

Questions from end of chapter 25

END OF CHAPTER PROBLEMS 25-1

Draw the logic diagrams that represent the following Boolean expressions:

- | | |
|--|--|
| 1. $\overline{A + \overline{B}}$ | 2. $\overline{AB} + A\overline{C}$ |
| 3. $\overline{ABC} + D$ | 4. $\overline{X}(\overline{Y} + \overline{Z})$ |
| 5. $A + \overline{BC}$ | 6. $\overline{AB} + \overline{AC}$ |
| 7. $A\overline{B} + \overline{AB}$ | 8. $B(\overline{C} + D)$ |
| 9. $\overline{AB} + C + D$ | 10. $\overline{\overline{BCD}} + E$ |
| 11. $AB + A\overline{C} + B\overline{C}$ | 12. $(B + C)(\overline{C} + D)$ |
| 13. $\overline{AB} + BC$ | 14. $\overline{B}(A + \overline{C})$ |
| 15. $\overline{ABC} + D$ | 16. $\overline{A} + \overline{B} + \overline{C}$ |
| 17. $(X + Y)(Y + Z)$ | 18. $\overline{\overline{AC} + \overline{D}}$ |
| 19. $\overline{\overline{AB} + CD}$ | 20. $\overline{\overline{AB} + \overline{C}}$ |

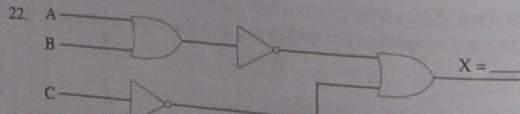
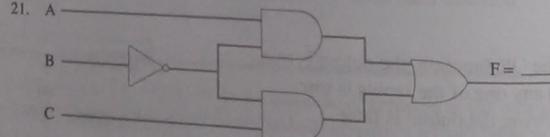
Write the Boolean expression represented by the logic diagrams in Figures 25-51 through 25-53.

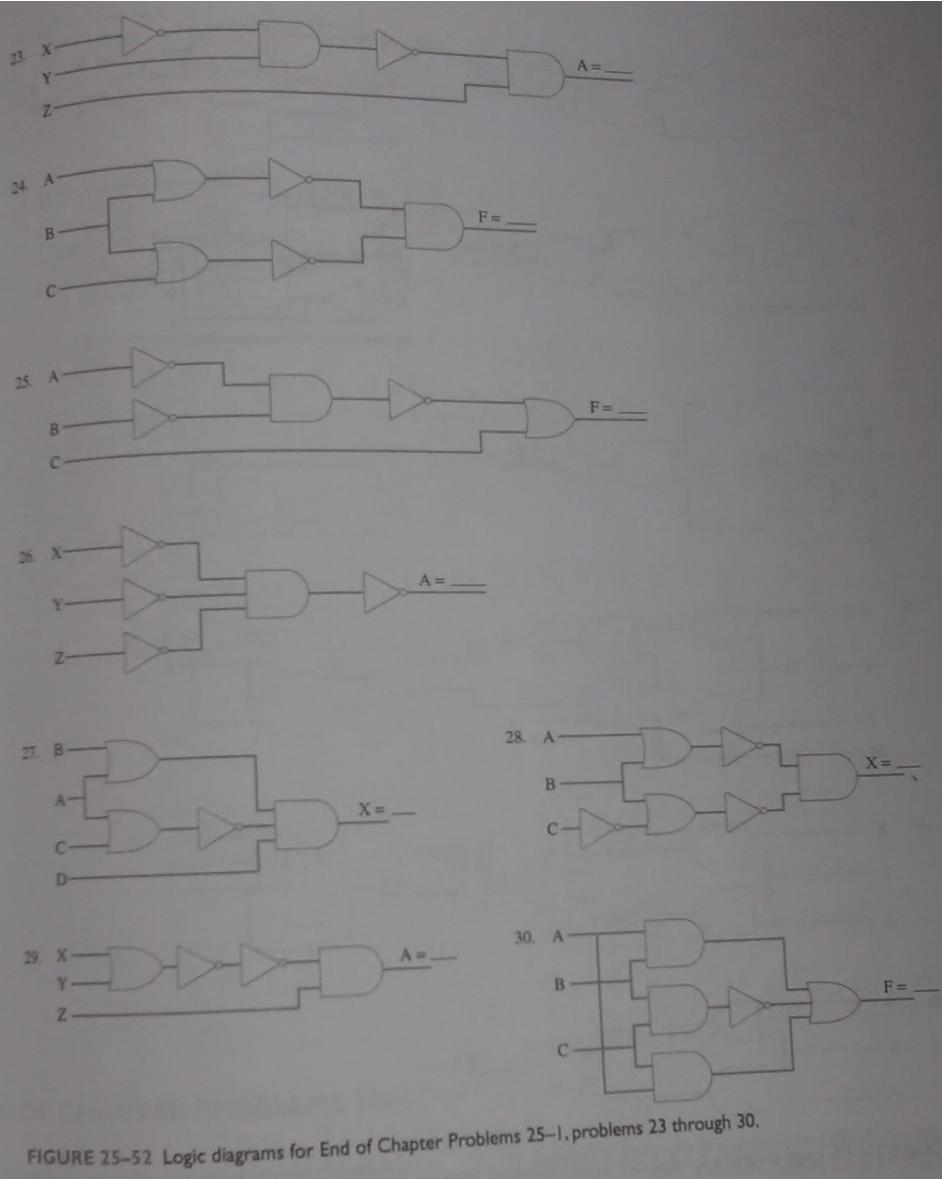
END OF CHAPTER PROBLEMS 25-2

For each logic diagram in Figure 25-54, (a) write the Boolean expression, (b) simplify the Boolean expression and justify each step, (c) draw the simplified logic diagram, and (d) construct a truth table to prove that the two expressions are equal.

1. See Figure 25-54, circuit 1.
2. See Figure 25-54, circuit 2.
3. See Figure 25-54, circuit 3.
4. See Figure 25-54, circuit 4.
5. See Figure 25-54, circuit 5.
6. See Figure 25-54, circuit 6.

FIGURE 25-51 Logic diagrams for End of Chapter Problems 25-1, problems 21 and 22.





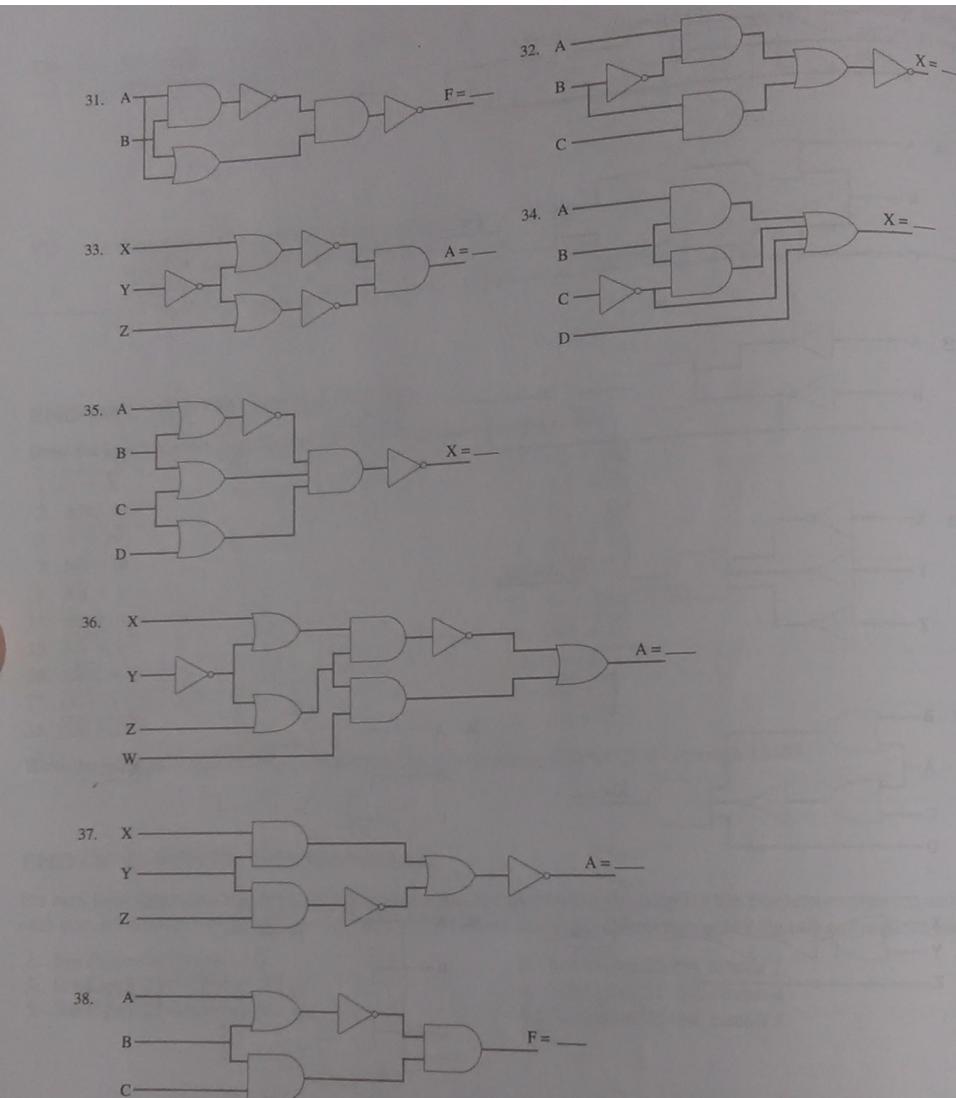


FIGURE 25-53 Logic diagrams for End of Chapter Problems 25-1, problems 31 through 40.

5. See Figure 25-53, circuit for Problem 32.

$$7. A + BC$$

$$9. (B + C)(C + D)$$

$$11. \overline{AB} + \overline{CD}$$

6. See Figure 25-53, circuit for Problem 40.

$$8. AB + \overline{AC}$$

$$10. \overline{B}(A + \overline{C})$$

$$12. \overline{A}\overline{B} + C$$

FIGURE 25–53
(cont.)

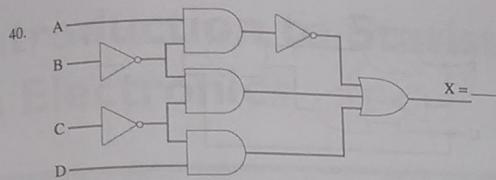
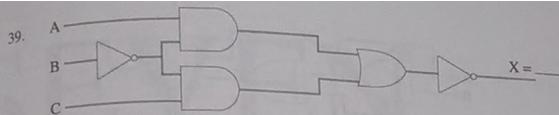
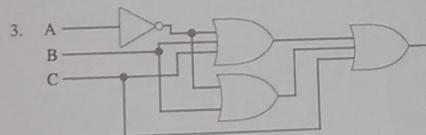
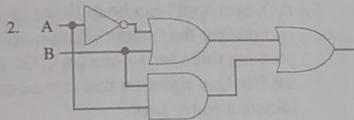


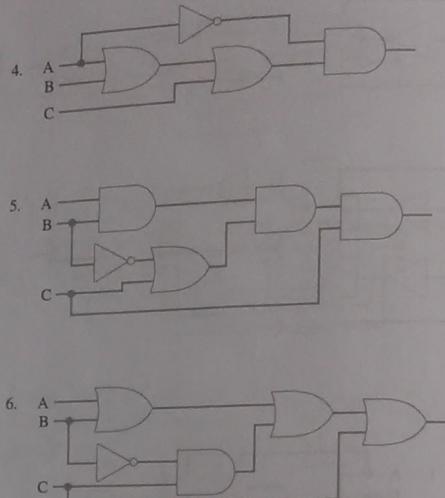
FIGURE 25–54



END OF CHAPTER PROBLEMS 25–4

1. In some automobiles, in order to start the engine, the transmission must be in PARK and the ignition key must be turned to ON. Write the Boolean equation that represents the conditions for the engine to start.
2. To start a truck, the brake must be ON, the transmission must be in neutral, and the ignition key must be turned to ON. Write the Boolean equation that represents the conditions for the engine to start.
3. A computer needs three things to start up correctly. It needs power, the ON button must be pressed, and it needs operating system software. Write the Boolean equation that represents the conditions for the computer to start up.
4. A computer needs three things to start up correctly. It must be plugged into a power source, it must be turned on, and it must have operating system software. However, if there is a data disk in the floppy drive, it will not start up. Write the Boolean equation that represents the conditions for the computer to start up correctly.

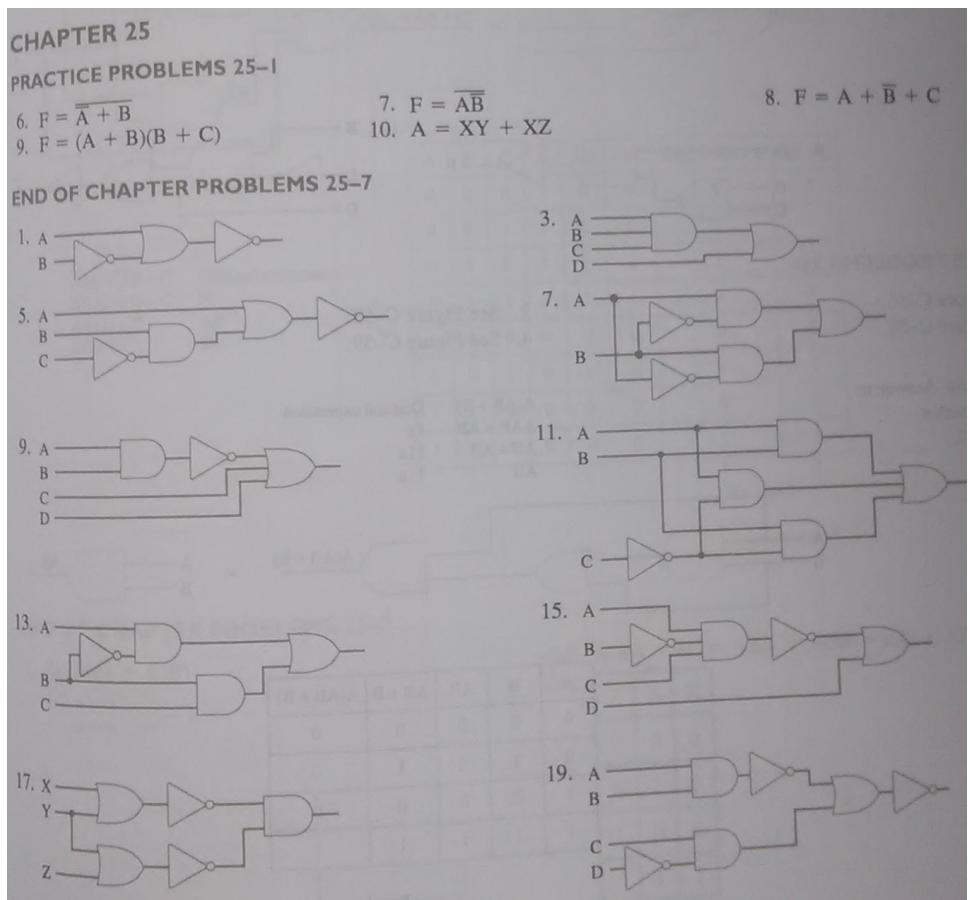
FIGURE 25-54 (cont.)



5. When using a word processor, you can scroll down a document by using the down arrow key, the page down key, or by placing the mouse pointer in the scroll bar and clicking the left mouse button. Write the Boolean equation that represents the condition to scroll down a document.

6. A “warm boot” can be initiated in some computers by pressing the “restart” button or by simultaneously pressing three keys—the Ctrl, Alt, and Del keys. Write the Boolean equation that represents the conditions to initiate a warm boot.

Solutions for end of chapter 25 questions



21. $A\bar{B} + \bar{B}C$
 27. $\overline{(A + B)(A + C)}D$
 33. $\overline{X + \bar{Y} \cdot \bar{Y} + Z}$
 39. $\overline{AB + \bar{B}C}$

SELF-TEST 25-1

1. $F = \overline{A}\bar{B} + C$
 4. $A = (\bar{X}Y)(Y + Z)$

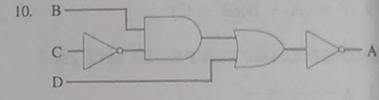
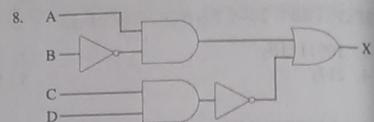
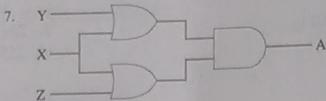
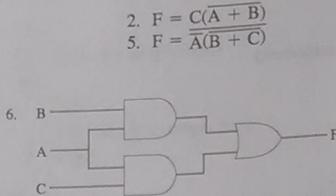
See Figure C-55.

FIGURE C-55 Answers to questions 6 through 10 for Self-test 25-1.

23. $\overline{\overline{XYZ}}$
 29. $\overline{Z(X + Y)}$
 35. $\overline{\overline{A + B}(B + C)(C + D)}$

25. $\overline{\overline{AB}} + C$
 31. $\overline{\overline{AB}}(A + B)$
 37. $XY + \overline{YZ}$

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



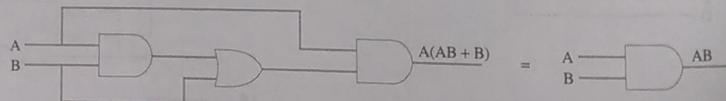
PRACTICE PROBLEMS 25-2

1. See Figure C-56.
 3. See Figure C-58.

2. See Figure C-57.
 4. See Figure C-59.

FIGURE C-56 Answer to problem 1, Practice Problems 25-2.

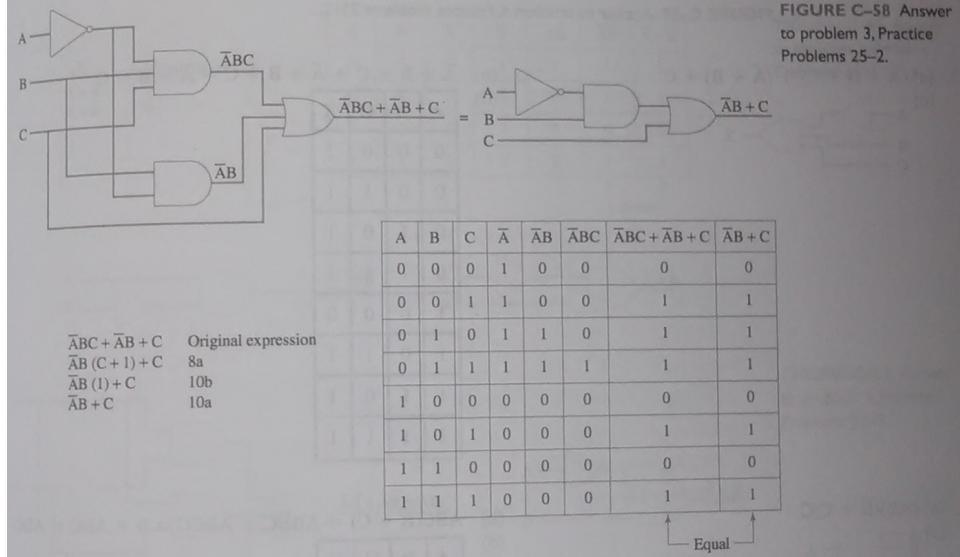
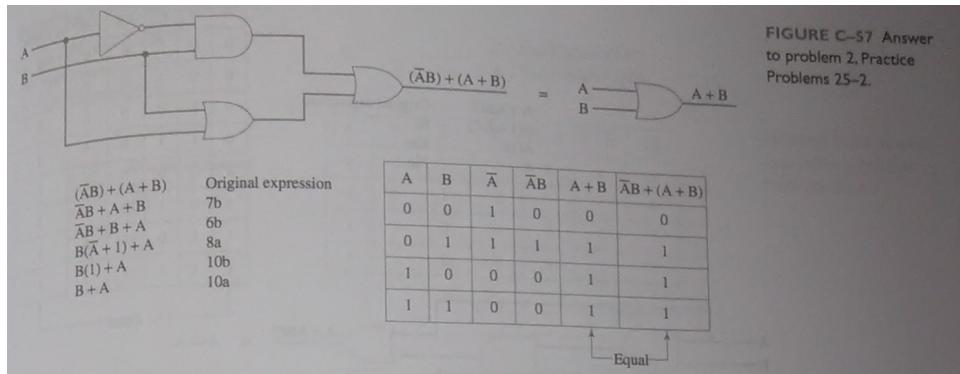
Original expression	
$A(AB + B)$	8a
$AAB + AB$	8a
$AB + AB$	11a
AB	11b



$= A \quad B \quad AB \quad AB + B \quad A(AB + B)$

A	B	AB	AB + B	A(AB + B)
0	0	0	0	0
0	1	0	1	0
1	0	0	0	0
1	1	1	1	1

↑ ↓
Equal

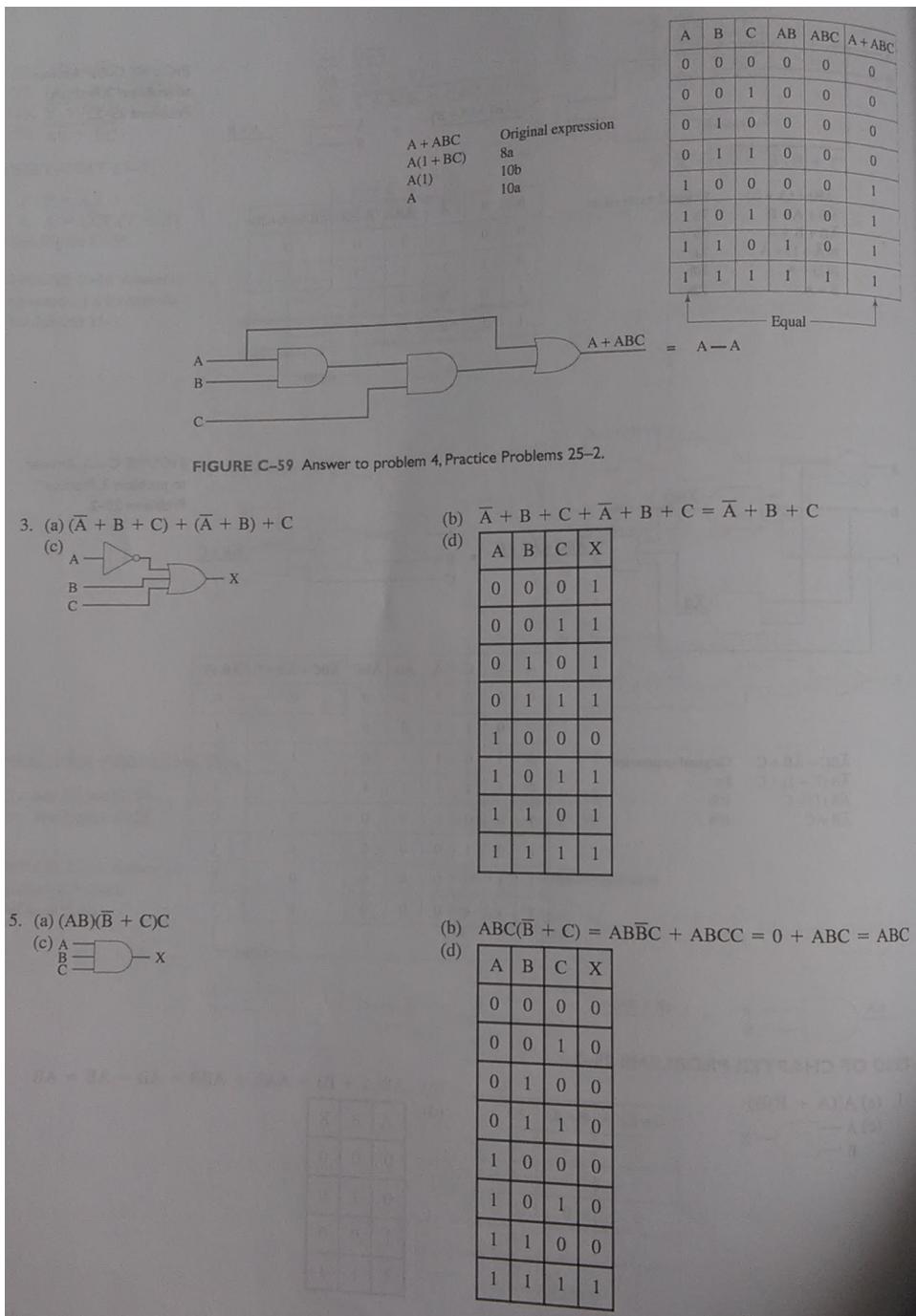


END OF CHAPTER PROBLEMS 25-2

1. (a) $A((A + B)B)$
 (c) A ——— X
 B

(b) $AB(A + B) = AAB + ABB = AB + AB = AB$
 (d)

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



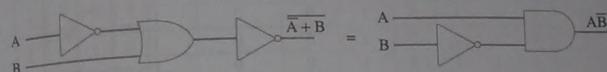
PRACTICE PROBLEMS 25-3

1. See Figure C-60.
3. See Figure C-62.
5. See Figure C-64.

$\overline{A+B}$ Original expression
 $\overline{A} \cdot \overline{B}$ 14a
 $A\overline{B}$ 13a

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

Equal



\overline{AB} Original expression
 $\overline{A} + \overline{B}$ 14b
 $\overline{A} + B$ 13b

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

Equal

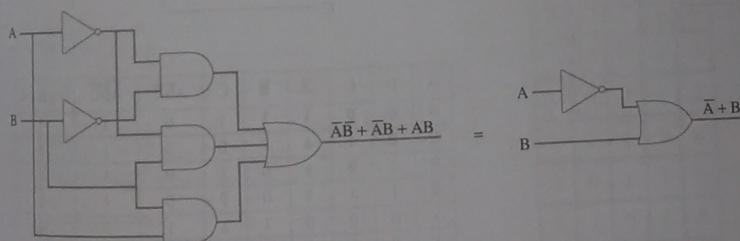
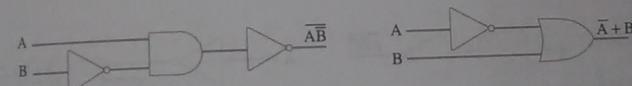


FIGURE C-60 Answer to problem 1, Practice Problems 25-3.

FIGURE C-61 Answer to problem 2, Practice Problems 25-3.

FIGURE C-62 Answer to problem 3, Practice Problems 25-3.

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

Equal

1

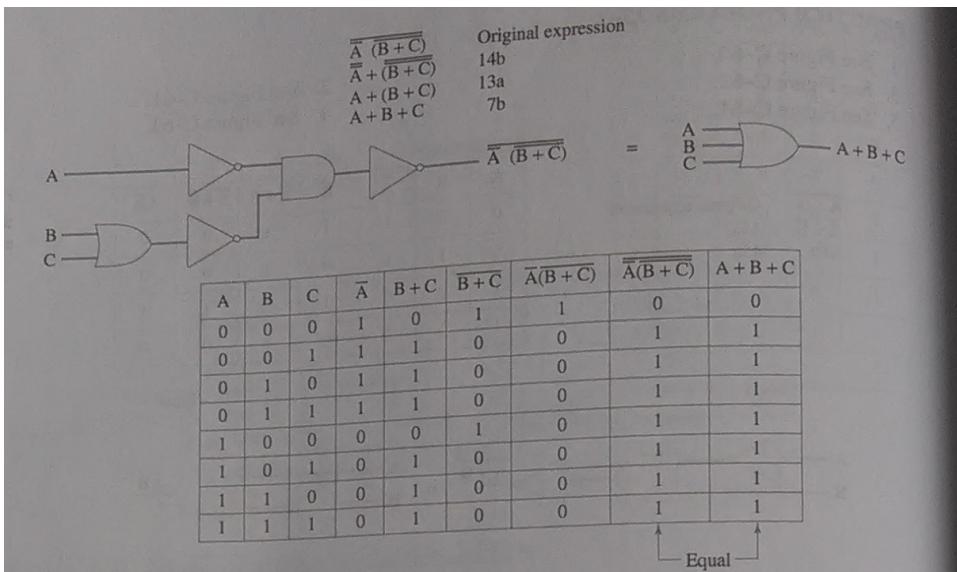
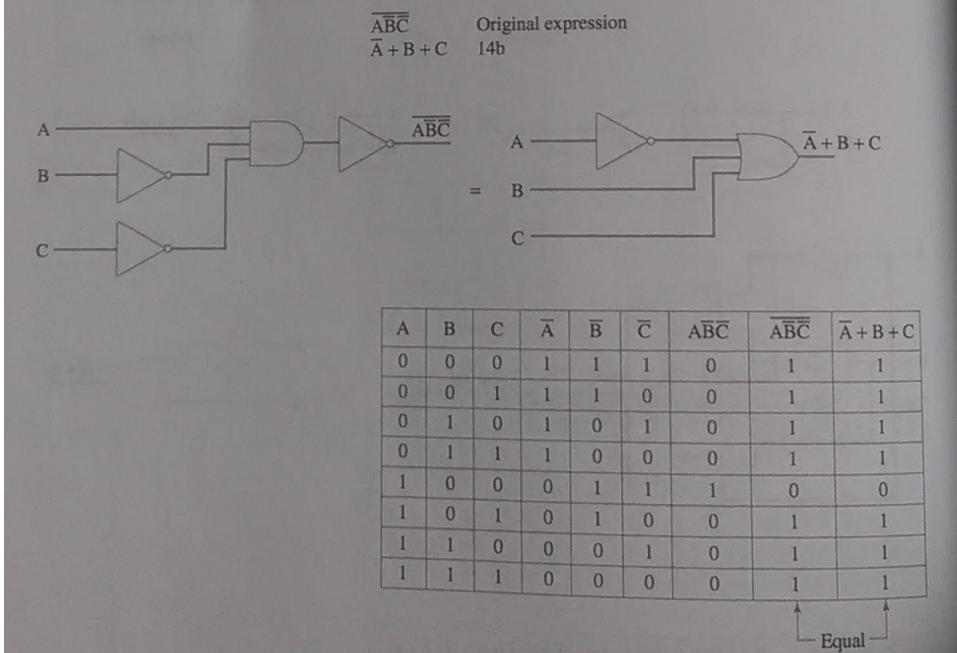


FIGURE C-63 Answer to problem 4, Practice Problems 25-3.



END OF CHAPTER PROBLEMS 25-3

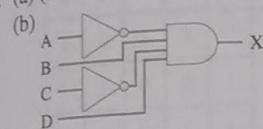
1. (a) $\overline{(A + B)} + \overline{C} = \overline{(A + B)\overline{C}}$

(c)

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



3. (a) $(A + B)(\overline{A + C})D = ((A + B)(\overline{A}\overline{C}))D = A\overline{A}\overline{C}D = \overline{AB}\overline{CD} = \overline{AB}\overline{CD}$



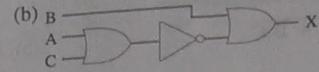
(c)

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

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

(c)

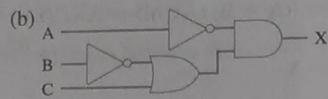
A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1



7. (a) $\overline{A + B\bar{C}} = \overline{A}(\overline{B\bar{C}}) = \overline{A}(\overline{B} + \overline{C})$

(c)

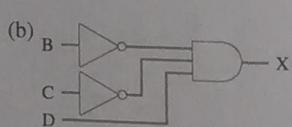
A	B	C	X
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0



9. (a) $(\overline{B + C})(C + D) = (\overline{B}\overline{C})(C + D) = \overline{B}\overline{C}C + \overline{B}\overline{C}D = \overline{B}\overline{C}D$

(c)

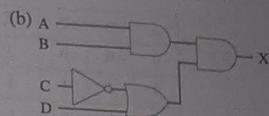
B	C	D	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0



11. (a) $\overline{AB} + \overline{CD} = \overline{(AB)} \cdot \overline{(CD)} = (AB) (\overline{C} + D)$

(c)

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



PRACTICE PROBLEMS 25-4

1. (ON) + ((AUTO) · (IR)) = (Lights on)
2. (TV pressed) · (ON pressed) = (Turn TV on)
(VCR pressed) · (ON pressed) = (Turn VCR on)
3. (SHIFT) · (SIN) = (calculate inverse sine)
(SHIFT) · (SIN) = (calculate sine)
4. (Pointer on print icon) · (left mouse button) = (print document)
(Pointer on page icon) · (left mouse button) = (display page)

END OF CHAPTER PROBLEMS 25-4

1. (PARK) · (key) = (start)
3. (Power) · (ON) · (OS) = (start)
5. (Down arrow) + (page down) + ((scroll bar) · (left mouse button)) = (scroll down)

SELF-TEST 25-2

1. See Figure C-65.
2. See Figure C-66.
3. See Figure C-67.

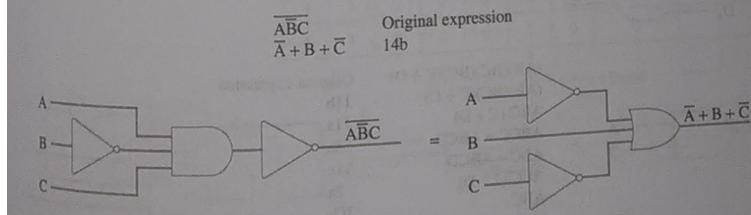


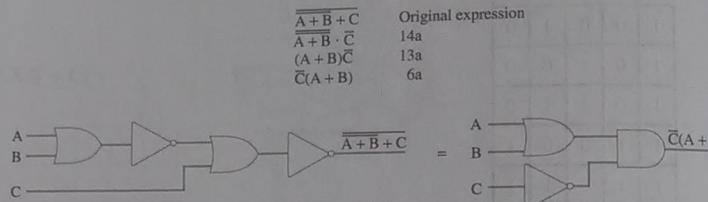
FIGURE C-65 Logic diagrams and truth table
 $\overline{ABC} = \overline{A} + B + \overline{C}$. A
to problem 1,
Self-test 25-2.

FIGURE C-65 (cont.)

A	B	C	\bar{A}	\bar{B}	\bar{C}	$A\bar{B}C$	$\bar{A}\bar{B}C$	$\bar{A} + B + \bar{C}$
0	0	0	1	1	1	0	1	1
0	0	1	1	1	0	0	1	1
0	1	0	1	0	1	0	1	1
0	1	1	1	0	0	0	1	1
1	0	0	0	1	1	0	1	1
1	0	1	0	1	0	1	0	0
1	1	0	0	0	1	0	1	1
1	1	1	0	0	0	0	1	1

Equal

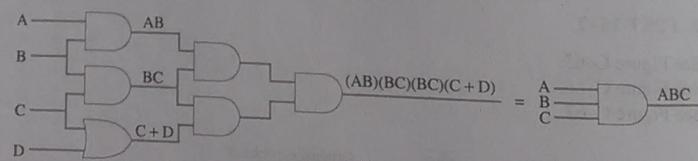
FIGURE C-66 Logic diagram and truth table for $A + B + C = \bar{C}(A + B)$. Answer to problem 2, Self-test 25-2.



A	B	C	\bar{C}	$A + B$	$\bar{A} + \bar{B}$	$\bar{A} + \bar{B} + C$	$\overline{\bar{A} + \bar{B} + C}$	$\bar{C}(A + B)$
0	0	0	1	0	1	1	0	0
0	0	1	0	0	1	1	0	0
0	1	0	1	1	0	0	1	1
0	1	1	0	1	0	1	0	0
1	0	0	1	1	0	0	1	1
1	0	1	0	1	0	1	0	0
1	1	0	1	1	0	0	1	1
1	1	1	0	1	0	1	0	0

Equal

FIGURE C-67 Answer to problem 3, Self-test 25-2.



$(AB)(BC)(BC)(C + D)$	Original expression
$(AB)(BC)(C + D)$	11b
$ABC(C + D)$	11a
$ABCC + ABCD$	8a
$ABC + ABCD$	11a
$ABC(1 + D)$	8a
ABC	10b

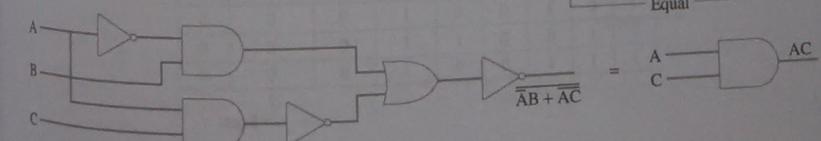
4. See Figure C-68.
 5. See Figure C-69.
 6. See Figure C-70.
 7. See Figure C-71.
 8. See Figure C-72.
 9. See Figure C-73 (p. 696).
 10. See Figure C-74 (p. 696).

A	B	C	D	AB	BC	C + D	(AB)(BC)	(BC)(C + D)	(AB)(BC)(BC)(C + D)	ABC
0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	1	0	0	0	0
0	0	1	0	0	0	1	0	0	0	0
0	0	1	1	0	0	1	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0
0	1	0	1	0	0	1	0	0	0	0
0	1	1	0	0	1	1	0	1	0	0
0	1	1	1	0	1	1	0	1	0	0
1	0	0	0	0	0	0	0	0	0	0
1	0	0	1	0	0	1	0	0	0	0
1	0	1	0	0	0	1	0	0	0	0
1	0	1	1	0	0	1	0	0	0	0
1	1	0	0	1	0	0	0	0	0	0
1	1	0	1	1	0	1	0	0	0	0
1	1	1	0	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1

FIGURE C-67 (cont)

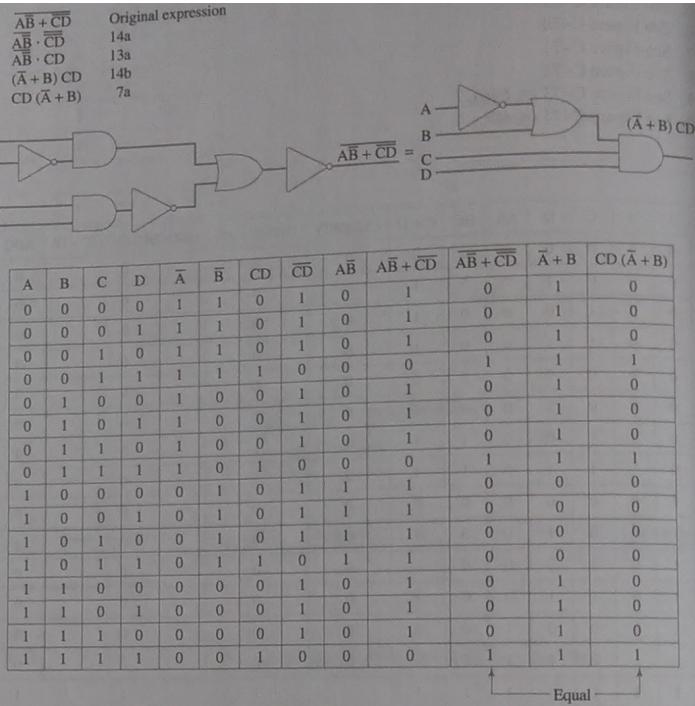
	A	B	C	\bar{A}	$\bar{A}B$	AC	$\bar{A}C$	$\bar{A}B + \bar{A}C$	$\bar{A}B + AC$
Original expression	0	0	0	1	0	0	1	1	0
$\bar{A}B + AC$	0	0	1	1	0	0	1	1	0
$AB + AC$	0	1	0	1	1	0	1	1	0
$(A + \bar{B})AC$	0	1	1	1	1	0	1	1	0
$AAC + A\bar{B}C$	1	0	0	0	0	0	0	1	0
$AC + A\bar{B}C$	1	0	1	0	0	0	1	1	0
$AC(1 + \bar{B})$	1	0	1	0	0	1	0	0	1
$AC(I)$	1	0	1	0	0	1	0	0	1
AC	1	1	0	0	0	0	1	1	0

FIGURE C-68
problem 4, Self-test



$$= A \quad C \quad \overline{AB + AC}$$

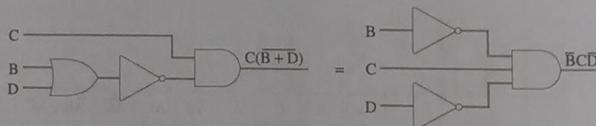
FIGURE C-69 Answer to problem 5, Self-test 25-2.



A	B	C	D	\bar{A}	\bar{B}	CD	\overline{CD}	$A\bar{B}$	$A\bar{B} + \overline{CD}$	$\overline{AB + \overline{CD}}$	$\bar{A} + B$	$CD(\bar{A} + B)$
0	0	0	0	1	1	0	1	0	1	0	1	0
0	0	0	1	1	1	0	1	0	1	0	1	0
0	0	1	0	1	1	0	1	0	1	0	1	0
0	0	1	1	1	1	1	0	0	0	1	1	1
0	1	0	0	1	0	0	1	0	1	0	1	0
0	1	0	1	1	0	0	1	0	1	0	1	0
0	1	1	0	1	0	0	1	0	1	0	1	0
0	1	1	1	1	0	1	0	0	0	1	1	1
1	0	0	0	0	1	0	1	1	1	0	0	0
1	0	0	1	0	1	0	1	1	1	0	0	0
1	0	1	0	0	1	0	1	1	1	0	0	0
1	0	1	1	0	1	1	0	1	1	0	0	0
1	1	0	0	0	0	0	1	0	1	0	1	0
1	1	0	1	0	0	0	1	0	1	0	1	0
1	1	1	0	0	0	1	0	1	1	0	1	0
1	1	1	1	0	0	1	0	0	0	1	1	1

Equal

FIGURE C-70 Answer to problem 6, Self-test 25-2.



Original expression

$C(B + \overline{D})$	14a
$C(\overline{B}\overline{D})$	14a
$\overline{CB\overline{D}}$	7a
$\overline{BC\overline{D}}$	6a

B	C	D	\bar{B}	\bar{D}	$B + D$	$\overline{B + D}$	$C(B + D)$	$\overline{BC\overline{D}}$
0	0	0	1	1	0	1	0	0
0	0	1	1	0	1	0	0	0
0	1	0	1	1	0	1	1	1
0	1	1	1	0	1	0	0	0
1	0	0	0	1	1	0	0	0
1	0	1	0	0	1	0	0	0
1	1	0	0	1	1	0	0	0
1	1	1	0	0	1	0	0	0

Equal

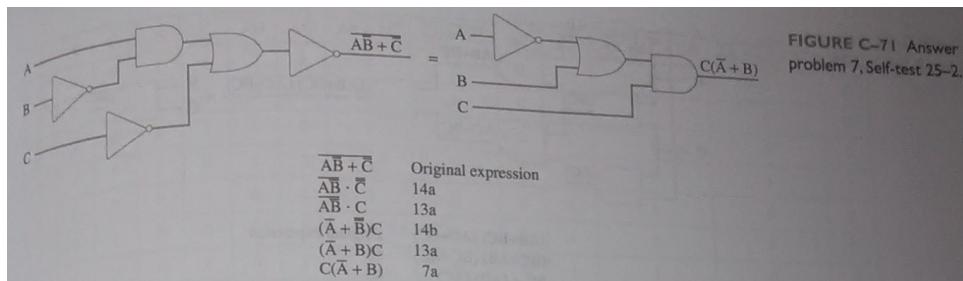


FIGURE C-71 Answer to problem 7, Self-test 25-2.

A	B	C	\overline{A}	\overline{B}	\overline{C}	\overline{AB}	$\overline{AB} + \overline{C}$	$\overline{\overline{AB} + \overline{C}}$	$\overline{A} + B$	$C(\overline{A} + B)$
0	0	0	1	1	1	0	1	0	1	0
0	0	1	1	1	0	0	0	1	1	1
0	1	0	1	0	1	0	1	0	1	0
0	1	1	1	0	0	0	0	1	1	1
1	0	0	0	1	1	1	1	0	0	0
1	0	1	0	1	0	1	1	0	0	0
1	1	0	0	0	1	0	1	0	1	0
1	1	1	0	0	0	0	0	1	1	1

↑ Equal ↑

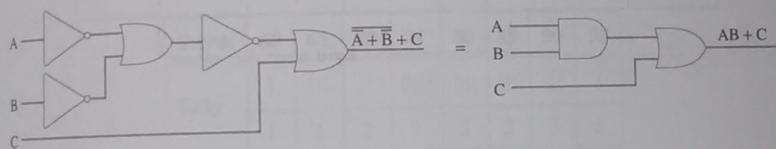


FIGURE C-72 Answer to problem 8, Self-test 25-2.

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

↑ Equal ↑

FIGURE C-73 Answer to problem 9, Self-test 25-2.

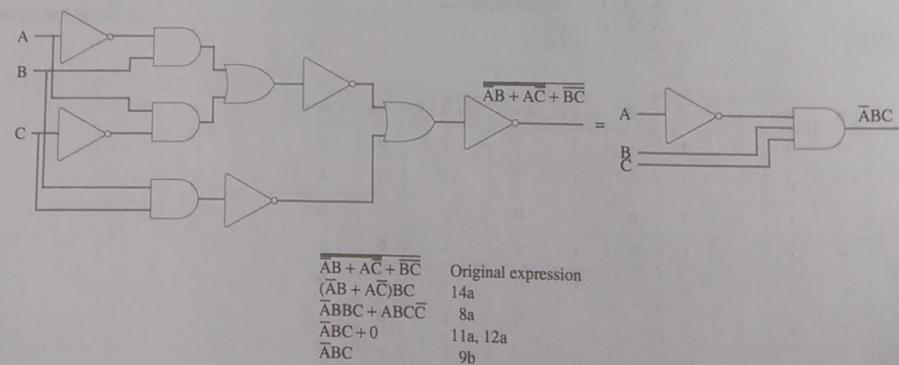
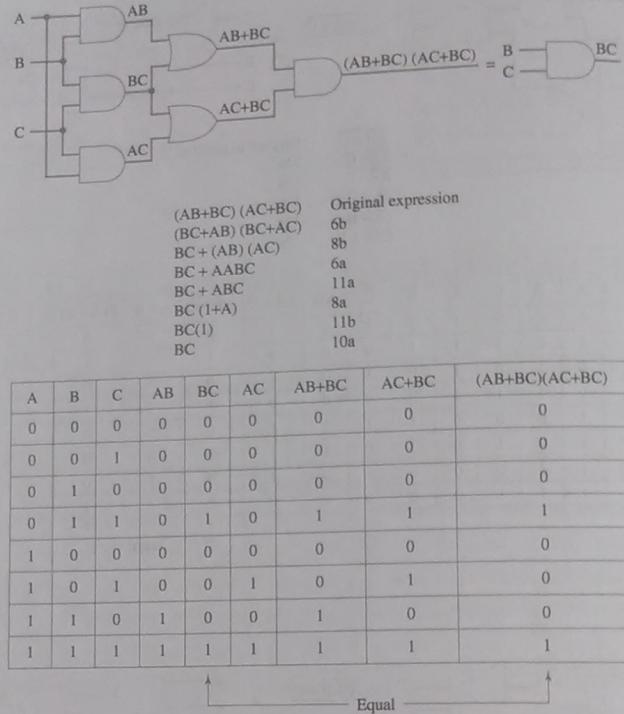


FIGURE C-74 Answer to problem 10, Self-test 25-2.

A	B	C	\bar{A}	\bar{C}	$\bar{A}B$	$A\bar{C}$	$\bar{A}B + A\bar{C}$	$\bar{A}B + AC$	BC	$\bar{B}\bar{C}$	$\bar{A}B + AC + \bar{B}\bar{C}$	$\bar{A}B + AC + \bar{B}\bar{C}$	\bar{ABC}
0	0	0	1	1	0	0	0	1	0	1	1	0	0
0	0	1	1	0	0	0	0	1	0	1	1	0	0
0	1	0	1	1	1	0	1	0	0	1	1	0	0
0	1	1	1	0	1	0	1	0	1	0	0	1	1
1	0	0	0	1	0	1	1	0	0	1	1	0	0
1	0	1	0	0	0	0	0	1	0	1	1	0	0
1	1	0	0	1	0	1	1	0	0	1	1	0	0
1	1	1	0	0	0	0	0	1	1	0	1	0	0

↑ Equal ↑

FIGURE C-74 (cont.)

