1. What is a P-type transistor? What is an N-type transistor? Name two differences between the two.

N-type: creates an electrical connection between source and drain by allowing negatively-charged particles to move from the source side to the drain side.

P-type: turned on when the gate is provided with low-voltage (or negative terminal of a battery). It operates by allowing positively-charged particles to move from source to drain.

Differences: Furthermore, for n-type transistors the source terminal is connected to low-voltage. And for p-type transistors the source-terminal is connected to high-voltage. When the switch is open, the output is undefined – electrically there is high impedance and we sometimes represent by saying the value is Z.

2. Given a gated D-latch, how would you create memory? How would you write to this memory? Describe the process in detail.

Create a row of memory by combining multiple D-latches. Arrange multiple rows to create memory. We can connect all the rows to a multiplexer whose select-line is connected to the addr port to select the correct row. To write the memory, we connect the addr into a decoder to produce a one-hot signal which is 1 at the row that is being written to. This can be ANDed with the we input and accomplishes the task of writing to the memory.

3.
a. Define DeMorgan's law.

b. Find the negation of the following expression:
(A + B' + C)(B+C')

~(A AND B) = ~A OR ~B
~(A OR B) = ~A AND ~B

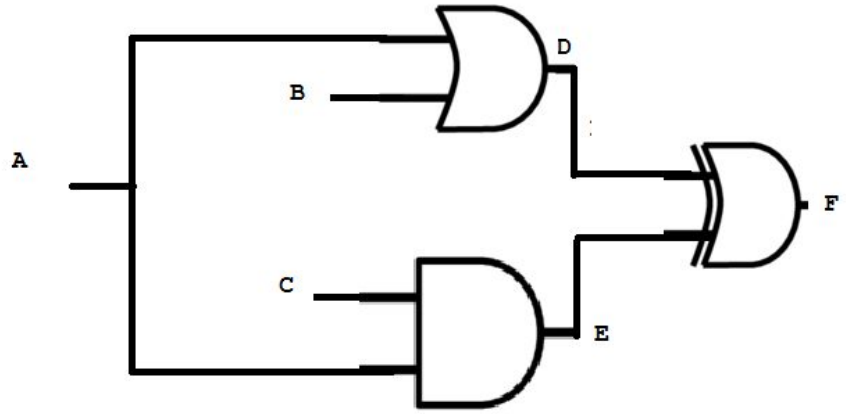
AND = *, OR = +
= (A+B' + C)' + (B+C') '
= A'BC' + B'C

4. Define Moore's law.
The number of transistors in a dense integrated circuit will double approximately every two years.

5. Which single logic gate can you use to check if two bits are equal? If they are equal, the gate should output a 1, and if not, the gate should output 0.

XNOR gate

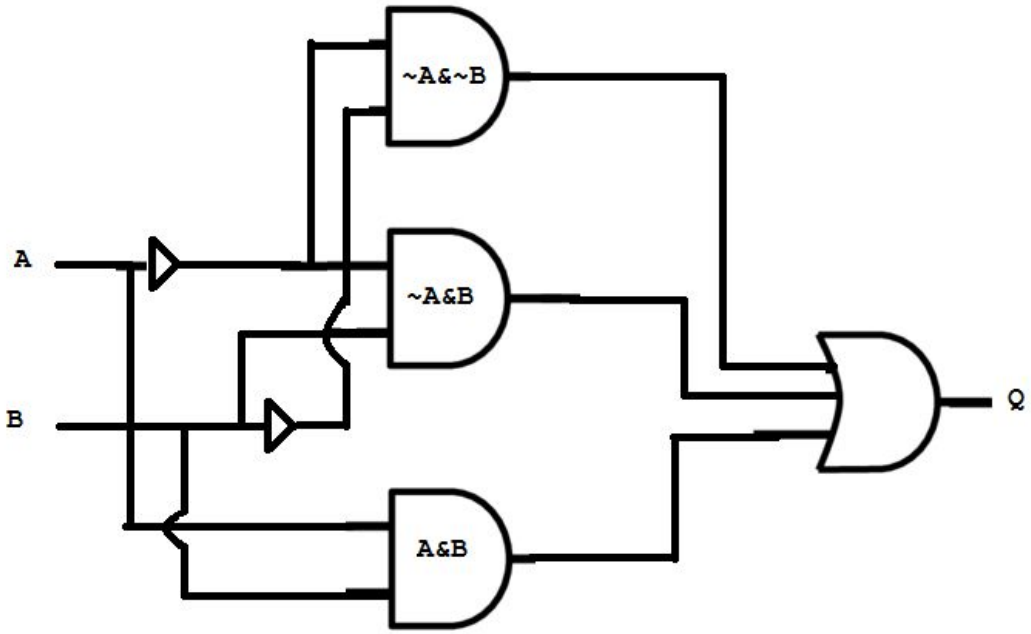
6. GIven the following logic gate, complete the truth table.



A	B	C	D	E	F
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	1	0	1
1	0	0	1	0	1
0	1	1	1	0	1
1	0	1	1	1	0
1	1	0	1	0	1
1	1	1	1	1	0

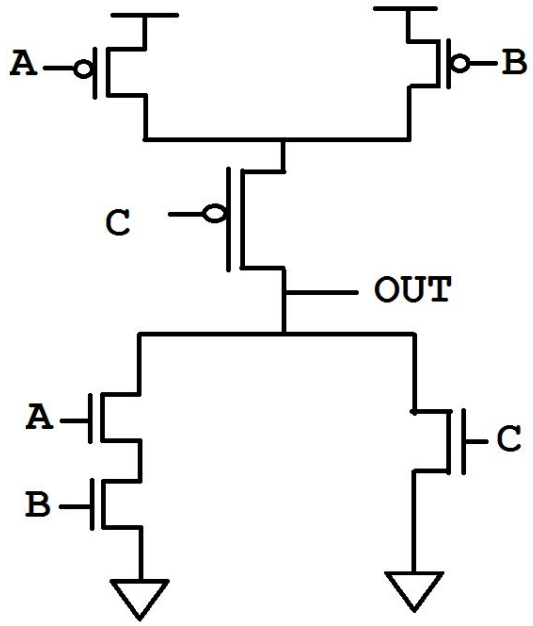
7. Given the following truth table, draw the circuit using gates.

A	B	Q
0	0	1
0	1	1
1	0	0
1	1	1



Alternative solution:

8. Given the following arrangement of transistors, find the truth table



A	B	C	OUT
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	1	0	0
1	0	1	0
1	1	1	0

9. Given the following truth table, write the sum-of-products equation.

A	B	C	Out
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

Answer: $\bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$