B→3-16. For each of the following expressions, construct the corresponding logic circuit, using AND and OR gates and INVERTERs.

(a) $x = \overline{AB(C + D)}$

B→3-16. For each of the following expressions, construct the corresponding logic circuit, using AND and OR gates and INVERTERs.

(b) $z = \overline{A + B + \overline{CDE}} + \overline{BCD}$

B→3-16. For each of the following expressions, construct the corresponding logic circuit, using AND and OR gates and INVERTERs.

(c) $y = (\overline{M + N} + \bar{P}Q)$

B→3-16. For each of the following expressions, construct the corresponding logic circuit, using AND and OR gates and INVERTERs.

(d) $x = \overline{W + P\bar{Q}}$

B→3-16. For each of the following expressions, construct the corresponding logic circuit, using AND and OR gates and INVERTERs.

(e) $z = MN(P + \overline{N})$

B→3-16. For each of the following expressions, construct the corresponding logic circuit, using AND and OR gates and INVERTERs.

(f) $x = (A + B)(\overline{A} + \overline{B})$

3-22. DRILL QUESTION

Complete each expression.

(a) $A + 1 =$ _____

(b) $A \cdot A =$ _____

(c) $B \cdot \overline{B} =$ _____

(d) $C + C =$ _____

(e) $x \cdot 0 =$ _____

(f) $D \cdot 1 =$ _____

(g) $D + 0 =$ _____

(h) $C + \overline{C} =$ _____

(i) $G + GF =$ _____

(j) $y + \overline{w}y =$ _____

→3-24. (a) Simplify the following expression using theorems (13b), (3), and (4):

$x = (M + N)(\overline{M} + P)(\overline{N} + \overline{P})$

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(b) Simplify the following expression using theorems (13a), (8), and (6):

$$z = \bar{A}B\bar{C} + AB\bar{C} + B\bar{C}D$$

→3-26. Simplify each of the following expressions using DeMorgan's theo

rems.

(a) $\overline{\bar{A}B\bar{C}}$ (d) $\overline{A + \bar{B}}$ (g) $\overline{A(B + \bar{C})D}$

→3-26. Simplify each of the following expressions using DeMorgan's theo

(b) $\overline{\bar{A} + \bar{B}C}$ (e) $\overline{\bar{A}\bar{B}}$ (h) $\overline{(M + \bar{N})(\bar{M} + N)}$

→3-26. Simplify each of the following expressions using DeMorgan's theo

(c) $\overline{AB\bar{C}\bar{D}}$ (f) $\overline{\bar{A} + \bar{C} + \bar{D}}$ (i) $\overline{\bar{A}BCD}$

→3-32. A jet aircraft employs a system for monitoring the rpm, pressure, and temperature values of its engines using sensors that operate as follows:

RPM sensor output = 0 only when speed < 4800 rpm
P sensor output = 0 only when pressure < 220 psi
T sensor output = 0 only when temperature < 200° F

Figure 3-56 shows the logic circuit that controls a cockpit warning light for certain combinations of engine conditions. Assume that a HIGH at output *W* activates the warning light.

(a) Determine what engine conditions will give a warning to the pilot.

(b) Change this circuit to one using all NAND gates.

URE 3-56