

## CS 3733 Virtual Memory Problem

- 1) Assume a machine uses 33-bit virtual addresses and 29-bit physical addresses and is byte-addressable. It uses a 2-level page table with a page size of 512 bytes. All page tables have 32-bit entries. The top level page table entries contain physical addresses. The second level page table entries contain a frame number, a valid bit and 5 bits for protection. The top level page tables and second level page tables are the same size.

Give the best answer to each of the following that you can. If you need to make additional assumptions to give an answer, state the assumptions you are making. If the answer is a power of 2, leave it in exponential form.

- a) How many bits of a virtual address are used for the page offset? a) \_\_\_\_\_
- b) How many bits of a physical address are used for the frame offset? b) \_\_\_\_\_
- c) How many bits of a virtual address are used to specify the top level page table entry? c) \_\_\_\_\_
- d) How many bits of a virtual address are used to specify the second level page table entry? d) \_\_\_\_\_
- e) What is the size in bytes of a top level page table? e) \_\_\_\_\_
- f) How many pages of memory does one top level page table require? f) \_\_\_\_\_
- g) How many bits are available in a physical address for the frame number? g) \_\_\_\_\_
- h) What is the maximum number of bytes of physical memory that this machine can have? h) \_\_\_\_\_
- i) If all of the page tables of a single process were in physical memory, how many bytes would this take up? i) \_\_\_\_\_