Student Name: _____ Student #:_____

Experiment 2b (RS Flip-Flops)

Lab B – Clocked RS NAND Flip-Flop

AIM:
To investigate the operation a RS NAND flip-flop with a clock (control).

The clocked RS flip-flop is very similar to an RS flip-flop except that it adds a clock as a control feature. This flip-flop is used to control the flow of data in a circuit. It has two inputs as well as the clock.

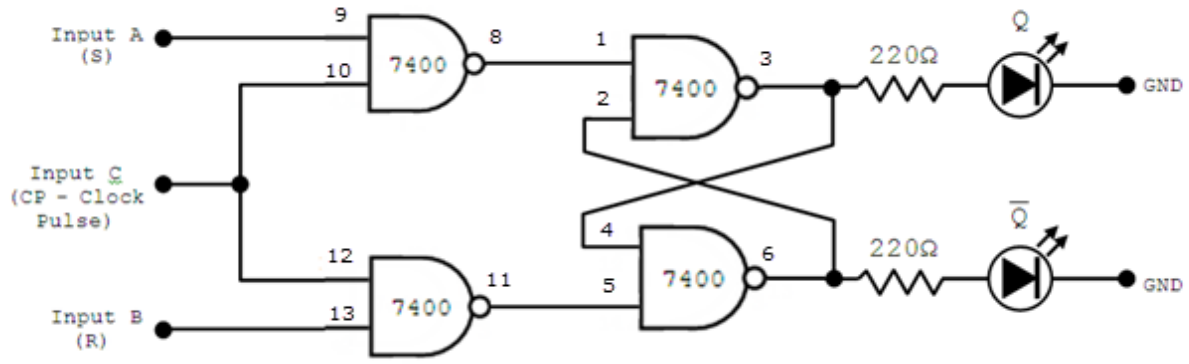
The output of an RS flip-flop with a clock depends upon the reset and set as well as the control (or clock or enable). The previous state is stored when either set and reset are low or when the clock is low.

The output Q and Q' only change on a clock pulse (clock being set high). The clocked RS flip-flop operates synchronously (with the clock). Synchronous operations are fundamental to ordering steps in a computer's operation.

PRE-LAB WORK:
From the Digital Electronics textbook, read section 7.2 and answer the Self-Test Questions.

MATERIALS:
1. 1 x 7400 integrated circuit (IC)
2. 5 x 220 ohm or 330 ohm resistors
3. 1 x DIP Switch (with 4 ON/OFF switches)
4. 2 x LEDs (Light Emitting Diode)

CIRCUIT:



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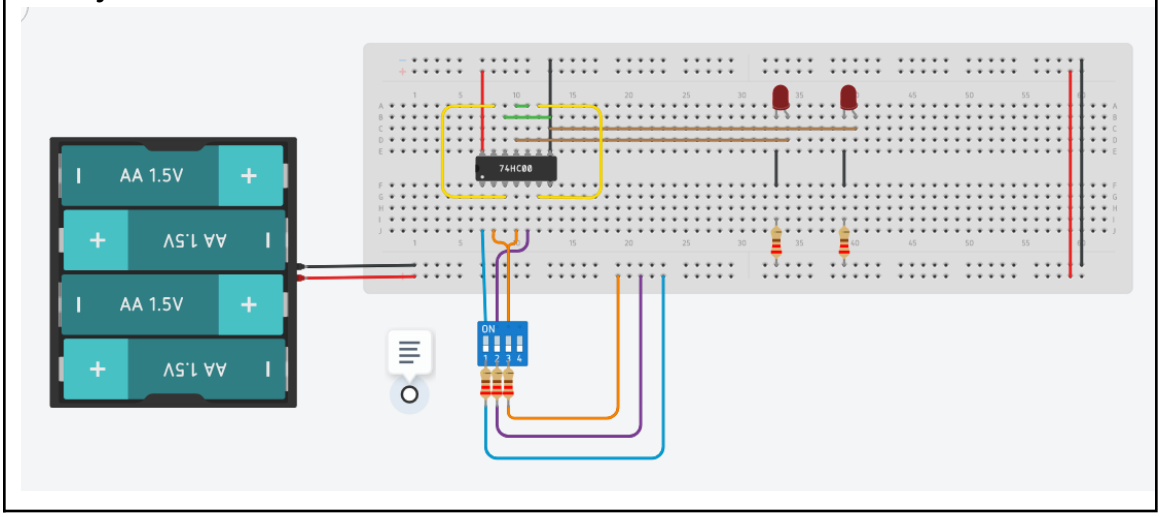
Student Name: _____ Student #:_____

PROCEDURE:

1. Assemble the circuit on the bread board. The inputs will come from the three push buttons.

Paste your screenshot below:



2. Toggle the inputs A, B and C, while observing the output for each of the input states listed in the observations chart below. Record your observations in the chart below. **Make sure that you set the inputs in the exact order given in the chart below.**

OBSERVATIONS:

		A	B	C	X	Y
Circuit Inputs and Outputs		**S**	**R**	**C (Clock)**	**Q**	**Q'**
Step	**a**	1	0	1	1	0
	b	1	0	0	1	1
	c	1	0	1	1	0
	d	0	0	0	1	0
	e	0	1	0	1	0
	f	0	1	1	0	1
	g	0	0	1	0	1
	h	1	0	1	1	0
	i	0	1	1	0	1
	j	0	1	0	0	1
	k	1	0	1	1	0
	l	1	0	0	1	0
	m	1	1	1	1	1
	n	0	0	1	1	0

Questions for Part B:

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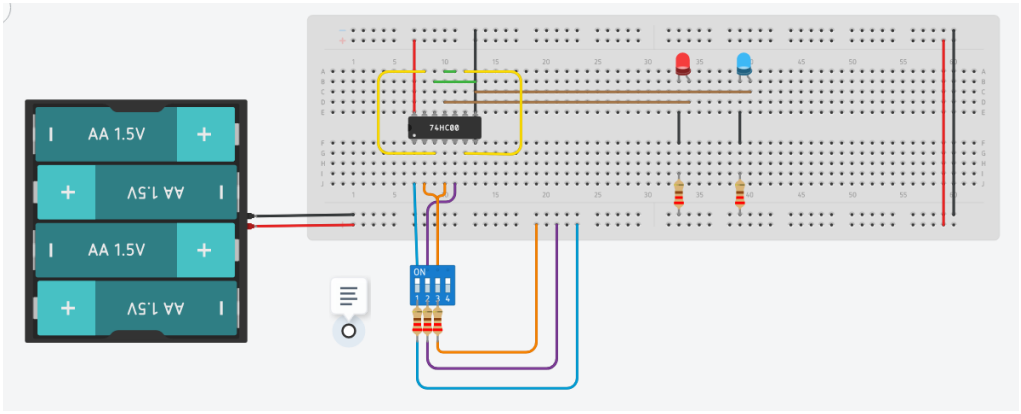
Student Name: _____ Student #:_____

1. Explain why the outputs change (or are stored from the previous output) when moving from steps a through m of the Truth Table.

When moving from steps “a” through “m” of the truth table.the output changes when every clock pulse goes from low to high.

2. Are the outputs for step m of the Truth Table complements? Could this indicate a problem?

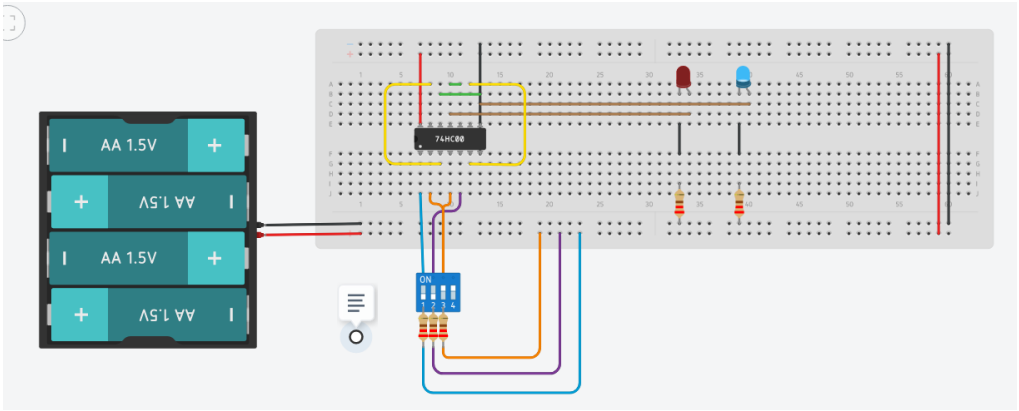
No, the outputs for step m are not complements of each other as Q and Q’ are both 1.



3. Move from step m to step n of the Truth Table several times. Are the outputs consistent?

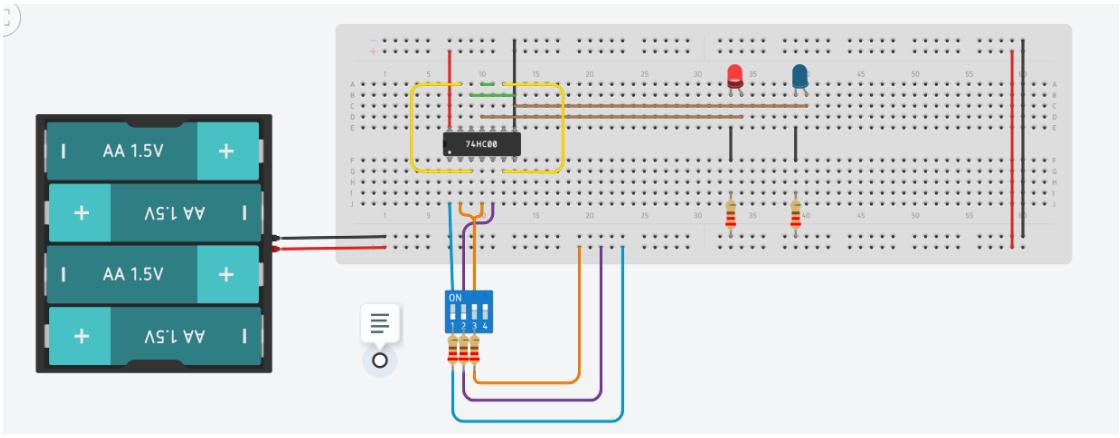
The outputs are not consistent as it depends on the order of turning off S and R.

When S is turned off, followed by R



When R is turned off, followed by S

Student Name: _____ Student #:_____



4. What is the “forbidden state”?

The forbidden state is when all inputs are 1, as the outputs of Q and Q’ are both 1. This is forbidden because Q and Q’ are complements of each other hence they cannot be in the same state.