State

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

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

 clk __⌐|_⌐|_⌐|_⌐|_⌐|_⌐|_⌐|__
  in _____⌐|_⌐|_____⌐|____
  s0
  s1
 out
```
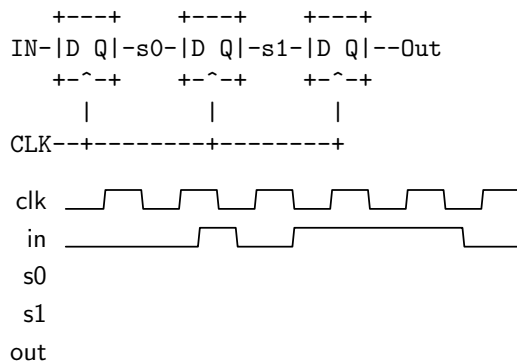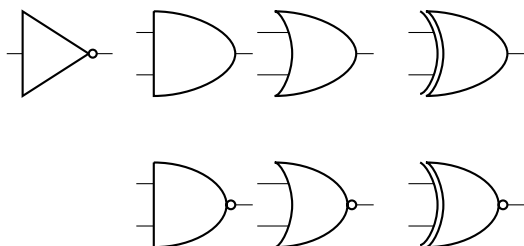
2. Fill out the timing diagram for the circuit below:

```
    +---+     +---+
 A--|D Q|-R1-|D Q|-R2--
    +-^-+     +-^-+
     |         |
 CLK--+---|>o--+

 clk __⌐|___⌐|___⌐|___⌐|__
!clk ⌐|___⌐|___⌐|___⌐|___
  A _⌐|_____⌐|_____
  R1
  R2
```
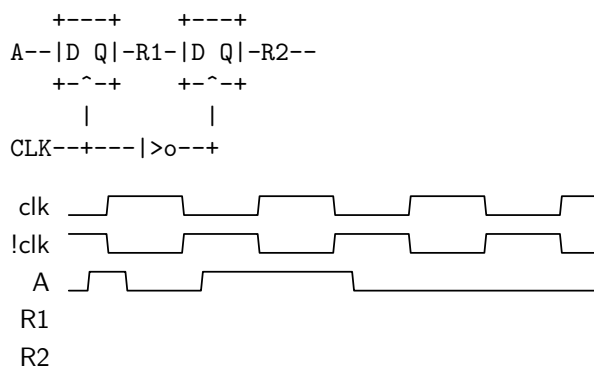
Logic Gates

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

$1 + A = 1$ $A + \bar{A} = 1$ $A + AB = A$ $(A + B)(A + C) = A + BC$

$0B = 0$ $B\bar{B} = 0$ $A + \bar{A}B = A + B$

DeMorgan's Law: $\overline{AB} = \bar{A} + \bar{B}$ $\overline{A + B} = \bar{A}\bar{B}$

1. Minimize the following boolean expressions:

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

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

   (c) DeMorgan's: $\overline{A(\bar{B}\bar{C} + BC)}$