Lab 1

Problem 3.

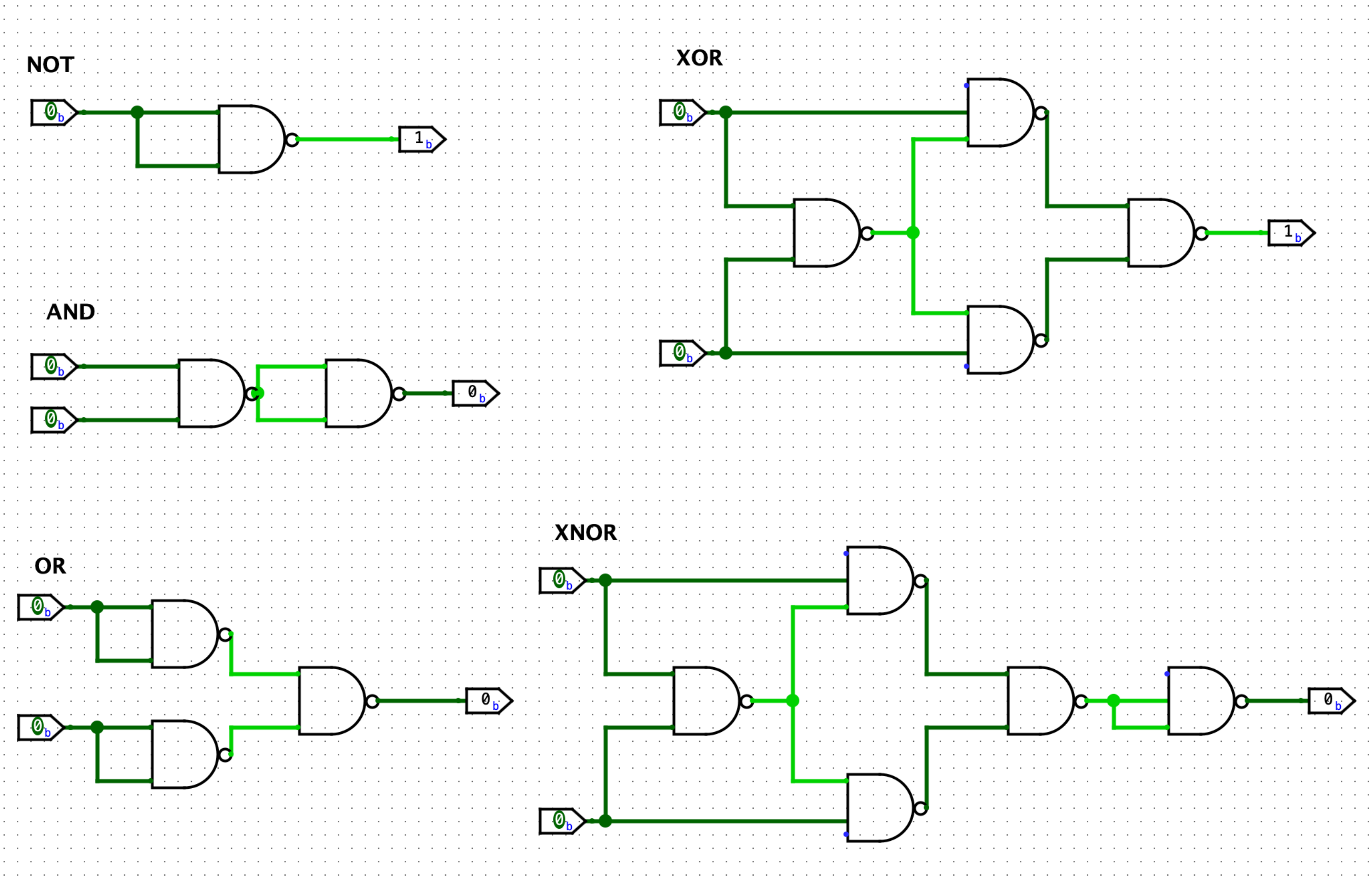


Figure 1: 5 basic gates using NAND gate

NOT : $\overline{A.A} = \overline{A}$

AND : $\overline{A.B} = \overline{A} \rightarrow \overline{\overline{A.B}} = A.B$

OR : $\overline{\overline{A}.\overline{B}} = A + B$ (De Morgan)

XOR : $\overline{\overline{A.\overline{AB}}.\overline{B.\overline{AB}}} = \overline{\overline{A.(\overline{A}+\overline{B})}.\overline{B.(\overline{A}+\overline{B})}} = A.\overline{B} + \overline{A}.B$

XNOR : We just use XOR gate and not in the end.

Problem 4.

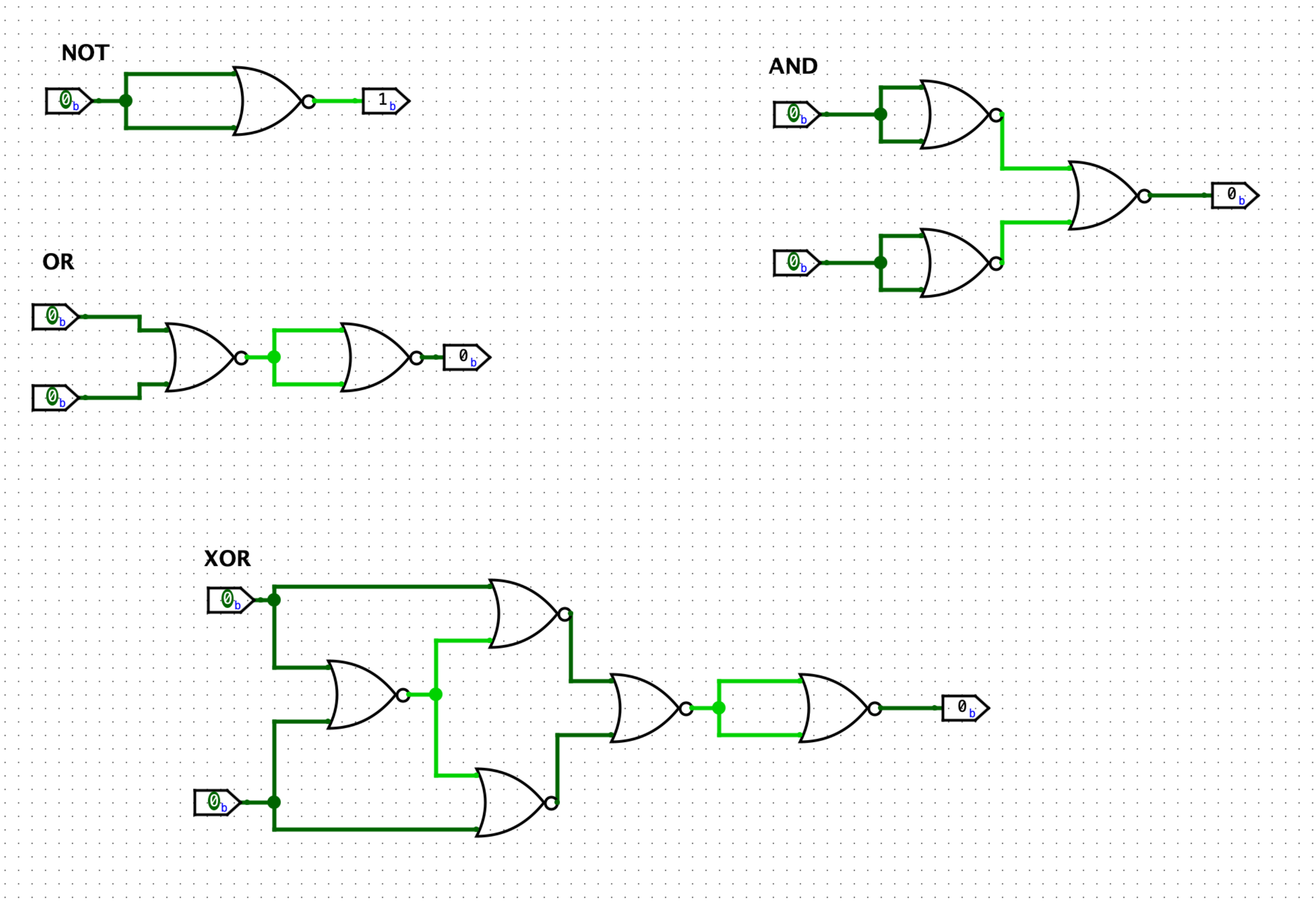


Figure 2: 4 basic gates using NOR gate

NOT : $\overline{A + A} = \overline{A}$

OR : $\overline{\overline{A + B} + \overline{A + B}} = A + B$

AND : $\overline{\overline{A} + \overline{B}} = A.B$ (De Morgan)

XOR : $\overline{\overline{A + B} + A} + \overline{\overline{A + B} + B} = (A + B).\overline{A} + (A + B).\overline{B} = \overline{A}.B + A.\overline{B}$

Problem 5.

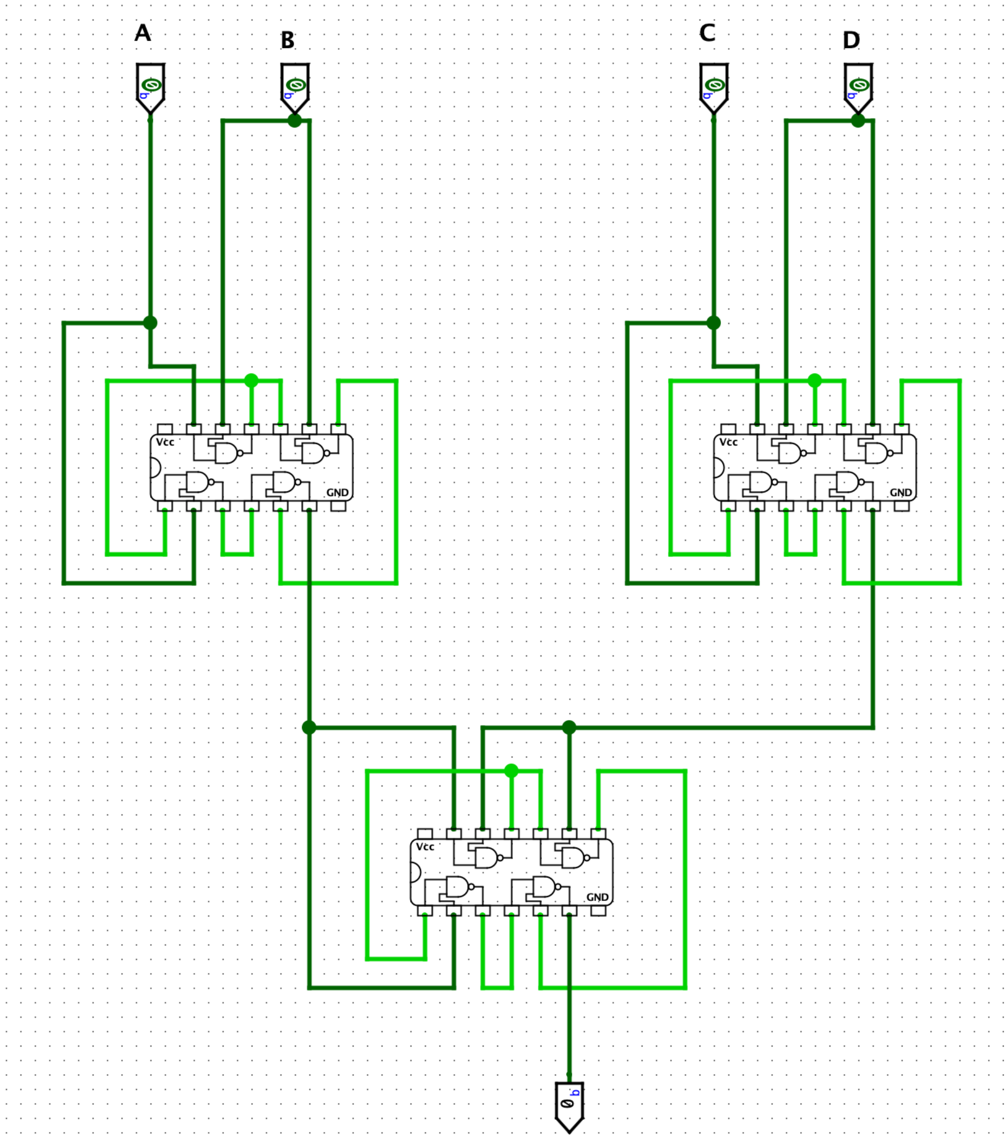


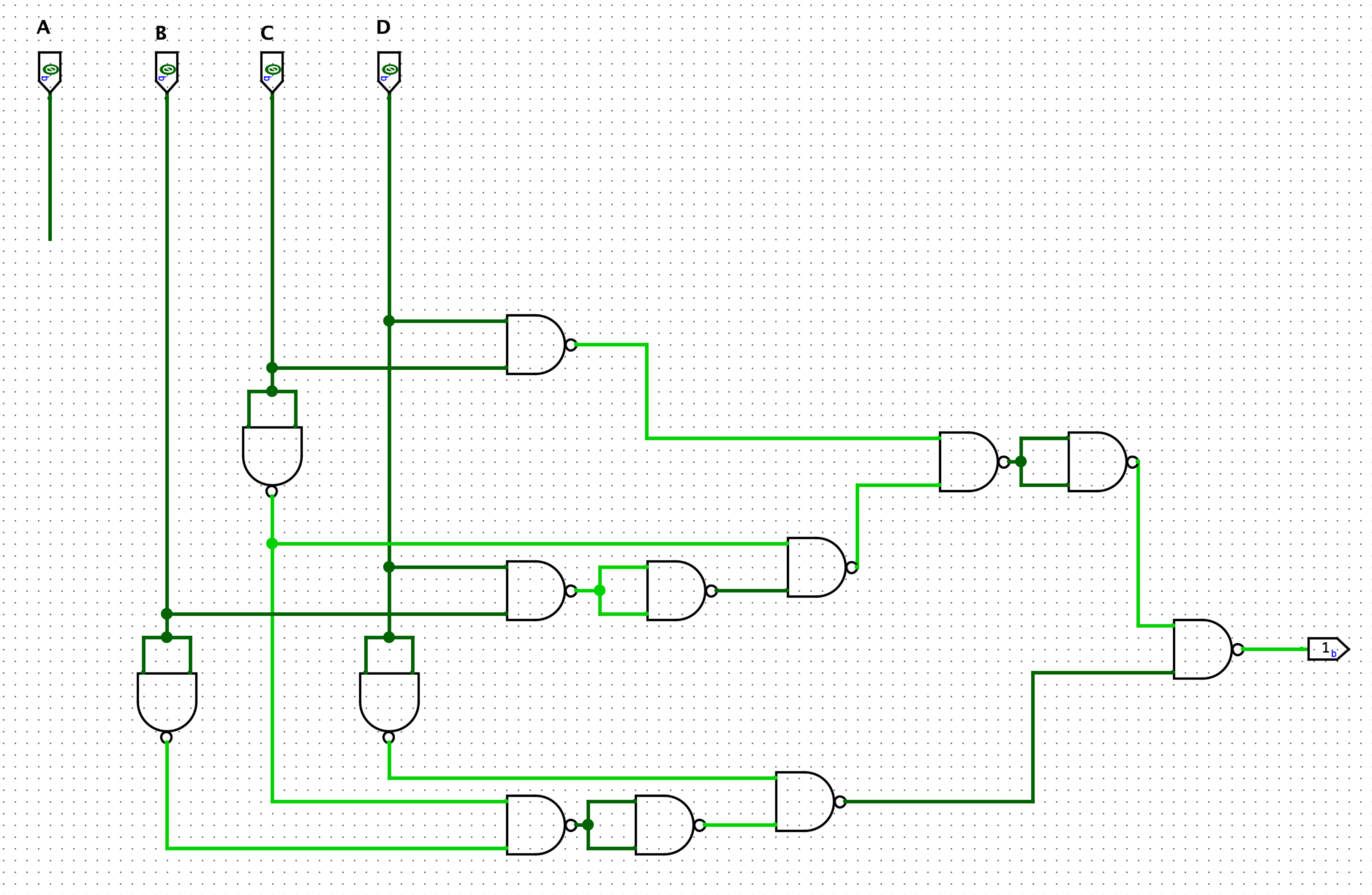
Figure 3: TTL 7400 to create XOR gate

We have:

$$A \oplus B \oplus C \oplus D = (A \oplus B) \oplus (C \oplus D)$$

Therefore, we can use the answer in problem 3.

Problem 6.



AB|CD	00	01	10	11
00	1	0	0	1
01	0	1	0	1
10	1	0	0	1
11	0	1	0	1

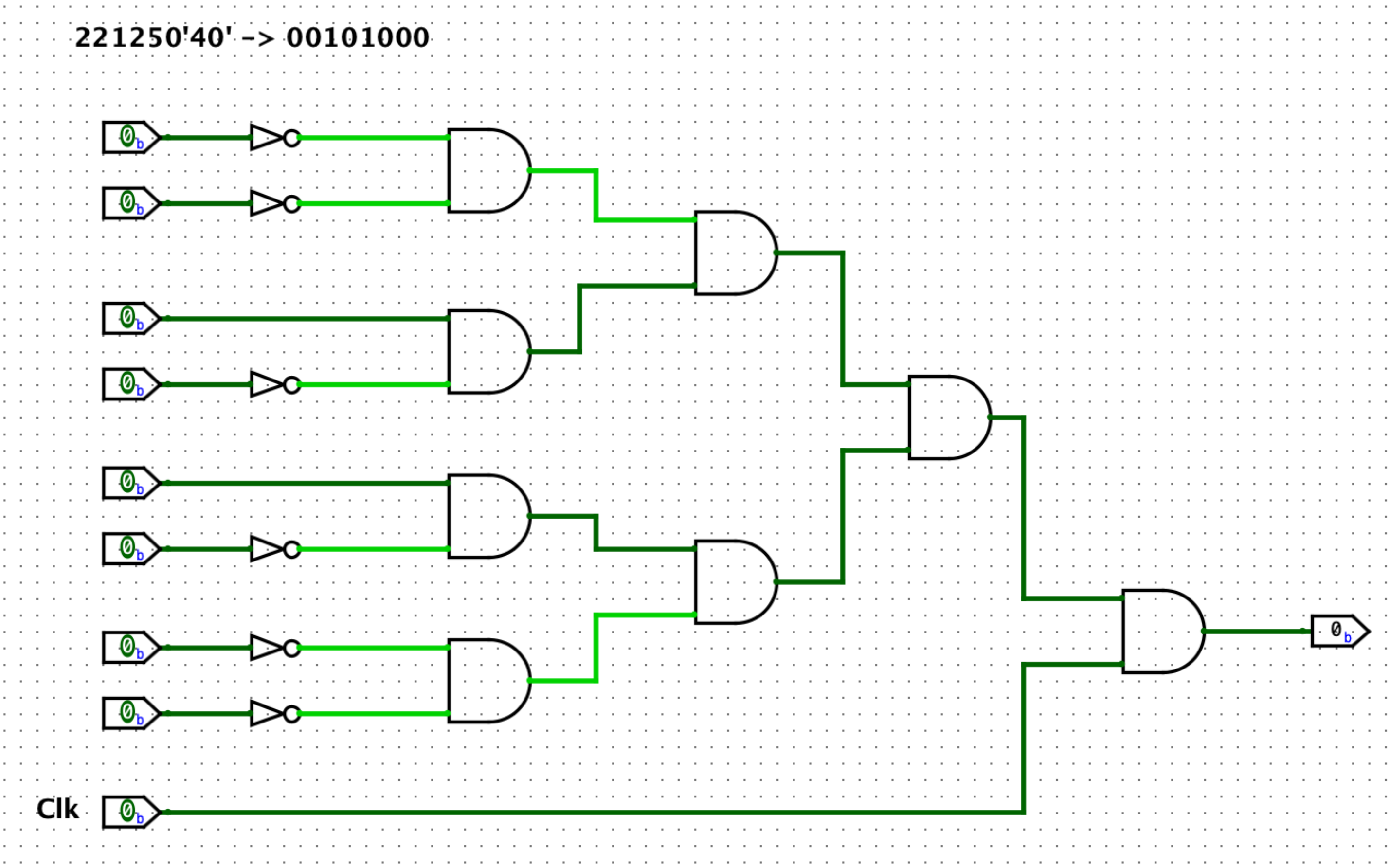
Table 1: K maps

The answer is :

$$CD + \overline{B}.\overline{C}.\overline{D} + B.\overline{C}.D = \overline{\overline{CD}.\overline{\overline{B}.\overline{C}.\overline{D}}.\overline{B.\overline{C}.D}}$$

Using De Morgan, we can easily convert to NAND and use this to draw based on problem 3.

Problem 7.

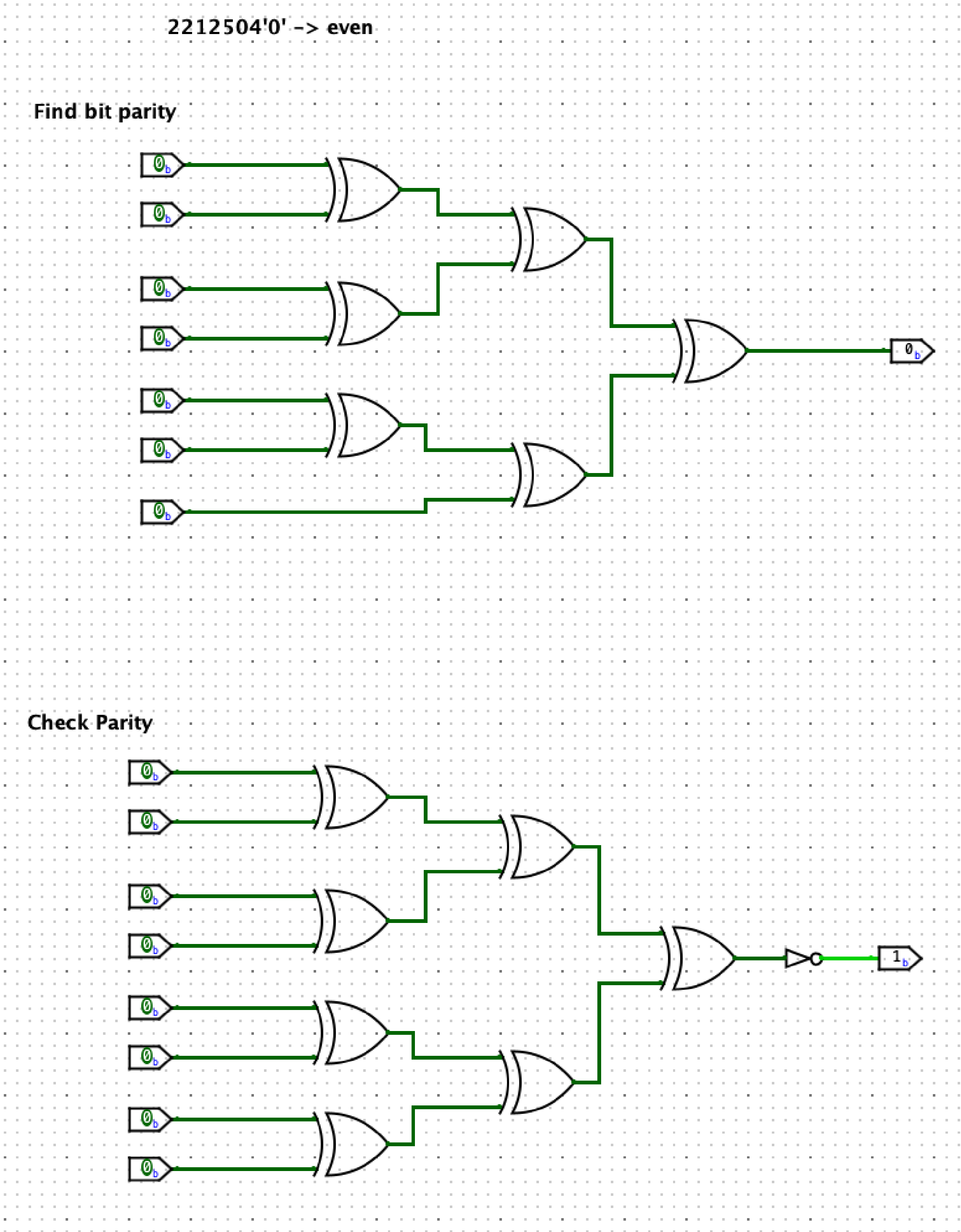


My last 2 numbers are 40. Therefore, it's binary is 00101000. The expression is

$$\overline{A}.\overline{B}.C.\overline{D}.\overline{D}.E.\overline{F}.\overline{G}.\overline{H}.Clk$$

So we can use this expression based on basic gates and we can easily build it.

Problem 8.



I XOR all of them to get the parity. Because my last number is even, so I NOT at the end to make that bit to 1 if true and vice versa.