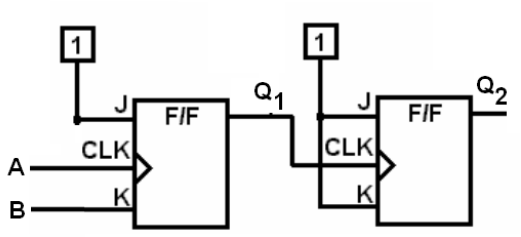
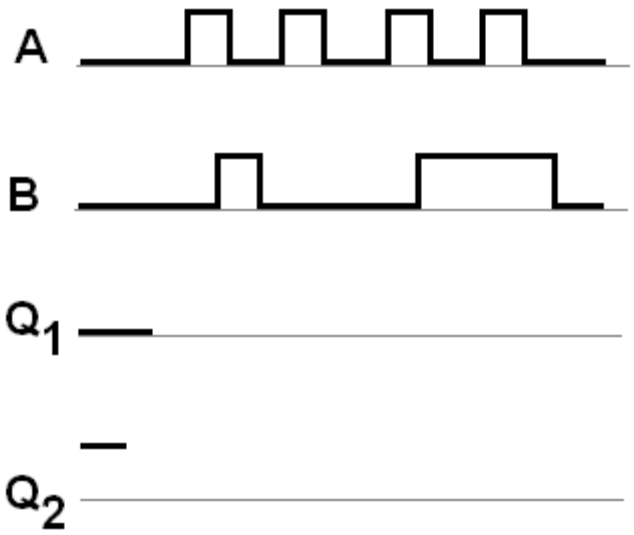
Electronics

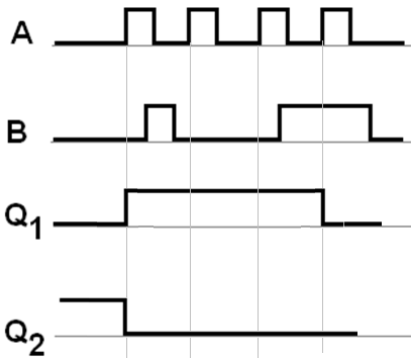
Flip-Flops

Problem 1.- The following circuit has two digital inputs labeled A and B and two digital outputs Q_1 and Q_2. Using your knowledge of how JK FFs work, predict the output sequence assuming the initial values are $Q_1=0$ and $Q_2=1$.





Solution:



Problem 2.- A new type of controlled flip-flop satisfying the truth table shown below is required for a design. Show how you can make this FF from a JK FF and a few gates.

A	B	Qn+1
0	0	$\overline{Qn}$
1	0	Qn
0	1	0
1	1	1

Solution: Notice that a JK flip-flop has a very similar table, but with different input signals. In fact, look at the two tables side by side:

New FF

A	B	Qn+1
0	0	$\overline{Qn}$
1	0	Qn
0	1	0
1	1	1

Regular JK

J	K	Qn+1
0	0	Qn
1	0	1
0	1	0
1	1	$\overline{Qn}$

If we rearrange the rows in the JK FF table to coincide with the new flip-flop we get:

New FF

A	B	Qn+1
0	0	$\overline{Qn}$
1	0	Qn
0	1	0
1	1	1

Regular JK

J	K	Qn+1
1	1	$\overline{Qn}$
0	0	Qn
0	1	0
1	0	1

If we could generate J and K inputs from A and B, we could just use the JK flip-flop. So notice that the truth tables need to be:

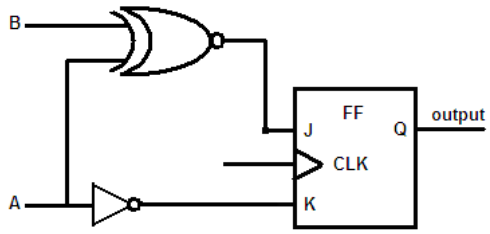
To generate J

A	B	J
0	0	1
1	0	0
0	1	0
1	1	1

To generate K

A	B	K
0	0	1
1	0	0
0	1	1
1	1	0

To generate K, notice that it is just NOT A.
To generate J, the truth table is similar to XOR, but reversed, or in other words it is NOT (XOR (A, B)).
Our new circuit could be:



Problem 3.- In digital electronics, what device or combination of devices would you use to divide by 16?

Solution: If it is an oscillating signal, we can use 4 JK FFs to divide by 16. If it is a byte or word, we could shift it four spaces to the right, effectively dividing by 16. A few D FFs will do that.