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Consider a system with a Paged Memory Management Unit (PMMU) that supports 12 bit physical addresses, however a process is only able to use 10 bit logical addresses. The page size is 64 byte, the word size is 1 byte.

1. Into how many pages is the logical address space divided?
   Svar: $2^{10} \div 2^6 = 2^4 = 16$ pages
2. Into how many frames is the physical address space divided?
   Svar: $2^{12} \div 2^6 = 2^6 = 64$ frames
3. What is the maximum degree of multiprogramming (how many programs can be loaded) if no swapping/demand paging is used?
   Svar: Each process could use all 16 of its pages. There are 64 frames, so 4 processes could be loaded at once.
4. Is it possible to state how many processes can be in the system simultaneously if swapping/demand paging is used? Explain.
   Svar: No. With swapping/demand paging, not all pages need to reside in physical memory at once, so more than 4 processes can be loaded.
5. How many entries does a page table have in this system?
   Svar: Each page table has 16 entries (one per page).
6. How many bits are needed for each page table entry (assuming only the minimal number for the frame number plus valid bit)?
   Svar: We need 6 bits for the frame number (since there are 64 frames) and 1 bit for the valid bit, so 7 bits in total.
7. Given the first four frame numbers in the page table are 7, 1, 10, 12 (the first entry = page 0, second entry = page 1, etc.), what is the physical address for logical address 42?
   Svar: The page number is 0 (since $42 < 64$), and offset is 42. Page 0 maps to frame 7, so the physical address is $7 \times 64 + 42 = 490$.
8. What logical address maps to physical address 681?
   Svar: $681 \div 64 = 10$ (integer division), remainder 41, so the frame is 10, the offset is 41. From the table, frame 10 corresponds to page 2. Hence the logical address is $2 \times 64 + 41 = 169$.