1. sw in EX stage. EPC is address of EX+4.

IF.Flush, ID.Flush, EX.Flush = 1, PCSel = 01,

all other control signals are 0.

2. (1) temporal locality: I, J, A[k][k], k∈[0,8)

(2) spatial locality: A[J][k], k∈[0,8)

3. (1)

	address	tag	index	Hit/Miss
4	100 00	0	100	M
12	1100 00	1	100	M
33	10000100	100	001	M
6	110 00	0	110	M
187	10111011 00	10111	011	M
65	10000010 0	1000	001	M
186	10111010 00	10111	010	M
19	1001100	10	011	M
125	11111010 0	1111	101	M
43	10101100	1010	011	M
152	1001100000	10011	000	M
253	1111110100	11111	101	M

1 word block
8 blocks.

(2)

	address	tag	index	Hit/Miss
4	100 00	0	10	M
12	1100 00	1	10	M
33	10000100	100	00	M
6	11000	0	11	M
187	10111011 00	10111	01	M
65	10000010 0	1000	00	M
186	10111010 00	10111	01	H
19	1001100	10	01	M
125	11111010 0	1111	10	M
43	10101100	1010	01	M
152	1001100000	10011	00	M
253	1111110100	11111	10.	M

2 word block
4 blocks.

index = 2 bits
word off = 1 bits

(3)

	address	tag	index	Hit/Miss
4	100 00	0	1	M
12	1100 00	1	1	M
33	10000100	100	0	M
6	11000	0	1	M
187	10111011 00	10111	0	M
65	10000100	1000	0	M
186	10111010 00	10111	0	M
19	1001100	10	0	M
125	1111 1000	1111	1	M
43	10101100	1010	0	M
152	1001100000	10011	0	M
253	1111110100	11111	1	M

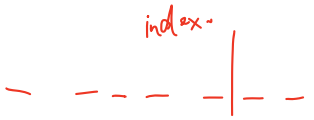
4 word block
2 blocks.
Index: 1 bit.
word off: 2 bits.

since 2-word blocks has 1 hit, its miss-rate is lowest, which is the best.

C1: $(35+2) \times 12 = 444$ clk

C2: $(35+3) \times 11 + 3 = 421$ clk

C3: $(35+5) \times 12 = 480$ clk still C2.



4. (1) offset: 2 bits for byte offset, 5 bits for word offset.

⇒ each block has 32 words.

index has 5 bits ⇒ $2^5 = 32$ blocks. for cache

tag has $32-7-5 = 20$ bits.

cache size: $2^5 \times (32 \times 32 + 20 + 1 + 1) = 33472$ bits

(2) $\frac{33472}{32 \times 32 \times 32} = 1.021$

5位 word off　5位 index

(3)

		word off	index	tag	miss/Hit
0	0	0	0	0	M
4	100	1	0	0	H
20	10100	101	0	0	H
136	10001000	10	1	0	M
232	11101000	11010	1	0	H
164	10100100	01001	1	0	H
1024	10000000000	0	00000	0	M
30	11110	00111	0	0	H
140	10001100	00011	1	0	H
3100	110000011100	00111	11000	0	M
176	10110000	01100	00001	0	H
2180	100010000100	00001	10001	0	M

5 blocks are replaced. index: 0, 1, 8, 24, 17　no block is replaced

(4) Hit ratio: $\frac{7}{12}$

(5)

Index	Tag	w_0	w_1	w_2	w_3	w_4	w_5 .. w_7 .. w_9 .. w_{12} .. w_{26} ..
0	0	M[0]	M[1]	8~31			M[5] M[7]
1	0	32~63	M[34]	M[35]			M[41] M[44] M[58]
8	0	M[256]					
24	0						M[775]
17	0	M[545]					