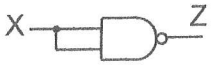
Selected Problem Solutions - Chapter 2

2.1 a)

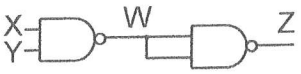


X	Z
0	1
1	0

X	Y	nand
0	0	1
0	1	1
1	0	1
1	1	0

Gate: NOT

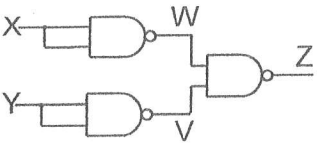
b)



X	Y	W	Z
0	0	1	0
0	1	1	0
1	0	1	0
1	1	0	1

Gate: AND

c)

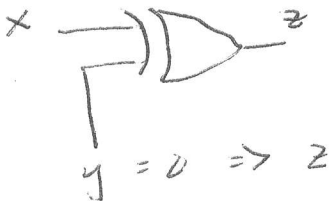


X	Y	W	V	Z
0	0	1	1	0
0	1	1	0	1
1	0	0	1	1
1	1	0	0	1

Gate: OR

2.3

x	y	z
0	0	0 ← z = x
0	1	1
1	0	1 ← z = x
1	1	0



y = 0 ⇒ z = x

y = 1 ⇒ z = x

2.5

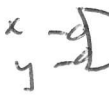
a) 

$z = \sim(\sim x \,\&\, \sim y) = x \mid y$

x	y	z
0	0	0
0	1	1
1	0	1
1	1	1

x	y	z
T	T	T
T	F	F
F	T	F
F	F	F

0 = TRUE - AND Gate

b) 

$z = \sim(\sim x \mid \sim y) = x \,\&\, y$

x	y	z
0	0	0
0	1	0
1	0	0
1	1	1

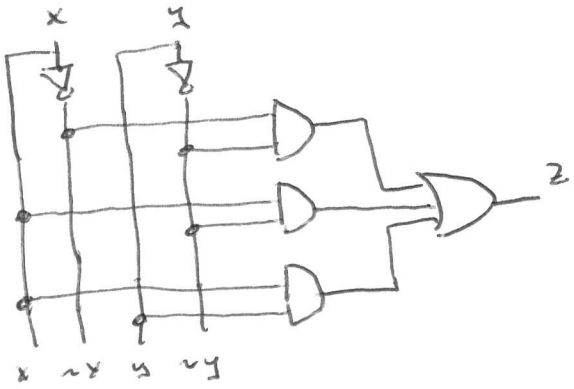
x	y	z
T	T	T
T	F	F
F	T	F
F	F	F

0 = TRUE OR Gate

2.7

x	y	z
0	0	1
0	1	0
1	0	1
1	1	1

a) $z = \sim x \,\&\, \sim y \mid x \,\&\, \sim y \mid x \,\&\, y$

b) 

c) $z = x \mid \sim y$

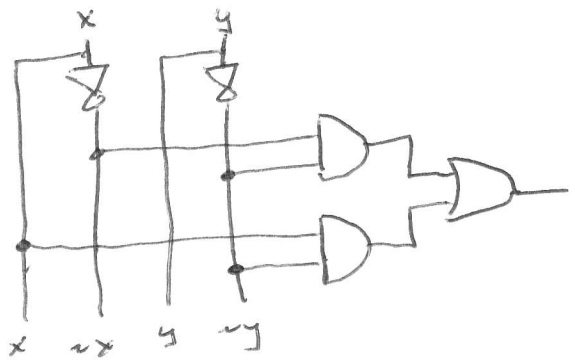
d) 

2.9

x	y	z
0	0	1
0	1	0
1	0	1
1	1	0

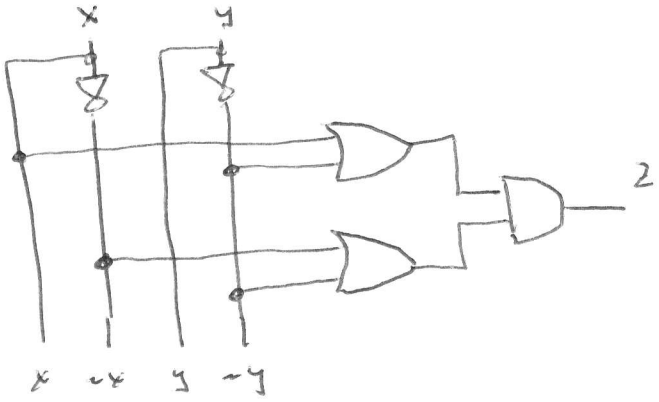
a) $z = \sim x \,\&\, \sim y \mid x \,\&\, \sim y$

b)



c) $z = (x \mid \sim y) \,\&\, (\sim x \mid \sim y)$

d)



2.11

X	~X	X & X	X & ~X	X | X	X | ~X	X ^ X	X ^ ~X
0	1	0	0	0	1	0	1
1	0	1	0	1	1	0	1

a) X & X = X

b) X & ~X = 0

c) X | X = X

d) X | ~X = 1

e) X ^ X = 0

f) X ^ ~X = 1

Problem 2.13

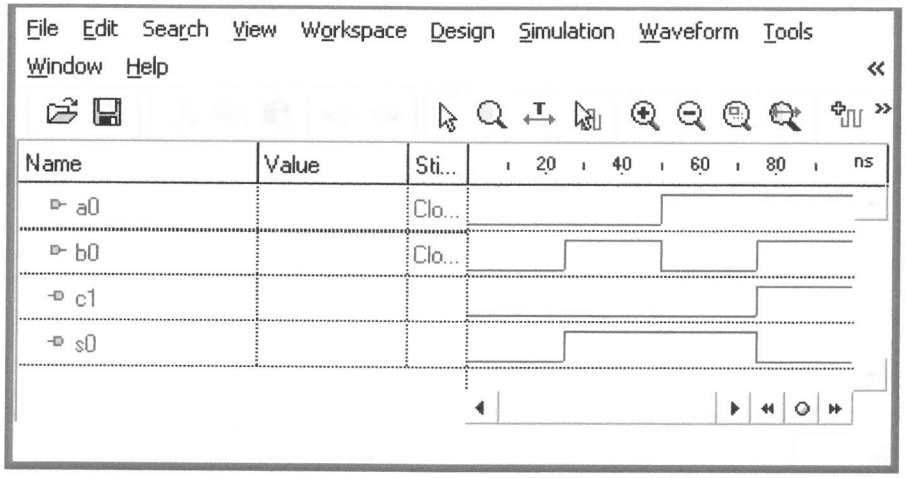
```
-- Title       : P2_13
-- Design      : halfadder
library IEEE;
use IEEE.STD_LOGIC_1164.all;

entity P2_13 is
       port(
              a0 : in STD_LOGIC;
              b0 : in STD_LOGIC;
              s0 : out STD_LOGIC;
              c1 : out STD_LOGIC
            );
end P2_13;

architecture P2_13 of P2_13 is
begin

s0 <= a0 xor b0;
c1 <= a0 and b0;

end P2_13;
```



a0	b0	s0	c1
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

half adder

Problem 1.15

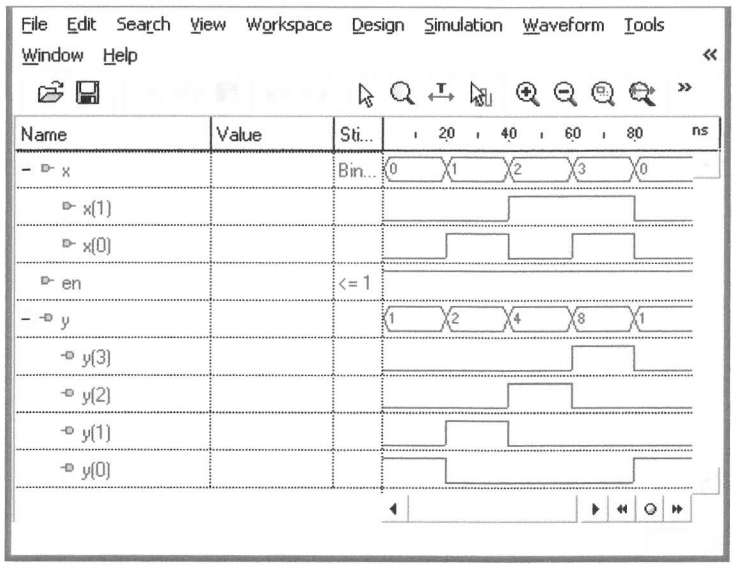
```
-- Title       : P2_15
-- Design      : decode24
library IEEE;
use IEEE.STD_LOGIC_1164.all;

entity P2_15 is
    port(
          en : in STD_LOGIC;
          x : in STD_LOGIC_VECTOR(1 downto 0);
          y : out STD_LOGIC_VECTOR(3 downto 0)
        );
end P2_15;

architecture P2_15 of P2_15 is
begin

y(0) <= (not x(1)) and (not x(0)) and en;
y(1) <= (not x(1)) and  x(0) and en;
y(2) <= x(1) and (not x(0)) and en;
y(3) <= x(1) and x(0) and en;

end P2_15;
```



$en = 1$

$x(1)$	$x(0)$	$y(3)$	$y(2)$	$y(1)$	$y(0)$
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0

$y(i) = 1$ when $x(1:0) = i$