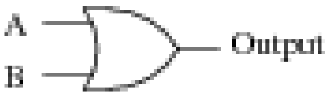
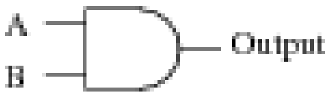
Logic Gates Worksheet 1

Question 1

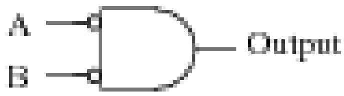
Identify each of these logic gates by name, and complete their respective truth tables:



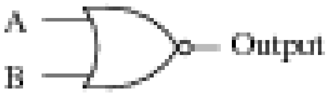
A	B	Output
0	0	
0	1	
1	0	
1	1	



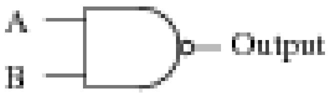
A	B	Output
0	0	
0	1	
1	0	
1	1	



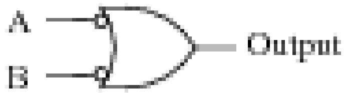
A	B	Output
0	0	
0	1	
1	0	
1	1	



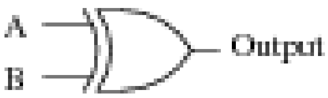
A	B	Output
0	0	
0	1	
1	0	
1	1	



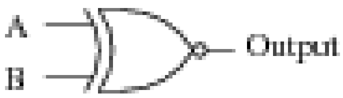
A	B	Output
0	0	
0	1	
1	0	
1	1	



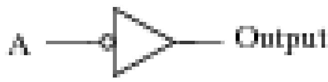
A	B	Output
0	0	
0	1	
1	0	
1	1	



A	B	Output
0	0	
0	1	
1	0	
1	1	



A	B	Output
0	0	
0	1	
1	0	
1	1	

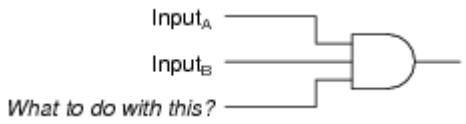


A	Output
0	
1	

Question 2

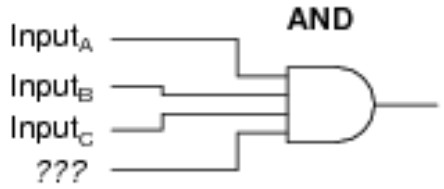
Suppose you needed a two-input AND gate, but happened to have an unused 3-input AND gate in one of the integrated circuits ("chips") already in the system you were building. Of course, you could just add another IC containing 2-input AND gates, but it seems a shame to waste the 3-input gate already there.

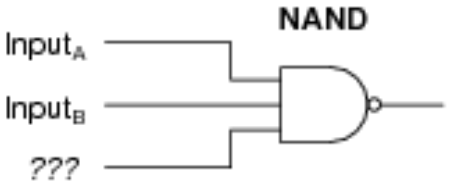
Explain what you would need to do with the third input terminal on this gate in order to use it as a 2-input AND gate:

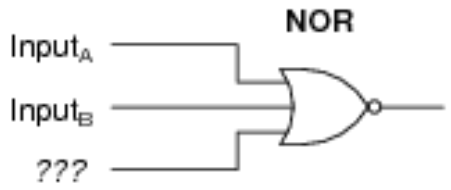


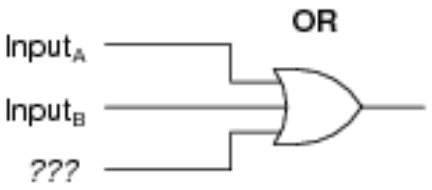
Question 3

Now, explain what to do with each of the following gates' third inputs, in order to use each of them as 2-input gates:





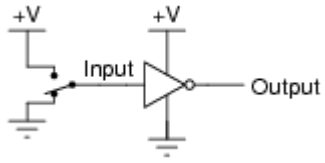




In each case, describe why your solution works.

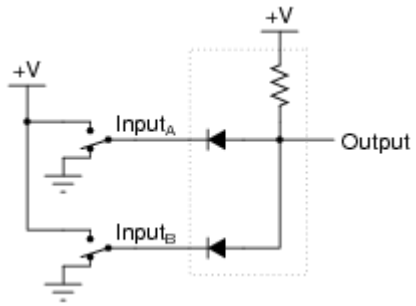
Question 4

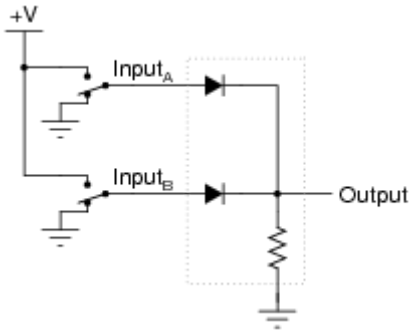
Identify the type of logic gate shown in this schematic diagram, and explain why it has the name it does:



Question 5

Crude logic gates circuits may be constructed out of nothing but diodes and resistors. Take for example these logic gate circuits:

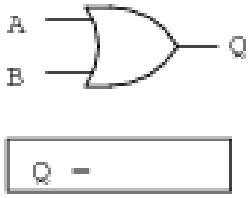


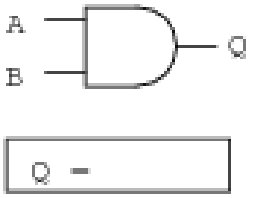


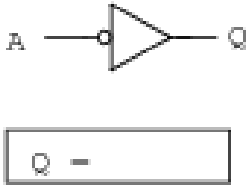
Identify what type of logic function is represented (AND, OR, inverter, etc.).

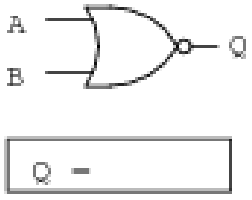
Question 6

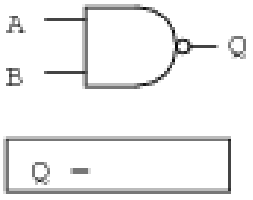
Write the Boolean expression for each of these logic gates, showing how the output (Q) algebraically relates to the inputs (A and B):

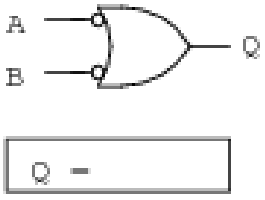


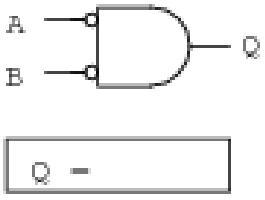






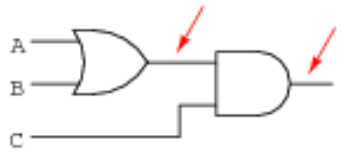


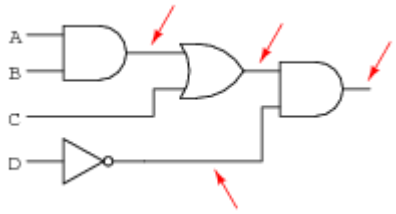


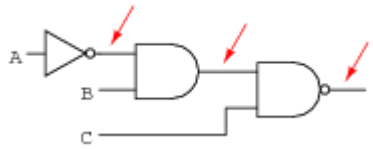


Question 7

Convert the following logic gate circuits into Boolean expressions, writing Boolean sub-expressions next to each gate output in the diagram:







Question 8

An automotive engineer wants to design a logic circuit that prohibits the engine in a car from being started unless the driver is pressing the clutch pedal while turning the ignition switch to the “start” position. The purpose of this feature will be to prevent the car from moving forward while being started if ever the transmission is accidentally left in gear.

Suppose we designate the status of the ignition switch “start” position with the Boolean variable S (1 = start; 0 = run or off), and the clutch pedal position with the Boolean variable C (1 = clutch pedal depressed; 0 = clutch pedal in normal, unpressed position). Write a Boolean expression for the starter solenoid status, given the start switch (S) and clutch (C) statuses. Then, draw a logic gate circuit to implement this Boolean function.

Question 9

An engineer hands you a piece of paper with the following Boolean expression on it, and tells you to build a gate circuit to perform that function:

$$\overline{A}\,\overline{B} + \overline{(A + B)}\,C$$

Draw a logic gate circuit for this function.

Question 10

Implement the following Boolean expression in the form of a digital logic circuit:

$$\overline{(\overline{AB} + C)B}$$

Form the circuit by making the necessary connections between pins of these integrated circuits on a solderless breadboard: