Questions for Memory Management

Which of the following statements about the naive memory allocation approach(es) is(are) true? Select all that apply.

A. To manage memory by fixed partitions, we have to decide partition boundaries before booting the system.

B. Managing memory by base and limit register need hardware support multiplication.

Which of the following statements about free space management is true. Select the best answer.

A. A Bitmap is a vector of zeros and ones that specify availability. It is not efficient approach especially for a large memory system.

B. The number of nodes in linked list is fixed in advance.

C. When a process terminates, the double directions of linked list make is easier to find the previous entry and to see if a merge is possible.

Which of the following statements about memory allocation strategies is false? Select the best answer.

A. Best-Fit is the best strategy since it always find the smallest block that is big enough.

B. Worst-Fit is not necessary the worst strategy. Sometimes it helps to reduce the external fragmentation.

C. Best-Fit is slower than First-Fit because it must search the entire list every time it is called.

Suppose we have a consecutive chunk of memory of size 128 pages, and there is a request for 13 pages of memory. What size of memory will the buddy algorithm allocate for the request? How many times should the memory be split to provide such an area? What the size of the internal fragmentation? Please enter your answer in the space provided below. Your answer should be in the format x; y; z;, where x represents the size of memory, y represents the number of times the memory should be split, and z represents the size of the internal fragmentation.

Is the following statement true or false?

Physical Memory Space is typically much larger than Virtual Memory Space.

A. True

B. False

You are interested in designing a new processor architecture with 16-bit addresses. What is the total size of the virtual address space?

A. 16384 Bytes

B. 16384 KB

C. 65536 KB

D. 65536 Bytes

In a 32-bit computer with a page size of 4 KB, what is the size, in bits, of the virtual address?
Enter your answer as a number in the space provided below. Do not enter any spaces or punctuation.

In a 32-bit computer with a page size of 4 KB, what is the number of offset bits in the virtual address?
Enter your answer as a number in the space provided below. Do not enter any spaces or punctuation.
Answer: 12

In a 32-bit computer with a page size of 4 KB, how many bits are there in the virtual address (x)? How many bits are the offset bits in the virtual address (y)? What is the size, in bits, of the page number? Enter your answer as a number in the space provided below. Do not enter any spaces or punctuation.

Given the page table (first table) and virtual address (second table), what is the physical address after the page table translation? Enter your answer as number in the space provided below. Do not add any spaces or punctuation.

15	000	0
14	000	0
13	000	0
12	000	0
11	111	1
10	000	0
9	101	1
8	000	0
7	000	0
6	000	0
5	011	1
4	100	1
3	000	1
2	110	1
1	001	1
0	010	1

Page Table

1	0	0	1	0	0	1	0	1	0	0	0	0	1	0

Virtual Address

Given the page table of process A and the swap file, please enter the page numbers mapped to each block in the swap file correspondingly. If a block in swap file is not used, enter “free”. If a block is used by page 3 of process A, please present if by A(3). Separate each page number with a comma and do not add any spaces. For example, one possible answer you could enter is A(0),free,A(1),free.

Page Table of process A

Page #	In-memory?	Frame#	Disk#
0	Y	0	-
1	N	-	B1
2	N	3	B3
3	Y	-	-

Swap File

Bitmap: 0101			

Swap File

Bitmap: 0101			
B0	B1	B2	B3

In a 32-bit operating system with an 8 KB page size, there are 9 bits in the top-level table and 10 bits in the second-level table. If a process uses 128 MB virtual memory, how many entries it will accept in the top-level table? Please enter your response as a number in the space provided below. Do not use any spaces or punctuation.

When will MMU evict an entry from TLB? Select all that apply.

A. When a requested virtual page number is missed in the TLB and TLB is full.
B. When a requested virtual page number is hit in the TLB.
C. When an entry in the page table is evicted from memory to swap file and the same address is also evicted from the TLB.

Is the following statement true or false?

Inverted page tables takes up less space than regular page tables.
A. True.
B. False.

Is the following statement true or false?

Swapping a page is an expensive process because in addition to swapping in the new page we need to write the eviction candidate back to disk.
A. True
B. False

Is the following statement true or false?

FIFO replacement scheme is a theoretically optimal algorithm.
A. True
B. False

Solution: According to the FIFO scheme, on a page fault, the frame that has been in memory the longest is replaced. This is not an optimal algorithm, in fact FIFO suffers from Bélády's anomaly, the phenomenon in which increasing the number of page frames results in an increase in the number of page faults for certain memory access patterns. In FIFO, the page fault may or may not increase as the page frames increase, but in Optimal algorithms, as the page frames increase the page fault decreases.

The second chance algorithm is looking for a candidate to evict. It looks at the front of the queue and encounters a page A with reference bit set to 1. What is the next step? Select the best answer

A. Evict A.
B. Decrement the reference bit and evict A.
C. Decrement the reference bit and add to back of queue, look for another candidate.
D. Increment the reference bit and add to back of queue, look for another candidate.

Given the 8-bit counter for four pages provided below, which of the following should be evicted if the LRU Aging scheme is applied. Select the best answer.
The 8-bit counter for 4 pages are provided below.

A. Page A - 100001
B. Page B - 001010
C. Page C - 010100

Which of the following page types is most likely to be evicted? Select the best answer.

A. Swappable
B. Unreclaimable
C. Discardable

Which of the following page types is least likely to be evicted? Select the best answer.

A. Swappable
B. Unreclaimable
C. Discardable

Is the following statement true or false?

Consider a page p stored in physical frame f. When accessing page p, the corresponding TLB will only get updated in the event of a TLB miss for p.
(multiple choice question with ONE correct answer)

A. True
B. False

Is the following statement true or false?

The best-fit memory allocation scheme always results in less fragmentation and satisfies more block requests compared to the first-fit scheme.
(multiple choice question with ONE correct answer)

A. True

B. False

Is the following statement true or false?

The TLB is motivated by the fact that accessing the disk is much slower than accessing main memory.
(multiple choice question with ONE correct answer)
A. True
B. False

Is the following statement true or false?

The LRU page replacement policy is a stack algorithm.
(multiple choice question with ONE correct answer)
A. True
B. False

Is the following statement true or false?

When the degree of multiprogramming increases, the CPU utilization will always increase and eventually saturate at 100%.
(multiple choice question with ONE correct answer)
A. True
B. False

Which is the following correctly reflects the maximum number of entries in an inverted page table?
(multiple choice question with ONE single correct answer)
A. Number of page frames in physical memory
B. Number of virtual pages of the currently running processes
C. Total number of virtual pages of all processes (blocked, ready, running).

In a 64-bit machine that has 4 KB page size, how many entries are there in the page table?

Please enter your answer as an exponent of the number 2.
For example: if your answer is 1048576, enter 2^20 as your answer in the space provided below. Do not use spaces or punctuation.
(free response question with numeric response)