Exercise 1

$$x_3 \cdot (x_1 x_2 + \bar{x}_1 \bar{x}_2) \quad A$$

$$+ x_1 (x_2 \bar{x}_3 + \bar{x}_2 x_3) \quad B$$

$$+ x_2 (x_1 x_3 + \bar{x}_1 \bar{x}_3) \quad C$$

$$= x_1 x_2 x_3 + \bar{x}_1 \bar{x}_2 x_3$$

$$+ x_1 x_2 \bar{x}_3 + x_1 \bar{x}_2 x_3$$

$$+ x_1 x_2 x_3 + \bar{x}_1 x_2 \bar{x}_3$$

$$= x_1 x_2 + \bar{x}_2 x_3 + \bar{x}_1 x_2 \bar{x}_3$$

$$= x_2 (x_1 + \bar{x}_1 \bar{x}_3) + \bar{x}_2 x_3$$

$$= x_2 (x_1 + \bar{x}_3) + \bar{x}_2 x_3$$

$= x_1x_2 + x_2\bar{x}_3 + \bar{x}_2x_3$

$x_3(x_1 + \bar{x}_2)$ A

$x_1(\bar{x}_2 + \bar{x}_3)$ B

$x_2(x_1 + \bar{x}_3)$ C

AB + AC + BC

$= x_3(x_1 + \bar{x}_2)x_1(\bar{x}_2 + \bar{x}_3)$

$+ x_3(x_1 + \bar{x}_2)x_2(x_1 + \bar{x}_3)$

$+ x_1(\bar{x}_2 + \bar{x}_3)x_2(x_1 + \bar{x}_3)$

$= [x_3x_1 + x_3\bar{x}_2][x_1\bar{x}_2 + x_1\bar{x}_3]$

$$+\left[x_3x_1 + x_3\bar{x}_2\right]\left[x_2x_1 + x_2\bar{x}_3\right]$$

$$+\left[x_1\bar{x}_2 + x_1\bar{x}_3\right]\left[x_2x_1 + x_2\bar{x}_3\right]$$

$$= x_1\bar{x}_2x_3 + \cancel{x_1\bar{x}_2x_3}$$

$$+ x_3x_2x_1 + \bar{x}_3x_2x_1$$

$$+ x_1x_2\bar{x}_3$$

$$= x_1\left(\bar{x}_2x_3 + x_2x_3 + x_2\bar{x}_3\right)$$

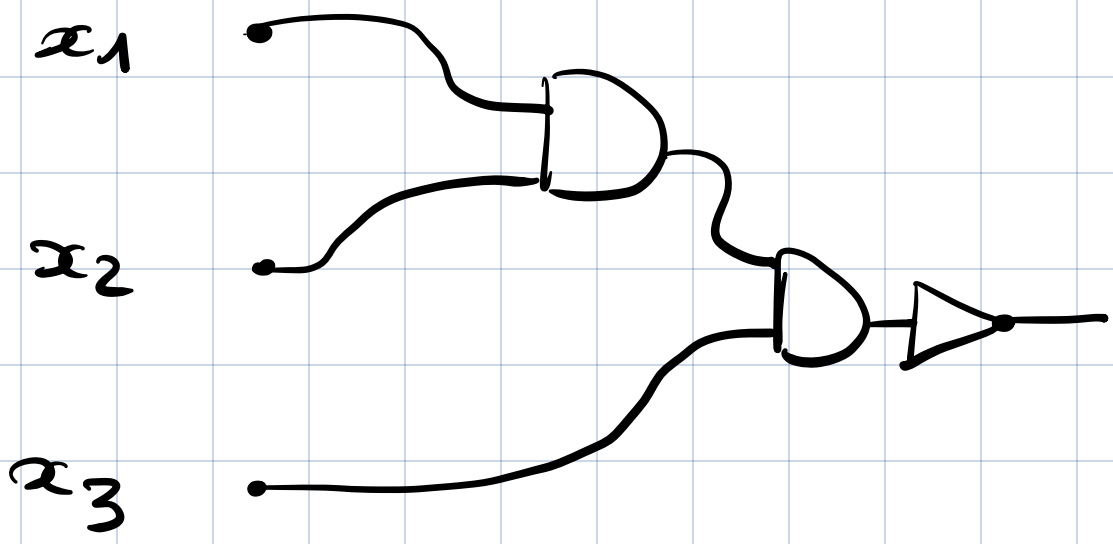
$$= x_1\left(x_2 + x_3\right)$$

(b) NAND

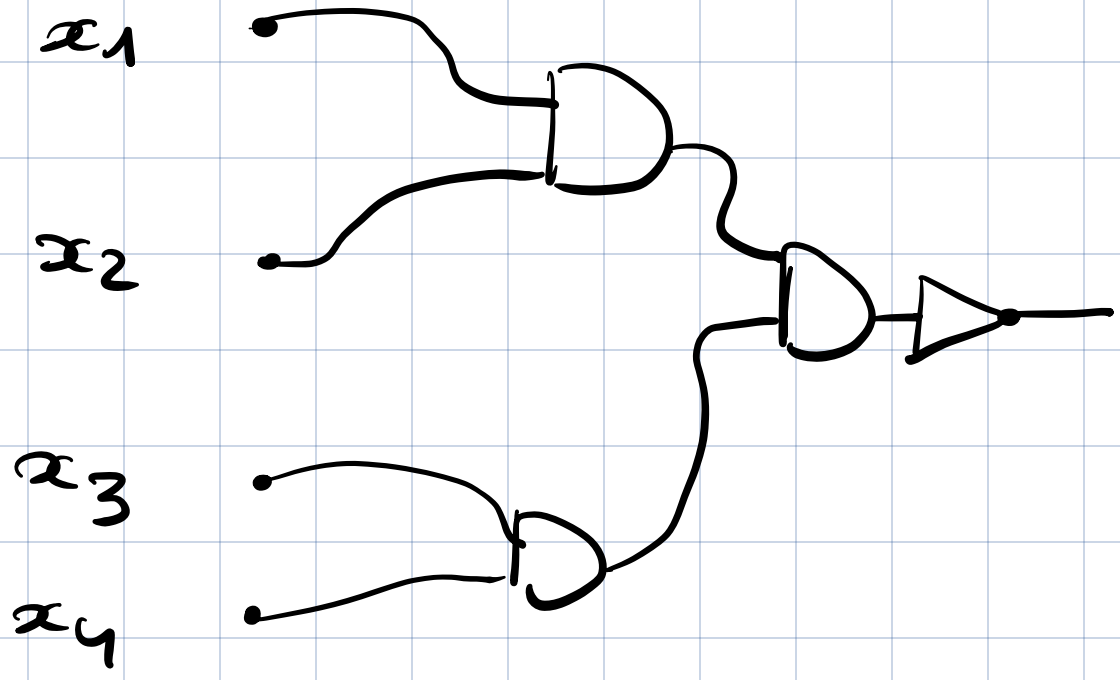
(i)

x_1	x_2	x_3	NAND
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

(ii)



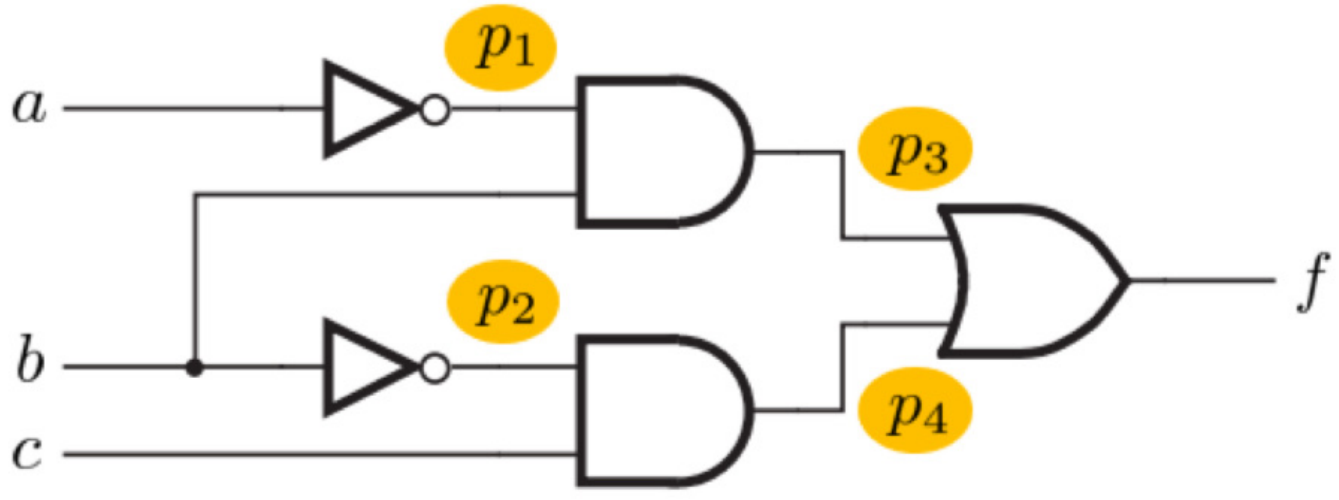
(iii)

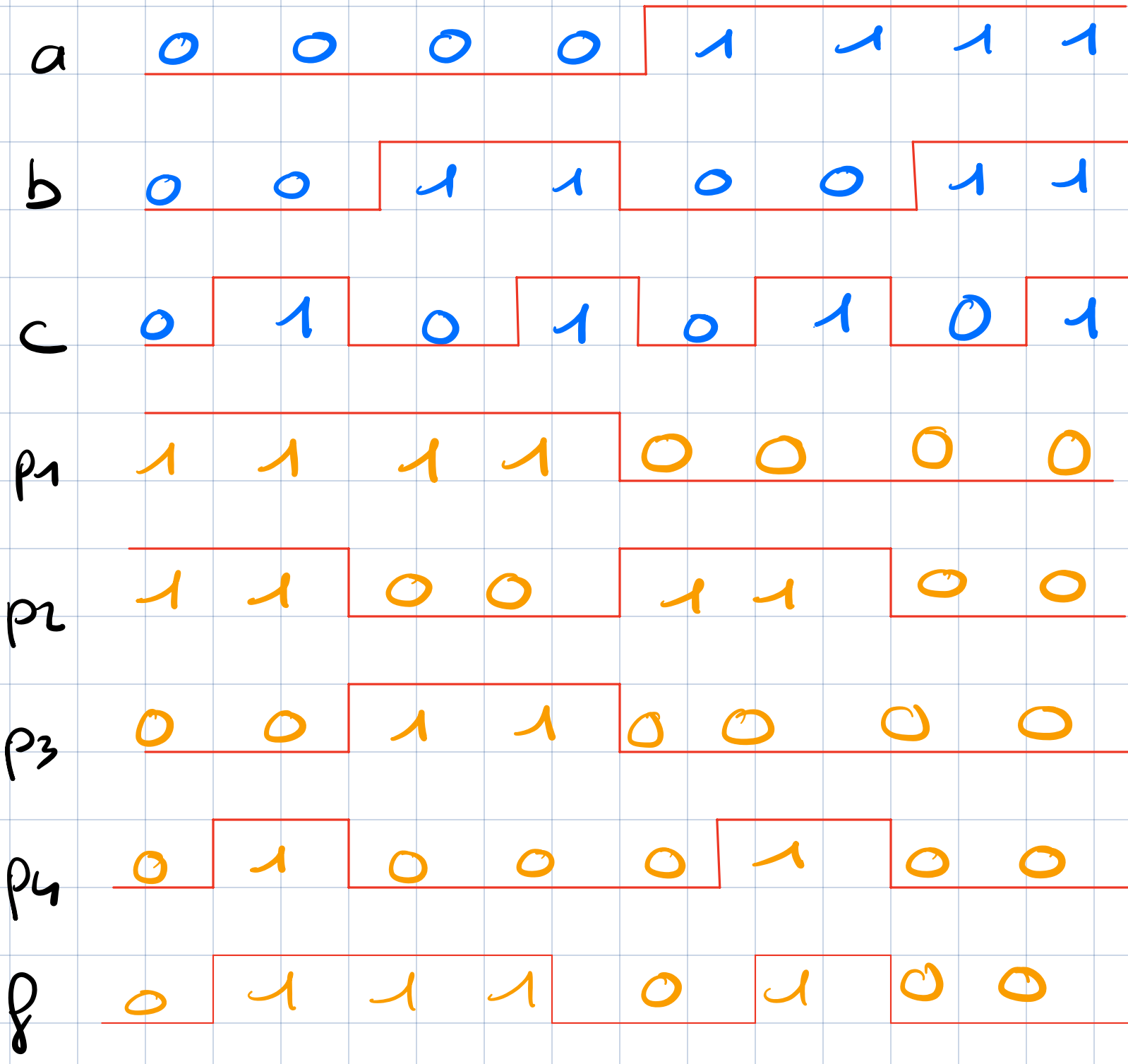


(c) (i)

x_1	x_2	XOR
0	0	0
0	1	1
1	0	1
1	1	0

Exercise 2




a
0 0 0 0 1 1 1 1
b
0 0 1 1 0 0 1 1
c
0 1 0 1 0 1 0 1
p1
1 1 1 1 0 0 0 0
p2
1 1 0 0 1 1 0 0
p3
0 0 1 1 0 0 0 0
p4
0 1 0 0 0 1 0 0
g
0 1 1 1 0 1 0 0