

## Memory Management: Binding and Relocation

1. **When does binding occur at load time?**
  - A) When the program is compiled
  - B) When the program is loaded into memory
  - C) When the program is executed
  - D) When the program terminates
2. **A program is loaded at base address 5000. An instruction uses logical address 1200. What is the corresponding physical address?**
  - A) 3800
  - B) 5000
  - C) 6200
  - D) 1200

## Memory Management: Contiguous Allocation

3. **Which technique tends to produce more external fragmentation in the long run?**
  - A) First-fit
  - B) Worst-fit
  - C) Best-fit
  - D) External fragmentation does not exist with contiguous allocation
4. **A 200 KB memory area allocates processes of 60 KB, 80 KB, and 40 KB. How much free space remains?**
  - A) 20 KB
  - B) 40 KB
  - C) 60 KB
  - D) 0 KB
5. **Assume the following list of free contiguous memory blocks: 15 KB, 35 KB, 60 KB, 90 KB. Which block will be allocated to a 50 KB process assuming the best-fit allocation strategy?**
  - A) 15 KB
  - B) 35 KB
  - C) 60 KB
  - D) 90 KB

## Memory Management: Paging

6. Which problem does paging eliminate?
  - A) Internal fragmentation
  - B) External fragmentation
  - C) Thrashing
  - D) Page faults
7. A process has a logical memory of 48 KiB and a page size of 4 KiB. How many logical pages are required?
  - A) 4
  - B) 8
  - C) 10
  - D) 12
8. In a virtual memory system, a process generates a reference to logical address 9876. The page size is 1024 bytes. What are the virtual page number (VPN) and the offset?
  - A) VPN 9, offset 660
  - B) VPN 8, offset 676
  - C) VPN 9, offset 548
  - D) VPN 10, offset 452
9. A system uses pages of size 512 B. Knowing that logical page 3 is mapped to physical frame 5 and that the offset is 200, what is the corresponding physical address?
  - A) 2760
  - B) 2762
  - C) 2660
  - D) 2560
10. A system has a virtual memory of 128 KiB and a page size of 2 KiB. How many page table entries (PTEs) are required in the page table?
  - A) 32
  - B) 64
  - C) 128
  - D) 256

11. A system has a logical memory of 1 GiB divided into pages of 4 KiB. Knowing that each page table entry (PTE) occupies 8 bytes, how much space is required for a single page table per process, assuming it is organized as a simple linear array?
- A) 256 KiB
  - B) 768 KiB
  - C) 1 MiB
  - D) 2 MiB
12. A system uses 48-bit logical addresses and a logical memory divided into pages of 4 KiB. Knowing that each page table/directory entry (PTE/PDE) occupies 8 bytes, how many levels are required to store each process's page table using a hierarchical (*multi-level paging*) structure, assuming that each page directory must fit within a single page?
- A) 2
  - B) 3
  - C) 4
  - D) 9
13. A 36-bit logical address is used in a system with a page size of 4 KiB. How many bits are required to identify the virtual page number (VPN)?
- A) 10
  - B) 12
  - C) 16
  - D) 24
14. A system with a virtual memory of 2 GiB uses pages of size 16 KiB. How many bits are required to represent a logical address, and how are they divided between page number and offset?
- A) 30 total bits: 16 for the page number, 14 for the offset
  - B) 30 total bits: 14 for the page number, 16 for the offset
  - C) 31 total bits: 17 for the page number, 14 for the offset
  - D) 32 total bits: 18 for the page number, 14 for the offset

## Memory Access Time

15. A system uses a TLB (Translation Lookaside Buffer) with an access time of 10 ns and a main memory access time of 100 ns. If the TLB hit rate is 90%, what is the effective average memory access time?
- A) 110 ns
  - B) 120 ns
  - C) 130 ns
  - D) 210 ns
16. In a paged system, the memory access time is 200 ns and each page fault requires 10 ms to handle. If the page fault rate is 1 out of 4000 accesses, what is the effective average memory access time?
- A) ~270 ns
  - B) ~2.7  $\mu$ s
  - C) ~4  $\mu$ s
  - D) ~27 ms

## Virtual Memory

17. Which page replacement algorithm can suffer from Belady's anomaly?
- A) LRU
  - B) OPT
  - C) FIFO
  - D) Second Chance
18. A system uses the LRU page replacement algorithm. The reference string is: A, B, C, A, D, B, E, C, C, D, E. With 3 frames, how many page faults occur, assuming that initially no frames are loaded (*pure demand paging*)?
- A) 7
  - B) 8
  - C) 9
  - D) 10
19. A system uses the FIFO page replacement algorithm. The reference string is: A, B, B, A, C, D, C, E, A, B, E. With 3 frames, how many page faults occur assuming that initially no frame is loaded (*pure demand paging*)?
- A) 7
  - B) 8
  - C) 9
  - D) 10

## Secondary Storage Devices

**20. Which component is NOT part of disk access time?**

- A) Seek time
- B) Rotational delay
- C) Transfer time
- D) Page fault time

## Disk Scheduling Algorithms

**21. Which disk scheduling algorithm guarantees the greatest fairness?**

- A) SSTF
- B) FCFS
- C) SCAN
- D) LOOK (optimized SCAN)

**22. In a magnetic disk using the SCAN scheduling algorithm, the requests arrive in the following order: 50, 20, 30, 90, 60. Assuming the disk head is at cylinder 40 and is moving toward the outer cylinders (toward lower-numbered cylinders), what is the order in which the requests are serviced?**

- A) 30, 20, 50, 60, 90
- B) 50, 60, 90, 30, 20
- C) 50, 20, 30, 90, 60
- D) 30, 20, 90, 60, 50

**23. In a magnetic disk using the FCFS scheduling algorithm, the requests arrive in the following order: 70, 20, 10, 50, 45. Assuming the disk head is initially at track 30, what is the total distance traveled (measured as the number of track movements)?**

- A) 105
- B) 115
- C) 145
- D) 155

**24. In a magnetic disk with 100 cylinders (numbered from 0 to 99) using the C-SCAN scheduling algorithm, the requests arrive in the following order: 60, 25, 45, 10, 90, 75. Assuming the disk head is at cylinder 35 and is moving toward the outer cylinders (toward lower-numbered cylinders), what is the total distance traveled (measured as the number of track movements)?**

- A) 88
- B) 168
- C) 178
- D) 188

**25. In a magnetic disk, the average seek time is 10 ms, and the rotational delay is 5 ms. Knowing that 5 MiB of data are transferred in 50 ms, what is the disk transfer rate?**

- A) ~124 MiB/s
- B) ~137 MiB/s
- C) ~143 MiB/s
- D) ~150 MiB/s