10장 연습문제 정답

01.

(a) ① 4차 ② 4차 ③ 3차 ④ 2차 ⑤ 3차 ⑥ 3차

(b) ③, ④, ⑤, ⑥

(c) ①, ③, ④

(d) ⑥

(e) 없음

02.

(a) ① 2차 ② 2차 ③ 4차 ④ 2차 ⑤ 3차 ⑥ 4차

(b) ②, ③, ⑥

(c) ④, ⑤, ⑥

(d) ②, ③

(e) ④, ⑤

03.

(a)

x	y	$\overline{y}$	$f(x,y)=x+\overline{y}$
1	1	0	1
1	0	1	1
0	1	0	0
0	0	1	1

(b)

x	y	$\overline{x}$	$\overline{y}$	$\overline{x}\,y$	$f(x,y)=x+\overline{x}\,y+\overline{y}$
1	1	0	0	0	1
1	0	0	1	0	1
0	1	1	0	1	1
0	0	1	1	0	1

(c)

x	y	$\overline{x}$	$\overline{y}$	xy	$\overline{x}\,\overline{y}$	$\overline{y}+xy$	$\overline{x}+\overline{x}\,\overline{y}$	$x(\overline{y}+xy)$	$y(\overline{x}+\overline{x}\,\overline{y})$	$f(x,y)=x(\overline{y}+xy)+y(\overline{x}$
1	1	0	0	1	0	1	0	1	0	1
1	0	0	1	0	0	1	0	1	0	1
0	1	1	0	0	0	0	1	0	1	1
0	0	1	1	0	1	1	1	0	0	0

(d)

x	y	z	$\overline{x}$	$\overline{y}$	$\overline{z}$	$\overline{x}\,\overline{y}$	$\overline{x}\,\overline{z}$	xy	xz	$f(x,y,z)=\overline{x}\,\overline{y}+\overline{x}\,\overline{z}+xy+xz$
1	1	1	0	0	0	0	0	1	1	1
1	1	0	0	0	1	0	0	1	0	1
1	0	1	0	1	0	0	0	0	1	1
1	0	0	0	1	1	0	0	0	0	0
0	1	1	1	0	0	0	0	0	0	0
0	1	0	1	0	1	0	1	0	0	1
0	0	1	1	1	0	1	0	0	0	1
0	0	0	1	1	1	1	1	0	0	1

(e)

x	y	z	$\overline{x}$	$\overline{z}$	xyz	$\overline{x}\,y$	$\overline{x}\,y\,\overline{z}$	$f(x,y,z)=xyz+\overline{z}+\overline{x}\,y+\overline{x}y\,\overline{z}$
1	1	1	0	0	1	0	0	1
1	1	0	0	1	0	0	0	1
1	0	1	0	0	0	0	0	0
1	0	0	0	1	0	0	0	1
0	1	1	1	0	0	1	0	1
0	1	0	1	1	0	1	1	1
0	0	1	1	0	0	0	0	0
0	0	0	1	1	0	0	0	1

(f)

x	y	z	$\overline{x}$	$\overline{y}$	$\overline{z}$	$\overline{x}\,y\,\overline{z}$	$xy\,\overline{z}$	$x\,\overline{y}$	$f(x,y,z)=\overline{x}\,y\,\overline{z}+xy\,\overline{z}+x\,\overline{y}$
1	1	1	0	0	0	0	0	0	0
1	1	0	0	0	1	0	1	0	1
1	0	1	0	1	0	0	0	1	1
1	0	0	0	1	1	0	0	1	1
0	1	1	1	0	0	0	0	0	0
0	1	0	1	0	1	1	0	0	1
0	0	1	1	1	0	0	0	0	0
0	0	0	1	1	1	0	0	0	0

04.

(a)

x	y	$f(x,y)=\overline{x}\,\overline{y}+xy$
1	1	1
1	0	0
0	1	0
0	0	1

(b)

x	y	$f(x,y)=\overline{x}+xy$
1	1	1
1	0	0
0	1	1
0	0	1

(c)

x	y	$f(x,y) = \overline{xy} + \overline{x + \overline{y}}$
1	1	0
1	0	1
0	1	1
0	0	1

(d)

x	y	z	$f(x,y,z) = \overline{x}\,y\,\overline{z} + xy\,\overline{z} + xyz$
1	1	1	1
1	1	0	1
1	0	1	0
1	0	0	0
0	1	1	0
0	1	0	1
0	0	1	0
0	0	0	0

(e)

x	y	z	$f(x,y,z) = x(\overline{y} + z) + \overline{xy} + \overline{z}$
1	1	1	1
1	1	0	1
1	0	1	1
1	0	0	1
0	1	1	1
0	1	0	1
0	0	1	1
0	0	0	1

(f)

x	y	z	$f(x,y,z) = xy\,\overline{z} + z(\overline{x} + y\,\overline{z})$
1	1	1	0
1	1	0	1
1	0	1	0
1	0	0	0
0	1	1	1
0	1	0	0
0	0	1	1
0	0	0	0

(g)

x	y	z	$f(x,y,z) = x + \overline{y}(x\,\overline{z} + \overline{x}) + \overline{x}\,z$
1	1	1	1
1	1	0	1
1	0	1	1
1	0	0	1
0	1	1	1
0	1	0	0
0	0	1	1
0	0	0	1

05.

풀이 생략

06.

(a)

①, ②, ③, ④ 풀이 생략

⑤

x	y	z	$\overline{x}$	$\overline{y}$	$\overline{z}$	xz	$\overline{x}\,z$	$\overline{y}\,\overline{z}$	$xz+\overline{x}\,z+\overline{y}\,\overline{z}$	$\overline{y}+z$
1	1	1	0	0	0	1	0	0	1	1
1	1	0	0	0	1	0	0	0	0	0
1	0	1	0	1	0	1	0	0	1	1
1	0	0	0	1	1	0	0	1	1	1
0	1	1	1	0	0	0	1	0	1	1
0	1	0	1	0	1	0	0	0	0	0
0	0	1	1	1	0	0	1	0	1	1
0	0	0	1	1	1	0	0	1	1	1

⑥

x	y	z	$\overline{y}$	$\overline{z}$	xyz	$\overline{y}\,\overline{z}$	$\overline{y}\,z$	xz	$xyz+\overline{y}\,\overline{z}+\overline{y}\,z$	$xz+\overline{y}$
1	1	1	0	0	1	0	0	1	1	1
1	1	0	0	1	0	0	0	0	0	0
1	0	1	1	0	0	0	1	1	1	1
1	0	0	1	1	0	1	0	0	1	1
0	1	1	0	0	0	0	0	0	0	0
0	1	0	0	1	0	0	0	0	0	0
0	0	1	1	0	0	0	1	0	1	1
0	0	0	1	1	0	1	0	0	1	1

(b)

①, ②, ③, ④ 풀이 생략

⑤ $f(x,y,z) = xz + \overline{x}\,z + \overline{y}\,\overline{z} = (x+\overline{x})z + \overline{y}\,\overline{z}$ ∵ 분배법칙

$= 1 \cdot z + \overline{y}\,\overline{z}$ ∵ 보수법칙

$= z + \overline{y}\,\overline{z}$ ∵ 항등법칙

$= (z+\overline{y})(z+\overline{z})$ ∵ 분배법칙

$= (z+\overline{y}) \cdot 1$ ∵ 보수법칙

$= z+\overline{y}$ ∵ 항등법칙

$= \overline{y}+z$ ∵ 교환법칙

⑥ $f(x,y,z) = xyz + \overline{y}\,\overline{z} + \overline{y}\,z = xyz + \overline{y}(\overline{z}+z)$ ∵ 분배법칙

$= xyz + \overline{y} \cdot 1$ ∵ 보수법칙

$= xyz + \overline{y}$ ∵ 항등법칙

$= (xz+\overline{y})(y+\overline{y})$ ∵ 분배법칙

$= (xz+\overline{y}) \cdot 1$ ∵ 보수법칙

$= xz+\overline{y}$ ∵ 항등법칙

07.

풀이 생략

08.

(a)

① $f(x,y)=x+\overline{y}=xy+x\overline{y}+\overline{x}\,\overline{y}$

② $f(x,y)=y=xy+\overline{x}y$

③ $f(x,y,z)=\overline{x}+x\overline{z}+y=\overline{x}yz+\overline{x}\,\overline{y}z+\overline{x}y\overline{z}+\overline{x}\,\overline{y}\,\overline{z}+xy\overline{z}+x\overline{y}\,\overline{z}+xyz$

④ $f(x,y,z)=xy+z=xyz+xy\overline{z}+\overline{x}yz+x\overline{y}z+\overline{x}\,\overline{y}z$

⑤ $f(x,y,z)=x\cdot 1\cdot 1+y\cdot 1\cdot 1+z\cdot 1\cdot 1$ ∵ 항등법칙

$=x(y+\overline{y})(z+\overline{z})+y(x+\overline{x})(z+\overline{z})+z(x+\overline{x})(y+\overline{y})$ ∵ 보수법칙

$=xyz+x\overline{y}z+xy\overline{z}+x\overline{y}\,\overline{z}+yxz+y\overline{x}z+yx\overline{z}+y\overline{x}\,\overline{z}+zxy+z\overline{x}y+zx\overline{y}+z\overline{x}\,\overline{y}$ ∵ 분배법칙

$=xyz+x\overline{y}z+xy\overline{z}+x\overline{y}\,\overline{z}+xyz+\overline{x}yz+xy\overline{z}+\overline{x}y\overline{z}+xyz+\overline{x}yz+x\overline{y}z+\overline{x}\,\overline{y}z$ ∵ 교환법칙

$=xyz+x\overline{y}z+xy\overline{z}+x\overline{y}\,\overline{z}+\overline{x}yz+\overline{x}y\overline{z}+\overline{x}\,\overline{y}z$ ∵ 멱등법칙

⑥ $f(x,y,z)=\overline{x}+\overline{z}=\overline{x}\cdot 1\cdot 1+\overline{z}\cdot 1\cdot 1$ ∵ 항등법칙

$=\overline{x}(y+\overline{y})(z+\overline{z})+\overline{z}(x+\overline{x})(y+\overline{y})$ ∵ 보수법칙

$=\overline{x}yz+\overline{x}\,\overline{y}z+\overline{x}y\overline{z}+\overline{x}\,\overline{y}\,\overline{z}+\overline{z}xy+\overline{z}\,\overline{x}y+\overline{z}x\overline{y}+\overline{z}\,\overline{x}\,\overline{y}$ ∵ 분배법칙

$=\overline{x}yz+\overline{x}\,\overline{y}z+\overline{x}y\overline{z}+\overline{x}\,\overline{y}\,\overline{z}+xy\overline{z}+\overline{x}y\overline{z}+x\overline{y}\,\overline{z}+\overline{x}\,\overline{y}\,\overline{z}$ ∵ 교환법칙

$=\overline{x}yz+\overline{x}\,\overline{y}z+\overline{x}y\overline{z}+\overline{x}\,\overline{y}\,\overline{z}+xy\overline{z}+x\overline{y}\,\overline{z}$ ∵ 멱등법칙

(b)

① $f(x,y)=x+\overline{y}=xy+x\overline{y}+\overline{x}\,\overline{y}$

② $f(x,y)=y=xy+\overline{x}y$

③ $f(x,y,z)=\overline{x}+x\overline{z}+y=\overline{x}yz+\overline{x}\,\overline{y}z+\overline{x}y\overline{z}+\overline{x}\,\overline{y}\,\overline{z}+xy\overline{z}+x\overline{y}\,\overline{z}+xyz$

④ $f(x,y,z)=xy+z=xyz+xy\overline{z}+\overline{x}yz+x\overline{y}z+\overline{x}\,\overline{y}z$

⑤ $f(x,y,z)=x+y+z=xyz+x\overline{y}z+xy\overline{z}+x\overline{y}\,\overline{z}+\overline{x}yz+\overline{x}y\overline{z}+\overline{x}\,\overline{y}z$

x	y	z	최소항	$f(x,y,z)$
0	0	0	$\overline{x}\,\overline{y}\,\overline{z}$	
0	0	1	$\overline{x}\,\overline{y}z$	1
0	1	0	$\overline{x}y\overline{z}$	1
0	1	1	$\overline{x}yz$	1
1	0	0	$x\overline{y}\,\overline{z}$	1
1	0	1	$x\overline{y}z$	1
1	1	0	$xy\overline{z}$	1
1	1	1	xyz	1

⑥ $f(x,y,z)=\overline{x}+\overline{z}=\overline{x}yz+\overline{x}\,\overline{y}z+\overline{x}y\overline{z}+\overline{x}\,\overline{y}\,\overline{z}+xy\overline{z}+x\overline{y}\,\overline{z}$

x	y	z	최소항	$f(x,y,z)$
0	0	0	$\overline{x}\,\overline{y}\,\overline{z}$	1
0	0	1	$\overline{x}\,\overline{y}z$	1
0	1	0	$\overline{x}y\overline{z}$	1
0	1	1	$\overline{x}yz$	1
1	0	0	$x\overline{y}\,\overline{z}$	1
1	0	1	$x\overline{y}z$	
1	1	0	$xy\overline{z}$	1
1	1	1	xyz	

09.

(a)

① $f(x,y,z)=xy+x\overline{z}=xyz+xy\overline{z}+x\overline{y}\,\overline{z}$

② $f(x,y,z)=\overline{y}\,\overline{z}=x\overline{y}\,\overline{z}+\overline{x}\,\overline{y}\,\overline{z}$

③ $f(w,x,y,z)=w+\overline{y}=wxyz+w\overline{x}yz+wx\overline{y}z+w\overline{x}\,\overline{y}z+wxy\overline{z}+w\overline{x}y\overline{z}+wx\overline{y}\,\overline{z}+w\overline{x}\,\overline{y}\,\overline{z}$
$+\overline{w}x\overline{y}z+\overline{w}\,\overline{x}\,\overline{y}z+\overline{w}x\overline{y}\,\overline{z}+\overline{w}\,\overline{x}\,\overline{y}\,\overline{z}$

④ $f(w,x,y,z)=wy+\overline{x}z=wxyz+wxy\overline{z}+w\overline{x}y\overline{z}+w\overline{x}yz+w\overline{x}\,\overline{y}z+\overline{w}\,\overline{x}yz+\overline{w}\,\overline{x}\,\overline{y}z$

⑤ $f(w,x,y,z)=wxyz+\overline{x}y\overline{z}=wxyz+w\overline{x}y\overline{z}+\overline{w}\,\overline{x}y\overline{z}$

⑥ $f(w,x,y,z)=wx\overline{y}+w\overline{y}\,\overline{z}+xy\overline{z}=wx\overline{y}z+wx\overline{y}\,\overline{z}+w\overline{x}\,\overline{y}\,\overline{z}+wxy\overline{z}+\overline{w}xy\overline{z}$

(b)

(a)와 같음

10.

(a)

① $f(x,y)=\overline{x}y+xy=y$

② $f(x,y)=x\overline{y}+xy+\overline{x}y=x+y$

③ $f(x,y,z)=xyz+xy\overline{z}+\overline{x}y\overline{z}+\overline{x}yz+\overline{x}\,\overline{y}z=y+\overline{x}z$

④ $f(x,y,z)=xyz+xy\overline{z}+x\overline{y}\,\overline{z}+\overline{x}yz+\overline{x}y\overline{z}+\overline{x}\,\overline{y}\,\overline{z}+\overline{x}\,\overline{y}z$

$=xy(z+\overline{z})+x\overline{y}\,\overline{z}+\overline{x}y(z+\overline{z})+\overline{x}\,\overline{y}(\overline{z}+z)$ ∵ 분배법칙

$=xy\cdot 1+x\overline{y}\,\overline{z}+\overline{x}y\cdot 1+\overline{x}\,\overline{y}\cdot 1$ ∵ 보수법칙

$=xy+x\overline{y}\,\overline{z}+\overline{x}y+\overline{x}\,\overline{y}$ ∵ 항등법칙

$=x(y+\overline{y})(y+\overline{z})+\overline{x}(y+\overline{y})$ ∵ 분배법칙

$=x\cdot 1(y+\overline{z})+\overline{x}\cdot 1$ ∵ 보수법칙

$=x(y+\overline{z})+\overline{x}$ ∵ 항등법칙

$=(x+\overline{x})(y+\overline{z}+\overline{x})$ ∵ 분배법칙

$=1\cdot(y+\overline{z}+\overline{x})$ ∵ 보수법칙

$=y+\overline{z}+\overline{x}$ ∵ 항등법칙

$=\overline{x}+y+\overline{z}$ ∵ 교환법칙

⑤ $f(w,x,y,z)=wxyz+wxy\overline{z}+w\overline{x}\,\overline{y}\,\overline{z}+w\overline{x}\,\overline{y}z+\overline{w}\,\overline{x}yz+\overline{w}xyz$

$=wxy(z+\overline{z})+w\overline{x}\,\overline{y}(\overline{z}+z)+\overline{w}yz(\overline{x}+x)$ ∵ 분배법칙

$=wxy\bullet 1+w\overline{x}\,\overline{y}\bullet 1+\overline{w}yz\bullet 1$ ∵ 보수법칙

$=wxy+w\overline{x}\,\overline{y}+\overline{w}yz$ ∵ 항등법칙

⑥ $f(w,x,y,z)=wxyz+wx\overline{y}z+w\overline{x}\,\overline{y}\,\overline{z}+\overline{w}\,\overline{x}\,\overline{y}\,\overline{z}+\overline{w}\,\overline{x}\,\overline{y}z+\overline{w}xyz+\overline{w}x\overline{y}\,\overline{z}+\overline{w}x\overline{y}z$

$=xz+\overline{x}\,\overline{y}\,\overline{z}+\overline{w}\,\overline{y}$

(b)

① $f(x,y)=\overline{x}y+xy=y$

② $f(x,y)=x\overline{y}+xy+\overline{x}y=x+y$

③ $f(x,y,z)=xyz+xy\overline{z}+\overline{x}y\overline{z}+\overline{x}yz+\overline{x}\,\overline{y}z=y+\overline{x}z$

④ $f(x,y,z)=xyz+xy\overline{z}+x\overline{y}\,\overline{z}+\overline{x}yz+\overline{x}y\overline{z}+\overline{x}\,\overline{y}\,\overline{z}+\overline{x}\,\overline{y}z=\overline{x}+y+\overline{z}$

	yz	$y\overline{z}$	$\overline{y}\,\overline{z}$	$\overline{y}z$
x	1	1	1	
$\overline{x}$	1	1	1	1

⑤ $f(w,x,y,z)=wxyz+wxy\overline{z}+w\overline{x}\,\overline{y}\,\overline{z}+w\overline{x}\,\overline{y}z+\overline{w}\,\overline{x}yz+\overline{w}xyz=wxy+w\overline{x}\,\overline{y}+\overline{w}yz=wxy+w\overline{x}\,\overline{y}+xyz$(점선)

	yz	$y\overline{z}$	$\overline{y}\,\overline{z}$	$\overline{y}z$
wx	1	1		
$w\overline{x}$			1	1
$\overline{w}\,\overline{x}$	1			
$\overline{w}x$	1			

⑥ $f(w,x,y,z)=wxyz+wx\overline{y}z+w\overline{x}\,\overline{y}\,\overline{z}+\overline{w}\,\overline{x}\,\overline{y}\,\overline{z}+\overline{w}\,\overline{x}\,\overline{y}z+\overline{w}xyz+\overline{w}x\overline{y}\,\overline{z}+\overline{w}x\overline{y}z=xz+\overline{x}\,\overline{y}\,\overline{z}+\overline{w}\,\overline{y}$

11.

(a)

① $f(x,y,z)=xz+\overline{x}\,\overline{y}+\overline{x}\,\overline{z}+yz=\overline{x}+z$

② $f(x,y,z)=\overline{x}y+\overline{y}\,\overline{z}+yz+\overline{y}z=\overline{x}+\overline{y}+z$

③ $f(x,y,z)=x\overline{y}+y\overline{z}+xyz+\overline{x}\,\overline{z}+\overline{x}\,\overline{y}z=x+\overline{y}+\overline{z}$

④ $f(w,x,y,z)=wyz+\overline{w}z+\overline{x}y+wz=\overline{x}y+z$

⑤ $f(w,x,y,z)=w\overline{y}\,\overline{z}+wxz+\overline{w}x\overline{y}z+\overline{x}y\overline{z}+w\overline{x}\,\overline{y}z+\overline{w}xz+xy\overline{z}=w\overline{y}+y\overline{z}+xz$

⑥ $f(w,x,y,z)=w\overline{x}z+\overline{w}\,\overline{x}z+wx\overline{z}+\overline{w}x\overline{z}+wxy=\overline{x}z+x\overline{z}+wxy=\overline{x}z+x\overline{z}+wyz$(점선)

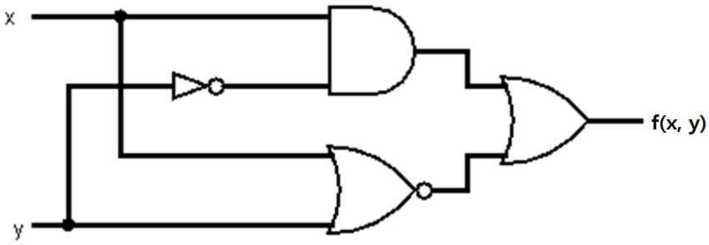
(b)

(a)와 같음

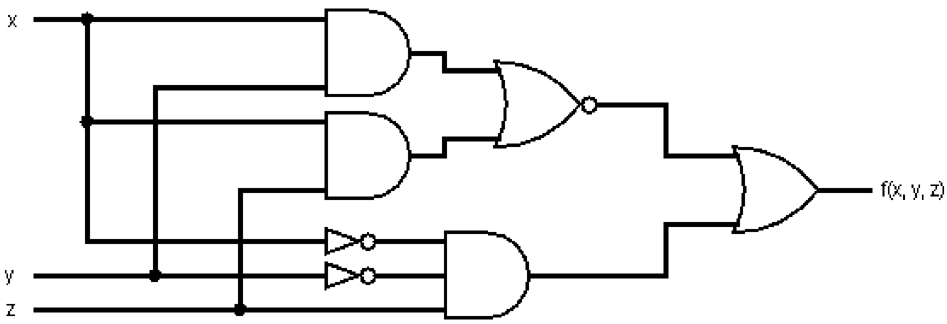
12.

(a)

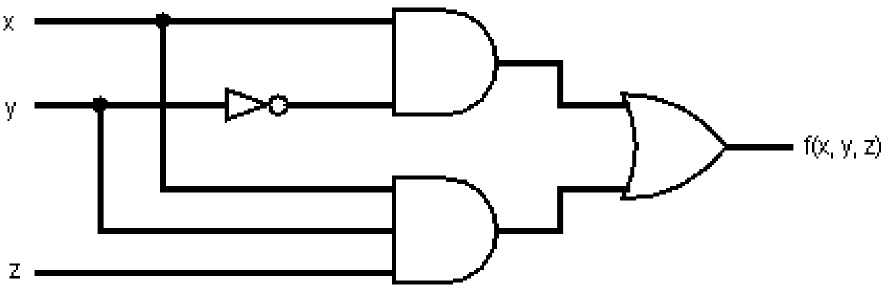
① $f(x,y)=x\overline{y}+\overline{x+y}$



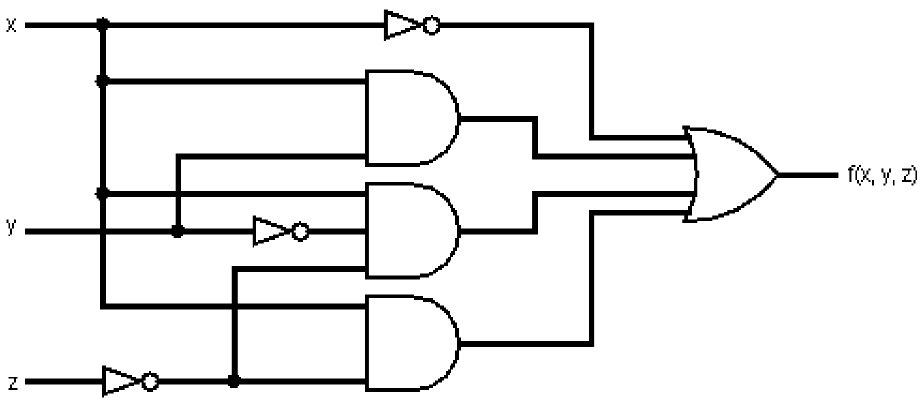
② $f(x,y,z)=\overline{xy+xz}+\overline{x}\,\overline{y}z$



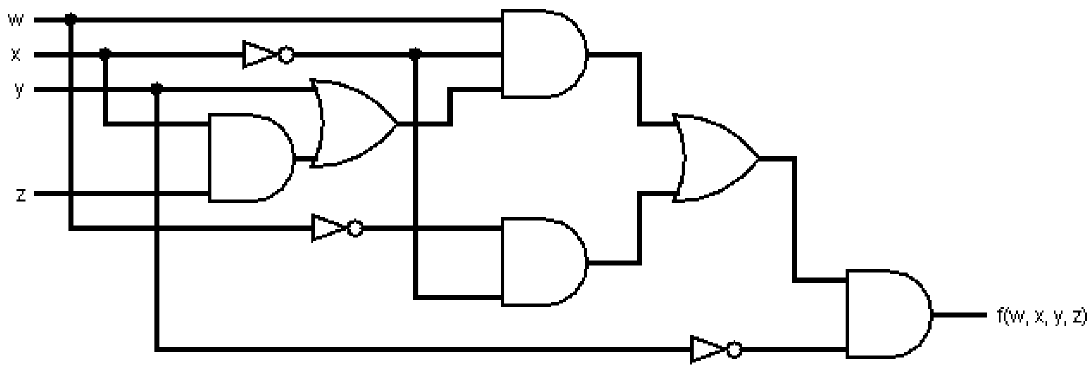
③ $f(x,y,z)=x\overline{y}+xyz$



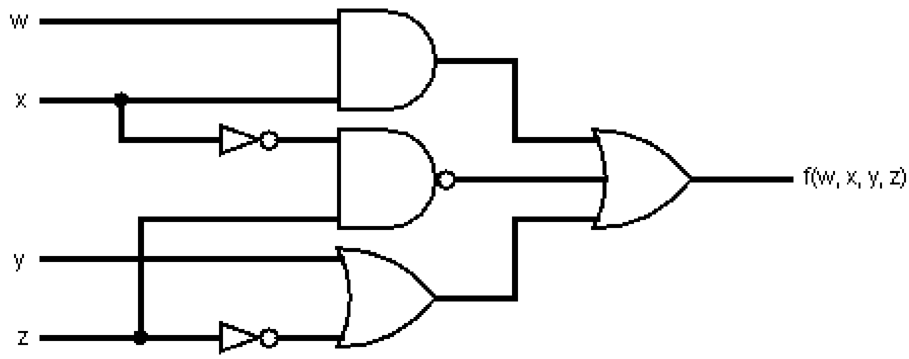
④ $f(x,y,z)=\overline{x}+xy+x\overline{z}+x\overline{y}\,\overline{z}$



⑤ $f(w,x,y,z) = \{w\overline{x}(y+xz) + \overline{w}\,\overline{x}\}\overline{y}$

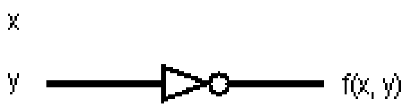


⑥ $f(w,x,y,z) = wx + \overline{\overline{x}z} + (y+\overline{z})$

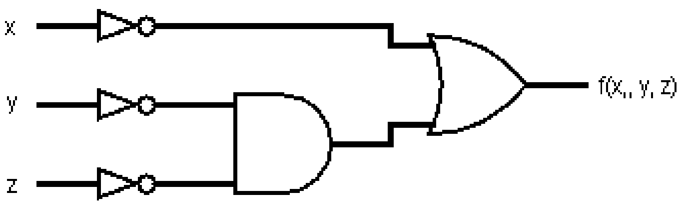


(b)

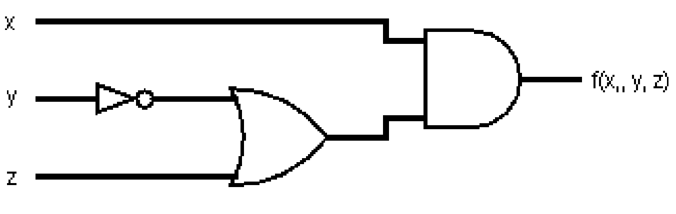
① $f(x,y) = x\overline{y} + \overline{x+y} = x\overline{y} + \overline{x}\,\overline{y} = (x+\overline{x})\overline{y} = \overline{y}$



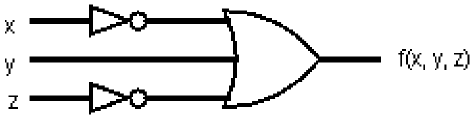
② $f(x,y,z) = \overline{xy+xz} + \overline{x}\,\overline{y}z = \overline{x} + \overline{y}\,\overline{z}$



③ $f(x,y,z) = x\overline{y} + xyz = x(\overline{y} + yz) = x(\overline{y} + y)(\overline{y} + z) = x(\overline{y} + z)$

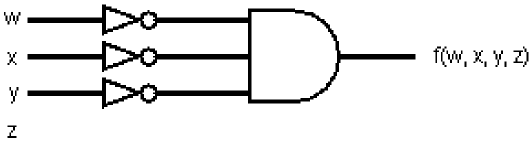


④ $f(x,y,z)=\overline{x}+xy+x\overline{z}+x\overline{y}\,\overline{z}=\overline{x}+y+\overline{z}$

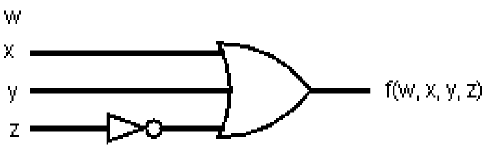


⑤ $f(w,x,y,z)=\{w\overline{x}(y+xz)+\overline{w}\,\overline{x}\}\overline{y}=\{w\overline{x}y+w\overline{x}xz+\overline{w}\,\overline{x}\}\overline{y}=(w\overline{x}y+\overline{w}\,\overline{x})\overline{y}=(wy+\overline{w})\overline{x}\,\overline{y}$

$=(w+\overline{w})(y+\overline{w})\overline{x}\,\overline{y}=(y+\overline{w})\overline{x}\,\overline{y}=\overline{x}\,\overline{y}\,y+\overline{w}\,\overline{x}\,\overline{y}=\overline{w}\,\overline{x}\,\overline{y}$



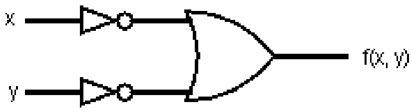
⑥ $f(w,x,y,z)=wx+\overline{\overline{x}\,z}+(y+\overline{z})=x+y+\overline{z}$



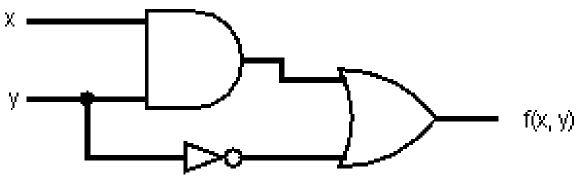
13.

(a)

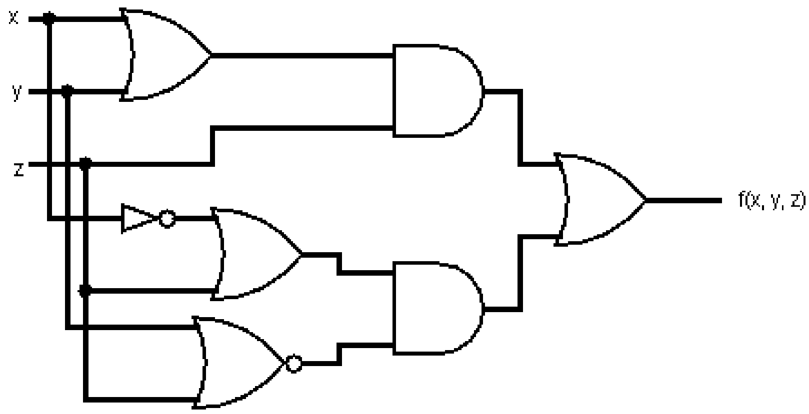
① $f(x,y)=\overline{x}+\overline{y}$



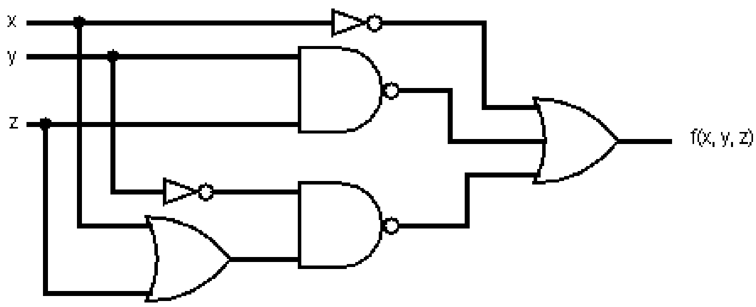
② $f(x,y)=xy+\overline{y}$



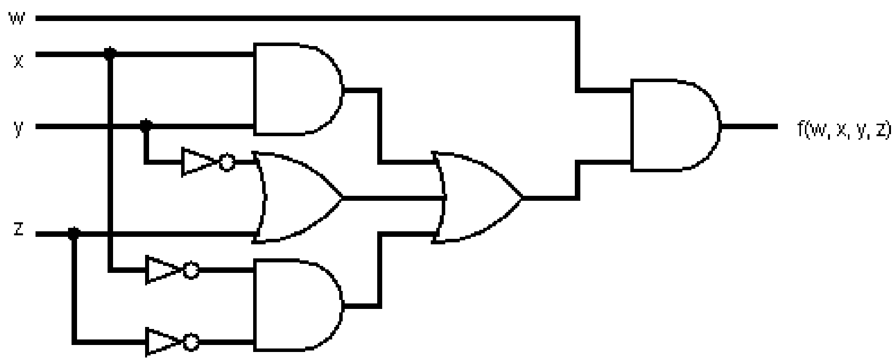
③ $f(x, y, z) = z(x+y) + (\overline{x}+z)\overline{y+z}$



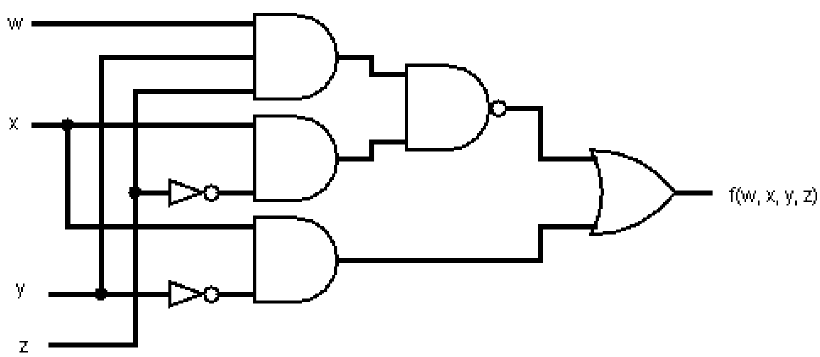
④ $f(x, y, z) = \overline{x} + \overline{yz} + \overline{\overline{y}(x+z)}$



⑤ $f(w, x, y, z) = w\{xy(z+\overline{y}) + \overline{x}\,\overline{z}\}$

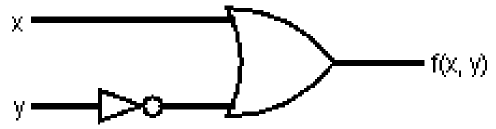


⑥ $f(w, x, y, z) = \overline{wyz + x\overline{z}} + x\overline{y}$

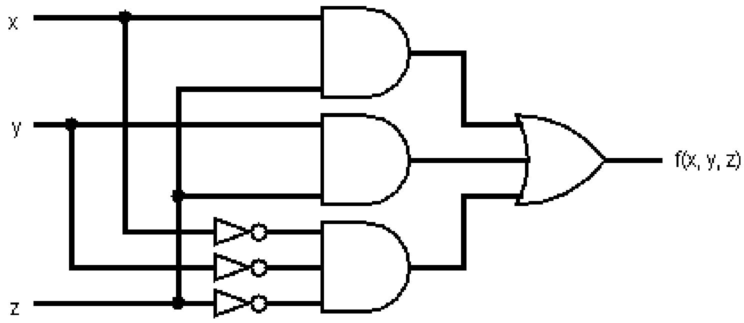


(b)

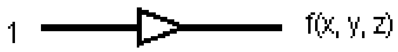
② $f(x, y) = x + \overline{y}$



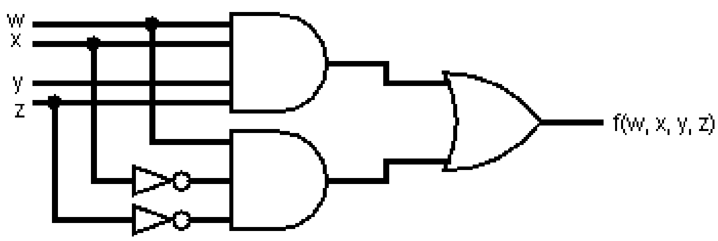
③ $f(x, y, z) = xz + yz + \overline{x}\,\overline{y}\,\overline{z}$



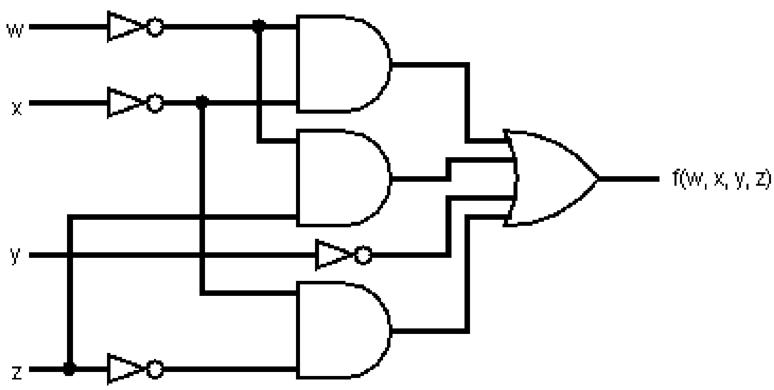
④ $f(x, y, z) = 1$



⑤ $f(w, x, y, z) = wxyz + w\overline{x}\,\overline{z}$



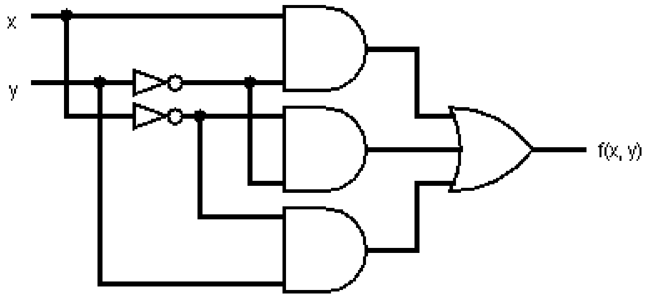
⑥ $f(w, x, y, z) = \overline{w}\,\overline{x} + \overline{w}z + \overline{y} + \overline{x}\,\overline{z}$



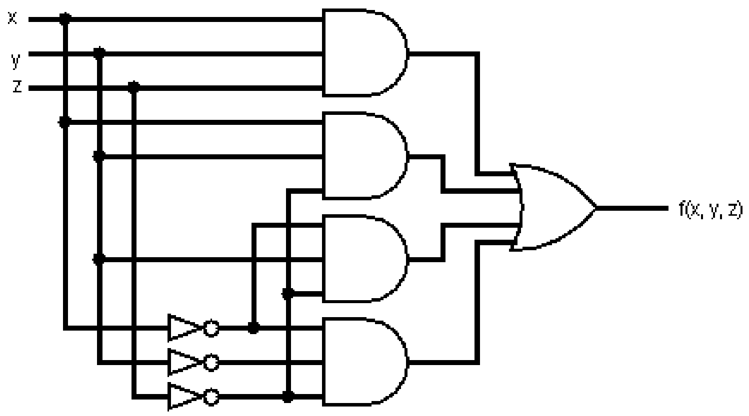
14.

(a)

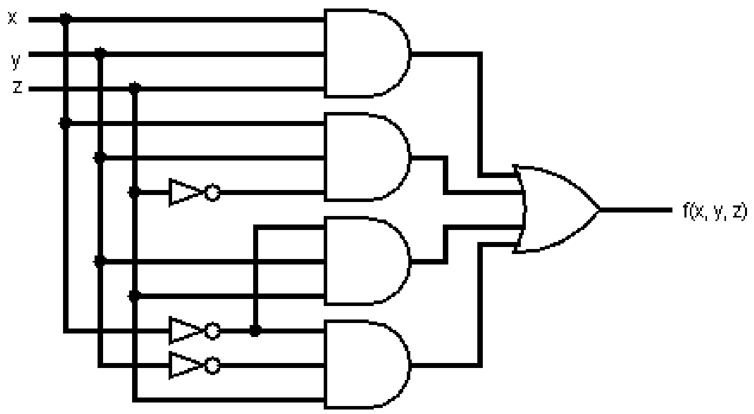
①



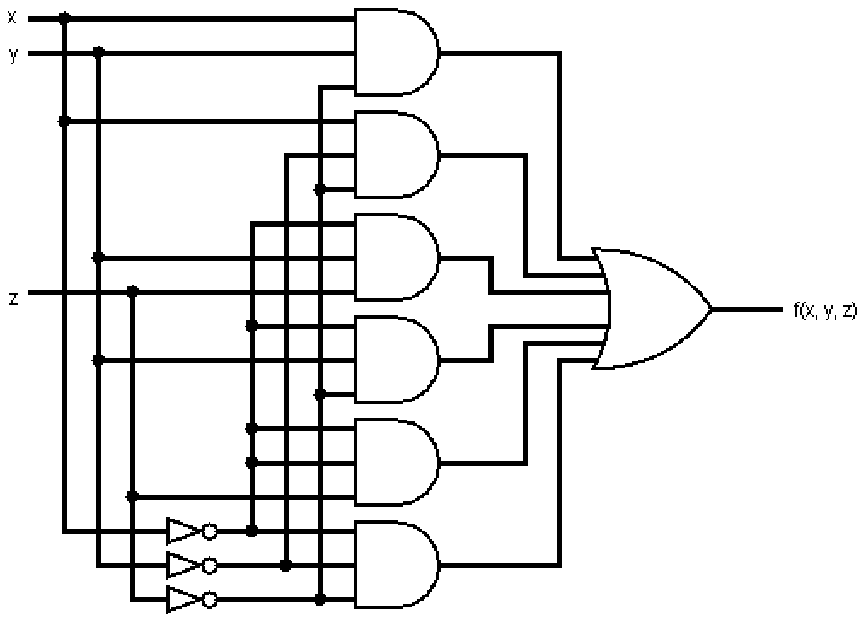
②



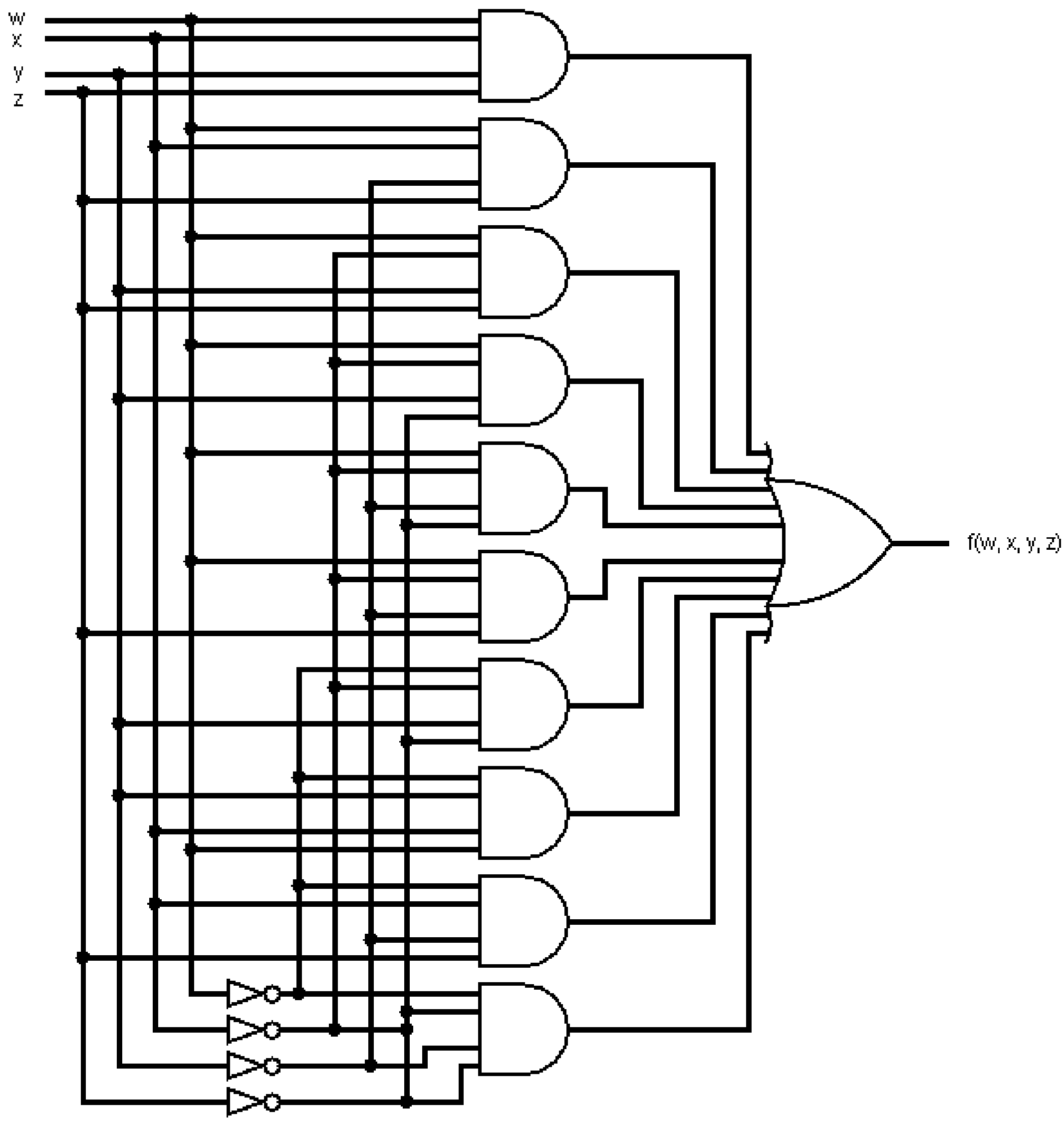
③



④

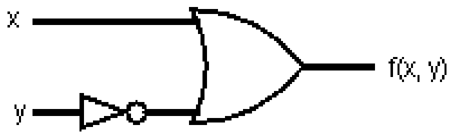


⑤

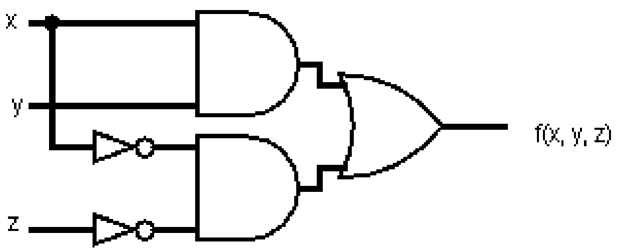


(b)

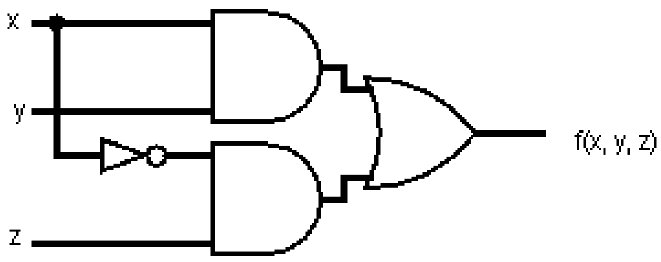
① $f(x,y) = x + \overline{y}$



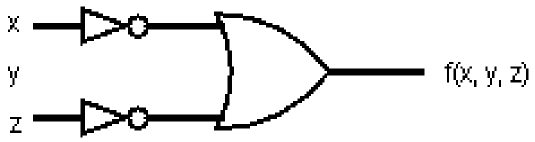
② $f(x,y,z) = xy + \overline{x}\,\overline{z}$



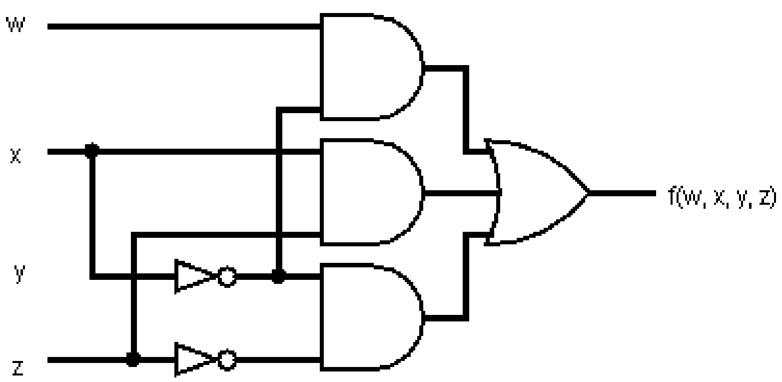
③ $f(x,y,z) = xy + \overline{x}\,z$



④ $f(x,y,z) = \overline{x} + \overline{z}$



⑤ $f(w,x,y,z) = xz + w\overline{x} + \overline{x}\,\overline{z}$



15.

(a) $f(x, y, z) = (x + y)(\overline{y} + z)$

(b) $f(x, y, z) = (x \oplus \overline{y}) + (\overline{x} \odot z)$

(c) $f(w, x, y, z) = \overline{\overline{w}\,x + \overline{w}\,yz + xy\,\overline{z}}$

(d) $f(w, x, y, z) = \overline{w}\,x + \overline{x\,\overline{y}} + \overline{w + \overline{y}} + \overline{y}\,\overline{z}$

(e) $f(x,y,z) = xyz + x\,\overline{yz}$