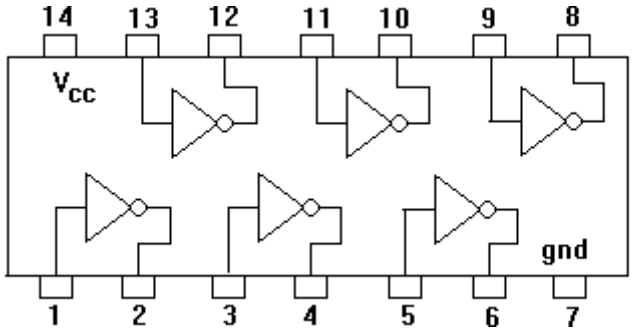
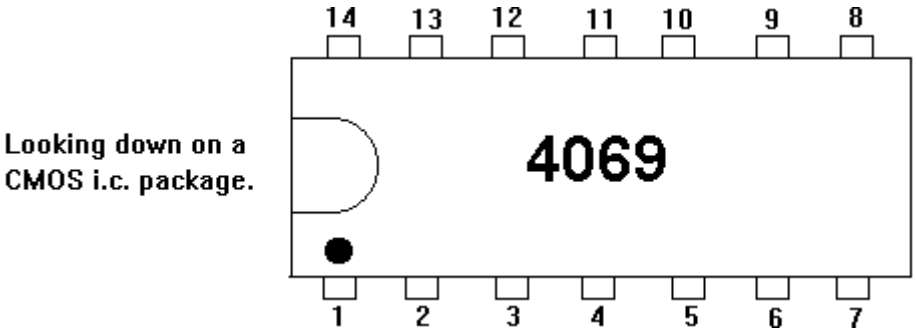
Investigating the NOT gate characteristic

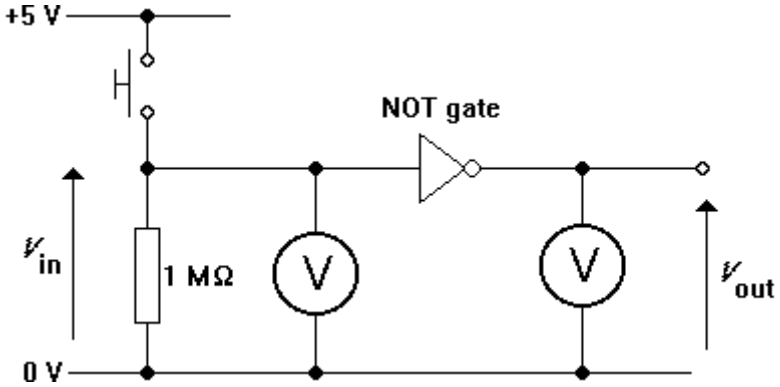
You are going to use a voltmeter to explore the behaviour of a NOT gate in a 4069 integrated circuit (i.c.). Here is the pinout of the i.c., showing you the layout of the six separate gates within the package. Pin 14 should be connected to +5 V and pin 7 to 0 V to provide power for the gates.



The diagram below shows you how to identify pin 1 of the package.



1. Assemble the circuit below on breadboard, without the voltmeters. Use the Discrete Components sheet to identify the 1 MΩ resistor.



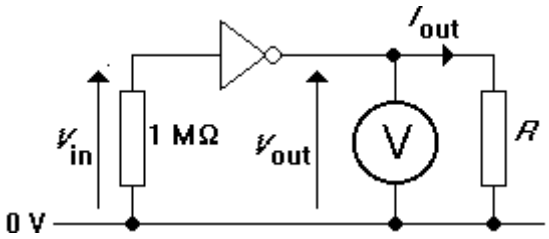
2. Connect one terminal of a voltmeter to 0 V. Connect the other terminal to the output of the NOT gate to measure V_{out}. If all is well it should go from +5 V to 0 V when the switch is pressed.

3. Now use the voltmeter to measure the values of V_{in} when the switch is pressed and released.

4. Use your results to complete this table for the NOT gate.

input	output
low	?
high	?

5. Now pull the input low with a 1 MΩ resistor (below). Check that V_{in} is at 0 V. Insert the values of R shown in the table, measuring the value of V_{out} each time.
6.



R/Ω	V_{out}/V	I_{out}/mA
100		
470		
1000		
4700		
10 000		

6. Use the values of V_{out} and R to calculate I_{out}, the current provided by the output of the NOT gate. As the resistance increases, the current should decrease.

7. Use the circuit below to find out how V_{out} depends on I_{out} when the gate input is high. Use the range of resistors given in the table above. Hint: when you calculate the current in R, remember that the voltage drop across R is $5.0 - V_{out}$.