its bad effects.
6. (8% in total) The classical definition of **wait** operation on a semaphore S in pseudo code is as follows:

```
wait(S) {  
    while (S <= 0) ;  
    S--;  
}
```

And the classical definition of **signal** operation on a semaphore S in pseudo code is as follows:

```
signal(S) {  
    S++;  
}
```

(4%) Modifications to the integer value of the semaphore in these two operations must be executed indivisibly. Why? You should illustrate a problem if this requirement is not enforced. (4%) In `wait(S)`, the testing of the integer value of S ($S \leq 0$) and its possible modification (`S--`) must also be executed without interruption. Why? You should illustrate a problem if this requirement is not

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part 1x enforced.

- 4
- part 13
7. (6% in total) Consider a system consisting of four resources of the same type that are shared by three processes, each of which needs at most two resources. Show that the system is deadlock-free.
 8. (8%) According to the previous question, assume that the OS is using the additional-reference-bits algorithm for LRU approximation. Assume that for each page, we use three bits to record the page reference history. Assume that when there are several pages with all zeros in their reference bits, the OS always chooses the one with the smallest page number to replace. After the page references in the sequence, pages (a), (b), (c), and (d) are in the frames. What is the value of $a^3 + b^3 + c^3 + d^3$?
 9. We have a disk with 200 tracks, numbered from 0 to 199. Initially, the disk head is at track 60 and moving in the direction of track 199. Now we have read-write requests to the following tracks: 198, 183, 37, and 56.
 - (a) (7%) Suppose the OS is using the SSTF disk scheduling policy. Then the disk head will visit the tracks a, b, c, and d in sequence. What is the value of $3a + 4b + c - d$?
 - (b) (7%) If we are using C-SCAN disk scheduling policy, what is the travel distance of the disk head?
 10. In distributed systems, it is very often that a coordinator is needed to synchronize the work among the processors in the systems. Election algorithms such as bully and ring-based algorithms are designed to determine which process is the coordinator process. Assume that there are n processors in the system and each process has a unique label. Please answer the following questions:
 - (a) (7%) In the conventional ring-based election algorithm, a unidirectional ring is used. What is the number of messages needed in worst case and in average to elect a new coordinator when only the coordinator process fails?
 - (b) (7%) In order to reduce the size of sent messages, Bob decides to include only the largest process ID in the message, rather than all the IDs for the processes receiving election messages. Can Bob's algorithm still work? Please explain your answer.
 11. (8%) Draw a diagram to explain the inverted page table design. Compare it with the normal page table design and list its several advantages and disadvantages.
 12. (6%) Please briefly explain "buffering", "caching", and "spooling".