Paging Questions: Solution

Q1. Consider a logical address space of 16 pages each of 1024 words (each word of 2 Bytes) mapped into a physical memory of 32 frames. Give the Logical and Physical address format. Also give the total Logical and Physical address space Compute the required page table size for this situation

Addressing within a 1024-word page requires 10 bits because $1024 = 2^{10}$. Since the logical address space consists of $16 = 2^4$ pages, the logical addresses must be 10+4 = 14 bits. Similarly, since there are $32 = 2^5$ physical pages, physical addresses are 5 + 10 = 15 bits long.

Q2. A system has 48 bit L.A & a main memory of 64 GBs. Page size is 4096 bytes. Compute the number of pages and frames that exist in the system. Also give L.A & P.A format.

Logical address = 48 bit
Main Memory = 64GBs = $2^6 + 2^{30} = 2^{36}$
Page size = 4096 = 2^{12}

Q3. Consider a system with
L.A = 32 bits ; Page Size = 4 K ; Main memory = 512 MB.
Compute the total process address space and maximum number of pages in a process address space. Also give the logical and physical address format. Also give the page table size for this situation.

Logical address = 32-bit
Process address space = 2^{32} B = 4 GB
Main memory = RAM = 512 MB
Page size = 4K
Maximum pages in a process address space = 2^{32} / 4K = 1M

|d| = 12 bits
|p| = 32 – 12 = 20 bits
No. of frames = 512 M / 4 K = 128 K
|f| = 17 bits
Physical address = 17+12 bits

Q4. Consider a LA space of 8 pages of 1024 words mapped into memory of 32 frames. How many bits are there in the LA? How many bits are there in PA?

Addressing within a 1024-word page requires 10 bits because $1024 = 2^{10}$. Since the logical address space consists of $8 = 2^3$ pages, the logical addresses must be 10+ 3= 13 bits. Similarly, since there are $32 = 2^5$ physical pages, physical addresses are 5 + 10 = 15 bits long.

Q5. In a system with a logical address space of 64 pages, each of 512 bytes mapped into physical memory of 1024 frames. Compute lengths (in bits) of p, d, f, logical and physical address format.

Addressing within a 512 bytes requires 9 bits because $512 = 2^9$. Since the logical address space consists of $64 = 2^6$ pages, the logical addresses must be 9 +6= 15 bits.

Similarly, since there are 1024 = 2^{10} physical pages, physical addresses are 9 + 10 = 19 bits long.

Q6. A system has 48 bit logical address, physical address space is 32 bits and page size is 4 KB. Determine the lengths of p, d, f, logical and physical address formats, maximum number of pages per process and maximum number of frames in the system, page table entry size (PTES) and the size of the page table.

Q7. For each of the following logical addresses (given in decimal), compute the page number and offset within the page; if the page size is 4 KB
– 20000
– 32768
– 60000
Repeat for an 8 KB page.

For case (a) for 4KB = 4096 B / page

Page number = 20000/4096 = 4

Offset = 20000 - (4*4096) = 3616

	20000	32768	60000	63540
4 KB	(4, 3616)	(8, 0)	(14, 2656)	(15, 2100)
8 KB	(2, 3616)	(4, 0)	(7, 2656)	(7, 6196)

Q8. A machine has a 48 bit virtual addresses and 32 bit physical addresses. Pages are 8 KB of size. How many entries are needed for the page table?

Ans. With 8K pages and a 48-bit virtual address space, the number of virtual pages is (2^48)/(2^13), which is 2^35 (about 34 billion).

Q9. Let 14000 is a logical address, in which page does it exist if the page size is 1 KB?
Page Number = 14000/1024 = 13

Q10. In a system with 34 bits logical address and 32 bits physical address and a 16 KB page size. How many entries will be there in the page table?
The number of virtual pages is (2^34)/2^14, which is 2^20 (about 1 million)

Q11. Consider a virtual address 40808. Compute the virtual page number and offset for a 4 KB page

Page Number = 40808/4096 = 9

Offset = 40808 - (9*4096) = 3944