CSCI-342 Operating Systems
Quiz 9
Chapter 9.6

Name _____

1. Suppose we have a 2^{32}-byte virtual address space. How many bits are needed to uniquely represent each virtual address?

2. Suppose the size of a virtual address space is 2^{32} bytes and we partition the virtual address space into 2048-byte virtual pages. How many PTEs are needed in a 1-level page table?

3. Suppose the size of a virtual address space is 2^{32} bytes and we partition the virtual address space into 2048-byte virtual pages. How many bits are needed to represent a VPOs?

4. Suppose we have 8GB of RAM. How many bits are required to uniquely address each byte in RAM?

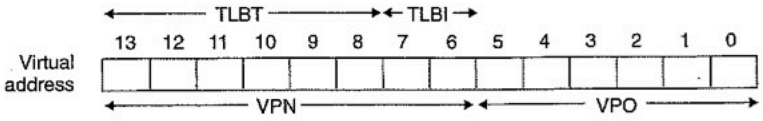
5. Suppose we have 8GB of RAM and we partition the RAM into 2048-byte physical pages. How many physical pages are created?

6. Suppose we have 8GB of RAM and we partition the RAM into 2048-byte physical pages. How many bits are needed to represent the PPNs.

7. Suppose we have 8GB of RAM and we partition the RAM into 2048-byte physical pages. How many bits are needed to represent the PPOs?

8. Suppose we have 8GB of RAM, we partition the RAM into 2048-byte physical pages, and each PTE is 8-bytes. How many bits are used for each page table entry?

9. Using Figure 9.20, determine the value in RAM at the physical address associated with the virtual address 0x0239.



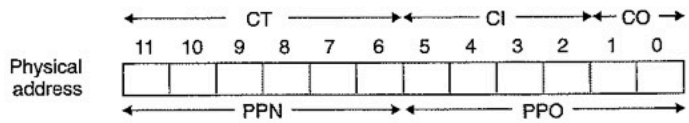
Set	Tag	PPN	Valid	Tag	PPN	Valid	Tag	PPN	Valid	Tag	PPN	Valid
0	03	–	0	09	0D	1	00	–	0	07	02	1
1	03	2D	1	02	–	0	04	–	0	0A	–	0
2	02	–	0	08	–	0	06	–	0	03	–	0
3	07	–	0	03	0D	1	0A	34	1	02	–	0

(a) TLB: 4 sets, 16 entries, 4-way set associative

VPN	PPN	Valid
00	28	1
01	—	0
02	33	1
03	02	1
04	—	0
05	16	1
06	—	0
07	—	0

VPN	PPN	Valid
08	13	1
09	17	1
0A	09	1
0B	—	0
0C	—	0
0D	2D	1
0E	11	1
0F	0D	1

(b) Page table: Only the first 16 PTEs are shown



Idx	Tag	Valid	Blk 0	Blk 1	Blk 2	Blk 3
0	19	1	99	11	23	11
1	15	0	—	—	—	—
2	1B	1	00	02	04	08
3	36	0	—	—	—	—
4	32	1	43	6D	8F	09
5	0D	1	36	72	F0	1D
6	31	0	—	—	—	—
7	16	1	11	C2	DF	03
8	24	1	3A	00	51	89
9	2D	0	—	—	—	—
A	2D	1	93	15	DA	3B
B	0B	0	—	—	—	—
C	12	0	—	—	—	—
D	16	1	04	96	34	15
E	13	1	83	77	1B	D3
F	14	0	—	—	—	—

(c) Cache: 16 sets, 4-byte blocks, direct mapped

Figure 9.20 TLB, page table, and cache for small memory system. All values in the TLB, page table, and cache are in hexadecimal notation.