|  |  |  |  |
| --- | --- | --- | --- |
| CDF ID: |  | Name: |  |
| CDF ID: |  | Name: |  |
| CDF ID: |  | Name: |  |

1. Define the following terms
2. Internal Fragmentation
3. Page Frame
4. TLB
5. Offset

2^10 = 1024  
2^11 = 2048  
2^12= 4096  
2^13 = 8192  
2^14 = 16384 (16K) 2^15 = 32K  
2^16 = 64K  
2^17 = 128K  
2^18 = 256K  
2^19 = 512K  
2^20 = 1M

1. Relocation
2. Suppose a logical address is 32 bits and a page is 8 kbytes
   1. How many bits of the logical address are used to address bytes within a page?
   2. How many bytes can be addressed with a logical address?
   3. How many logical pages are there?
   4. If a page table entry is 4 bytes in size, how much space is required for the page table? (One entry for every logical page.)

3. The memory system in question has **24 bit virtual (logical) addresses** with 212 byte pages. Here is a fragment of a page table. “—” indicates that a page is not resident in physical memory.

| Logical Page Number | Physical Frame Number |
| --- | --- |
| … | … |
| 0x010 | 0x2C |
| 0x011 | 0x8B |
| 0x012 | — |
| 0x013 | — |
| 0x014 | 0x00 |
| 0x015 | — |
| 0x016 | 0x03 |
| 0x017 | 0x40 |
| … | … |

a) At maximum, how many entries are in a process’s page table?

b) If a page table entry takes 4 bytes, how many entries can be stored in one page?

c) If there are 28 physical page frames, how large is physical memory, in bytes?

|  |  |
| --- | --- |
| hexadecimal | binary |
| 0x1 | 0001 |
| 0x4 | 0100 |
| 0x8 | 1000 |
| 0xF | 1111 |

|  |
| --- |
| 24 = 16 |
| 28 = 256 |
| 210 = 1024 |
| 212 = 4096 |
| 214 = 16384 (16K) |
| 216 = 65536 (64K) |
| 220 = 1048576 (1M) |
| 224 = 16777216 (16M) |

d) Using the table above, what physical address does the virtual address 0x01008B correspond to?

e) Using the table above, what virtual address does the physical address 0x4008B correspond to?

f) If the virtual address 0x01502C is accessed, what will occur?