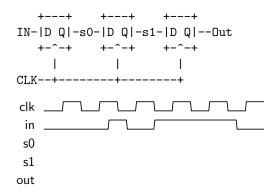
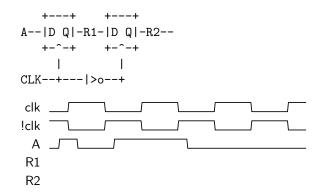
## State

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

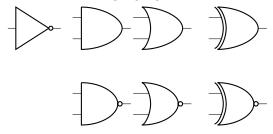


2. Fill out the timing diagram for the circuit below:



## 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?

## **Boolean Logic**

$$\begin{array}{lll} 1+A=1 & A+\bar{A}=1 & A+AB=A & (A+B)(A+C)=A+BC\\ 0B=0 & B\bar{B}=0 & A+\bar{A}B=A+B\\ \text{DeMorgan's Law:} & \overline{AB}=\bar{A}+\bar{B} & \overline{A+B}=\bar{A}\bar{B} \end{array}$$

- 1. Minimize the following boolean expressions:
  - (a) Standard:  $(A+B)(A+\bar{B})C$
  - (b) Grouping & Extra Terms:  $\bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + AB\bar{C} + A\bar{B}\bar{C} + ABC + A\bar{B}C$
  - (c) DeMorgan's:  $\overline{A(\bar{B}\bar{C}+BC)}$