

交通大學

operating system

高彬 老師解題

97

科目：作業系統
系所：資訊聯招

試題

一、單一選擇題：共四大題，每一大題三小題，每一小題答對給五分，答錯倒扣兩分。

1. Process, Threads, and CPU Scheduling.

(1) Which of the descriptions about the following C program with fork() is correct?

```
#include <stdio.h>
#include <unistd.h>

void func(int *input)
{
    (*input)++;
}

int main()
{
    pid_t pid;
    int k;
    k = 3;
    pid = fork();
    if (pid < 0) {
        func(&k);
        printf("k=%d ", k);
        exit(-1);
    } else if (pid == 0) {
        func(&k);
        printf("k=%d ", k);
    } else {
        wait(NULL);
    }
}
```

```

func(&k);
printf("k=%d ", k);
exit(0);
}
}

```

- (A) The output "k" of the parent process is 4.
 (B) The output "k" of the child process is 3.
 (C) The last output of "k" is 5.
 (D) None of the above.
- (2) Suppose a non-preemptive scheduler uses variable properties and time quanta as the following table, where the highest priority is 5.

priority	time quantum	new priority after time quantum is expired	new priority after returning from I/O
5	40	4	5
4	60	3	5
3	100	2	4
2	200	1	4
1	320	1	3

Which of the following statements is incorrect?

- (A) Response time of interactive threads will increase.
 (B) Priorities of CPU-intensive threads will be lowered.
 (C) Time-quantum of I/O-bound threads will decrease.
 (D) None of the above.
- (3) Consider the descriptions: (α) having separate program counters (β) having shared data (γ) having separate register sets (δ) scheduling by a thread library (ϵ) parallel running on a multi-processor system. Which of the following statements is incorrect?
- (A) (α)(β)(ϵ) can be characteristics of kernel threads of a multi-threaded process.
 (B) (α)(β)(δ) can be characteristics of user threads of a multi-threaded process.
 (C) (α)(β)(γ) can be characteristics of cooperating processes.
 (D) None of the above.

2. Process Synchronization and Deadlocks

(1) We have three processes and four resource classes, which are tape drivers, plotters, scanners, and CD-ROM drives. There are 3 tape drives, 5 scanners, 2 plotters, and 2 CD-ROM drives in the system. Process 1 has one scanner. Process 2 has two tape drivers and a CD-ROM drive. Process 3 has a plotter and two scanners. Process 1 needs additional 2 tape drives and one CD-ROM drive. Process 2 needs additional 1 tape drive and 1 scanner. Process 3 needs additional 2 tape drives and 1 plotter. Which of the following statements is correct?

- (A) The system will not be in the safe state for the above needs.
- (B) If process 2 request a CD-ROM, two tape drives, and one plotter, the system will be in a safe state.
- (C) If process 3 request a plotter, and 2 scanners, the system will be in a safe state.
- (D) None of the above.

(2) Which of the following statements is correct?

- (A) If a system is not in the safe state, it will be in a deadlock state.
- (B) If there is a cycle of resource allocation graph for a system with single instance resource, it will be in a deadlock state.
- (C) If there is a cycle of resource allocation graph for a system with resource of multiple instances, it will be in a deadlock state.
- (D) None of the above.

(3) Which of the following statements is correct?

- (A) If the conditions of mutual exclusion, hold and wait, no preemption, and circular wait, hold simultaneously in system, a deadlock situation will arise.
- (B) The conditional variable with signal operation can be executed even no process is suspended without influencing the system state.
- (C) A preemptive kernel is free from race conditions on kernel data structures.
- (D) None of the above.

3. Memory Management

(1) A system enables the MMU(memory-management unit) and supports logical addressing and virtual memory management. Which of the following statements is NOT correct?

- (A) To add more physical memory may increase the logical address space of a program.
- (B) To add more physical memory may increase the number of entries in page tables if the inverted page table scheme is employed.
- (C) A system with more swapping spaces in the backing store can execute more programs on the system simultaneously.
- (D) A system with more swapping spaces can grant more memory requests generated by programs.

(2) Please compare the speed of a memory access under below conditions. (a) A system enables the MMU, the TLB (translation look-aside buffer) and paging. A program accesses a memory address with a TLB miss and a page miss. (b) A system without the TLB enables the MMU and paging. A program accesses a memory address with a page hit. (c) A system without the TLB enables the MMU and paging. A program accesses a memory address with a page miss. (d) A system enables the MMU, the TLB and paging. A program accesses a memory address with a TLB hit. (e) A system enables the MMU, the TLB and paging. A program accesses a memory address with a TLB miss but a page hit. (f) A system does not enable the MMU and paging. A program accesses a memory address. Which of the following statements is correct?

- (A) (c) > (a)
- (B) (b) > (e)
- (C) (d) > (f)
- (D) (d) > (b)

(3) Which of the following statements is NOT correct?

- (A) If the TLB does not support separate ASIDs (address-space identifiers), the TLB must be flushed in each context switch.

- (B) The TLB entries for kernel codes are usually wired down, meaning that they cannot be removed from the TLB.
- (C) To increase the size of the TLB can always improve the performance of paged-based memory accesses.
- (D) A processor with the TLB can always improve the performance of paged-based memory accesses comparing with a processor without the TLB.

4. File Systems and I/O

- (1) Consider an inode-like disk-space allocation scheme. An inode is of 10 direct pointers, 1 indirect pointer, 1 double indirect pointer, and 1 triple indirect pointer. One pointer references one disk block, which is 512 bytes. Let one pointer be 4 bytes. Which one of the following is the smallest file size that is too large to be managed by this allocation scheme?
 - (A) 2^8 bytes.
 - (B) 2^{16} bytes.
 - (C) 2^{32} bytes.
 - (D) None of the above.
- (2) Consider a RAID-5 system which is of 5 disks. Suppose that one disk is out of order. Up to how many disks can be involved by a read of one disk block?
 - (A) 2.
 - (B) 4.
 - (C) 5.
 - (D) None of the above.
- (3) Which of the following technique **cannot** save precious CPU cycles for processes?
 - (A) interrupts.
 - (B) DMA.
 - (C) polling.
 - (D) all of the above.

二、問答題：共四大題，每題十分

1. Four processes, with the following sequences of CPU and I/O bursts, will be performed on a single-processor system with multiple and parallel I/O supports.

Process	Arrival Time	CPU and I/O Burst sequence(time unit)
P1	0	5(CPU),6(I/O),4(CPU)
P2	3	15(CPU)
P3	8	3(CPU),10(I/O),9(CPU)
P4	14	8(CPU)

Suppose the round-robin scheduling algorithm (time quanta = 5) is applied.

- (1) How many times of context switches occur?
- (2) Please calculate the turnaround time of P1.
- (3) Please calculate the turnaround time of P2.
- (4) Please calculate the waiting time of P3.
- (5) Please calculate the waiting time of P4.

2. Consider a system with five processes P_0 through P_4 and three resource types A, B, C. Resource type A has 11 instances, resource type B has 5 instances, and resource type C has 7 instances. Suppose at time T_0 , the following snapshot of the system has been taken,

	Allocation	Max
	A B C	A B C
P_0	0 1 0	7 5 3
P_1	2 0 0	3 2 2
P_2	3 0 2	9 0 2
P_3	2 1 1	2 2 2
P_4	0 0 2	4 3 3

Please calculate the maximum request (consider type A first, then B, and C last, and all together) which can be granted for process P_0 , P_1 , P_2 , P_3 , and P_4 , respectively, for the system to be in safe states.

3. Page replacement mechanisms are designed to handle page faults. Consider a reference string 1,0,2,1,2,3,0,3,2,4,0,3,0,2,1,0,7 and the system has three frames that are initially empty.

If a FIFO page-replacement algorithm is applied, the number of page faults is (first three references cause page faults) _____.

If the optimal page-replacement algorithm is applied, the number of page faults is (first three references cause page faults) _____.

If the LRU page-replacement algorithm is applied, the number of page faults is (first three references cause page faults) _____.

If the second-change algorithm is applied, the number of page faults is (first three references cause page faults) _____.

If the LFU page-replacement algorithm is applied, the number of page faults is (first three references cause page faults) _____.

4. Consider a 6,000 rpm disk, which is of one single head, 11 tracks, and 110 sectors in total. Let the seek time is linearly proportional to the number of tracks traveled, and to move the head across one track takes 1ms. Suppose that the current head position is at track 0, sector 0. It takes _____ milli-seconds to seek to track 10, sector 5. (note that tracks and sectors are numbered from 0)