Homework #4 Solution

1. a)   After change from system mode to user mode, resume the execution, the write happened updating the information to the process own pages which are no longer shared by processes.

    b)   When parent process is large, and shared pages needed between parent process and child process, to save memory the copy-on-write is effecient.

2. a)   the virtual address is 12 bits long, the first 3 bits to identify the pages, the last 9 bits used as offset to identify bytes in page.

    b)   the physical address is 13 bits long, the first 4 bits to identify the frames, the last 9 bits used as offset to identify bytes in frame.

    c)   virtual address of page 4 corresponds to frame 3, so the physical address is 0011011110001.

3.   It is easier for processes to share code pages in a system that includes segmentation, since you can share an entire segments as well as individual pages within a segment.

4.a)   Totally 400 nanoseconds needed, 200 nanoseconds for page table look up and 200 nanoseconds for memory access to extract data.

    b)   let x be the probability of a TLB hit, in this case $x = 0.75$,
let ma be the memory access time, in this case ma = 200 nanoseconds, then

$ema = x * ma + (1-x) * 2 * ma$
$= 0.75 * 200 + 0.25 * 400$
$= 250$ nanoseconds