1

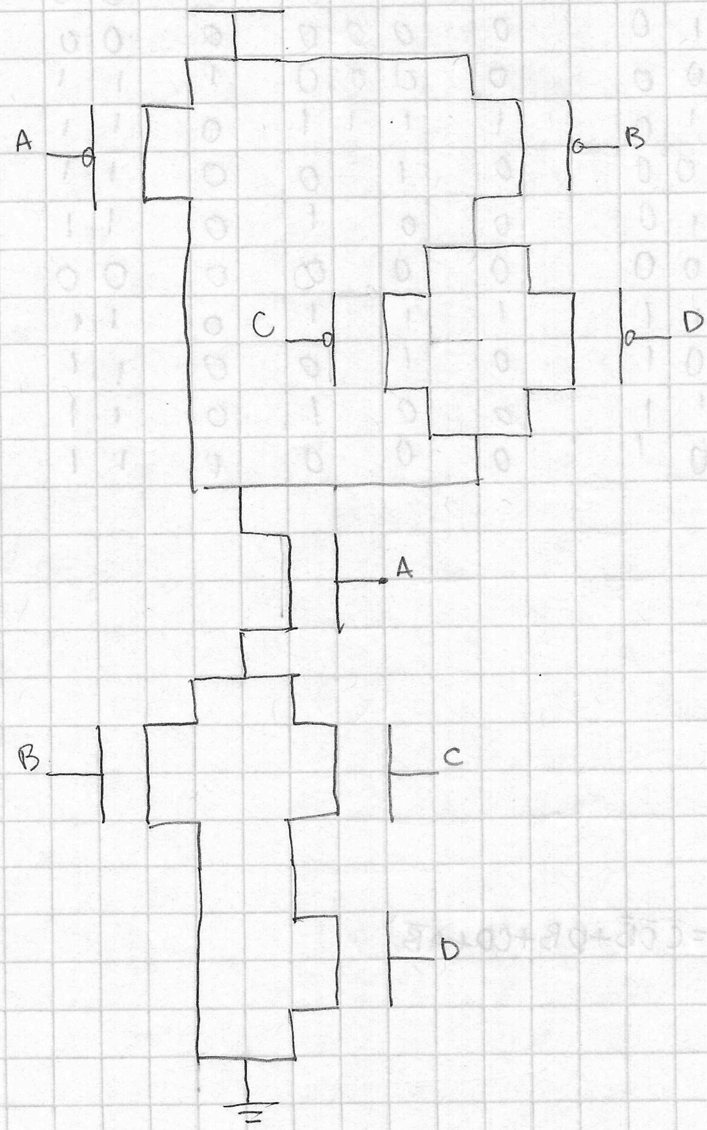
Intro CE - Exam practice - Exam #2

Exam fall 2012

/1)

/a) $2^5 = 32$

/b)



① $A' + B'(C'+D')$

② $(A'+B'(C'+D'))'$

$= A\cdot(B'(C'+D'))' = A\cdot(B'(C'+D'))'$

$= A\cdot(B+(C'+D')') = A\cdot(B+CD)$

/c) ① $F = A(B+CD)$

2

1)

D)

A	B	C	D	$\bar{A}$	$\bar{B}$	$\bar{C}$	$\bar{D}$	$\bar{A}\oplus B$	$\bar{C}\bar{D}$	$A\bar{C}$	$A\bar{D}$	BCD	f_1	f_2
0	0	0	0	1	1	1	1	1	1	0	0	0	1	1
0	0	0	1	1	1	1	0	1	0	0	0	0	1	1
0	0	1	0	1	1	0	1	1	0	0	0	0	1	1
0	0	1	1	1	1	0	0	1	0	0	0	0	1	1
0	1	0	0	1	0	1	1	0	1	0	0	0	1	1
0	1	0	1	1	0	1	0	0	0	0	0	0	0	0
0	1	1	0	1	0	0	1	0	0	0	0	0	0	0
0	1	1	1	1	0	0	0	0	0	0	0	1	1	1
1	0	0	0	0	1	1	1	0	1	1	1	0	1	1
1	0	0	1	0	1	1	0	0	0	1	0	0	1	1
1	0	1	0	0	1	0	1	0	0	0	1	0	1	1
1	0	1	1	0	1	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	1	1	1	1	1	1	0	1	1
1	1	0	1	0	0	1	0	1	0	1	0	0	1	1
1	1	1	0	0	0	0	1	1	0	0	1	0	1	1
1	1	1	1	0	0	0	0	1	0	0	0	1	1	1

E)

A	B	Q	P	
0	0	0	0	stable
0	1	0	1	stable
1	0	1	1	bistable
		0	0	
1	1	1	1	stable

2)

a)

CD \ AB	00	01	11	10
00	1	0	X	1
01	0	1	1	X
11	1	1	1	1
10	0	0	0	1

① $F = \bar{C}\bar{D}\bar{B} + DB + CD + A\bar{B}$

b)

CD \ AB	00	01	11	10
00	1	0	X	1
01	0	1	1	X
11	1	1	1	1
10	0	0	0	1

① $F = (D+\bar{B})(C+\bar{D}+B)(\bar{C}+D+A)$

3

2)

c) ① the don't cares were treated differently ② for part a, one of them was treated as a '1' & in part b it was a '0' ③ the functions cannot be the same

D) $B_3B_2B_1B_0 \rightarrow F_3F_2F_1F_0$

F_2

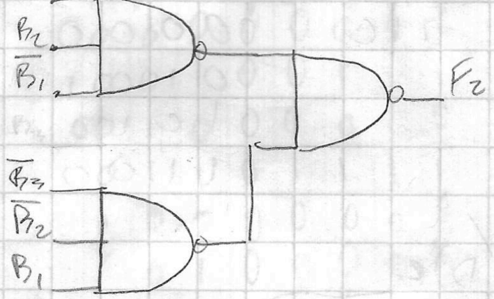
B_1B_0 \ B_3B_2	00	01	11	10
00	0	1	0	0
01	0	1	0	0
11	1	0	0	0
10	1	0	0	0

B_3	B_2	B_1	B_0	F_3	F_2	F_1	F_0
0	0	0	0	1	0	0	1
0	0	0	1	1	0	0	0
0	0	1	0	0	1	1	1
0	0	1	1	0	1	1	0
0	1	0	0	0	1	0	1
0	1	0	1	0	1	0	0
0	1	1	0	0	0	1	1
0	1	1	1	0	0	1	0
1	0	0	0	0	0	0	1
1	0	0	1	0	0	0	0
1	0	1	0	0	0	0	0
1	0	1	1	0	0	0	0
1	1	0	0	0	0	0	0
1	1	0	1	0	0	0	0
1	1	1	0	0	0	0	0
1	1	1	1	0	0	0	0

① $F_2 = \overline{B_3}B_2\overline{B_1} + \overline{B_3}\,\overline{B_2}B_1$

E) $F_2 = \overline{B_3}B_2\overline{B_1} + \overline{B_3}\overline{B_0} + B_1$

F)



3)

a) (1) the program finds the number of bits in a ⊕ b that are '1'.
(2) this is the number of bits that differ between a & b

b) a=15, 2=b

a:		1	1	1	1
b:	⊕	0	0	1	0
		1	1	0	1

(5) out: The output value is 3

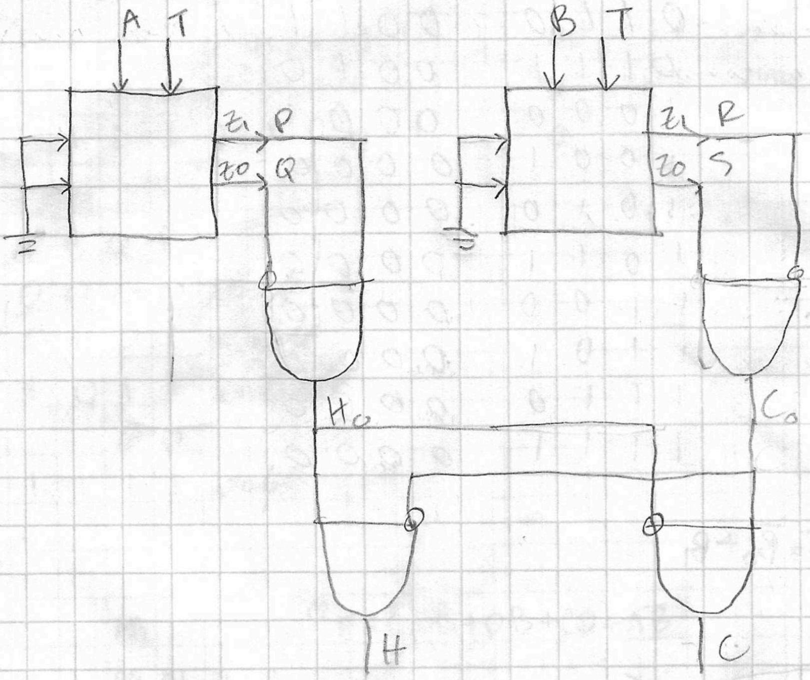
c) a=256, b=30

(3) out: The output value is 5

a:		1	0	0	0	0	0	0	0	0
b:	⊕	0	0	0	0	1	1	1	1	0
		1	0	0	0	1	1	1	1	0
		256	128	64	32	16	8	4	2	1

4)

a)



Z_1AT	Z_2AT	H
0	0	0
0	1	0
1	0	1
1	1	X

Z_1B_T	Z_2B_T	C
0	0	0
0	1	1
1	0	0
1	1	X

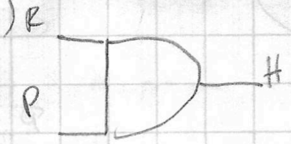
H_0C_0		H	C
0	0	0	0
0	1	0	1
1	0	1	0
1	1	0	0

b)

RS \ PQ	00	01	11	10
00	0	0	X	0
01	0	0	X	0
11	X	X	X	X
10	0	0	X	1

c) (1) H = RP

D)



5

5)

a) ① 2 → needs to pass up to 3 values + 1 to report failure → 3 bits

P	Q	out	#0s
0	0	0	0
0	1	0	1
1	0	0	2
1	1	1	3 → fail

b) ① ② 1 → −, 0 → +

A +/−	B +/−	+/−	new third block
0	0	1	1
0	1	1	0
1	0	1	0
1	1	1	1

③ the same number of bits is needed to represent the magnitude

④ only the third block needs to change

spring 2013

1)

1) $y'(x'z+y'z)' = y'(x'z)'(y'z)'$ de morgan

$= y'(x+z')(y+z')$ de morgan

$= y'(x(y+z')+z'(y+z'))$ associativity of +

$= y'(xy+xz'+yz'+z')$ fail ; $z'z'=z'$

$= xy'z'+y'z'$ fail ; $yy'=0$

$= y'z'(x+1)$ factor

$= y'z'$ $x+1=1$

2)

x	y	z	xy	yz	x'z	f_1	f_2
0	0	0	0	0	0	0	0
0	0	1	0	0	1	1	1
0	1	0	0	0	0	0	0
0	1	1	0	1	1	1	1
1	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0
1	1	0	1	0	0	1	1
1	1	1	1	1	0	1	1

3) ① $x'+y'zx'+0\cdot x \rightarrow x\cdot(y'+z+x')\cdot(1+x)$

1) 4) ①

	w	x	y	z	
9	1	0	0	1	m9

→ ② $w\bar{x}\bar{y}z \to (w+x+\bar{y}+z)$ ③ 0 1 1 0 m_6

2) 1)

a	b	c	g
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

2) ① $SOP = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$

3) ① $SOP = m_3 + m_5 + m_6 + m_7 = \sum m(3,5,6,7)$

4) ① $POS = (A+B+C)(A+B+\bar{C})(A+\bar{B}+C)(\bar{A}+B+C)$

5) ① $POS = M_0 M_1 M_2 M_4 = \prod m(0,1,2,4)$

6) ① $f(a,b,c,d) = a'bc + a'cd' = (a'bc)(d+d') + (a'cd')(b+b')$
$= a'bcd + a'bcd' + a'bcd' + a'b'cd'$

7) ① $g(w,x,y,z) = (w+x')(w+x'+y+z') = (w+x'+y'+z)(w+x'+y+z)(w+x'+y'+z')$
$(w+x'+y+z')$

3)

wx \ yz	00	01	11	10
00	X	0	1	1
01	1	0	1	X
11	1	1	0	0
10	0	X	0	1

1) ①

wx \ yz	00	01	11	10
00	X	0	1	1
01	1	0	1	X
11	1	1	0	0
10	0	X	0	1

② $\bar{w}y,\ y\bar{z}\bar{x}$

2) ①

wx \ yz	00	01	11	10
00	X	0	1	1
01	1	0	1	X
11	1	1	0	0
10	0	X	0	1

② $f = \bar{w}\bar{z} + \bar{w}y + y\bar{z}\bar{x} + wx\bar{y}$

x

3) /3)

wx \ yz	00	01	11	10
00	X	0	1	1
01	1	0	1	X
11	1	1	0	0
10	0	X	0	1

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

/4) ① we used the don't cares for different values ② the functions are not the sam

/5) ①

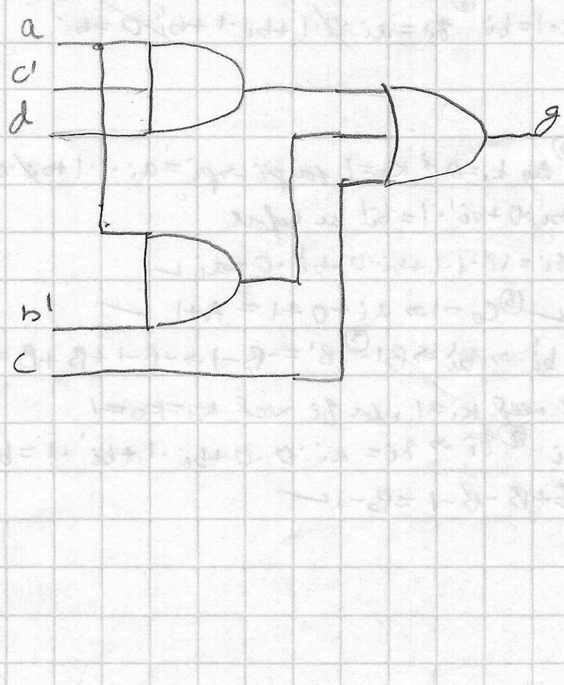
x	y	z	$y\oplus z$	g
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	0
1	0	0	0	0
1	0	1	1	1
1	1	0	1	1
1	1	1	0	0

②

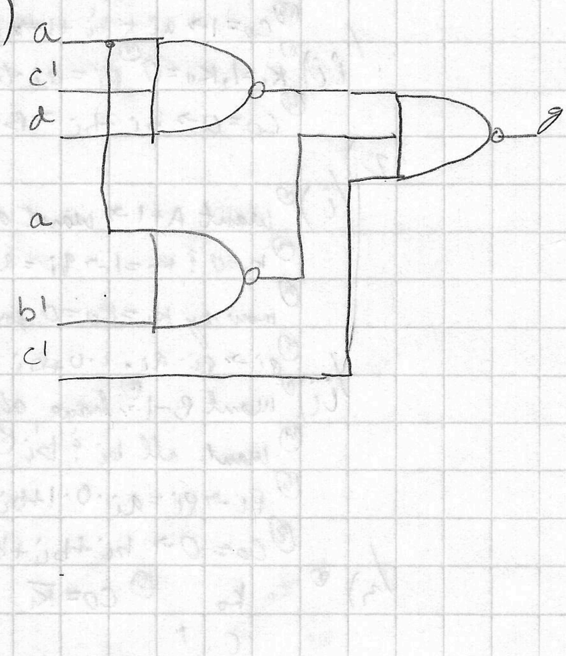
x \ yz	00	01	11	10
0	0	0	0	0
1	0	1	0	1

③ $g=x(y+z)(\bar{y}+\bar{z})$

4) /1) $g(a,b,c,d)=ac'd+ab'+c$



/2)



8

4)

3) ①

a	b	c	d	$ac'd$	ab'	g
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	1	0	0	0	1
0	0	1	1	0	0	1
0	1	0	0	0	0	0
0	1	0	1	0	0	0
0	1	1	0	0	0	1
0	1	1	1	0	0	1
1	0	0	0	0	1	1
1	0	0	1	1	1	1
1	0	1	0	0	1	1
1	0	1	1	0	1	1
1	1	0	0	0	0	0
1	1	0	1	1	0	1
1	1	1	0	0	0	1
1	1	1	1	0	0	1

②

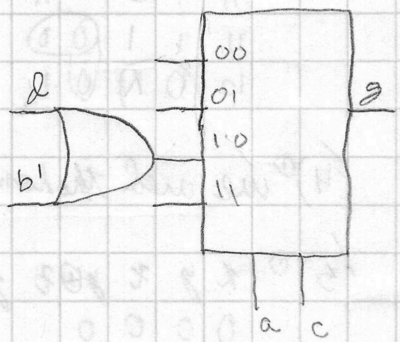
cd \ ab	00	01	11	10
00	0	0	0	1
01	0	0	1	1
11	1	1	1	1
10	1	1	1	1

③ $g=(c+a)(c+d+\bar{b})$

④

a	c	g
0	0	0
0	1	1
1	0	$d+\bar{b}$
1	1	1

⑤



5)

a) $p_i = a_i K_1' K_0 + b_i K_1$, $q_i = a_i K_1' K_0' + b_i K_1 + b_i' K_0$

1)

i) ① $K_1=0, K_0=1$ ② $p_i = a_i \cdot 1 \cdot 1 + \cancel{b_i} \cdot 0 = a_i$ ③ $q_i = \cancel{a_i \cdot 1} \cdot 0 + \cancel{b_i} \cdot 0 + b_i' \cdot 1 = b_i'$

④ $c_0 = 1 \to a_i + b_i' + 1 \to \underline{A-B}$

ii) ① $K_1=1, K_0=0$ ② $p_i = a_i \cdot 0 \cdot 0 + b_i \cdot 1 = b_i$ ③ $q_i = a_i \cdot \cancel{0} \cdot 1 + b_i \cdot 1 + \cancel{b_i' \cdot 0} = b_i$

④ $c_0 = 0 \to b_i + b_i \to B+B$

2)

i) ① want $A+1 \to$ want a_i & 0 ② try $k_1=0$ & $K_0=1$ for $p_i \to p_i = a_i \cdot 1 \cdot 1 + \cancel{b_i} \cdot 0 = a_i$ ✓

③ $k_1=0$ & $K_0=1 \to q_i = a_i \cdot \cancel{1} \cdot 0 + \cancel{b_i} \cdot 0 + b_i' \cdot 1 = b_i'$ as before

④ now try $K_1=K_0=0$ for $q_i \to q_i = a_i \cdot 1 \cdot 1 + b_i \cdot 0 + b_i' \cdot 0 = a_i$ ✓

⑤ $p_i \to p_i = a_i \cdot 1 \cdot 0 + b_i \cdot 0 = 0$ ✓ ⑥ $c_0 = 1 \to a_i + 0 + 1 = A+1$ ✓

ii) ① want $B-1$ ② have a_i, b_i & $b_i' \to b_i' \to B'$ ③ $B' = -B-1 \to -B-1+B+B = B-1$

④ want all b_i & b_i' ⑤ for p_i need $K_1=1$, for q_i need $K_1=K_0=1$

⑥ $p_i \to p_i = a_i \cdot 0 \cdot 1 + b_i \cdot 1 = b_i$ ⑦ $q_i \to q_i = a_i \cdot 0 \cdot 0 + b_i \cdot 1 + b_i' \cdot 1 = b_i + b_i'$

⑧ $c_0 = 0 \to b_i + b_i + b_i' \to B+B-B-1 = B-1$ ✓

3) ①

K_1 \ K_0	0	1
0	1	1
1	0	0

② $c_0 = \overline{K_1}$

/5) b)

1) ①

b_i	x_i	y_i	b_{i+1}	d_i	$d_i = x_i - b_i - y_i$
0	0	0	0	0	$0-0-0=0$, $b_{i+1}=0$
0	0	1	1	1	$0-1-0=-1 \to b_{i+1}=1 \to 2-1-0=1$
0	1	0	0	1	$1-0-0=1 \to b_{i+1}=0$
0	1	1	0	0	$1-1-0=0 \to b_{i+1}=0$
1	0	0	1	1	$0-1-0=-1 \to b_{i+1}=1 \to 2-1-0=1$
1	0	1	1	0	$0-1-1=-2 \to b_{i+1}=1 \to 2-2=0$
1	1	0	0	0	$1-1-0=0 \to b_{i+1}=0$
1	1	1	1	1	$1-1-1=-1 \to b_{i+1}=1 \to 3-1-1=1$

② d_i

b_i \ $x_i y_i$	00	01	11	10
0	0	1	0	1
1	1	0	1	0

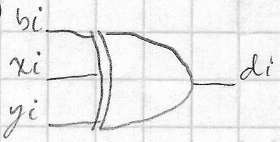
③ b_{i+1}

b_i \ $x_i y_i$	00	01	11	10
0	0	1	0	0
1	1	1	1	0

/2) ① $d_i = b_i \oplus x_i \oplus y_i = (b_i + x_i + y_i)(\overline{b_i} + x_i + \overline{y_i})(b_i + \overline{x_i} + \overline{y_i})(\overline{b_i} + \overline{x_i} + y_i)$

② $b_{i+1} = (b_i + y_i)(b_i + \overline{x_i})(\overline{x_i} + y_i)$

/3)



/6) a)

1) ①

C	D	Q^+
0	0	Q
0	1	Q
1	0	0
1	1	1

②

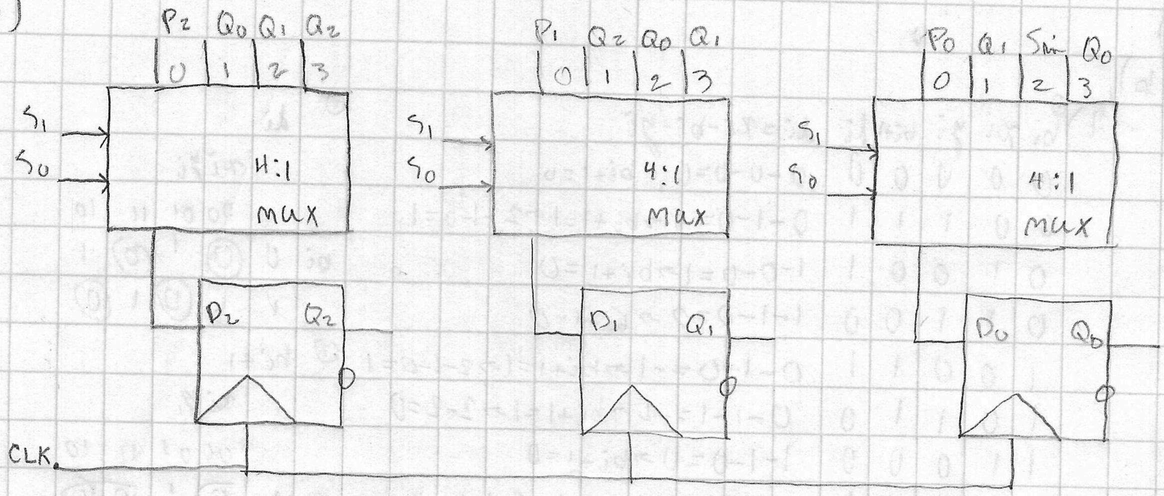
A	B	$\overline{AB}$
0	0	1
0	1	1
1	0	1
1	1	0

2) ①

C	D	Q	Q^+
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

② $SOP = \overline{C}\overline{D}Q + \overline{C}DQ + CD\overline{Q} + CDQ$

6) b)



7) 1) ⓪

a	b	c	function = a & (b|~c)	not print out	
0	0	0	0=0&(011)	0	
		1	0=0&(010)	0	
	1	0	0=0&(111)	0	
		1	0=0&(110)	0	
1	0	0	1=1&(011)	1	ab'c'
		1	0=1&(010)	1	
	1	0	1=1&(111)	1	+abc'
		1	1=1&(110)	1	+abc

⓪ out ⇒ ab'c' + abc' + abc

2) ⓪ it prints out the SOP form of the function