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) ~400 ns
    B) ~40 µs
    C) ~4 ms
    D) ~40 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