**Lab – Logic Gates and Truth Tables**

**Objectives:**

-To determine the truth tables of NAND, NOR, and Inverter Logic gates.

-To look at an application that uses logic gates

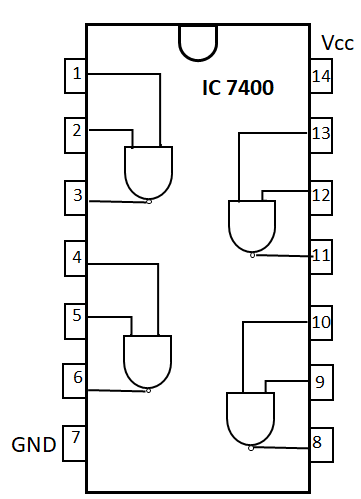
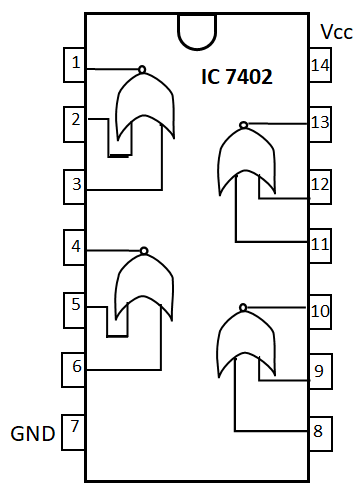
**Pre-Lab:**

-Determine the truth table for an OR and an AND gate

|  |  |  |  |
| --- | --- | --- | --- |
| Input A | Input B | Output  Logic  State | Output Voltage (V) |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
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**Equipment:**

7400 Quad 2-Input NAND gate; 7402 Quad 2-Input NOR gate; Two 1 kOhm resistors

IC Pin Diagrams

**Procedure**

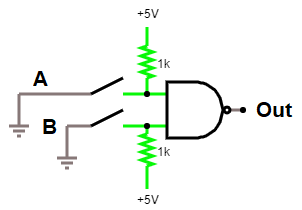
1. Use the pin diagram for the 7400 and 7402 ICs and wire up each circuit on the breadboard. Both of these chips have 4 logic gates since in many cases you will need to use more than one logic gate to build a complex circuit.

2.Make sure that you know which pins of the IC are the inputs and which are the outputs. Also, be sure you are applying power (Vcc) and ground to the correct pins otherwise your circuit will not function. The value of Vcc should be 5 Volts.

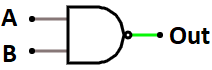
3. For each circuit below, apply a logic 1 through a series 1kW and a logic 0 directly to ground.

5. Use a multimeter (DC mode) to measure the voltage at the output pin.

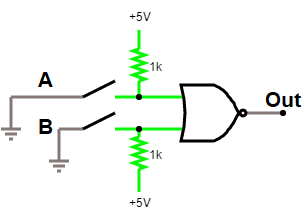
**Data and Observations**

Determine the truth table for each of the following logic circuits. Draw these tables in your notebook and fill them with your results.

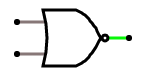
1. NAND Gate[[1]](#endnote-1)



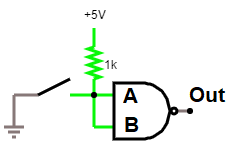
|  |  |  |  |
| --- | --- | --- | --- |
| Input A | Input B | Output  Logic  State | Output Voltage (V) |
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|  |  |  |  |
|  |  |  |  |
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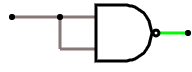


b. NOR Gate



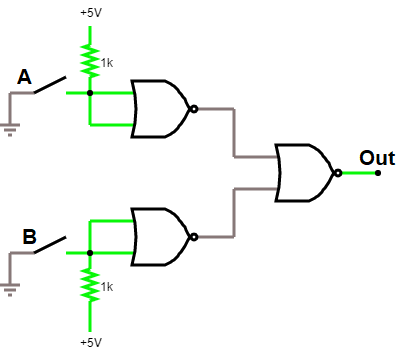
|  |  |  |  |
| --- | --- | --- | --- |
| Input A | Input B | Output  Logic  State | Output Voltage (V) |
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|  |  |  |  |
|  |  |  |  |

c.



|  |  |  |  |
| --- | --- | --- | --- |
| Input A | Input B | Output  Logic  State | Output Voltage (V) |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

d.



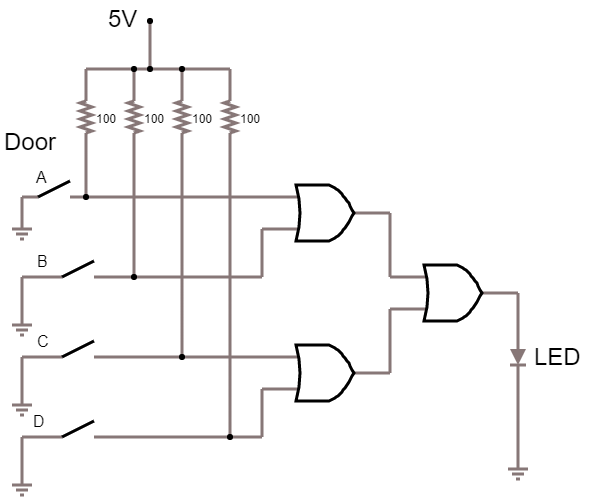
|  |  |  |  |
| --- | --- | --- | --- |
| Input A | Input B | Output  Logic  State | Output Voltage (V) |
|  |  |  |  |
|  |  |  |  |
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**Questions**

1. Based on the truth tables that you found, what circuits are equivalent to inverters?
2. Based on the truth tables that you found, what circuits are equivalent to an AND Gate?

**Mini-Project**

The light inside your car is normally set so that when the car doors are closed the light is off. If any door is opened the light comes on. The light requires an active-HIGH output meaning that it comes on only when its input is set to a logic level of ‘1’. What type of basic gate is needed to provide this logic? **Note:** Think of the switches in the circuits as doors. When the switch is open the door is open.



1. All schematic diagrams were created with Falstad circuit simulator (https://falstad.com/circuit/) [↑](#endnote-ref-1)