1 (1) $1.18 + 7.3\% \cdot \cancel{98.57} \; 5.34 + 7.3\% \cdot 1.5\% \cdot 70 = 1.64$ ns

(2) $CPI = \frac{1.64}{1.18} \cdot 36\% + 1 \cdot (1 - 36\%)$

$= 1.14$ ✗

2 (1)   3 hits   小问题 ×1.

Block Address of memory	Hit/Miss	Evicted Block	Contents of Cache			
			Set 0		Set 1	
1	M				1	
3	M				1	3
5	M	1			5	3
1	M	3			5	1
3	M	5			3	1
1	H				3	1
3	H				3	1
5	M	1			3	5
3	H				3	5

(2)   3 hits.

Block Address of memory	Hit/Miss	Evicted Block	Contents of Cache			
			Set 0		Set 1	
1	M				1	
3	M				1	3
5	M	3			1	5
1	H				1	5
3	M	1			3	5
1	M	3			1	5
3	M	1			3	5
5	H				3	5
3	H				3	5

(3)   3 hits.

Block Address of memory	Hit/Miss	Evicted Block	Contents of Cache			
			Set 0		Set 1	
1	M				1	
3	M				1	3
5	M	3			1	5
1	H				1	5
3	M	1			3	5
1	M	3			1	5
3	M	1			3	5
5	H				3	5
3	H				3	5

3. 12948 : 0x 3294   13975: 0x 3697   52236: 0x cc0c
   49419 : 0x c10b   40004 :0x 9c44
   46814 : 0xb6de   12707 :0x 31a3

(1) address   hit status.

0x 3294   TLB hit.

0x c10b.   page fault

0xb6de   TLB hit.

0x 3697   TLB hit

0x 9c44   page fault

0x 31a3   TLB hit

0x cc0c   TLB hit

TLB hit infers page table hit.

TLB becomes

Valid	Tag	Physical Page Num
1	11	12
1	9	14
1	3	6
1	12	13

TLB:

Valid	Tag	Physical Page Number
1	11	12
1	7 → 9	4 → 14
1	3	6
0 → 1	4 → 12	9 → 13

Page Table: becomes

	Valid	Physical Page Number
0	1	5
1	0	Disk
2	0	Disk
3	1	6
4	1	9
5	1	11
6	0	Disk
7	1	4
8	0	Disk
9	0 → 1	Disk → 14
a	1	3
b	1	12
c	1	13

(2)   address   hit status

0011   0x 3294   hit page table

1100   0x c10b   TLB hit   3.

1011   0x b6de   page fault   2

        0x 3697   TLB hit

1001   0x 9c44   TLB hit   2.

        0x 31a3   TLB hit

        0x cc0c   TLB hit

TLB: becomes:

Valid	Tag	Physical Page Number
1	11 → 2	12 → 13
1	7	4
1	3	6
0 → 1	4 → 0	9 → 5

Page Table: becomes:

	Valid	Physical Page Number
0	1	5
1	0	Disk
2	0 → 1	Disk → 13
3	1	6
4	1	9
5	1	11
6	0	Disk
7	1	4
8	0	Disk
9	0	Disk
10	1	3
11	1	12

All the TLB hit infer page table hit.

(3) larger page size:

advantage: One access fetches more data, reduce page fault rate.

disadvantage: Internal fragmentation (not all memory in page is used)

Larger page fault panalty (more time to read from disk)

[b] 题。

(4) address   hit status   assume TLB empty first.

00 1¦1   0x3294   page table hit   找的还是3   TLB finally becomes:

1 10¦0   0xc10b   page fault.

10 1¦1   0xb6de   page table hit.

0 01¦1   0x3697   TLB hit.

1 00¦1   0x9c44   page fault.

001¦1   0x31a3   TLB hit.

110¦0   0xcc0c   TLB hit.

TLB hit infers page table hit.

Index	Valid	Tag	Physical Page Num
0	1	6	13
	0	×	×
1	1	1	6
	1	4	14.

Page Table:

	Valid	Physical Page Number
0	1	5
1	0	Disk
2	0	Disk
3	1	6
4	1	9
5	1	11
6	0	Disk
7	1	4
8	0	Disk
9	0 →1	Disk →14
10	1	3
11	1	12
12	1	13