# ECE 320 - Quiz #8 - Name _____

Boolean Logic, DTL, TTL Logic.

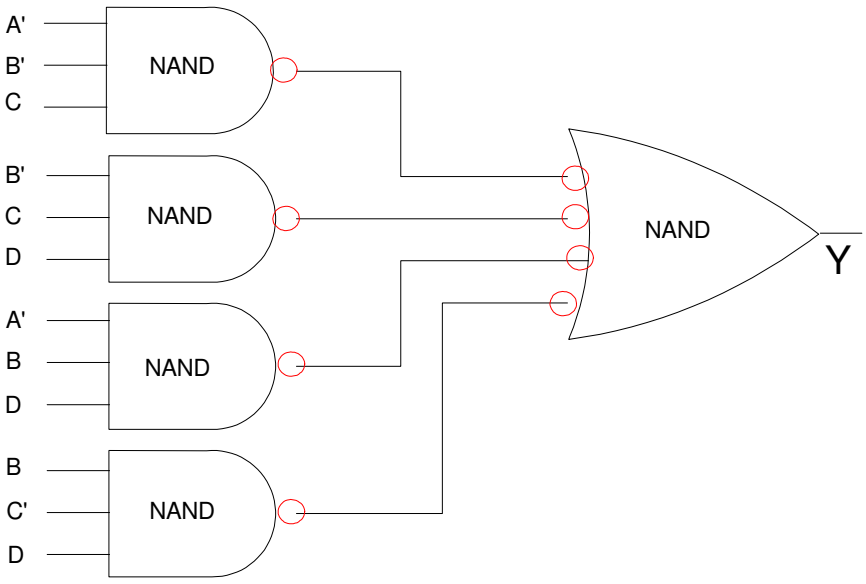
## Boolean Logic

1) Implement the following logic using NAND gates (circuit the ones).
   - Y = 1 if ABCD is prime: {2, 3, 5, 7, 11, 13}

Y

| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 0 | 1 | 1 |
| 01 | 0 | 1 | 1 | 0 |
| 11 | 0 | 1 | 0 | 0 |
| 10 | 0 | 0 | 1 | 0 |

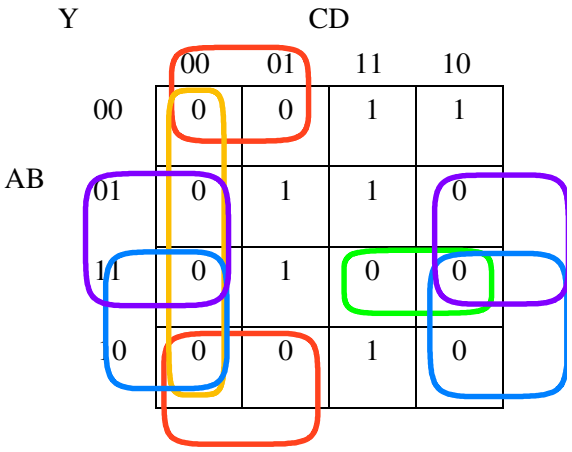
Y = A'B'C + B'CD + A'BD + BC'D



## Boolean Logic

2) Implement the following logic using NOR gates (circuit the zeros).

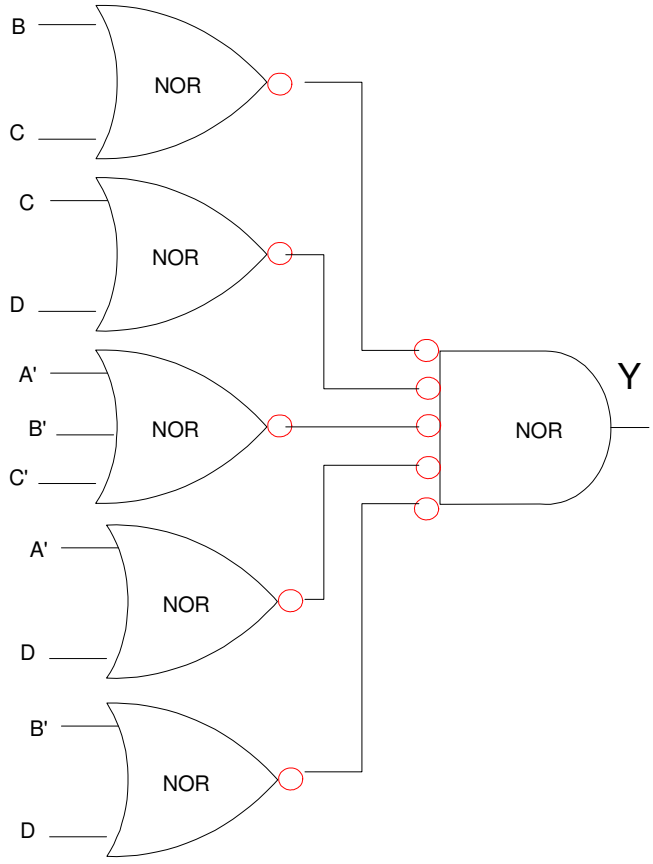
- Y = 1 if ABCD is prime: {2, 3, 5, 7, 11, 13}




Y' = B'C' + C'D' + ABC + AD' + BD'

using DeMorgan's theorem

Y = (B + C)(C + D)(A' + B' + C')(A' + D)(B' + D)

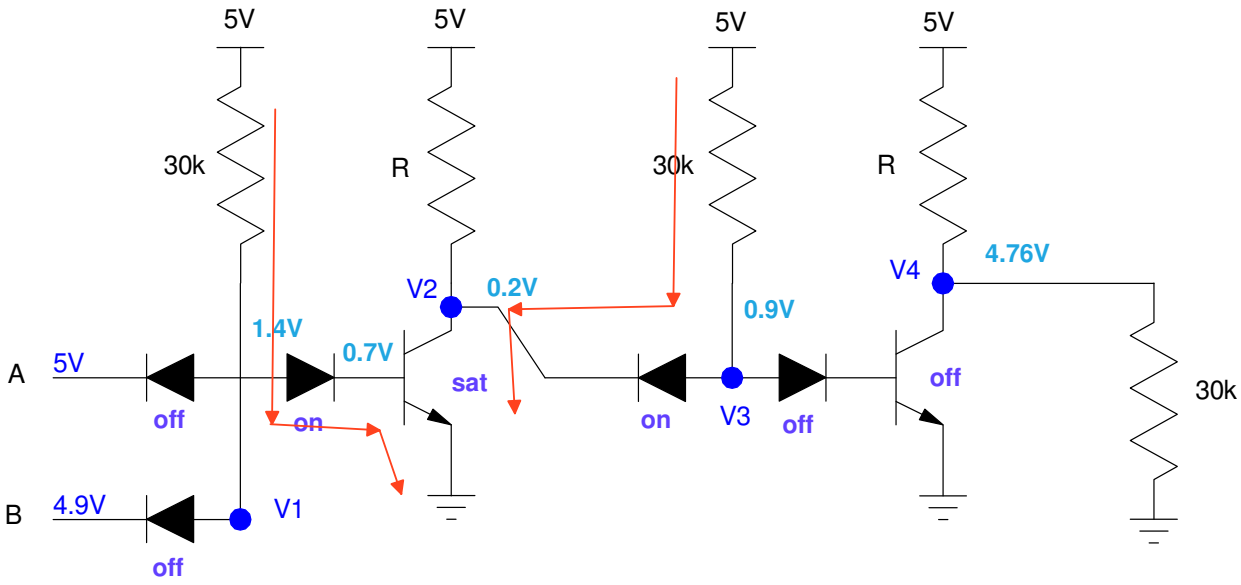


## DTL Logic Gate:

3) Determine the voltges and currents for the following DTL gate. Assume

- Ideal 3904 transistors (Vbe = 0.7V, Vce(sat) = 0.2V, gain = 100)
- Ideal silicon diodes (Vf = 0.7V)
- R = 1000 + 100(Birth Month) + (Birth Day). For example, May 14th gives R = 1514 Ohms.

| R | V1 | V2 | V3 | V4 |
|---|---|---|---|---|
| **1514** | **1.4V** | **0.2V**<br>T1 saturated | **0.9V** | **4.76V**<br>T2 off |

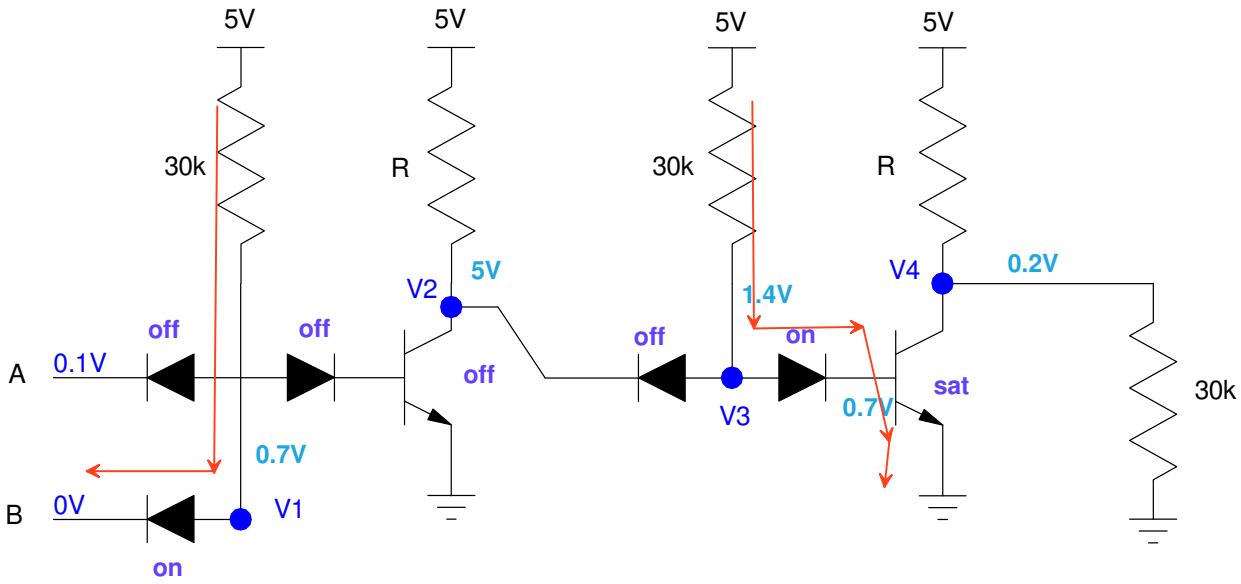


## DTL Logic Gate:

4) Determine the voltges and currents for the following DTL gate. Assume

- Ideal 3904 transistors (Vbe = 0.7V, Vce(sat) = 0.2V, gain = 100)
- Ideal silicon diodes (Vf = 0.7V)
- R = 1000 + 100(Birth Month) + (Birth Day). For example, May 14th gives R = 1514 Ohms.

| R | V1 | V2 | V3 | V4 |
|---|---|---|---|---|
| **1514** | **0.7V** | **5V** | **1.4V** | **0.2V** |

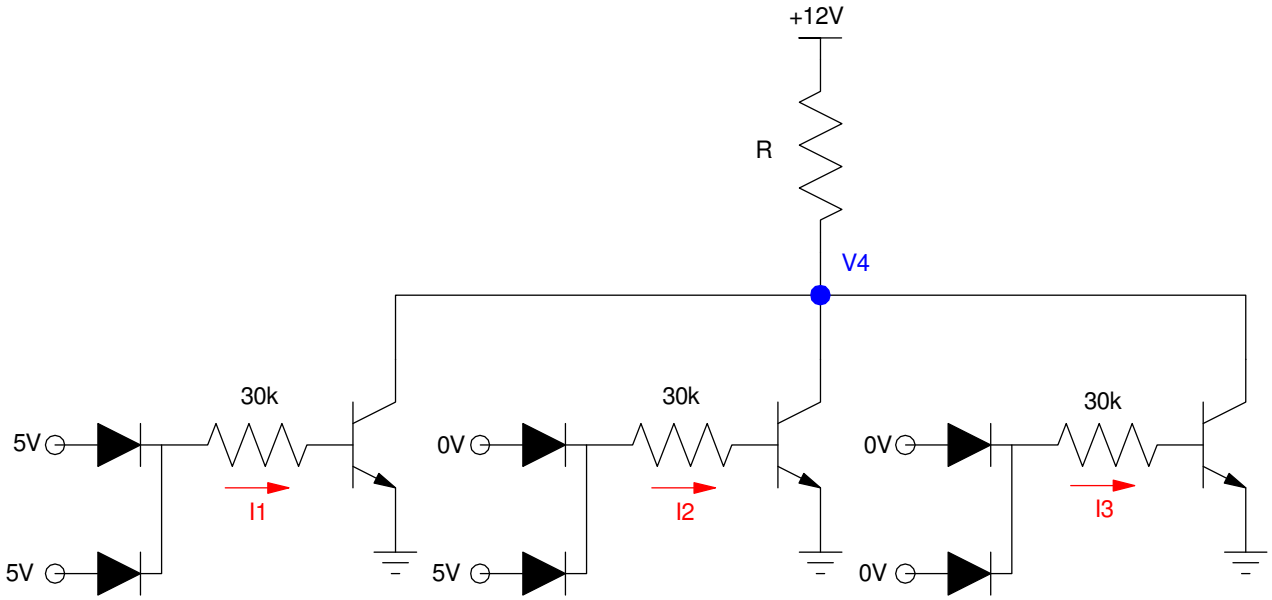


## Open Collector Logic

5) Determine the voltages and currents for the following circuit. Assume

- Ideal silicon diodes (Vf = 0.7V)
- Vbe = 0.7V
- β = 100
- R = 1000 + 100(Birth Month) + (Birth Day). For example, May 14th gives R = 1514 Ohms.

| R | I1 | I2 | I3 | V4 |
|---|---|---|---|---|
| **1514** | **120uA** | **120uA** | **0** | **0.2V** saturated |




$$I_1 = \left(\frac{5V - 1.4V}{30k}\right) = 120\mu A$$

$$I_2 = \left(\frac{5V - 1.4V}{30k}\right) = 120\mu A$$

$$I_3 = 0$$

$$I_R = \left(\frac{12V - 0.2V}{1514}\right) = 7.794mA$$

Check that the transistors are saturated

$\beta I_b = 100 \cdot 120\mu A = 12mA$ (x 2 meaning the transistors together allow 24mA to flow)

$24mA > 7.74mA$ saturated

## TTL Logic

6) Determine the voltges and currents for the following DTL gate. Assume

- Ideal 3904 transistors (Vbe = 0.7V, Vce(sat) = 0.2V, $\beta$ = 2 (left) or 100 (right) transistor
- R = 1000 + 100(Birth Month) + (Birth Day). For example, May 14th gives R = 1514 Ohms.

| R | V1 | V2 | V3 | V4 |
|---|---|---|---|---|
| **1514** | **4.273V** | **1.4V** | **0.7V** | **0.2V** |