

15)

$$\begin{array}{r} \text{a) AND } \begin{array}{r} 10101100 \\ 11000101 \\ \hline 10000100 \end{array} \end{array}$$

$$\begin{array}{r} \text{b) AND } \begin{array}{r} 00100010 \\ 11111101 \\ \hline 00100000 \end{array} \end{array}$$

$$\begin{array}{r} \text{c) OR } \begin{array}{r} 10101100 \\ 11000101 \\ \hline 11101101 \end{array} \end{array}$$

$$\begin{array}{r} \text{d) OR } \begin{array}{r} 00100010 \\ 11111101 \\ \hline 11111111 \end{array} \end{array}$$

$$\begin{array}{r} \text{e) XOR } \begin{array}{r} 10101100 \\ 11000101 \\ \hline 01101001 \end{array} \end{array}$$

$$\begin{array}{r} \text{f) XOR } \begin{array}{r} 00100010 \\ 11111101 \\ \hline 11011111 \end{array} \end{array}$$

$$\text{g) NOT } 00101100 = 11010011$$

$$\text{h) NOT } 11000101 = 00111010$$

$$\begin{array}{r} \text{i) NAND } \begin{array}{r} 10101100 \\ 11000101 \\ \hline 01111110 \end{array} \end{array}$$

$$\begin{array}{r} \text{j) NAND } \begin{array}{r} 00100010 \\ 11111101 \\ \hline 11011111 \end{array} \end{array}$$

$$\begin{array}{r} \text{k) NOR } \begin{array}{r} 10101110 \\ 11010101 \\ \hline 00000000 \end{array} \end{array}$$

$$\begin{array}{r} \text{l) NOR } \begin{array}{r} 00101010 \\ 11100101 \\ \hline 00010000 \end{array} \end{array}$$

$$\begin{array}{r} \text{m) XNOR } \begin{array}{r} 10101100 \\ 11000101 \\ \hline 01010110 \end{array} \end{array}$$

$$\begin{array}{r} \text{n) XNOR } \begin{array}{r} 10101100 \\ 11111101 \\ \hline 10101110 \end{array} \end{array}$$

16)

$$\begin{array}{r} \text{a) OR } \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \\ \hline 1 & X_6 & 1 & X_4 & 1 & X_2 & 1 & X_0 \end{array} \end{array}$$

$$\begin{array}{r} \text{b) OR } \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ \hline 1 & 1 & 1 & 1 & 1 & X_2 & X_1 & X_0 \end{array} \end{array}$$

$$\begin{array}{r} \text{c) AND } \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \\ \hline X_7 & 0 & X_5 & 0 & X_3 & 0 & X_1 & 0 \end{array} \end{array}$$

$$\begin{array}{r} \text{d) AND } \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 1 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ \hline X_7 & 0 & 0 & 0 & X_3 & X_2 & X_1 & X_0 \end{array} \end{array}$$

$$\begin{array}{r} \text{e) XOR } \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 1 & 0 \\ \hline \overline{X_7} & X_6 & \overline{X_5} & X_4 & \overline{X_3} & X_2 & \overline{X_1} & X_0 \end{array} \end{array}$$

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f)	XOR	X_7	X_6	X_5	X_4	X_3	X_2	X_1	X_0
		0	0	0	0	1	1	1	1
		<hr/>							
		X_7	X_6	X_5	X_4	$\overline{X_3}$	$\overline{X_2}$	$\overline{X_1}$	$\overline{X_0}$
g)	OR	X_7	X_6	X_5	X_4	X_3	X_2	X_1	X_0
		1	0	0	0	0	0	0	0
		<hr/>							
	AND	1	X_6	X_5	X_4	X_3	X_2	X_1	X_0
		1	1	1	1	0	0	0	0
		<hr/>							
	XOR	1	X_6	X_5	X_4	0	0	0	0
		0	0	0	1	1	1	1	0
		<hr/>							
		1	X_6	X_5	$\overline{X_4}$	1	1	1	0
h)	AND	X_7	X_6	X_5	X_4	X_3	X_2	X_1	X_0
		1	0	1	0	1	1	1	1
		<hr/>							
	OR	X_7	0	X_5	0	X_3	X_2	X_1	X_0
		1	1	1	1	0	0	0	0
		<hr/>							
	XOR	1	1	1	1	X_3	X_2	X_1	X_0
		0	0	0	1	1	1	1	0
		<hr/>							
		1	1	1	0	$\overline{X_3}$	$\overline{X_2}$	$\overline{X_1}$	X_0
i)	XOR	X_7	X_6	X_5	X_4	X_3	X_2	X_1	X_0
		1	0	1	0	1	0	1	0
		<hr/>							
	AND	$\overline{X_7}$	X_6	$\overline{X_5}$	X_4	$\overline{X_3}$	X_2	$\overline{X_1}$	X_0
		1	1	1	1	0	0	0	0
		<hr/>							
	OR	$\overline{X_7}$	X_6	$\overline{X_5}$	X_4	0	0	0	0
		0	0	0	1	1	1	1	0
		<hr/>							
		$\overline{X_7}$	X_6	$\overline{X_5}$	1	1	1	1	0
j)	XNOR	X_7	X_6	X_5	X_4	X_3	X_2	X_1	X_0
		1	0	1	0	1	0	1	0
		<hr/>							
	NAND	$\overline{X_7}$	X_6	$\overline{X_5}$	X_4	$\overline{X_3}$	X_2	$\overline{X_1}$	X_0
		1	1	1	1	0	0	0	0
		<hr/>							
	NOR	$\overline{X_7}$	X_6	$\overline{X_5}$	X_4	0	0	0	0
		0	0	0	1	1	1	1	0
		<hr/>							
		$\overline{X_7}$	X_6	$\overline{X_5}$	1	1	1	1	0

k)

XOR	X ₇	X ₆	X ₅	X ₄	X ₃	X ₂	X ₁	X ₀
	1	0	1	0	1	0	1	0
	<hr/>							
NAND	$\overline{X_7}$	$\overline{X_6}$	$\overline{X_5}$	$\overline{X_4}$	$\overline{X_3}$	$\overline{X_2}$	$\overline{X_1}$	$\overline{X_0}$
	1	1	1	1	0	0	0	0
	<hr/>							
NOR	$\overline{X_7}$	$\overline{X_6}$	$\overline{X_5}$	$\overline{X_4}$	1	1	1	1
	0	0	0	1	1	1	1	0
	<hr/>							
	$\overline{X_7}$	$\overline{X_6}$	$\overline{X_5}$	0	0	0	0	0

17)

a) 1000 **OR** 1101 = 1101 b) 1111 **AND** 0101 = 0101

c) 1101 **XOR** 1001 = 0100 d) **NOT** (1111 **AND** 0011 = 0011) = 1100

e)

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18)

a)
$$\begin{array}{r} \text{OR} \quad \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 \end{array} \\ \hline \begin{array}{cccccccc} X_7 & 1 & X_5 & X_4 & X_3 & 1 & X_1 & 1 \end{array} \end{array}$$

b)
$$\begin{array}{r} \text{OR} \quad \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{array} \\ \hline \begin{array}{cccccccc} 1 & X_6 & X_5 & 1 & X_3 & X_2 & X_1 & X_0 \end{array} \end{array}$$

c)
$$\begin{array}{r} \text{AND} \quad \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 1 & 0 & 1 & 1 & 1 & 0 & 1 & 0 \end{array} \\ \hline \begin{array}{cccccccc} X_7 & 0 & X_5 & X_4 & X_3 & 0 & X_1 & 0 \end{array} \end{array}$$

d)
$$\begin{array}{r} \text{AND} \quad \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 0 & 1 & 1 & 0 & 1 & 1 & 1 & 1 \end{array} \\ \hline \begin{array}{cccccccc} 0 & X_6 & X_5 & 0 & X_3 & X_2 & X_1 & X_0 \end{array} \end{array}$$

e)
$$\begin{array}{r} \text{XOR} \quad \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 0 & 1 \end{array} \\ \hline \begin{array}{cccccccc} X_7 & \overline{X_6} & X_5 & X_4 & X_3 & \overline{X_2} & X_1 & \overline{X_0} \end{array} \end{array}$$

f)
$$\begin{array}{r} \text{XOR} \quad \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{array} \\ \hline \begin{array}{cccccccc} \overline{X_7} & X_6 & X_5 & \overline{X_4} & X_3 & X_2 & X_1 & X_0 \end{array} \end{array}$$

g)
$$\begin{array}{r} \text{OR} \quad \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \end{array} \\ \hline \text{AND} \quad \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & 1 & X_2 & X_1 & X_0 \\ 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 \end{array} \\ \hline \text{XOR} \quad \begin{array}{cccccccc} X_7 & 0 & X_5 & X_4 & 1 & X_2 & X_1 & X_0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \end{array} \\ \hline \begin{array}{cccccccc} X_7 & 0 & X_5 & X_4 & 1 & \overline{X_2} & X_1 & X_0 \end{array} \end{array}$$

g)
$$\begin{array}{r} \text{AND} \quad \begin{array}{cccccccc} X_7 & X_6 & X_5 & X_4 & X_3 & X_2 & X_1 & X_0 \\ 0 & 1 & 1 & 1 & 0 & 1 & 1 & 0 \end{array} \\ \hline \text{XOR} \quad \begin{array}{cccccccc} 0 & X_6 & X_5 & X_4 & 0 & X_2 & X_1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \end{array} \\ \hline \begin{array}{cccccccc} 0 & X_6 & X_5 & X_4 & 0 & \overline{X_2} & X_1 & 0 \end{array} \end{array}$$

19)

1)

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

2)

A	B	C	D	A.B	C+D	$(A.B) \oplus (C+D) = F$
0	0	0	0	0	0	0
0	0	0	1	0	1	1
0	0	1	0	0	1	1
0	0	1	1	0	1	1
0	1	0	0	0	0	0
0	1	0	1	0	1	1
0	1	1	0	0	1	1
0	1	1	1	0	1	1
1	0	0	0	0	0	0
1	0	0	1	0	1	1
1	0	1	0	0	1	1
1	0	1	1	0	1	1
1	1	0	0	1	0	1
1	1	0	1	1	1	0
1	1	1	0	1	1	0
1	1	1	1	1	1	0

3)

A	B	C	D	$\overline{A+B}$	$\overline{(\overline{A+B})}.C$	$\overline{\overline{(\overline{A+B})}.C \oplus D} = F$
0	0	0	0	1	1	0
0	0	0	1	1	1	1
0	0	1	0	1	0	1
0	0	1	1	1	0	0
0	1	0	0	0	1	0
0	1	0	1	0	1	1
0	1	1	0	0	1	0
0	1	1	1	0	1	1
1	0	0	0	0	1	0
1	0	0	1	0	1	1
1	0	1	0	0	1	0
1	0	1	1	0	1	1
1	1	0	0	0	1	0
1	1	0	1	0	1	1
1	1	1	0	0	1	0
1	1	1	1	0	1	1

6)

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

2) $F = (A.B) \oplus (C+D)$

3) $F = \overline{\overline{(\overline{A+B})}.C \oplus D}$