1. a) $-11 + 22 \rightarrow$

$$\begin{array}{r} 110101 \\ 010110 \\ \hline 1011111 \end{array}$$

Overflow

b) $-17 + 20 \rightarrow$

$$\begin{array}{r} 101111 \\ 010100 \\ \hline 1000011 \end{array}$$

no overflow

c) $18 + 21 \rightarrow$

$$\begin{array}{r} 010010 \\ 010101 \\ \hline 100111 \end{array}$$

Overflow

d) $19 + 8 \rightarrow$

$$\begin{array}{r} 010011 \\ 001000 \\ \hline 011011 \end{array}$$

no overflow

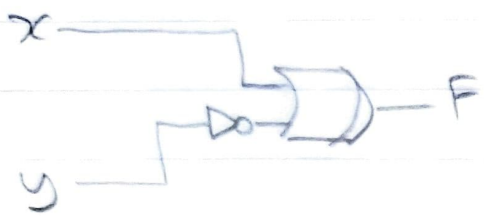
2.

x	y	z	P1	P2	P3	N1	N2	N3	F
0	0	0	ON	ON	ON	OFF	OFF	OFF	1
0	0	1	ON	OFF	ON	OFF	OFF	ON	1
0	1	0	ON	ON	OFF	OFF	ON	OFF	1
0	1	1	ON	OFF	OFF	OFF	ON	ON	1
1	0	0	OFF	ON	ON	ON	OFF	OFF	1
1	0	1	OFF	OFF	ON	ON	OFF	ON	0
1	1	0	OFF	ON	OFF	ON	ON	OFF	0
1	1	1	OFF	OFF	OFF	ON	ON	ON	0

$$F = \bar{x}\bar{y}\bar{z} + \bar{x}\bar{y}z + \bar{x}y\bar{z} + \bar{x}yz + x\bar{y}\bar{z}$$
$$= \bar{x}\bar{y}(\bar{z}+z) + \bar{x}y(\bar{z}+z) + \bar{y}\bar{z}(x+\bar{x})$$
$$= \bar{x}\bar{y} + \bar{x}y + \bar{y}\bar{z} = \boxed{\bar{x} + \bar{y}\bar{z}}$$

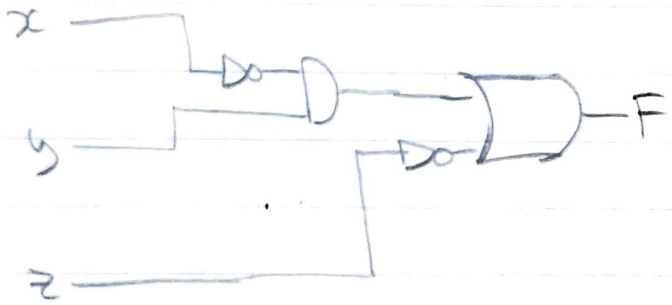
3. a) $f = x\bar{z} + y\bar{z} + xz + \bar{y}z = x(\bar{z}+z) + y\bar{z} + \bar{y}z$

$= x + y\bar{z} + \bar{y}z = x + \bar{y}(\bar{z}+z) = x + \bar{y}$



b) $F = \overline{xz + \bar{y}z} = (\bar{x}+\bar{z})(\bar{\bar{y}}+\bar{z}) = \bar{x}y + \bar{x}\bar{z} + y\bar{z} + \bar{z}$

$= \bar{x}y + \bar{z}(\bar{x}+1) + \bar{z}(y+1) = \bar{x}y + \bar{z}$



c) $F = (x+y)(\bar{x}+y+z)(\bar{x}+y+\bar{z}) = x(\bar{x}+y+z)(\bar{x}+y+\bar{z})$

$+ y(\bar{x}+y+z)(\bar{x}+y+\bar{z}) = xy + xz(\bar{x}+y+z) + \bar{x}y + y + y$

$(\bar{x}+y+\bar{z}) = xy + xyz + xz + \bar{x}y + \bar{x}y + \bar{x}yz + y + yz + y$

$= xy + \bar{x}y + y + y\bar{z} = \bar{x}y + y + y\bar{z} = y$

y — F

4. a) $f(x,y,w,z) = \Sigma(0,1,4,5,12,13)$

wz \ xy	00	01	11	10
00	1	1	1	0
01	1	1	1	0
11	0	0	0	0
10	0	0	0	0

$\bar{x}\bar{w} + xy\bar{w}$

$= \bar{w}(xy + \bar{x})$

$= \bar{w}(y + \bar{x})$

$= \boxed{\bar{w}y + \bar{w}\bar{x}}$

b) $f(x,y,w,z) = \Sigma(1,7,11,13) + d(0,5,10,15)$

wz \ xy	00	01	11	10
00	X	0	0	0
01	1	X	1	0
11	0	1	X	1
10	0	0	0	X

$yz + x\bar{y}w + \bar{x}\bar{y}\bar{w}$

$= yz + \bar{y}(xw + \bar{x}\bar{w})$

$= \boxed{yz + \bar{y}(\overline{x \oplus w})}$

5 a)

	Current State S_1	S_0	Inputs A	Next State S_1'	S_0'
S0	0	0	0	0	0
S0	0	0	1	0	1
S1	0	1	0	0	0
S1	0	1	1	1	0
S2	1	0	0	0	0
S2	1	0	1	1	1
S3	1	1	0	0	0
S3	1	1	1	1	1

Current State	S_1	S_0	Outputs Q
S0	0	0	0
S1	0	1	0
S2	1	0	1
S3	1	1	1

b) $S_1' = \bar{S}_1 S_0 A + S_1 \bar{S}_0 A + S_1 S_0 A$

$= AS_0 + S_1 \bar{S}_0 A = A(S_0 + S_1 \bar{S}_0)$

$= A(S_0 + S_1) = AS_0 + AS_1$

$S_0' = \bar{S}_1 \bar{S}_0 A + S_1 \bar{S}_0 A + S_1 S_0 A$

$= \bar{S}_0 A + S_1 S_0 A = A(\bar{S}_0 + S_1 S_0)$

$= A(\bar{S}_0 + S_1) = A\bar{S}_0 + AS_1$

$Q = S_1 \bar{S}_0 + S_1 S_0 = S_1$

c)