8.6 Suppose the page table for the process currently executing on the processor looks like the following. All numbers are decimal, everything is numbered starting from zero, and all addresses are memory byte addresses. The page size is 1024 bytes.

Virtual page number	Valid bit	Reference bit	Modify bit	Page frame number
0	1	1	0	4
1	1	1	1	7
2	0	0	0	—
3	1	0	0	2
4	0	0	0	—
5	1	0	1	0

a. Describe exactly how, in general, a virtual address generated by the CPU is translated into a physical main memory address.

b. What physical address, if any, would each of the following virtual addresses correspond to? (Do not try to handle any page faults, if any.)

  i. 1052
  ii. 2221
  iii. 5499

8.8 A process references seven pages, A, B, C, D, E, F and G in the following order:

A; C; F; G; F; D; B; E; B; C; D; C

Assume that the replacement algorithm is least recently used and find the number of page transfers during this sequence of references starting with an empty main memory with four page frames. Repeat for five page frames

8.9 The following sequence of virtual page numbers is encountered in the course of execution on a computer with virtual memory:

9 4 2 5 9 4 1 3 1 2 4 1 3 4 2

Assume that a first-in-first-out page replacement policy is adopted. Make a table of page hit ratio (fraction of page references in which the page is in main memory) as a function of main-memory page capacity n for $1 \leq n \leq 6$. Assume that main memory is initially empty.

8.10 In the VAX computer, user page tables are located at virtual addresses in the system space. What is the advantage of having user page tables in virtual rather than main memory? What is the disadvantage?

8.11 Suppose the program statement

```
for (i = 1; i <= n; i + )
    a[i] = b[i] + c[i];
```

is executed in a memory with page size of 1000 words. Let $n = 1000$. Using a machine that has a full range of register-to-register instructions and employs index registers, write a hypothetical program to implement the foregoing statement. Then show the sequence of page references during execution.