

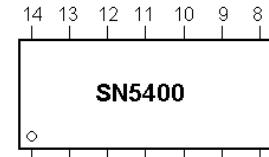
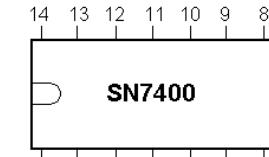
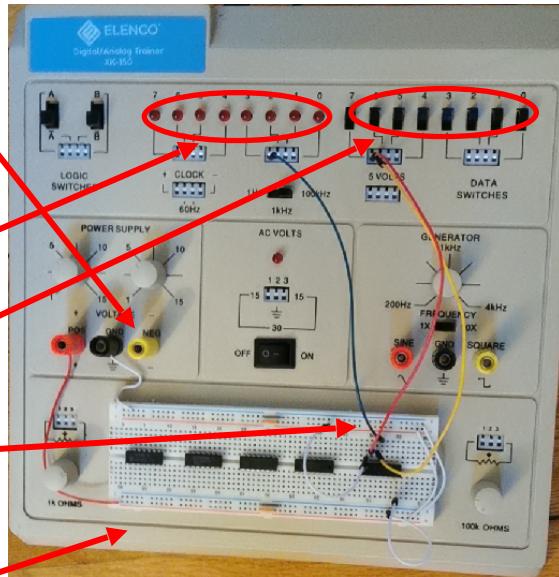
Lab 1 Digital Logic Equipment and Simulator

The objectives of this lab are to be familiar with the equipment and Tinkercad online circuits simulator.

Equipment

The following figure shows the equipment (Elenco Digital/Analog Trainer X-150) used in the lab for CSC 347. Prototyping of simple electronic circuits can use a solderless breadboard. Breadboard is used to connect the components together.

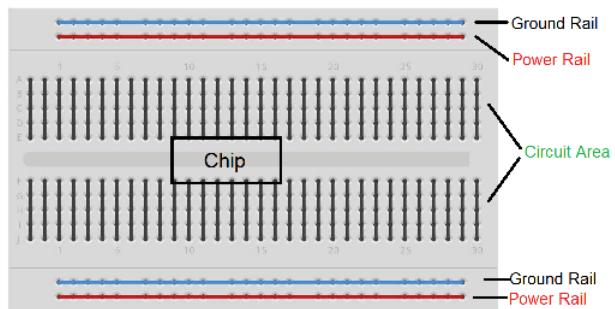
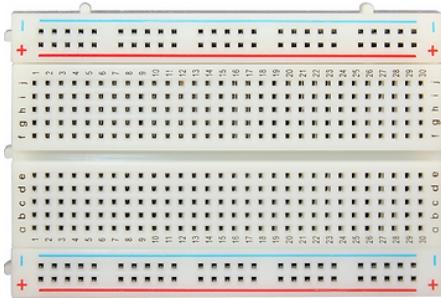
- 1. Power Supply:** It provides a +5 Volt source (often designated + or **VCC**) and a 0 Volt source (called **ground** and abbreviated - or **GND**) for the circuits. DO NOT change the voltage!
- 2. Logic Indicators:** The logic indicators are eight signal outputs which are light emitting diodes (**LEDs**). Red indicates "high" and no light indicates "low".
- 3. Logic Switches:** each of the eight logic switches provides high and low signals.
- 4. Jump Wire:** for making connections to or between points on a breadboard.
- 5. ICs:** The integrated circuits used in lab look nearly the same. It is important to know how to tell them apart and how to locate pin 1. Each IC has a variety of information on its top which can include the manufacturer's name and location, a manufacturer's part number, and date of fabrication as well as the industry standard part number which is the item of primary interest to us. The ICs we will be using belong to families from the 74xx series.



The figure shows a 14-pin integrated circuit (IC) chip labeled SN7400. Below it are two pinout diagrams for the SN7400 and SN5400 families. The SN7400 diagram shows pins 14 through 8 on top and 1 through 7 on the bottom. The SN5400 diagram shows pins 14 through 8 on top and 1 through 7 on the bottom. The text states that the figure shows a 14-pin integrated circuit (IC) chip labeled SN7400, and that pin 1 is often present, sometimes a dot, and sometimes both. In constructing circuits, wiring errors can be reduced and debugging aided by orienting the ICs in the same direction on the breadboard.

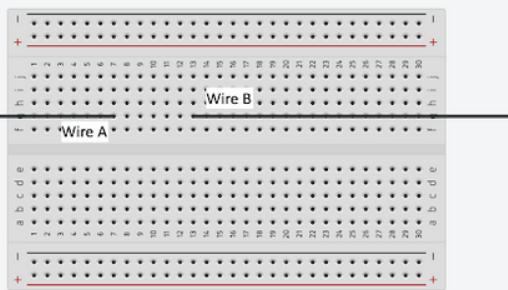
6. Breadboard Sockets

This figure below illustrates a segment of a breadboard strip. It contains a series of columns and two rails on each side. The holes are internally interconnected as shown. The outer horizontal "rails" (shown on the top and bottom in the figure) are usually used to supply VCC and ground to the circuit while the inner vertical "rails" are used for signal connections. An integrated circuit (IC) chip is placed over the central channel so its pins make connection with the first row of holes on either side of the channel. This leaves the four remaining holes in each column available to make connections to other points.

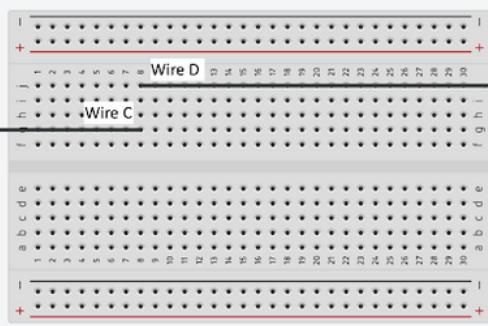


7. Basic Breadboard Wiring

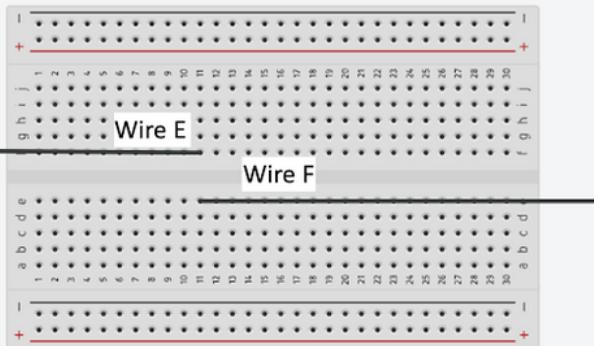
Wire A and Wire B are not connected.



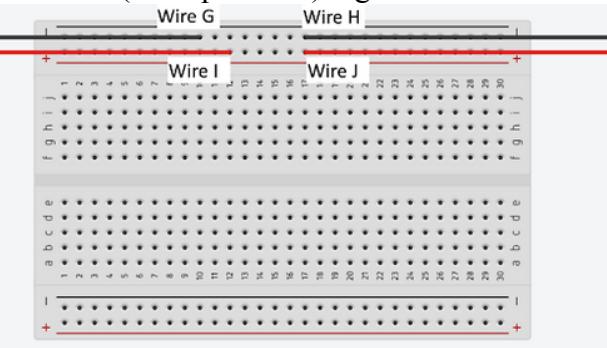
Wire C and Wire D are connected together



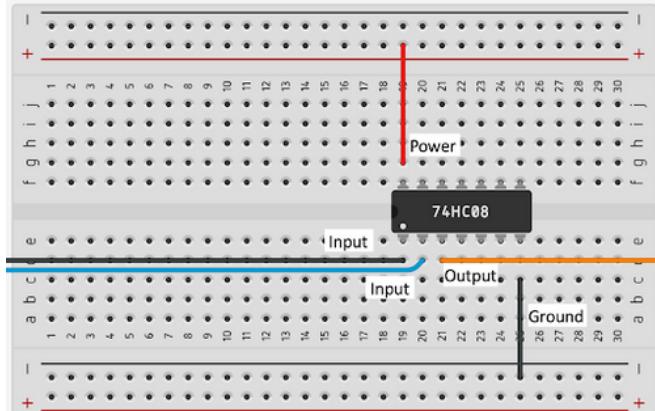
Wire E and Wire F are not connected



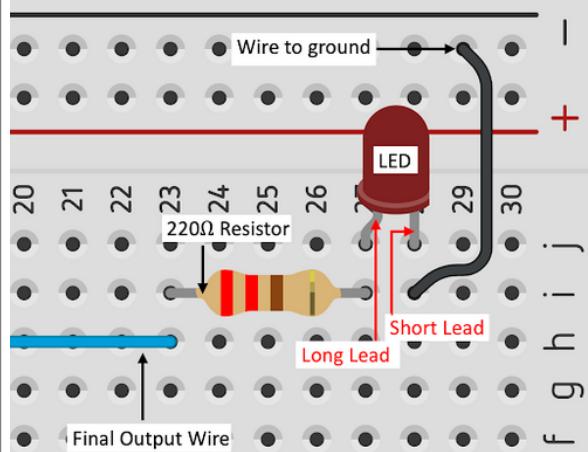
Wire G and Wire H are connected (to be grounded) together. Wire I and Wire J are connected (to be powered) together



An example of one of the AND gated connected with inputs and outputs for that gate shown

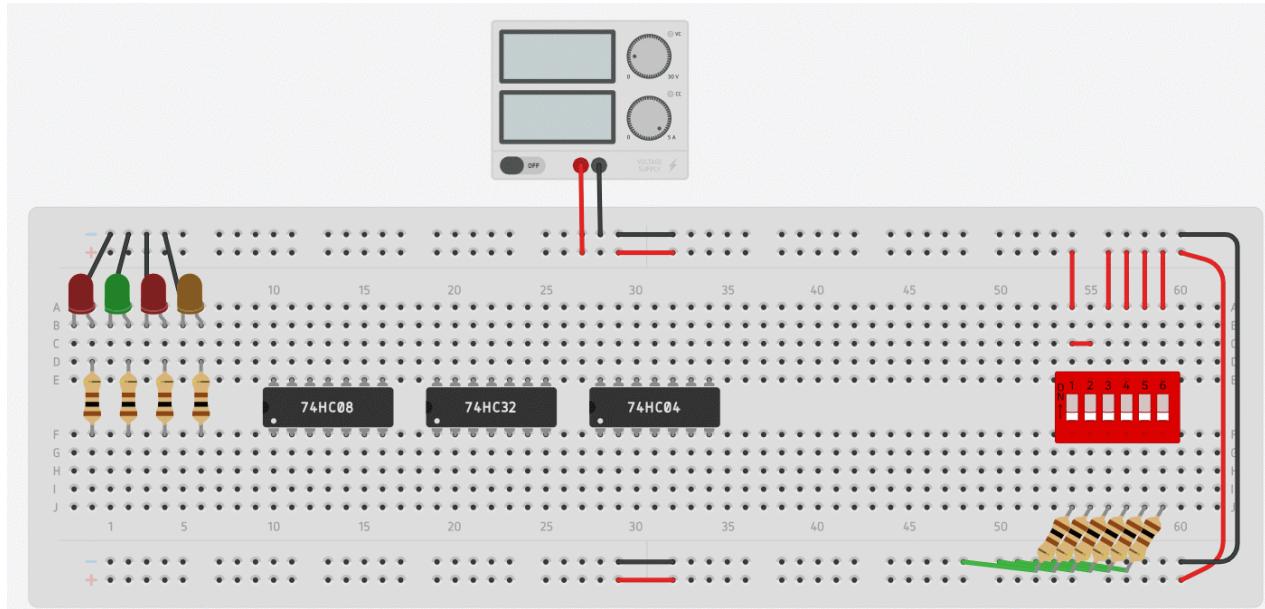


Sample connection for an LED with $220\ \Omega$ resistor



8. Tinkercad Online Circuits Simulator:

Tinkercad Circuits a free and easy to use breadboard simulator. We will use it to design, build, and test simple circuits. In this lab, students will build a circuit as shown below to simulate the real equipment, which will be used in the other labs.



- 1) Visit Tinkercad's website (<https://www.tinkercad.com/>) and log into an existing account or create an account if you do not have an account. Then select “**Circuits**” on the left side of the screen, and select “**Create new Circuit**” on the next page.
- 2) Follow the image above and place each part. Start by dragging a long **breadboard** into your design from the components list on the right side, placing a **voltage source** on top of the breadboard and connecting the positive and negative terminals to the breadboard.
- 3) Connect the power wires for the top and bottom rails. Use **black color for GND wires** and **red color for +5V (+)** wires. Add the other components and connect them properly:
 - a. On the left side of the breadboard, place **4 LEDs** and **4 resistors**. Change each resistor's

- value to 100Ω .
- b. On the right side of the breadboard, place one **DIP Switch** and six 100Ω resistors on the right. Press key ‘R’ to rotate the resistors.
 - 4) Note the holes in the plastic strip near the switches and LEDs. **You can only use holes in the lower half of the breadboard for LEDs and Switches.** Connect a wire from one of the logic switches to one of the logic indicators (lights). Click on the “Start Simulation” button at the top right corner. Flip the switch several times and observe the output. Click on the “Stop Simulation” button when you are done.

Submission Instructions:

No submission is needed for this lab.