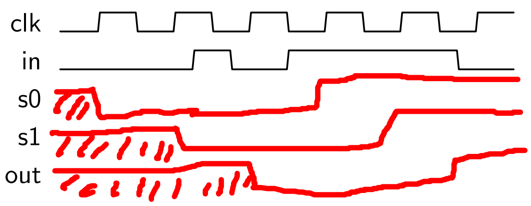
State

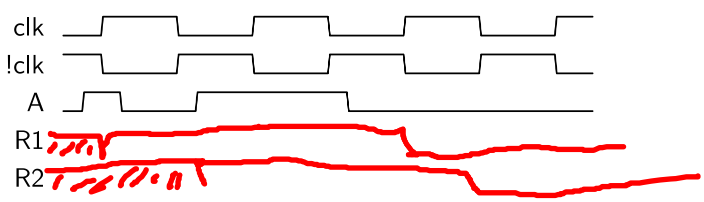
1. Fill out the timing diagram for the circuit below:

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



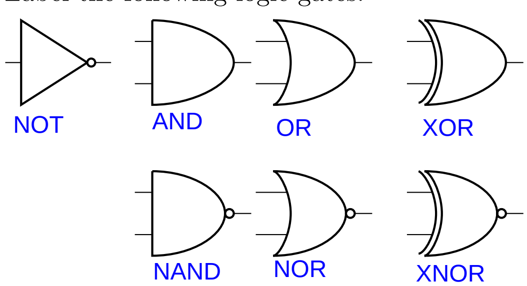
2. Fill out the timing diagram for the circuit below:

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



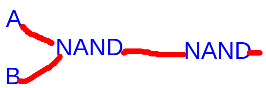
Logic Gates

1. Label the following logic gates:



2. Convert the following to boolean expressions:
   (a) NAND ~(AB) + A~(B) + ~(A)B
   (b) XOR A~(B) + ~(A)B
   (c) XNOR ~(AB) + AB

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?

16, 2^2^n

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: $(A + B)(A + \bar{B})C$ = (AA + AB + A~(B) + B~(B))C = (A(A + B + ~(B)) + B~(B))C =
   = (A(A + 1) + B~(B))C = (A + B~(B))C = (A + 0)C = AC

   AC

   (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)((~(B) + B)((~(A) + A))) + AC(B + ~(B)) = ~(C)(1 & 1) + AC(1) = ~C + AC = A + ~C

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