Here are two sample activities, one very simple (suitable for Grade 10) and one quite complex (suitable for Grade 12).

4.2.1 AND Gate – Activity # 1 (from Chapter 4)

Purpose:

To investigate one gate of a 74LS08 chip.

Theory:

The 74LS08 chip contains four separate AND gates. Pins 1 and 2 are inputs and pin 3 is an output for the first gate. The Boolean equation is

$$Y = A \bullet B$$

It is read as Y equals A and B.

The chip must straddle the center groove of the breadboard. The 74LS08 is inserted into the breadboard with the small dent in the top of the chip facing left. The pins are numbered from 1 through 14. Pins 1 through 7 are placed in order from bottom-left to bottom-right. Pins 8 through 14 are placed in order from top-right to top-left.

Pins 1 and 2 are connected to the input terminal strip at A and B, and pin 3 is connected to the output terminal strip at Y.

Pin 14 is connected to a +5V power source and pin 7 is connected to ground.

A 0 in the Truth Table indicates the input LED (red) or output LED (green) is off. A 1 in the Truth Table indicates the input or output LED is on.

Note: In all Activities the dent on the top of the chip faces left.

Procedure:

Use the following diagram to wire the circuit. Connect pin 14 to a +5V power source and pin 7 to ground. A logic high, or high, and logic 1, or 1, are all equivalent. A logic low, or low, and logic 0, or 0, are all equivalent.

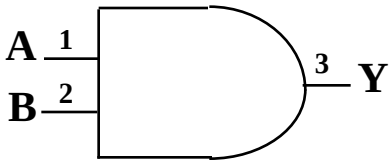

Figure 4.5

This diagram includes the pin numbers.

Results:

Complete the Truth Table.

A	B	Y
0	0	
0	1	
1	0	
1	1	

Conclusion:

What are the states (1/0) of A and B, in order for the output at Y to be high?

What are the states of A and B in order for the output at Y to be low?

Questions:

1. $0 \bullet 1 =$ _____
2. $0 \bullet 0 =$ _____
3. $1 \bullet 0 =$ _____
4. In a two-input AND gate, how many inputs must be high (logic 1) to yield a high (logic 1) ?
5. How many gates are there in a regular 74LS08 chip?
6. How many pins are there on a regular 74LS08 chip?
7. How many output states does a two-input AND gate have?
8. What is the Boolean equation for Y in terms of A and B?

7.5.6 Stepper Motor – Activity # 6 (from Chapter 7)

Purpose:

To control a DC stepper motor with the computer.

Theory:

A stepper motor can be controlled more accurately than a regular DC motor. The physical difference between a stepper motor and a normal DC motor is the number of connecting wires. Stepper motors have multiple power and ground wires, while a regular motor has a positive and negative lead.

All of the wires for a stepper motor must be connected to either power or ground in the correct order before the motor will step (turn). A typical stepper motor configuration has six leads: two positive and four negative. The two positive leads can be connected to the power supply and the other four must be grounded individually through the TIP 31 transistor which is triggered by the computer. Diodes are used to protect the transistors in the circuit from feedback.

Diagram:

Here is a diagram of a stepper motor that is powered through four transistors using pins 2 through 5 on the parallel port.

Note 1: Isolate the computer. (See Section 7.2 for more information on protecting the computer.)

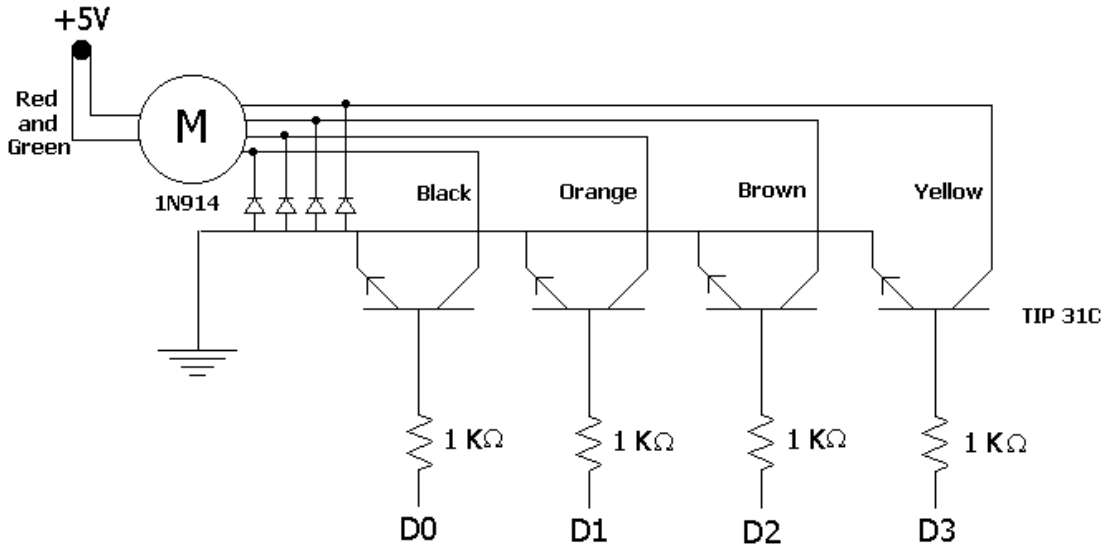

Figure 7.9

Code:

This program rotates the motor forward, stops the motor, then rotates it backwards.

```
% Repeats the sequence one hundred times.
for count : 1..100
    % Counts 0, 1, 2, and 3 which activates D0, D1, D2,
    % and D3 successively.
    for counter : 0 .. 3
        % Outputs to the parallel port.
        parallelput (2**counter)
        % Delays for one-tenth of a second.
        delay (100)
    end for
end for
% Delays for one second.
delay (1000)
% Again, repeats pattern one hundred times.
for count 2 : 1 .. 100
    % Counts 3, 2, 1, and 0 which activates D3, D2, D1,
    % and D0 successively.
    for decreasing counter 2: 3..0
        % Outputs to the parallel port.
        parallelput (2**counter2)
        % Delays for one-tenth of a second.
        delay (100)
    end for
end for
```

The above program has rotated through all the stages of the motor one hundred times in both directions.

Note 2: The exact number of steps and the exact coloring of the wires depends on the particular stepper motor being used. The principle is the same.

Project:

Wire a stepper motor that will:

(a) rotate through 90^o clockwise, then rotate 90^o counterclockwise,

(b) rotate clockwise through 360 degrees in 20 seconds,

(c) rotate clockwise through 180 degrees in 10 seconds.