Memory Management: Binding and Relocation

1. **Which type of binding is performed at runtime?**
   A) Static
   B) Dynamic
   C) Temporal
   D) Spatial
   Correct Answer: B) Dynamic

2. **A program is loaded at a base address of 2000. If an instruction refers to the logical address 800, what is the corresponding physical address?**
   A) 1200
   B) 800
   C) 2800
   D) 1800
   Correct Answer: C) 2800 = 2000 + 800

   Physical address = base address + logical address

3. **A program is loaded at a base address of 1000. If an instruction refers to the physical address 1500, what is the corresponding logical address?**
   A) 500
   B) 1500
   C) 2500
   D) 1000
   Correct Answer: A) 500 = 1500 - 1000

Memory Management: Contiguous Allocation

4. **Which contiguous allocation technique suffers the most from external fragmentation?**
   A) Best-fit
   B) First-fit
   C) Worst-fit
   D) Next-fit
   Correct Answer: B) First-fit

5. **You have a block of contiguous memory of 100 KB. After allocating processes of 30 KB, 40 KB, and 20 KB, how much space remains?**
A) 90 KB
B) 10 KB
C) 0 KB
D) 100 KB
Correct Answer: B) 10 KB

6. **Given the following list of free contiguous memory blocks: 20 KB, 50 KB, 30 KB, 80 KB, which block will be allocated to a 25 KB process using the *first-fit* strategy?**
A) 30 KB
B) 20 KB
C) 50 KB
D) 80 KB
Correct Answer: C) 50 KB

7. **Given the following list of free contiguous memory blocks: 20 KB, 50 KB, 30 KB, 80 KB, which block will be allocated to a 25 KB process using the *best-fit* strategy?**
A) 30 KB
B) 20 KB
C) 50 KB
D) 80 KB
Correct Answer: A) 30 KB

Memory Management: Paging

8. **Which data structure is used to map logical addresses to physical addresses in a paging system?**
A) Segment table
B) Page table
C) Base register
D) Limit register
Correct Answer: B) Page table

9. **A process has 32 KiB of logical memory with a page size of 4 KiB. How many logical pages are needed?**
A) 8
B) 16
C) 32
D) 64
Correct Answer: A) 8

2^15/2^12=2^3=8

10. **In a virtual memory system, a process generates a reference to the logical address 4200. The page size is 1000 bytes. What is the logical page number and the offset?**
A) Page 4, Offset 200
B) Page 4, Offset 1000
C) Page 5, Offset 200
D) Page 5, Offset 1000
Correct Answer: A) Page 4, Offset 200

4200 div 1000 = 4 (page ID); 4200 mod 1000 = 200 (offset)

11. **A process generates a logical address 5678. The page size is 1024 bytes. What is the logical page number and the offset?**
A) Page 5, Offset 678
B) Page 6, Offset 578
C) Page 5, Offset 558
D) Page 6, Offset 558
Correct Answer: C) Page 5, Offset 558

5678 div 1024 = 5 (page ID); 5678 mod 1024 = 558 (offset)

12. **A system has 16 logical pages and 8 physical frames. If a logical address is 2110 and the page size is 256 bytes, what is the corresponding physical address, given that logical page 8 is mapped to physical frame 3?**
A) 1186
B) 830
C) 768
D) 2272
Correct Answer: B) 830

2110 div 256 = 8 (page ID); 2110 mod 256 = 62 (offset)
Frame 3 starts at byte 256 * 3=768; 768+62=830

13. **A virtual memory system has 64 KiB of memory with a page size of 4 KiB. How many entries are needed in the page table?**
    A) 8
    B) 16
    C) 32
    D) 64
    Correct Answer: B) 16

    2^16/2^12=2^4=16

14. **A 48-bit logical address is used in a system with a page size of 8 KiB. How many bits are used for the page number?**
    A) 13
    B) 12
    C) 48
    D) 35
    Correct Answer: D) 35

    48 - log2(2^13) = 48 - 13 = 35

15. **A virtual memory system with 256 MiB uses 16 KiB pages. How many bits are needed for a logical address, and how are they split between page number and offset?**
    A) 24 bits total: 14 for the page number, 10 for the offset
    B) 24 bits total: 12 for the page number, 12 for the offset
    C) 28 bits total: 14 for the page number, 14 for the offset
    D) 28 bits total: 12 for the page number, 16 for the offset
    Correct Answer: C) 28 bits total: 14 for the page number, 14 for the offset

    log2(2^28)=28; offset = log2(2^14)=14; page number = 28 - 14 = 14

Memory Access Time

16. **A system uses a TLB with an access time of 20 ns and a main memory access time of 200 ns. If the TLB hit rate is 80%, what is the effective memory access time?**
    A) 220 ns
    B) 240 ns
    C) 260 ns
    D) 300 ns
    Correct Answer: C) 260 ns

    T_TLB = 20 nsec; T_M = 200 nsec; P_hit = 0.8

P_hit * (T_TLB + T_M) + (1-P_hit) * (T_TLB + 2*T_M)

0.8 * 220 + 0.2 * 420 = 260

17. **In a paged memory system, memory access time is 100 ns, and a page fault requires 5 ms. If the page fault rate is 1 in 1000 accesses, what is the effective memory access time?**
A) 100 ns
B) 105 ns
C) 5.1 µs
D) 6 µs
Correct Answer: C) 5.1 µs

T_M = 100 ns = 10^{-7} s; T_fault = 5 ms = $5*10^{-3}$ s; P_fault = 10^{-3};

P_fault * T_fault + (1-P_fault) * T_M

$10^{-3} * 5*10^{-3} + (1-10^{-3}) * 10^{-7} = 5.1 * 10^{-6}$ s

Virtual Memory

18. **Which page replacement strategy is optimal but difficult to implement in practice?**
A) FIFO
B) LRU
C) Second Chance
D) OPT
Correct Answer: D) OPT

19. **A system uses the LRU page replacement algorithm. The reference sequence is A, B, C, A, D, E. With 3 frames and no pages initially loaded, how many page faults occur?**
A) 3
B) 4
C) 5
D) 6
Correct Answer: C) 5

20. **A virtual memory system has 4 frames. The reference sequence is A, B, C, D, A, B, E, A, B, C, D, E. Using FIFO, how many page faults occur?**
A) 7
B) 8
C) 9
D) 10
Correct Answer: D) 10

21. **If a virtual memory system uses a page size of 1 KiB and a process has a working set of 8 pages, what is the minimum number of frames required to avoid thrashing?**
A) 4
B) 8
C) 16
D) 32
Correct Answer: B) 8

Secondary Storage Devices

22. **What is the time required to position the disk's read/write head on the correct track?**
A) Transfer time
B) Rotational delay
C) Seek time
D) Access time
Correct Answer: C) Seek time

Disk Scheduling Algorithms

23. **Which disk scheduling algorithm always selects the request closest to the current head position?**
A) FCFS
B) SSTF
C) SCAN
D) C-SCAN
Correct Answer: B) SSTF

24. **In a system using the SCAN algorithm, the requests are: 10, 20, 50, 90. The head is initially at position 40 and moving to the right. What is the order in which the requests are served?**
A) 50, 90, 10, 20
B) 50, 90, 20, 10
C) 90, 50, 20, 10
D) 10, 20, 50, 90
Correct Answer: B) 50, 90, 20, 10

25. **Using FCFS, if the requests are: 55, 38, 18, 90, and the head starts at position 50, what is the total distance traveled?**
A) 124
B) 114
C) 104
D) 132
Correct Answer: A) 114