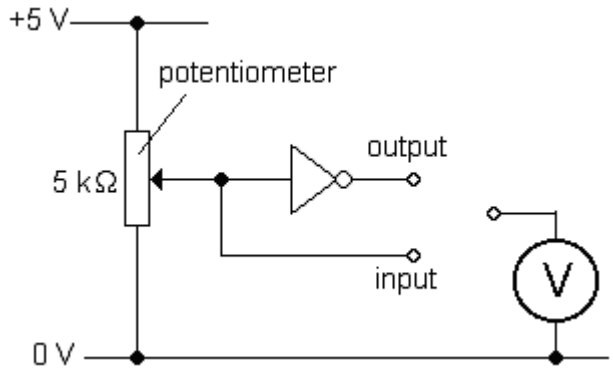
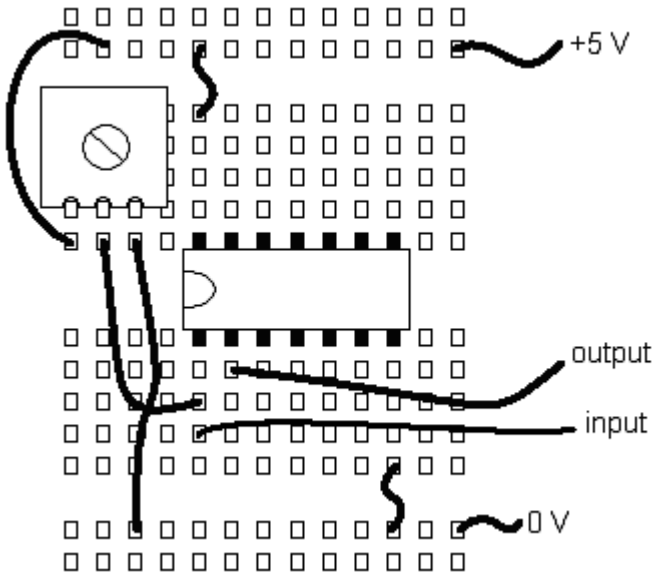
Transfer characteristic of a NOT gate

You are going to find out how the voltage at the output of a NOT gate on a 4069 integrated circuit is related to the voltage at its input.

1 Assemble the circuit shown below on breadboard. The potentiometer is a three-terminal device which allows you to feed any voltage between +5 V and 0 V into the input of the NOT gate. Note the supply connections to the integrated circuit.



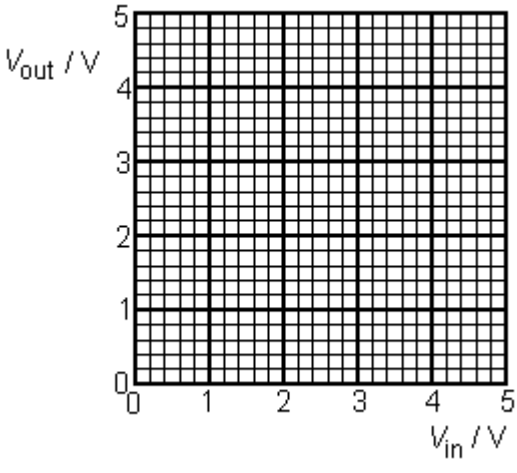


2 Connect the voltmeter to the NOT gate input. Rotate the shaft of the potentiometer. If all is well, the voltage at the input, V_{in} should vary between 0 V and +5 V.

3 Connect the voltmeter to the NOT gate output. Verify that the voltage at the output, V_{out} varies between 0 V to +5 V.

4 Record values of V_{out} for a variety of values of V_{in} over the range +5 V and 0 V. Use the values to plot a transfer characteristic on the axes opposite.

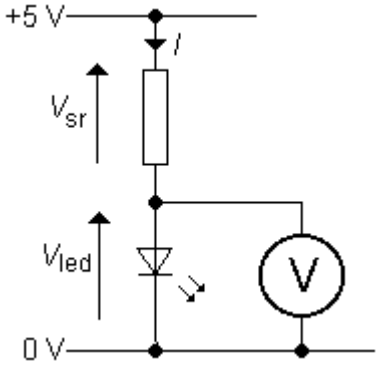
5 Identify the three regions on the graph where the output signal is high, uncertain or low.

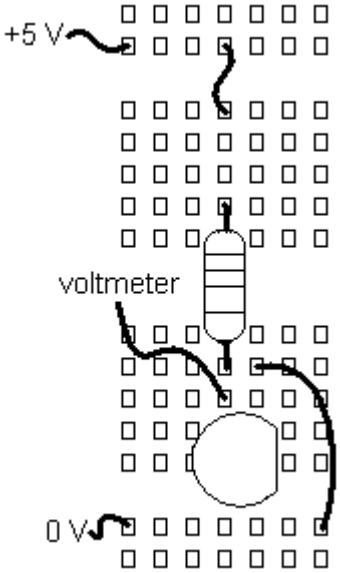


Current-voltage graph of an LED

You are going to find out how the current in an LED depends on the voltage drop across it.

1 Assemble the circuit below on breadboard.
Use a 220 Ω resistor. Note the orientation of the flat section of rim on the LED. This places the LED in forward bias.



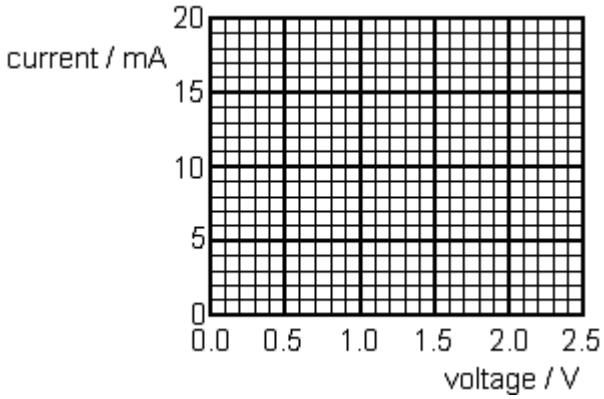


2 If all is well, the LED should glow and the voltmeter reading should be about 2 V.
Enter the voltmeter reading V_{led} in the table below. Calculate the voltage drop V_{sr} across the series resistor. Use the rule $I = \frac{V_{sr}}{R}$ to calculate the current in the circuit.

R	V_{led}	V_{sr} **= 5.0 -** V_{led}	**current**
220 Ω			
470 Ω			
1000 Ω			
2200 Ω			
4700 Ω			

3 Repeat step 2 for the other resistors shown in the table.

4 Use the results to plot a current-voltage graph for the LED.

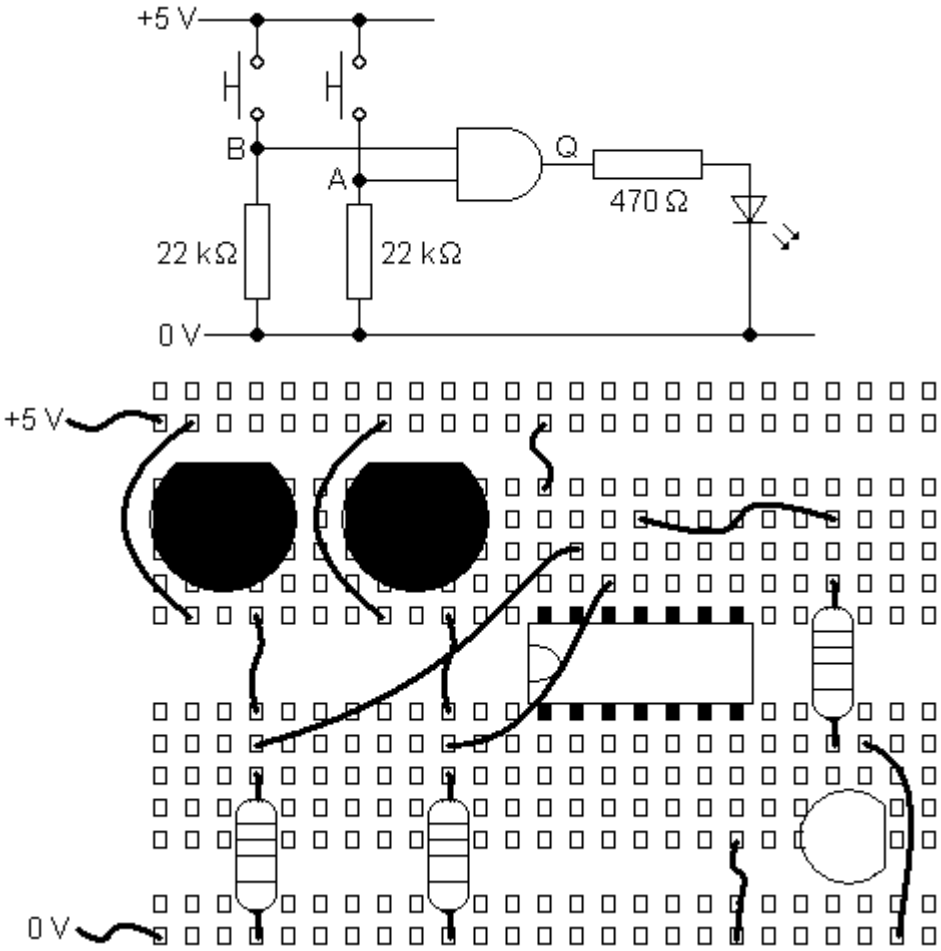


5 Now connect the LED in reverse bias with a 220 Ω series resistor. The LED should not glow and the voltmeter should read +5 V, indicating no current.

Truth tables of logic gates

You are going to use switches, resistors and an LED to find the truth tables of logic gates.

1 Assemble the circuit shown below. Use an AND gate from a 4081 integrated circuit.



2 If all is well, the LED should only glow when both switches are pressed. Use a voltmeter to verify that the pressing a switch pulls an input high, and that the output is high when the LED glows.

3 By pressing the switches and observing the LED, complete a truth table for the gate.

B	A	Q
0	0	
0	1	
1	0	
1	1	

4 Replace the AND gate with each of these gates in turn: OR, EOR, NOR and NAND. Use the switches and the LED to complete a truth table for each gate.