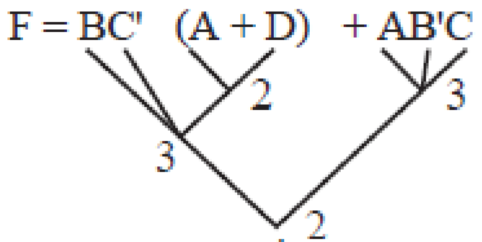
7.4 $F(A, B, C, D) = \sum m(5, 10, 11, 12, 13)$

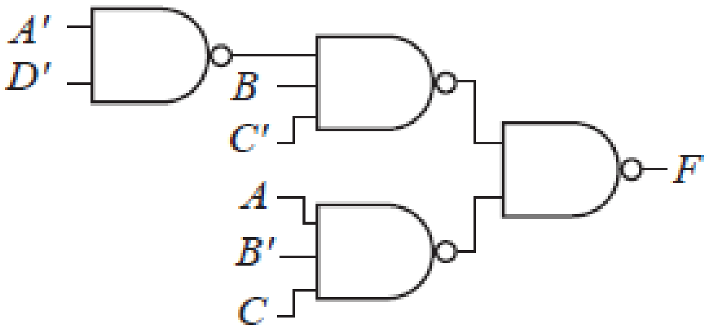
CD \ AB	00	01	11	10
00	0	0	1	0
01	0	1	1	0
11	0	0	0	1
10	0	0	0	1

F = BC'D + AB'C + ABC'

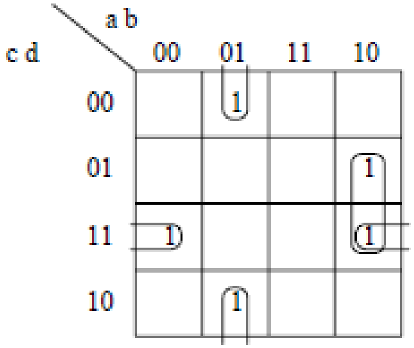
$F = ABC' + BC'D + AB'C = BC'(A + D) + AB'C$



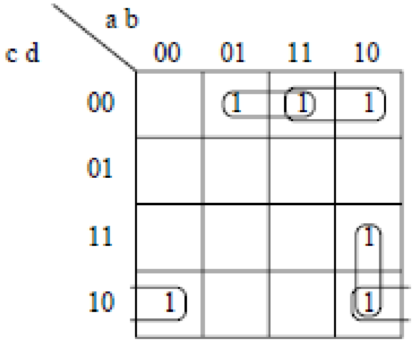
4 gates, 10 inputs



7.10 $f_1(A, B, C, D) = \sum m(3, 4, 6, 9, 11)$
$f_2(A, B, C, D) = \sum m(2, 4, 8, 10, 11, 12)$
$f_3(A, B, C, D) = \sum m(3, 6, 7, 10, 11)$



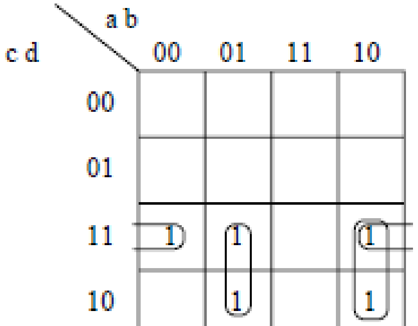
$f_1 = ab'd + \underline{\underline{b'cd}} + a'bd'$



$f_2 = \underline{ab'c} + b'cd' + bc'd' + ac'd'$

$f_2 = \underline{ab'c} + b'cd' + bc'd' + ab'd'$

11 gates



$f_3 = \underline{ab'c} + \underline{\underline{b'cd}} + a'bc$

7.17 (a)

	$ABCD$	F
0	0 0 0 0	0
1	0 0 0 1	0
2	0 0 1 0	0
3	0 0 1 1	1
4	0 1 0 0	0
5	0 1 0 1	1
6	0 1 1 0	1
7	0 1 1 1	1
8	1 0 0 0	0
9	1 0 0 1	1
10	1 0 1 0	1
11	1 0 1 1	1
12	1 1 0 0	1
13	1 1 0 1	1
14	1 1 1 0	1
15	1 1 1 1	1

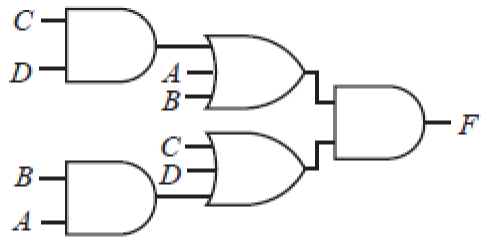
F = $\prod M(0, 1, 2, 4, 8)$

7.17 (b)

CD \ AB	00	01	11	10
00	0	0	1	0
01	0	1	1	1
11	1	1	1	1
10	0	1	1	1

$F = (A + C + D)(A + B + C)$
$\quad (A + B + D)(B + C + D)$
$= (A + D + BC)(B + C + AD)$ <u>or</u>
$= (A + C + BD)(B + D + AC)$ <u>or</u>
$= (C + D + AB)(A + B + CD)$

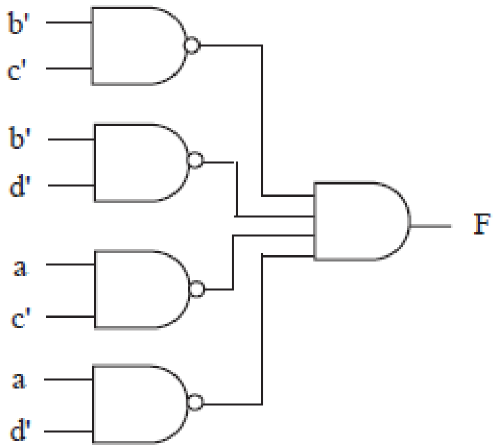
This solution has 5 gates, 12 inputs. Beginning with the sum of products requires 6 gates.



7.23 (a)

cd \ ab	00	01	11	10
00	0	1	0	0
01	0	1	0	0
11	1	1	1	1
10	0	1	0	0

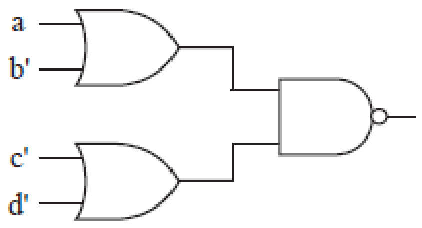
$$f = (b + c)(b + d)(a' + c)(a' + d)$$



7.23 (b)

cd \ ab	00	01	11	10
00	1	0	1	1
01	1	0	1	1
11	0	0	0	0
10	1	0	1	1

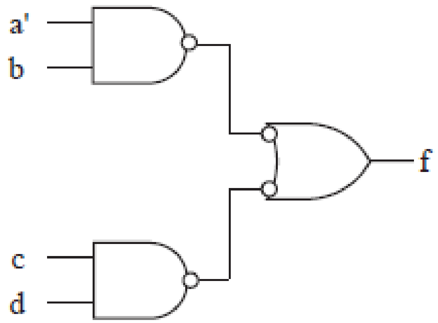
$f' = (a + b')(c' + d')$



7.23 (c)

cd \ ab	00	01	11	10
00	0	1	0	0
01	0	1	0	0
11	1	1	1	1
10	0	1	0	0

$f = a'b + cd$



7.33 (a)

CD \ AB	00	01	11	10
00	1			
01		1	1	
11	1	1		1
10	1			

$F = BC'D + B'CD + A'B'D' + A'CD$

$F = BC'D + B'CD + A'B'D' + A'BD$

Draw AND-OR circuit and replace all gates with NANDs.

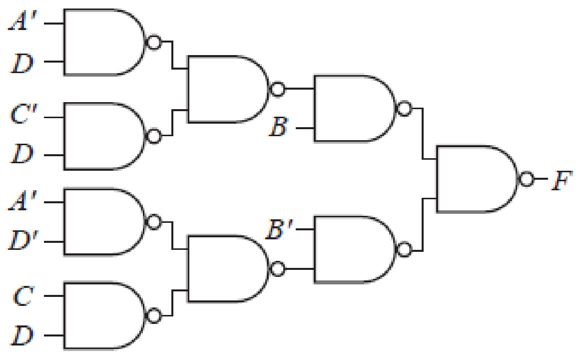
7.33 (b)

CD \ AB	00	01	11	10
00	1	0	0	0
01	0	1	1	0
11	1	1	0	1
10	1	0	0	0

$F = (B + C + D')(B' + D)(A' + D)(A' + B' + C')$

Draw OR-AND circuit and replace all gates with NORs.

7.33 (c) $F = B(A'D + C'D) + B'(A'D' + CD)$



Alternative:

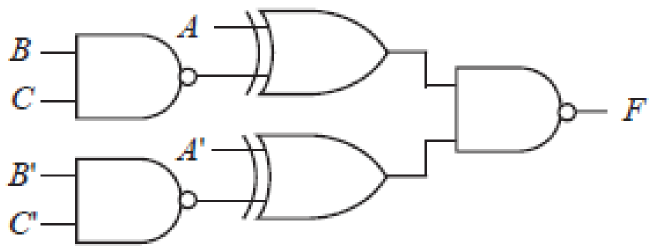
$F = A'(B'D' + BD) + D(B'C + BC')$

$= D(A'B + BC') + B'(A'D' + CD)$

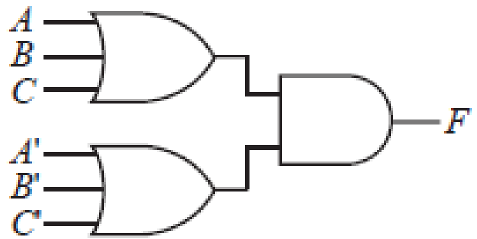
$= A'(B'D' + CD) + D(B'C + BC')$

$= D(A'C + BC') + B'(A'D' + CD)$

7.40 (a) An inverter on the output of an XOR can be moved to one of its inputs.



7.40 (b) $F = (A \oplus BC) + (A' \oplus B'C') = A'BC + AB' + AC'$
$+ AB'C' + A'B + A'C$
$= AB' + AC' + A'B + A'C$
$= A(B' + C') + A'(B + C)$
$= (A + B + C)(A' + B' + C')$



7.40 (c) $F = A(B' + C') + A'(B + C)$