

Ph.D. Qualifying Exam: Operating Systems
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1. MINIX system calls (20%):

Please select the system call from the following box based on the description of each sub-question. Don't guess. You will be deducted **extra 2 points** for each wrong answer until there is no point in Question 1.

A	chomd	G	getuid	M	umask	S	time
B	times	H	setuid	N	link	T	mount
C	mknod	I	ioctl	O	access	U	lseek
D	sigsuspend	J	sigpending	P	sigprocmask	V	sigaction
E	fork	K	execve	Q	waitpid	W	wait
F	brk	L	pause	R	fcntl	X	sync

- (1) Conduct locking on a file
- (2) Wait for a specified child to terminate
- (3) Set the size of the data segment
- (4) Replace the signal mask and suspend the process
- (5) Get the elapsed time since Jan. 1, 1970
- (6) Create a regular, special, or directory i-node
- (7) Return the caller's user ID
- (8) Change the file's protection bits
- (9) Create a child process
- (10) Move the file pointer

2. Term explanation (24%):

- (1) Degree of multiprogramming
- (2) Working directory
- (3) MBR (master boot record)
- (4) Memory-mapped I/O
- (5) Key logger
- (6) Data integrity
- (7) Demand paging
- (8) Deadlock

3. Process scheduling (16%):

Suppose that five processes P1~P5 come to serve at time 0 (following their number sequence). Processes P1, P2, P3, P4, and P5 have burst time of 10, 1, 2, 1, and 5 and are

assigned with priority of 3, 1, 3, 4, and 2, respectively. Consider the four scheduling schemes: First-come first-served (FCFS), round robin (RR with quantum = 1), shortest job first (SJF), and non-preemptive priority (where a smaller priority number indicates a higher priority).

(1) Draw the Gantt chart to show the execution of all processes based on each scheduling scheme (8%).

(2) Compute the turnaround time of each process in the four scheduling schemes. (4%)

(3) Calculate the average waiting time of each scheduling scheme. (4%)

4. Virtual memory management (12%):

Given a reference string (9, 2, 3, 4, 2, 5, 2, 6, 4, 5, 2, 5, 4, 3, 4) and a memory with only three frames, please draw the following page-replacement figures for

(1) FIFO algorithm (4%)

(2) Optimal algorithm (4%)

(3) LRU algorithm (4%)

	9	2	3	4	2	5	2	6	4	5	2	5	4	3	4
9	9	9													
	2	2													
		3													

5. Memory protection (8%):

What are the four protection levels supported by Pentium?

6. Resource deadlock (12%):

(1) What are the four conditions to cause a deadlock? Notice that you will get no point without explaining each condition. (8%)

(2) What is the difference between deadlock prevention and deadlock avoidance? (4%)

7. Disk scheduling (8%):

Consider a disk with 40 cylinders. Suppose that the disk arm stays at cylinder 11 and new requests come in for cylinders 1, 36, 16, 34, 9, and 12, in that order. Please show how the disk arm moves by adopting the following disk scheduling algorithms:

(1) SSF (shortest seek first) algorithm (4%)

(2) Elevator algorithm whose direction bit is initially UP (4%)