

# Flip-Flops

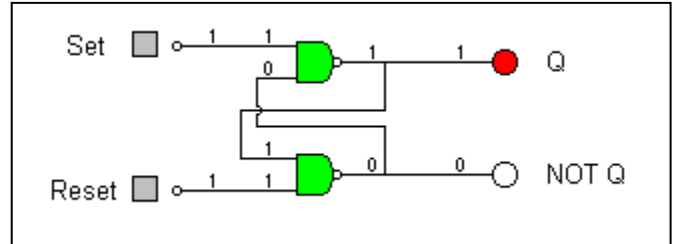
Construct the following circuits using Crocodile Clips. Create a directory in My Documents using your name and your partner's name and save all your circuits there.

## 1. R-S Flip-Flop Circuits

Build the circuit on the right, then complete the corresponding truth table on the left.

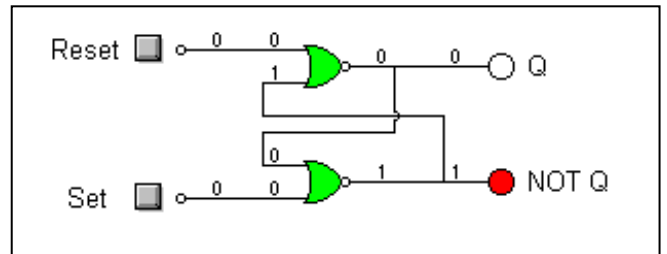
NAND GATE FLIP-FLOP

Mode of Operation	INPUTS		OUTPUTS		
	S	R	Q	$\bar{Q}$	Effect on Q
	0	0			
	0	1			
	1	0			
	1	1			



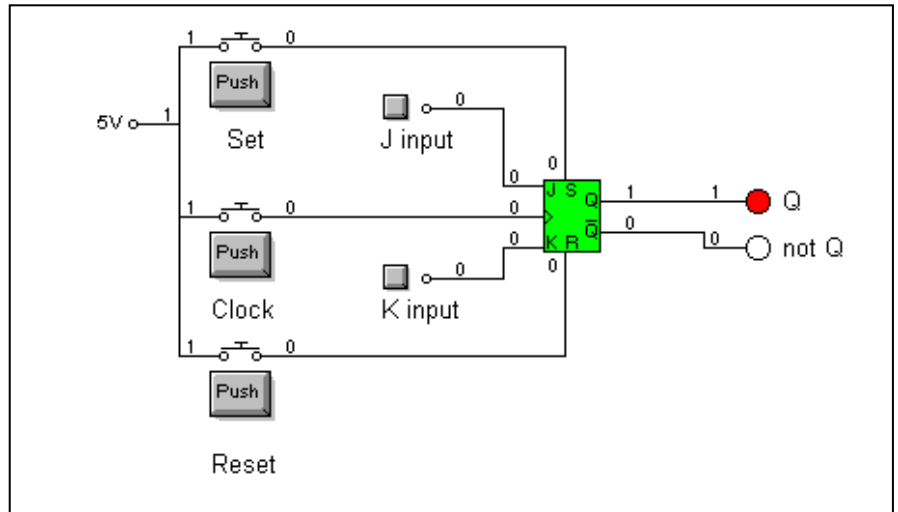
NOR GATE FLIP-FLOP

Mode of Operation	INPUTS		OUTPUTS		
	S	R	Q	$\bar{Q}$	Effect on Q
	0	0			
	0	1			
	1	0			
	1	1			



## 2. The J-K Flip-Flop

Build the circuit on the right, and then complete the truth table below.

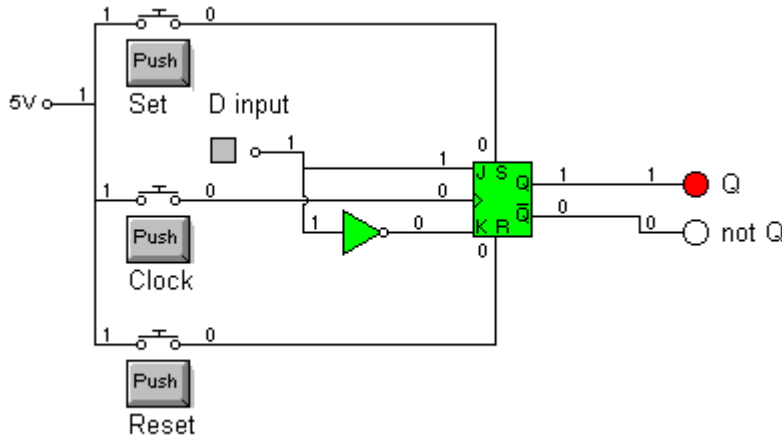


J-K FLIP-FLOP

Mode of operation	INPUTS					OUTPUTS	
	Asynchronous		Synchronous			Q	$\bar{Q}$
	Preset	Clear	Clock	J	K		
Asynchronous Set	1	0	X	X	X		
Asynchronous Reset	0	1	X	X	X		
	1	1	X	X	X		
	0	0	CLK	0	0		
	0	0	CLK	0	1		
	0	0	CLK	1	0		
	0	0	CLK	1	1		

### 3. The D Flip-Flop

The D Flip-Flop is essentially a J-K Flip-Flop which has been modified as shown in the circuit below. Only one input is used, which is connected directly to the J input, while the K input is inverted. The result is that the Hold and Toggle modes of operation are unavailable. When the D input is 1, Q is set to 1 when the clock pulse is received. Likewise, if the D input is 0, Q is reset to 0 on the clock pulse.

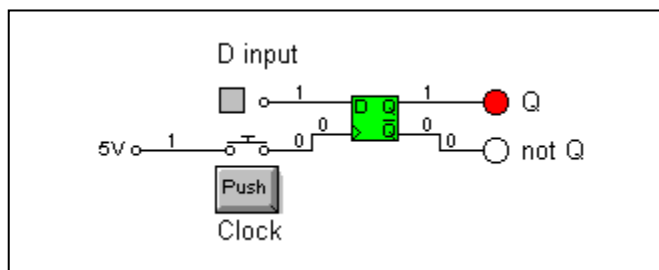


Build the circuit above, and then complete the truth table below.

Mode of operation	INPUTS				OUTPUTS	
	Asynchronous		Synchronous		Q	$\overline{Q}$
	Preset	Clear	Clock	D		
Asynchronous Set	1	0	X	X		
Asynchronous Reset	0	1	X	X		
	1	1	X	X		
	0	0	CLK	0		
	0	0	CLK	1		

Crocodile Physics has a simplified version of the D Flip-Flop, that has no asynchronous inputs.

Build the circuit below, and then complete the truth table.



INPUTS		OUTPUTS	
D	Clock	Q	$\overline{Q}$
0	-----		
1	-----		
0	CLK		
1	CLK		