

1c)

Convert the following descriptions to Boolean Algebra.

Generate an alarm if the system is armed and either the door is open or the window is open.

$$\begin{aligned} \text{System armed} &= S & \text{Door open} &= D & \text{Window open} &= W \\ \text{Alarm} &= A & \boxed{A = S(D+W)} & & & \end{aligned}$$

2) Alarm activates when one or more of the following three conditions occur. A smoke detector, carbon monoxide detector, and intruder alarm. It can be silenced with a key.

a) List the inputs and outputs for the system

Inputs: Smoke detector, CO detector, Intruder alarm,
Silence key
Outputs: Alarm

b) Write down a verbal description for what the system should do.

Alarm is activated if (Smoke Detected OR CO detected
OR Intruder detected) AND no safety key.

c) Define the boolean variables you would use for input and output.

In:	Smoke Detected		S	Out:	Alarm		A
	CO Detected		C				
	Intruder Detected		I				
	Safety Key		K				

- d) Write a logic expression for the output using Boolean Algebra

$$A = \bar{K}(S + C + I)$$

- 3a) A digital system takes three inputs (A, B, and C), and produces output (Y) whenever the total number of input ones is odd. Write a truth table for the system.

A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

- b) Find a logical expression for Y using minterms

Need minterms 1, 2, 4, 7

$$m_1 = \bar{A} \bar{B} C$$

$$m_2 = \bar{A} B \bar{C}$$

$$m_4 = \bar{A} B C$$

$$m_7 = A \bar{B} \bar{C}$$

$$Y = \bar{A} \bar{B} C + \bar{A} B \bar{C} + \bar{A} B C + A \bar{B} \bar{C}$$

3d) Simplify the logical expression for y as in 4.8.

$$y = \sum m(1, 2, 4, 7)$$

4a) Simplify the following logic expressions using only the properties in Figure 4-8. For each step, state the property that applies.

$$Y = (A + B)(CD + E + \overline{CD})$$

From back of book:

$$Y = (A + B)(CD + \overline{CD} + E)$$

$$CD + \overline{CD} = 1 \quad \text{Complementary}$$

$$1 + E = E \quad \text{Property of 1}$$

$$(A + B)E$$

$$\boxed{AE + BE} \quad \text{Distributive}$$

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

Prop.
of 0

$$0 + CB = CB$$

$$\boxed{= CB}$$

$$A \cdot \overline{A} = 0$$

$$0 \cdot B = 0$$

$$C(B + \overline{C}) = CB + C\overline{C}$$

$$C \cdot \overline{C} = 0$$

Complementary

Property of 0

Distributive

Complementary

5b) Simplify the logic expressions using the properties and theorems found in Fig 4-8 and 4-9. State the property used.

$$Y = \overline{A}\overline{B}C + A\overline{B}C + A\overline{B}\overline{C}$$

$$A\overline{B}C + A\overline{B}\overline{C} = A\overline{B} \quad \text{Logic Adjacency}$$

$$Y = \overline{A}\overline{B}C + A\overline{B}$$

$$\boxed{\overline{B}(\overline{A}C + A)}$$

Distributive

- 7a) Digital system takes a 3-bit number and shows the sides of a die. Write a truth table for this system.

	B_2, B_1, B_0			A	B	C	D
0	0	0	0	0	0	0	0
1	0	0	1	1	0	0	0
2	0	1	0	0	1	0	0
3	0	1	1	1	1	0	0
4	1	0	0	0	1	1	0
5	1	0	1	1	1	1	0
6	1	1	0	0	1	1	1
7	1	1	1	1	1	1	1

- b) Find a not simplified logic expression for each output a-d using minterms.

$$\begin{aligned}
 A &= \sum m(1, 3, 5) & B &= \sum m(2, 3, 4, 5, 6) \\
 A &= \bar{B}_2 \bar{B}_1 B_0 + \bar{B}_2 B_1 B_0 + B_2 \bar{B}_1 B_0 & B &= \bar{B}_2 B_1 \bar{B}_0 + \bar{B}_2 B_1 B_0 + B_2 \bar{B}_1 \bar{B}_0 + \\
 C &= \sum m(4, 5, 6) & & B_2 \bar{B}_1 B_0 + B_2 B_1 \bar{B}_0 \\
 C &= B_2 \bar{B}_1 \bar{B}_0 + B_2 \bar{B}_1 B_0 + B_2 B_1 \bar{B}_0 & D &= \sum m(6) \quad D = B_2 B_1 \bar{B}_0
 \end{aligned}$$

- c) Simplify each logic expression you derived in part (b).

$$\begin{aligned}
 A &= \bar{B}_2 B_1 B_0 + \bar{B}_1 B_0 & B &= \bar{B}_2 B_1 + B_2 \bar{B}_1 + B_2 B_1 \bar{B}_0 \\
 C &= B_2 \bar{B}_1 + B_2 B_1 \bar{B}_0 & D &= B_2 B_1 \bar{B}_0
 \end{aligned}$$