Problem 7 of 8

Virtual Memory

This problem concerns the way virtual addresses are translated into physical addresses.

Warmup

Please select the most appropriate choice for the following statements.

1) Programs with better locality will have larger working sets.

◯ True ◯ False

2) A virtual page can be stored in different physical pages at different times.

◯ True ◯ False

3) The `.text` and `.data` sections are copied, page by page, on demand by the virtual memory system.

◯ True ◯ False

Virtual Address Translation

Imagine a system has the following parameters:

- The memory is byte addressable, and memory accesses are to 1-byte not 4-byte words
- 256 KB of virtual memory
- 16 KB of physical memory
- Page size is 256 bytes
- The TLB table is 4-way set associative with total 16 entries

Please give your answers to the following in decimal.

4) How many bits are needed to represent the virtual address space? ☐

5) How many bits are needed to represent the physical address space? ☐

6) How many bits are needed to represent a page offset? ☐

7) How many bits are needed to represent the TLB index? ☐

8) How many bits are needed to represent the TLB tag? ☐

The contents of the TLB and the first 32 entries of the page table are shown as follows. All numbers are given in hexadecimal.

TLB

Index	Tag	PPN	Valid

0	46	A	0
	DB	D	1
	A3	9	0
	A3	F	1
1	54	2	0
	03	6	0
	A3	5	0
	7D	A	1
2	07	6	0
	1B	4	1
	11	C	1
	2D	8	0
3	03	E	0
	9A	B	1
	8A	1	0
	53	F	1

Page Table

VPN	PPN	Valid	VPN	PPN	Valid
00	1	0	10	0	0
01	F	0	11	1	0
02	E	1	12	1	0
03	A	1	13	6	0
04	9	0	14	0	1
05	1	0	15	C	0
06	B	0	16	4	0
07	B	1	17	2	1
08	3	0	18	0	0
09	5	0	19	9	0
0A	F	1	1A	3	0
0B	2	0	1B	D	0
0C	A	0	1C	1	0
0D	3	0	1D	7	0
0E	4	0	1E	2	1
0F	8	1	1F	A	0

Fill in the following table.

If the answer is a number, use HEX, e.g. 0x0 or 0xF00. For answering whether there was a "TLB Hit" or "Page Fault", use "Y" or "N". If a page fault has occurred, fill in all unknown blanks with "-".

Virtual Address	TLBI	TLBT	TLB Hit? (Y/N)	Page Fault? (Y/N)	Physical Address
0x28CBA					
0x01E42					
0x00D13					