Chapter 4

5. (a) $AB = 1$ when $A = 1, B = 1$
(b) $A\overline{B}C = 1$ when $A = 1, B = 0, C = 1$
(c) $A + B = 0$ when $A = 0, B = 0$
(d) $\overline{A} + B + \overline{C} = 0$ when $A = 1, B = 0, C = 1$
(e) $\overline{A} + \overline{B} + C = 0$ when $A = 1, B = 1, C = 0$
(f) $\overline{A} + B = 0$ when $A = 1, B = 0$
(g) $A\overline{B}\overline{C} = 1$ when $A = 1, B = 0, C = 0$

6. (a) $X = (A + B)C + B$

A	B	C	$A + B$	$(A + B)C$	X
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	1	0	1
0	1	1	1	1	1
1	0	0	1	0	0
1	0	1	1	1	1
1	1	0	1	0	1
1	1	1	1	1	1

(b) $X = \overline{(A + B)}C$

A	B	C	$\overline{A + B}$	X
0	0	0	1	0
0	0	1	1	1
0	1	0	0	0
0	1	1	0	0
1	0	0	0	0
1	0	1	0	0
1	1	0	0	0
1	1	1	0	0

(c) $X = A\overline{B}C + AB$

A	B	C	$A\overline{B}C$	AB	X
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	0	0	0
0	1	1	0	0	0
1	0	0	0	0	0
1	0	1	1	0	1
1	1	0	0	1	1
1	1	1	0	1	1

(d) $X = (A + B)(\overline{A} + B)$

A	B	$A + B$	$\overline{A} + B$	X
0	0	0	1	0
0	1	1	1	1
1	0	1	0	0
1	1	1	1	1

(e) $X = (A + BC)(\overline{B} + \overline{C})$

A	B	C	$A + BC$	$\overline{B} + \overline{C}$	X
0	0	0	0	1	0
0	0	1	0	1	0
0	1	0	0	1	0
0	1	1	1	0	0
1	0	0	1	1	1
1	0	1	1	1	1
1	1	0	1	1	1
1	1	1	1	0	0

8. Refer to Table 4-1 in the textbook.

(a) Rule 9: $\overline{\overline{A}} = A$
(b) Rule 8: $A\overline{A} = 0$ (applied to 1st and 3rd terms)
(c) Rule 5: $A + \overline{A} = A$
(d) Rule 6: $A + \overline{A} = 1$
(e) Rule 10: $A + AB = A$
(f) Rule 11: $A + \overline{A}B = A + B$ (applied to 1st and 3rd terms)

12. (a) $AB = X$
(b) $\overline{A} = X$
(c) $A + B = X$
(d) $A + B + C = X$

13. See Figure 4-1.

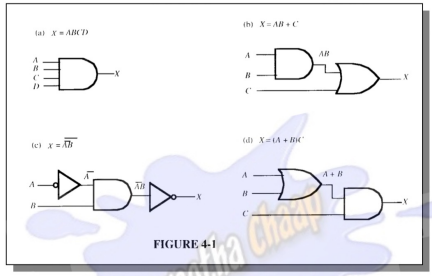

FIGURE 4-1

15. See Figure 4-3.

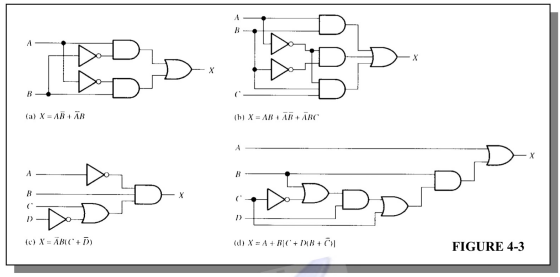

FIGURE 4-3

18. (a) $X = A + B$

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

(b) $X = AB$

A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

(c) $X = AB + BC$

A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

(d) $X = (A + B)C$

A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

(e) $X = (A + B)(\overline{B} + C)$

A	B	C	$A + B$	$\overline{B} + C$	X
0	0	0	0	1	0
0	0	1	0	1	0
0	1	0	1	0	0
0	1	1	1	1	1
1	0	0	1	1	1
1	0	1	1	1	1
1	1	0	1	0	0
1	1	1	1	1	1

21. (a) $BD + B(D + E) + \overline{D}(D + F) = BD + BD + BE + \overline{D}D + \overline{D}F$
$= BD + BE + 0 + \overline{D}F = \boldsymbol{BD + BE + \overline{D}F}$

(b) $A\overline{B}C + (\overline{A + B + C}) + A\overline{B}CD = A\overline{B}C + \overline{A}\overline{B}C + A\overline{B}CD = \overline{A}\overline{B}C + \overline{A}\overline{B}CD$
$= \overline{A}\overline{B}(C + CD) = \overline{A}\overline{B}(C + D) = \boldsymbol{\overline{A}\overline{B}C + \overline{A}\overline{B}D}$

(c) $(B + BC)(B + \overline{B}C)(B + D) = B(1 + C)(B + C)(B + D)$
$= B(B + C)(B + D) = (BB + BC)(B + D) = (B + BC)(B + D)$
$= B(1 + C)(B + D) = B(B + D) = BB + BD = B + BD = B(1 + D) = \boldsymbol{B}$

(d) $ABCD + AB(\overline{CD}) + (A\overline{B})CD = ABCD + AB(\overline{C} + \overline{D}) + (\overline{A} + \overline{B})CD$
$= ABCD + AB\overline{C} + AB\overline{D} + \overline{A}CD + \overline{B}CD$
$= CD(AB + \overline{A} + \overline{B}) + AB\overline{C} + AB\overline{D} = CD(B + \overline{A} + \overline{B}) + AB\overline{C} + AB\overline{D}$
$= CD(1 + \overline{A}) + AB\overline{C} + AB\overline{D} = CD + AB\overline{C} + AB\overline{D} = CD + AB(\overline{CD}) = \boldsymbol{CD + AB}$

(e) $ABC[AB + \overline{C}(B\overline{C} + AC)] = ABABC + ABC\overline{C}(B\overline{C} + AC)$
$= ABC + 0(BC + AC) = \boldsymbol{ABC}$

24. (a) $AB + CD(A\overline{B} + CD) = AB + A\overline{B}CD + CDCD = AB + A\overline{B}CD + CD$

$= AB(A\overline{B} + 1)CD = \boldsymbol{AB + CD}$

(b) $AB(\overline{\overline{B}C} + BD) = AB\overline{\overline{B}C} + ABBD = 0 + ABD = \boldsymbol{ABD}$

(c) $A + B[AC + (B + \overline{C})D] = A + ABC + (B + \overline{C})BD$

$= A + ABC + BD + B\overline{C}D = A(1 + BC) + BD + B\overline{C}D = A + BD(1 + \overline{C})$

$= \boldsymbol{A + BD}$

26. (a) $AB + CD = ABCD + ABC\overline{D} + AB\overline{C}D + AB\overline{C}\,\overline{D} + A\overline{B}CD + A\overline{B}C\overline{D} + A\overline{B}\,\overline{C}D + A\overline{B}\,\overline{C}\,\overline{D}$

(b) $ABD = ABCD + AB\overline{C}D$

(c) $A + BD = A\overline{B}CD + A\overline{B}C\overline{D} + A\overline{B}\,\overline{C}D + A\overline{B}\,\overline{C}\,\overline{D} + AB\overline{C}D + AB\overline{C}\,\overline{D}$
$+ ABC\overline{D} + ABCD + \overline{A}B\overline{C}D + \overline{A}BCD$

33. (a) $\overline{A}B + AB\overline{C} + \overline{AC} + A\overline{B}C = \overline{A}BC + \overline{A}B\overline{C} + AB\overline{C} + \overline{A}\,\overline{B}C + A\overline{B}C$

(b) $\overline{X} + Y\overline{Z} + WZ + X\overline{Y}Z = \overline{W}\,\overline{X}YZ + \overline{W}X\overline{Y}Z + \overline{W}XY\overline{Z} + W\overline{X}\,\overline{Y}Z + W\overline{X}Y\overline{Z}$
$+ W\overline{X}\,\overline{Y}\,\overline{Z} + W\overline{X}YZ + WX\overline{Y}Z + WXY\overline{Z} + WXYZ$

Table 4-7

A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

Table 4-8

W	X	Y	Z	Q
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

36. (a) $X = \overline{A}B\overline{C} + A\overline{B}\,\overline{C} + A\overline{B}C + ABC$

$X = (A + B + C)(A + \overline{B} + C)(A + \overline{B} + \overline{C})(\overline{A} + \overline{B} + C)$

(b) $X = AB\overline{C} + A\overline{B}C + ABC$

$X = (A + B + C)(A + B + \overline{C})(A + \overline{B} + C)(A + \overline{B} + \overline{C})(\overline{A} + \overline{B} + C)$

(c) $X = \overline{A}BCD + \overline{A}B\overline{C}D + \overline{A}\overline{B}CD + \overline{A}\overline{B}\,\overline{C}D + A\overline{B}CD + A\overline{B}\,\overline{C}D + AB\overline{C}D + AB\overline{C}\,\overline{D}$

$X = (A + B + \overline{C} + D)(A + \overline{B} + C + D)(A + \overline{B} + \overline{C} + \overline{D})(\overline{A} + B + C + D)(\overline{A} + B + \overline{C} + D)$
$(\overline{A} + B + \overline{C} + \overline{D})(\overline{A} + \overline{B} + C + \overline{D})(\overline{A} + \overline{B} + \overline{C} + D)(\overline{A} + \overline{B} + \overline{C} + \overline{D})$

(d) $X = \overline{A}B\overline{C}D + \overline{A}B\overline{C}\,\overline{D} + \overline{A}\overline{B}CD + \overline{A}\overline{B}\,\overline{C}D + A\overline{B}CD + A\overline{B}\,\overline{C}\,\overline{D} + AB\overline{C}D + ABCD$

$X = (A + B + C + D)(A + B + C + \overline{D})(A + B + \overline{C} + \overline{D})(A + \overline{B} + \overline{C} + D)(\overline{A} + B + C + D)$
$(\overline{A} + B + C + \overline{D})(\overline{A} + B + \overline{C} + D)(\overline{A} + \overline{B} + C + \overline{D})(\overline{A} + \overline{B} + \overline{C} + D)$

38. See Figure 4-10.

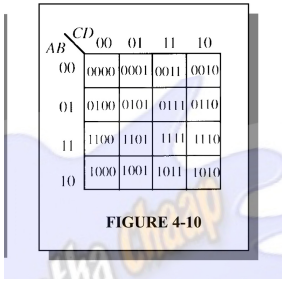

FIGURE 4-10

44. See Figure 4-15.

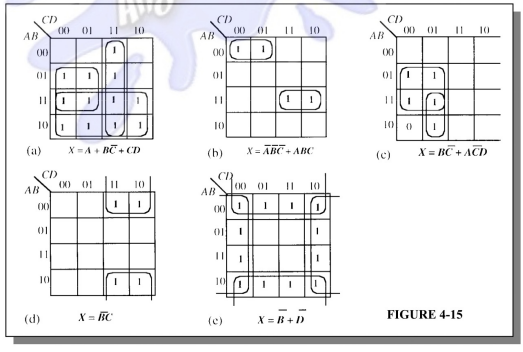

FIGURE 4-15

46. Plot the 1's from Table 4-12 in the text on the map as shown in Figure 4-17 and simplify.

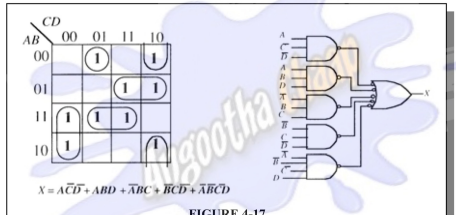

FIGURE 4-17