Solution 3

1.

(a) Direct-mapped: 3-bit **Block = A_{5-3}**, 1-bit **Word = A_2**; miss rate = 10/12.

Tag	Word 1	Word 0	
00	[04]	[00]	Block 0
00	[0C]	[08]	Block 1
			Block 2
			Block 3
10	[A4]	[A0]	Block 4
10	[AC]	[A8]	Block 5
			Block 6
			Block 7

(b) 4-way set-associative: 1-bit **Set = A_3**, 1-bit **Word = A_2**; miss rate = 6/12.

Tag	Word 1	Word 0	
1000	[84]	[80]	Set 0
1010	[A4]	[A0]	Set 0
0000	[04]	[00]	Set 0
			Set 0
1000	[8C]	[88]	Set 1
1010	[AC]	[A8]	Set 1
0000	[0C]	[08]	Set 1
			Set 1

(c) Fully-associative: 1-bit **Word = A_2**; miss rate = 6/12.

Tag	Word 1	Word 0
10001	[8C]	[88]
10000	[84]	[80]
10100	[A4]	[A0]
10101	[AC]	[A8]
00001	[0C]	[08]
00000	[04]	[00]

2.

(a) Direct-mapped: 2-bit **Block = A_{5-4}**, 2-bit **Word = A_{3-2}**; miss rate = 6/10.

Tag	Word 3	Word 2	Word 1	Word 0	
01	[4C]	[48]	[44]	[40]	Block 0
00	[1C]	[18]	[14]	[10]	Block 1
00	[2C]	[28]	[24]	[20]	Block 2
					Block 3

(b) 2-way set-associative: 1-bit **Set = A_4**, 2-bit **Word = A_{3-2}**; miss rate = 7/10.

Tag	Word 3	Word 2	Word 1	Word 0	
100	[8C]	[88]	[84]	[80]	Set 0
010	[4C]	[48]	[44]	[40]	Set 0
000	[1C]	[18]	[14]	[10]	Set 1
					Set 1

(c) Fully associative: 2-bit **Word = A_{3-2}**; miss rate = 4/10.

Tag	Word 3	Word 2	Word 1	Word 0
0010	[2C]	[28]	[24]	[20]
1000	[8C]	[88]	[84]	[80]
0001	[1C]	[18]	[14]	[10]
0100	[4C]	[48]	[44]	[40]

3.

$T_{ave} = h_1C_1 + (1-h_1)C_2 + (1-h_1)(1-h_2)M = 7.2\tau - 4.8h_2$.

If **$h_2 = 1$** (i.e., 100% hit rate), then **$T_{ave} = 2.4\tau$** (minimum).

If **$T_{ave} = 4\tau$**, then **$h_2 = 2/3$** (i.e., 67% hit rate).