Practice Problems 1 Solutions
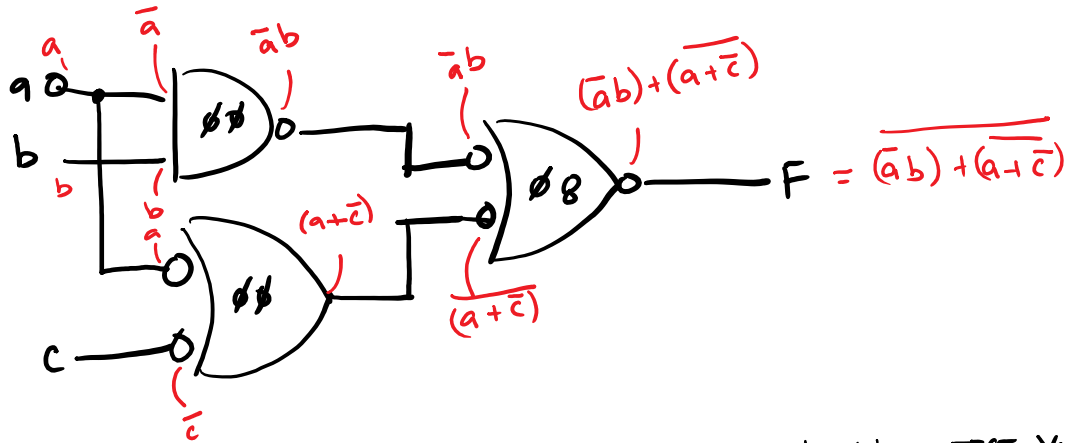
Tuesday, September 13, 2016   3:24 PM

FIND THE EQUATION:
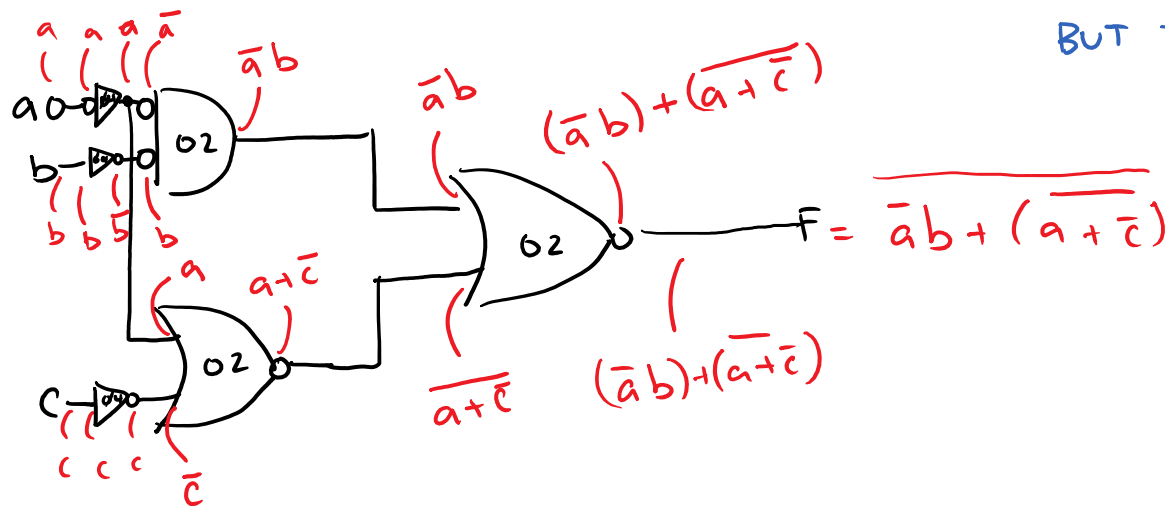

ASSUMPTIONS:

A IS ACTIVE LOW

B, C, F ARE ACTIVE HIGH

$$F = \overline{(\overline{a}b) + \overline{(a + \overline{c})}}$$

REDESIGN THE CIRCUIT USING ONLY $\emptyset 2$'s & $\emptyset 4$'s. TEST YOUR CIRCUIT

BUT THERE'S A BETTER DESIGN!

$$F = \overline{\overline{a}b + \overline{(a + \overline{c})}}$$

Practice Problems 1 Solutions

	A	B	C	F
0	0	0	0	1
1	0	0	1	0
2	0	1	0	0
3	0	1	1	0
4	1	0	0	1
5	1	0	1	1
6	1	1	0	1
7	1	1	1	1

$$F = \overline{(\bar{a}b) + (a + \bar{c})}$$
$$= \overline{(\bar{a}b)} \cdot \overline{\bar{a}} \cdot \overline{\bar{c}}$$
$$= \overline{\bar{a}b} + \overline{\bar{a}c}$$
$$= \overline{\bar{a}b} \cdot \overline{\bar{a}c}$$
$$= (a + \bar{b})(a + \bar{c})$$
$$= a + a\bar{c} + a\bar{b} + \bar{b}\bar{c}$$
$$= a(b+\bar{b})(c+\bar{c}) + a\bar{c}(b+\bar{b}) + a\bar{b}(c+\bar{c}) + \bar{b}\bar{c}(a+\bar{a})$$
$$= (ab + a\bar{b})(c+\bar{c}) + ab\bar{c} + a\bar{b}\bar{c} + abc + a\bar{b}c + a\bar{b}\bar{c} + \bar{a}\bar{b}\bar{c}$$
$$= abc + ab\bar{c} + a\bar{b}c + a\bar{b}\bar{c} + ab\bar{c} + a\bar{b}\bar{c} + a\bar{b}c + a\bar{b}c + a\bar{b}\bar{c} + \bar{a}\bar{b}\bar{c}$$
$$= abc + ab\bar{c} + a\bar{b}c + a\bar{b}\bar{c} + \bar{a}\bar{b}\bar{c} \quad \text{(CANONICAL FORM)}$$

$$F = A + \bar{B}\bar{C} \quad \text{(SIMPLIFIED)}$$

Karnaugh map:

BC \ A	0	1
00	1	1
01	0	1
11	0	1
10	0	0

	A	B	C	F
0	H	L	L	H
1	H	L	H	L
2	H	H	L	L
3	H	H	H	L
4	L	L	L	H
5	L	L	H	H
6	L	H	L	H
7	L	H	H	H

F = A + B̄C̄
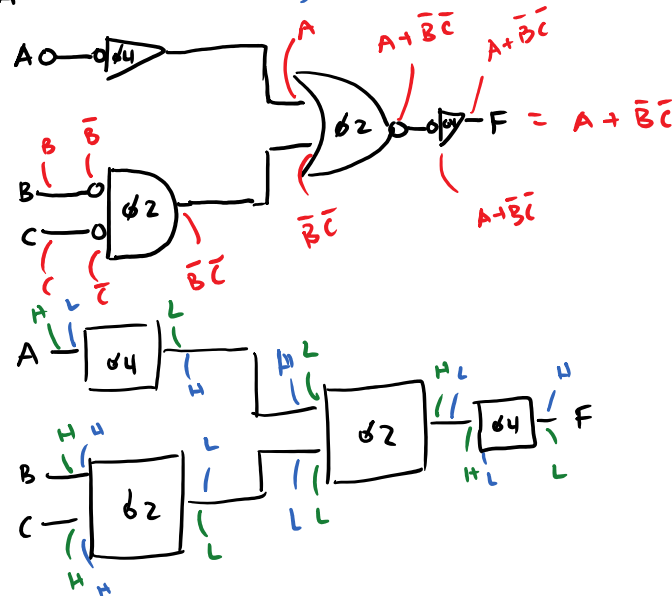
Practice Problems 1 Solutions

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FIND THE EQUATION

CHANGE PART #

THIS CIRCUIT HAS ERRORS AND THERE'S TWO WAYS TO "FIX" IT. HOW YOU FIX IT DEPENDS ON THE "CUSTOMER"
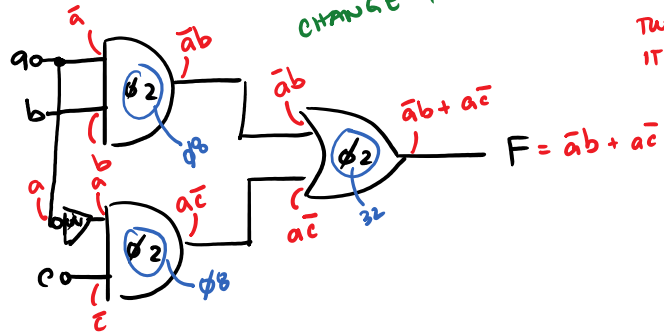
USE PART #2 AND FIX THE BUBBLES

$\bar{a}$

$\bar{a}b$

$\phi 2$

$\phi 8$

$\bar{a}b$

a
b

b

a

$a\bar{c}$

$\phi 2$

$\phi 8$

$a\bar{c}$

$\phi 2$

32

$\bar{a}b + a\bar{c}$

$F = \bar{a}b + a\bar{c}$

c

a
b

$a\bar{b}$

$\phi 2$

$a\bar{b}$

$a\bar{c} + \bar{a}c$

a
b
a

$\bar{a}c$

$\phi 2$

$\phi 2$

$\bar{a}c$

$F = \overline{a\bar{b} + \bar{a}c}$

c
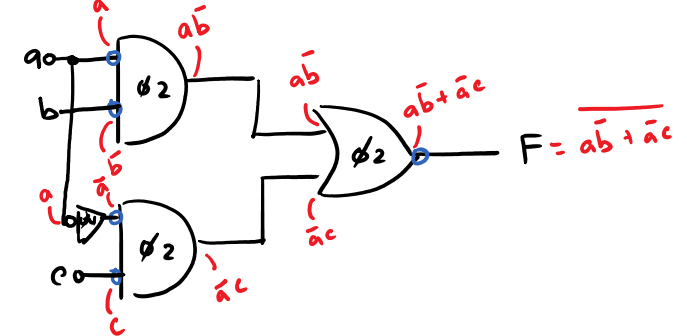
REDO WITH ONLY $\phi\phi$'s & $\phi 4$'s. TEST YOUR CIRCUIT

$\bar{a}$

$\bar{a}b$

$\phi\phi$

$\bar{a}b$

a
b

b

a   a

$a\bar{c}$

$\phi\phi$

$a\bar{c}$

$\phi\phi$

$\bar{a}b + a\bar{c}$

$F = \bar{a}b + a\bar{c}$

c
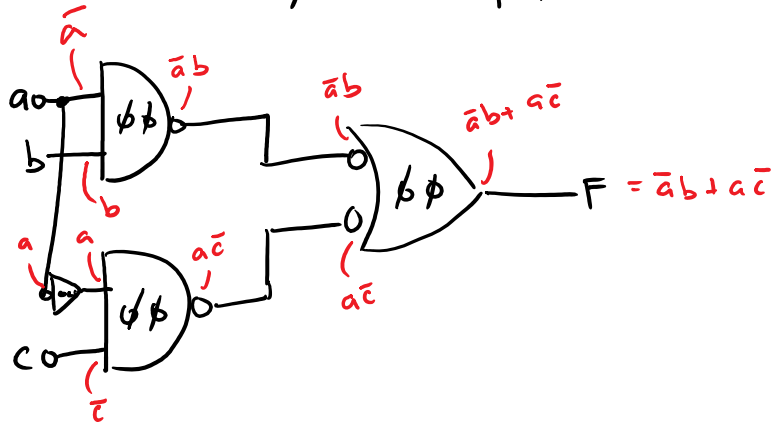
ASSUMPTIONS:

A, C ARE ACTIVE LOW

B, F ARE ACTIVE HIGH

$F = \bar{a}b + a\bar{c}$ IS WHAT THE CUSTOMER WANTED

Practice Problems 1 Solutions

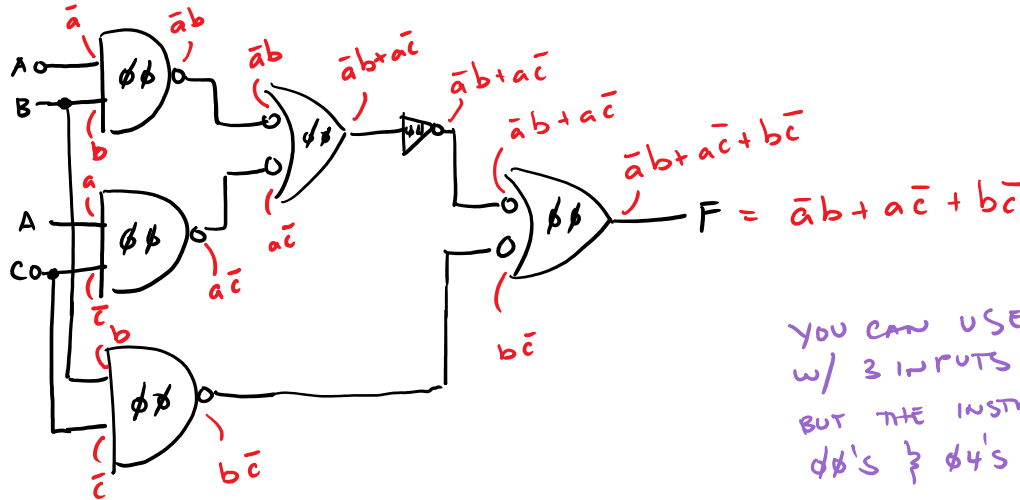|	A	B	C	F
0	0	0	0	0
1	0	0	1	0
2	0	1	0	1
3	0	1	1	1
4	1	0	0	1
5	1	0	1	0
6	1	1	0	0
7	1	1	1	0

$$F = \bar{a}b + a\bar{c}$$
$$= \bar{a}b(c + \bar{c}) + a\bar{c}(b + \bar{b})$$
$$= \bar{a}bc + \bar{a}b\bar{c} + ab\bar{c} + a\bar{b}\bar{c}$$

K-map:

$$F = \bar{a}b + a\bar{c} + b\bar{c}$$

BC \ A	0	1
00	0	4
01	1	5
11	3	7
10	2	6

	A (- -, + +)	B (- -, + +)	C (- -, + +)	F
0	H	L	H	L
1	H	L	L	L
2	H	H	H	H ✓
3	H	H	L	H
4	L	L	H	H
5	L	L	L	L ✓
6	L	H	H	H
7	L	H	L	L

$$F = \bar{a}b + a\bar{c} + b\bar{c}$$

Circuit diagram (NAND gates 00, 04):

A, B → 00 → $\bar{a}b$
A, C → 00 → $a\bar{c}$
B, C → 00 → $b\bar{c}$

→ $\bar{a}b + a\bar{c}$ → $\bar{a}b + a\bar{c} + b\bar{c}$

$$F = \bar{a}b + a\bar{c} + b\bar{c}$$

YOU CAN USE AN OR FUNCTION
W/ 3 INPUTS HERE INSTEAD
BUT THE INSTRUCTIONS SAY TO USE
00's & 04's

Second circuit diagram:

A, B → 00
A, C → 00
B, C → 00
→ 00 → 04 → 00 → F

DESIGN A CIRCUIT THAT CAN DETECT BCD (BINARY CODED DECIMAL)

ASSUMPTIONS:
$B_{3,2,1,0}$ ARE ACTIVE HIGH
F IS ACTIVE LOW
CHALLENGE: ONLY USE 32 & ∅8

$$F = \overline{B_3} + \overline{B_2}\,\overline{B_1}$$

B_3	B_2	B_1	B_0	F
0	0	0	0	0	1
1	0	0	0	1	1
2	0	0	1	0	1
3	0	0	1	1	1
4	0	1	0	0	1
5	0	1	0	1	1
6	0	1	1	0	1
7	0	1	1	1	1
8	1	0	0	0	1
9	1	0	0	1	1
10	1	0	1	0	0
11	1	0	1	1	0
12	1	1	0	0	0
13	1	1	0	1	0
14	1	1	1	0	0
15	1	1	1	1	0

NOT BCD { 10 – 15 }

0

K-map (B3 B2 columns: 00, 01, 11, 10 ; B1 B0 rows: 00, 01, 11, 10):

$B_1 B_0$ \ $B_3 B_2$	00	01	11	10
00	1 (0)	1 (4)	0 (12)	1 (8)
01	1 (1)	1 (5)	0 (13)	1 (9)
11	1 (3)	1 (7)	0 (15)	0 (11)
10	1 (2)	1 (6)	0 (14)	0 (10)

$F = \overline{B_3} + \overline{B_2}\,\overline{B_1}$

Active-low truth table:

++ B_3	++ B_2	++ B_1	++ B_0	-- F
0	L	L	L	L	L
1	L	L	L	H	L ✓
2	L	L	H	L	L
3	L	L	H	H	L
4	L	H	L	L	L
5	L	H	L	H	L
6	L	H	H	L	L
7	L	H	H	H	L
8	H	L	L	L	L
9	H	L	L	H	L
10	H	L	H	L	L
11	H	L	H	H	H ✓

X