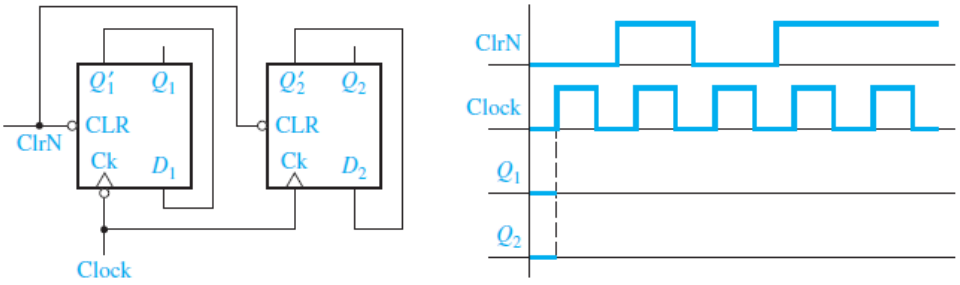
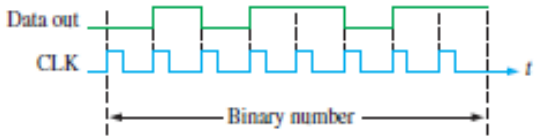
1. An AB latch operates as follows: If $A = 0$ and $B = 0$, the latch state is $Q = 0$; if either $A = 1$ or $B = 1$ (but not both), the latch output does not change; and when both $A = 1$ and $B = 1$, the latch state is $Q = 1$.
   (a) Construct the truth table and derive the characteristic equation for this AB latch.
   (b) Derive a circuit for the AB latch that has four two-input NAND gates and two inverters.

2. Complete the timing diagram for the following circuit. Note that the Ck inputs on the two flip-flops are different.



3. The sequence 1011 is applied to the input of a 4-bit serial shift register that is initially cleared. What is the state of the shift register after three clock pulses?

4. A leading-edge clocked serial in/serial out shift register has a data-output waveform as shown in figure. What binary number is stored in the 8-bit register if the first data bit out (leftmost) is the LSB?



5. If a 10-bit ring counter similar has the initial state 1010000000, determine the waveform for each of the Q outputs.