5.6 (1) clock rate$_1$ = $\frac{1}{0.66 \times 10^{-9}\,s}$ = 1.52×10^9 HZ = 1.52 GHZ

clock rate$_2$ = $\frac{1}{0.90 \times 10^{-9}\,s}$ = 1.11×10^9 HZ = 1.11 GHZ

(2) $\frac{70}{0.66} = 106.06$

AMAT$_1$ = 1 + 0.08 × 107 = 9.56 cycles

AMAT$_2$ = 1 + 0.06 × 78 = 5.68 cycles

(3) 0.08 × 107 = 8.56

P$_1$: 0.36 × 0.08 × 107 = 3.0816

CPI$_1$ = 1 + 8.56 + 3.0816 = 12.6416

CPI$_1$ × cycle time$_1$ = 12.6416 × 0.66 ns = 8.343456 ns

P$_2$: CPI$_2$ = 1 + 4.68 + 1.6848 = 7.3648

CPI$_2$ × cycle time$_2$ = 7.3648 × 0.9 ns = 6.62832 ns

故 P2 更快

(4) $\lceil \frac{5.62}{0.66} \rceil = \lceil 8.52 \rceil = 9$

9 + 0.95 × 107 = 110.65 cycles

AMAT$_1$' = 1 + 0.08 × 110.65 = 9.852 cycles

比 L2 差

(5) 110.65 × 0.08 = 8.852

0.08 × 0.36 × 110.65 = 3.18672

CPI$_1$' = 1 + 8.852 + 3.18672 = 13.03872

(6) 13.03872 × 0.66 ns = 8.61 ns

CPI$_1$'' × 0.66 ns = 6.62832 ns ⇒ CPI$_1$'' = 10.04

又 CPI$_1$'' = 1 + miss chance$_{new\,L1}$ × 110.65 + miss chance$_{new\,L1}$ × 0.78 × 110.65

設 miss chance$_{new\,L1}$ = 0.06 = 6%

5.7 (1)

Word Address	Binary Address	Tag	Index	Hit/Miss
3	0000 0011	0	1	M

180	1011	0100	11	2	M
43	0010	1011	2	5	M
2	0000	0010	0	1	M
191	1011	1111	11	7	M
88	0101	1000	5	4	M
190	1011	1110	11	7	H
14	0000	1110	0	7	M
181	1011	0101	11	2	H
44	0010	1100	2	6	M
186	1011	1010	11	5	M
253	1111	1101	15	6	M

(2)

Tag	Hit/Miss	Contents
3	M	3
180	M	3, 180
43	M	3, 180, 43
2	M	3, 180, 43, 2
191	M	3, 180, 43, 2, 191
88	M	3, 180, 43, 2, 191, 88
190	M	3, 180, 43, 2, 191, 88, 190
14	M	3, 180, 43, 2, 191, 88, 190, 14
181	M	181, 180, 43, 2, 191, 88, 190, 14
44	M	181, 44, 43, 2, 191, 88, 190, 14
186	M	181, 44, 186, 2, 191, 88, 190, 14
253	M	181, 44, 186, 253, 191, 88, 190, 14

(3)

Address	Tag	Hit/Miss	Contents
3	1	M	1
180	90	M	1, 90
43	21	M	1, 90, 21
2	1	H	1, 90, 21
191	95	M	1, 90, 21, 95
88	44	M	1, 90, 21, 95, 44
190	95	H	1, 90, 21, 95, 44
14	7	M	1, 90, 21, 95, 44, 7
181	90	H	1, 90, 21, 95, 44, 7
44	22	M	1, 90, 21, 95, 44, 7, 22
186	143	M	1, 90, 21, 95, 44, 7, 22, 143
253	126	M	1, 90, 126, 95, 44, 7, 22, 143

(4) $\frac{1}{2GHz} = 0.5ns$ $\frac{100ns}{0.5ns} = 200$ cycles

$0.07 \times 200 = 14$ $CPI = 1.5 + 14 = 15.5$

$0.07 \times (12 + 0.035 \times 200) = 1.33$, $CPI = 1.5 + 1.33 = 2.83$

$0.07 \times (28 + 0.015 \times 200) = 2.17$, $CPI = 1.5 + 2.17 = 3.67$

$1.5 + 0.07 \times 400 = 29.5$

$1.5 + 0.07 \times (12 + 0.035 \times 400) = 3.32$

$1.5 + 0.07 \times (28 + 0.015 \times 400) = 3.88$

$1.5 + 0.07 \times 100 = 8.5$

$1.5 + 0.07 \times (12 + 0.035 \times 100) = 2.585$

$1.5 + 0.07 \times (28 + 0.015 \times 100) = 3.565$

(5) $1.5 + 0.07 \times (12 + 0.035 \times (50 + 0.013 \times 200)) = 2.47$

(6) $1.5 + 0.07 \times (50 + 200x) \leq 2.83 \Rightarrow x \leq -0.155$

$1.5 + 0.07 \times (50 + 200x) \leq 3.67 \Rightarrow x \leq 0.012$

5.8 (1) $MTBF = MTTF + MTTR = 3\text{年}1\text{天}$

(2) $\frac{MTTF}{MTBF} = \frac{3 \text{ years}}{3 \text{ years and } 1 \text{ day}} = \frac{1095}{1096} = 0.9991 = 99.91\%$

(3) availability approaches 1

(4) 若 MTTF 不长、则 availability 为0
反之，availability 增长

5.9 (1) $2^p \geq p + d + 1 \Rightarrow 2^p \geq p + 129$

$\Rightarrow p = 8$

(2) $128 + 9 = 137$ bits $\Rightarrow \frac{1}{137}$

(3) 0011 0110 0101 = 0x365