1 Logic Gates

1. Label the following logic gates:

2. Convert the following to boolean expressions:

   (a) NAND
   (b) XOR
   (c) XNOR

3. Create an AND gate using only NAND gates.

4. How many different two-input logic gates can there be? How many n-input logic gates?

2 State

1. Fill out the timing diagram for the circuit below:

   IN | D   | Q   | s0  | s1  | D   | Q   | -- Out
   +--^-+ +--^-+ +--^-+
   |       |       |
   CLK --+----------------+

   clk
   in
   s0
   s1
   out
2. Fill out the timing diagram for the circuit below:

![](image)

3. **Boolean Logic**

- \( A + \bar{A} = 1 \)
- \( 1 + A = 1 \)
- \( A + AB = A \)
- \( 0B = 0 \)
- \( B\bar{B} = 0 \)
- \( A + \bar{A}B = A + B \)

1. Minimize the following boolean expressions:

   (a) Standard: \((A + B)(A + \bar{B})C\)

   (b) Grouping & Extra Terms: \(\bar{A}\bar{B}\bar{C} + \bar{A}BC + AB\bar{C} + A\bar{B}\bar{C} + ABC + A\bar{B}C\)

   (c) DeMorgan’s: \(\overline{A(BC + \overline{BC})}\)