Q1) The power consumption stays the same at 20W and the microprocessor becomes 40% faster to 5.6GHz in the next technology node based on the perfect Dennard scaling.

Q2) $V_{IL} = 0.75V$; $V_{IH} = 1.25V$; $V_{OL} = 0V$; $V_{OH} = 2V$

Noise margin high = 0.75V

Noise margin low = 0.75V.

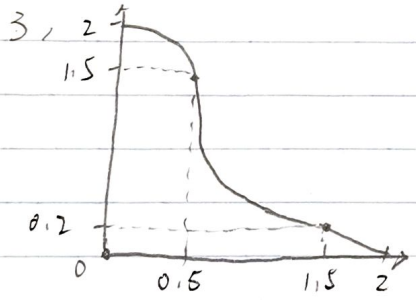
Q3) 1. NAND gate.

2. a) Let two inputs be the same.

b) Use one blackbox with input A and B, then use the output of the blackbox as the both inputs for another blackbox.

c) Let A be the two inputs for one blackbox, B be the two inputs for another blackbox, and let the two outputs from these two blackbox be the input of the third blackbox.

3.



4. Propagation delay is 5 microseconds.

Q4) 1. $C0 = 1$, $C1 = 0$, $C2 = 1$, $C3 = 0$.

2. Yes, any arbitrary 2 input logics only has 4 possible inputs, the above architecture has all the possible combination as inputs to an OR gate with a control $C_1 \sim C_4$.

Q5)

2) not ((not A and B) and (C xor D)) and not (E or F)

$= \sim((\sim A B)(C \wedge D)) \sim (E + F)$

$= \sim C \sim D + CD + \sim B + F + E + A$

= not C and not D or C and D or not B or F or E or A

Q6) 1. $(\bar{A})(\bar{B}) + C)(A + B)(\bar{B} + AC)$

$= ((\bar{A})(\bar{B}) + C)(A + B)((B)(\bar{A}C))$

$= ((\bar{A})(\bar{B}) + C)(A + B)((B)(\bar{A} + \bar{C}))$

$= (((\bar{A})(\bar{B}) + C)(A) + ((\bar{A})(\bar{B}) + C)(B))((\bar{A})(B) + (\bar{C})(B))$

$= (\bar{A}A\bar{B} + AC + \bar{A}\bar{B}B + BC)(\bar{A}B + B\bar{C})$

$= (AC + BC)(\bar{A}B + B\bar{C})$

$= \bar{A}B(AC + BC) + B\bar{C}(AC + BC)$

$= (\bar{A}BAC + \bar{A}BBC) + (ACB\bar{C} + B\bar{C}BC)$

$= \bar{A}BC$

2, $(\bar{A})(\bar{B}) + AB + \bar{A}B$

$= (\bar{A})(\bar{B}) + (B(A + \bar{A}))$

$= (\bar{A})(\bar{B}) + B$

$= (\bar{A} + B)(\bar{B} + B)$

$= \bar{A} + B$

3, $\bar{A}(A + B) + (B + AA)(A + \bar{B})$

$= A\bar{A} + \bar{A}B + (A + B)(A + \bar{B})$

$= \bar{A}B + (A(A + B) + B(A + \bar{B}))$

$= \bar{A}B + (A + (AB + B\bar{B}))$

$= \bar{A}B + (A + AB)$

$= A + \bar{A}B + AB$

$= A + B(\bar{A} + A)$

$= A + B$

A	B	C	D	E	F	Y
0	0	0	0	0	0	1
0	0	0	0	0	1	1
0	0	0	0	1	0	1
0	0	0	0	1	1	1
0	0	0	1	0	0	1
0	0	0	1	0	1	1
0	0	0	1	1	0	1
0	0	0	1	1	1	1
0	0	1	0	0	0	1
0	0	1	0	0	1	1
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1	1	1	1	1	0	1
1	1	1	1	1	1	1