8.6

a. The virtual address consists of page number and offset. On the other hand, the physical address consists of a frame number and an offset. Each process has a page table that has the frame number of the physical address.

Physical address can be generated by combining frame number corresponding to the page number of the virtual address in the page table of the process and the offset of the virtual address.

b.

i. $1052_{10} = 1\,0000011100_2$ Because page size is 1024byte, 1_2 is page number and 0000011100_2 is offset.

Frame number of 1_2 is $7_{10} = 111_2$, physical adress of 1052_{10} is $111\,0000011100_2 = 7196_{10}$

ii. $2221_{10} = 10\,0010101101_2$ 10_2 is page number and 0010101101_2 is offset.

Frame number of 10_2 isn't exist, physical adress of 2221_{10} is page fault

iii. $5499_{10} = 101\,0101111011_2$ 101_2 is page number and 0101111011_2 is offset.

Frame number of 101_2 is $0_{10} = 0_2$, physical adress of 5499_{10} is $0\,0101111011_2 = 379_{10}$

8.8

Case 1: three page frame

1	A(page fault)		
2	A	B(page fault)	
3	A	B	C(page fault)
4	D(page fault, replaced)	B	C
5	D	A(page fault, replaced)	C
6	D	A	B(page fault, replaced)
7	E(page fault, replaced)	A	B
8	E	A(no page fault)	B
9	E	A	B(no page fault)
10	E	C(page fault, replaced)	B
11	E	C	D(page fault, replaced)
12	E(no page fault)	C	D

Page transfers in step 1,2,3,4,5,6,7,10,11. Therefore, page transfer occurred 9 times.

Case 2: four page frame

1	A(page fault)			
2	A	B(page fault)		
3	A	B	C(page fault)	
4	A	B	C	D(page fault)
5	A(no page fault)	B	C	D
6	A	B(no page fault)	C	D
7	E(page fault, replaced)	B	C	D
8	E	A(page fault, replaced)	C	D
9	E	A	B(page fault, replaced)	D
10	E	A	B	C(page fault, replaced)
11	D(page fault, replaced)	A	B	C
12	D	E(page fault, replaced)	B	C

Page transfers in step 1,2,3,4,7,8,9,10,11,12. Therefore, page transfer occurred 10 times.

8.9

* express change/hit location, H/M are hit, miss

When page capacity is 1, hit ratio is $\frac{0}{15} = 0\%$

Step	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Page capacity	3	4	2	6	4	7	1	3	2	6	3	5	1	2	3
H/M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M

When page capacity is 2, hit ratio is $\frac{0}{15} = 0\%$

Step	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Page capacity	3*	3	2*	2	4*	4	1*	1	2*	2	3*	3	1*	1	3*
		4*	4	6*	6	7*	7	3*	3	6*	6	5*	5	2*	2
H/M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M

When page capacity is 3, hit ratio is $\frac{2}{15} = 13.\dot{3}\%$

Step	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Page capacity	3*	3	3	6*	6	6	1*	1	1	6*	6	6	1*	1	1
		4*	4	4	4*	4	4	3*	3	3	3*	3	3	2*	2
			2*	2	2	7*	7	7	2*	2	2	5*	5	5	3*
H/M	M	M	M	M	H	M	M	M	M	M	H	M	M	M	M

When page capacity is 4, hit ratio is $\frac{3}{15} = 20\%$

Step	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Page capacity	3*	3	3	3	3	7*	7	7	7	6*	6	6	6	2*	2
		4*	4	4	4*	4	4	4	2*	2	2	2	1*	1	1
			2*	2	2	2	1*	1	1	1	1	5*	5	5	5
				6*	6	6	6	3*	3	3	3*	3	3	3	3*
H/M	M	M	M	M	H	M	M	M	M	M	H	M	M	M	H

When page capacity is 5, hit ratio is $\frac{5}{15} = 33.\dot{3}\%$

Step	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Page capacity	3*	3	3	3	3	3	1*	1	1	1	1	1	1*	1	1
		4*	4	4	4*	4	4	4	4	6*	6	6	6	6	6
			2*	2	2	2	2	3*	3	3	3*	3	3	3	3*
				6*	6	6	6	6	2*	2	2	2	2	2*	2
						7*	7	7	7	7	7	5*	5	5	5
H/M	M	M	M	M	H	M	M	M	M	M	H	M	H	H	H

When page capacity is 6, hit ratio is $\frac{8}{15} = 53.\dot{3}\%$

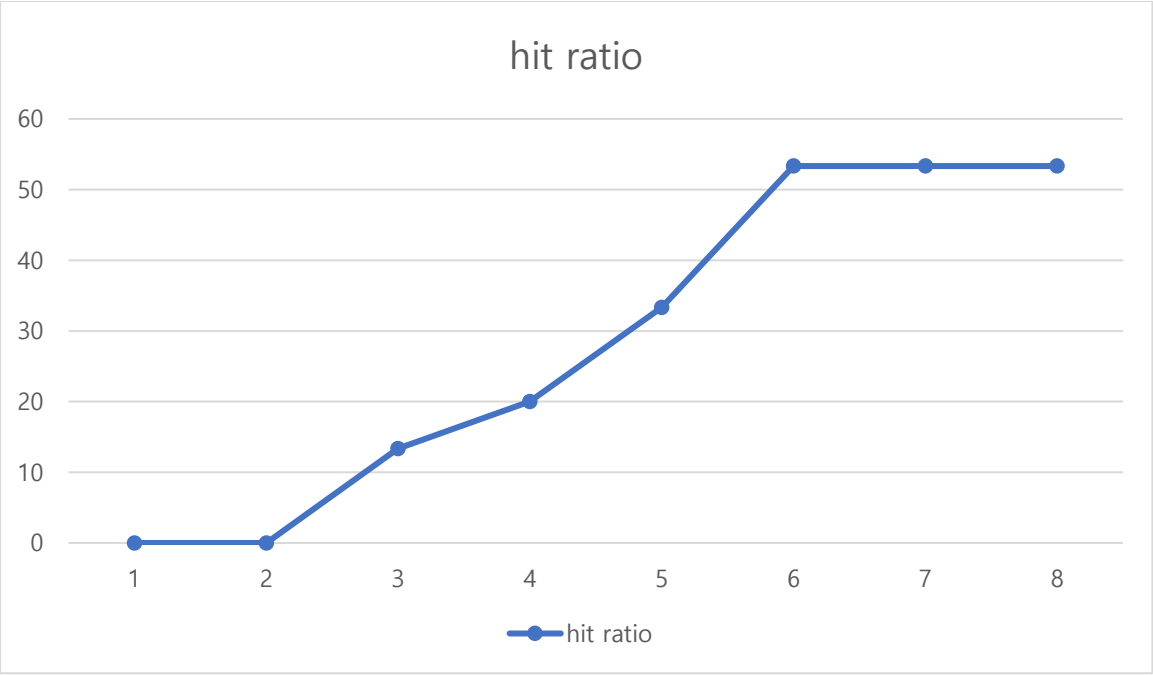
Step	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Page capacity	3*	3	3	3	3	3	3	3*	3	3	3*	3	3	3	3*
		4*	4	4	4*	4	4	4	4	4	4	5*	5	5	5
			2*	2	2	2	2	2	2*	2	2	2	2	2*	2
				6*	6	6	6	6	6	6*	6	6	6	6	6
						7*	7	7	7	7	7	7	7	7	7
							1*	1	1	1	1	1	1*	1	1
H/M	M	M	M	M	H	M	M	H	H	H	H	M	H	H	H

When page capacity is 7, hit ratio is $\frac{8}{15} = 53.\dot{3}\%$

Step	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Page capacity	3*	3	3	3	3	3	3	3*	3	3	3*	3	3	3	3*
		4*	4	4	4*	4	4	4	4	4	4	4	4	4	4
			2*	2	2	2	2	2	2*	2	2	2	2	2*	2
				6*	6	6	6	6	6	6*	6	6	6	6	6
						7*	7	7	7	7	7	7	7	7	7
							1*	1	1	1	1	1	1*	1	1
												5*			
H/M	M	M	M	M	H	M	M	H	H	H	H	M	H	H	H

When page capacity is 8, hit ratio is $\frac{8}{15} = 53.\dot{3}\%$

Step	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Page capacity	3*	3	3	3	3	3	3	3*	3	3	3*	3	3	3	3*
		4*	4	4	4*	4	4	4	4	4	4	4	4	4	4
			2*	2	2	2	2	2	2*	2	2	2	2	2*	2
				6*	6	6	6	6	6	6*	6	6	6	6	6
						7*	7	7	7	7	7	7	7	7	7
							1*	1	1	1	1	1	1*	1	1
												5*			
H/M	M	M	M	M	H	M	M	H	H	H	H	M	H	H	H



8.11

4000 (R1) <- ONE

4001 (R2) <- n

4002 compare R1, R2

4003 branch greater 4009

4004 (R3) <- B[R1]

4005 (R3) <- (R3) + C[R1]

4006 A[R1] <- (R3)

4007 (R1) <- (R1) + ONE

4008 branch 4002

...

6000~6999 A[1000]

7000~7999 B[1000]

8000~8999 C[1000]

9000 ONE

9001 n

Instruction	4000	4001	4002	4003	4004	4005	4006	4007	4008
Page references	4, 9	4, 9	4	4	4, 7	4, 8	4, 6	4, 9	4