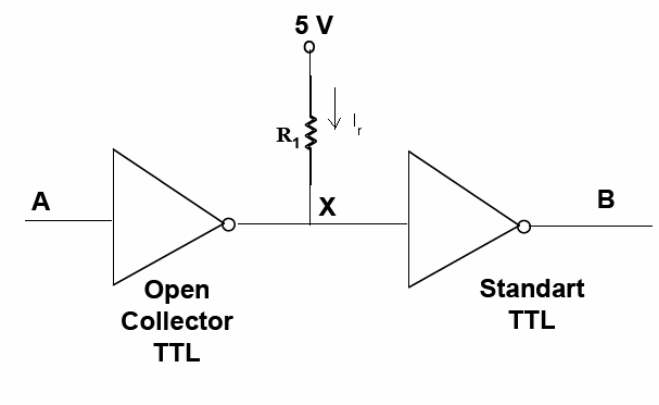
Homework 7
Solution for Problem 4

Open Collector TTL
$V_{supply} = 5$ V
$I_{OH\ Max} = 250\ \mu A$
$I_{OL\ Max} = 20$ mA
$V_{OL\ Max} = 0.4$ V

Standart TTL
$V_{supply} = 5$ V
$I_{IL\ Max} = -2$ mA
$I_{IH\ Max} = 250\ \mu A$
$V_{IH\ Min} = 2.0$ V
$V_{IL\ Max} = 0.8$ V

a)

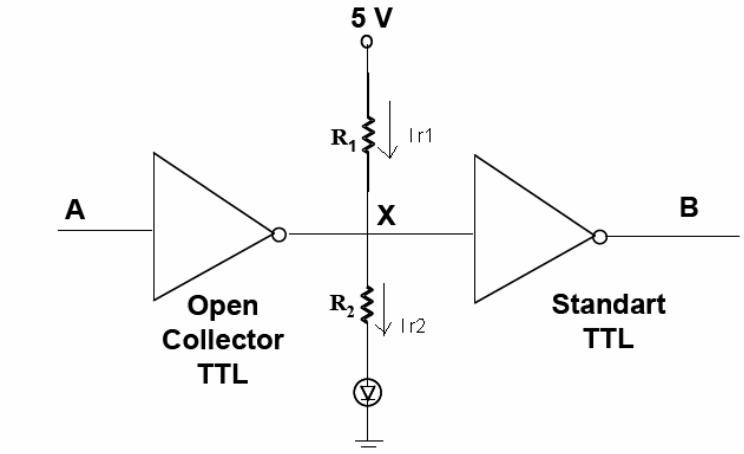


High input and high output ; and LED is off :

Vxmax=0.4 V ; I rmax=20-2 = 18 mA

$$R_{1min} = \frac{(5-0{,}4)V}{18mA} = 255.56\ \Omega$$

b) **Low input, output B is low and LED is on :**



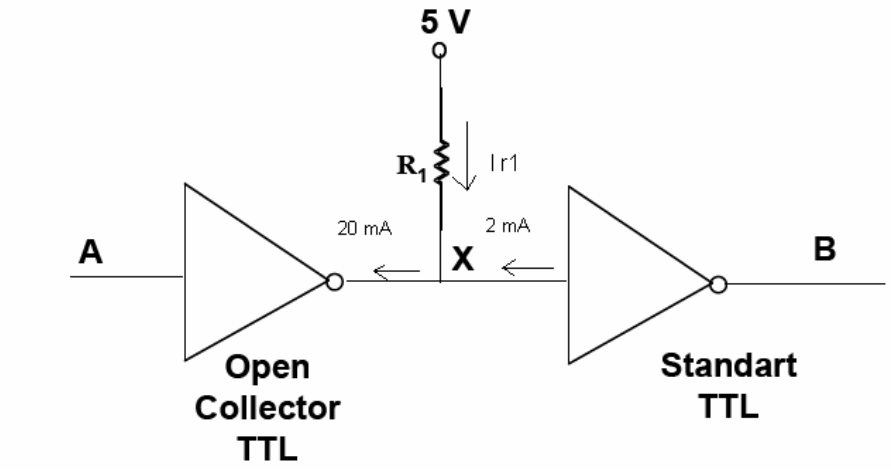
Vx = $V_{IH\ min}$; I_{r2} = 1 mA

For open collector TTL I_{OHmax} = 250 µA ; for standart TTL I_{IHmax}= 250 µA

I_{r2min}= 1+0,25+0,25 = 1.5 mA

$R_{1max}=\frac{(5-2)V}{1.5\mu A}$ = 2 k Ω

c) R_1= 1 k Ω , R_2= 500 Ω



low X case :

Vx = $V_{OL\ max}$ = 0.4 V ; I_{r2} = 0 ; I_{OLmax} =20 mA ; I_{ILmax}= -2 mA

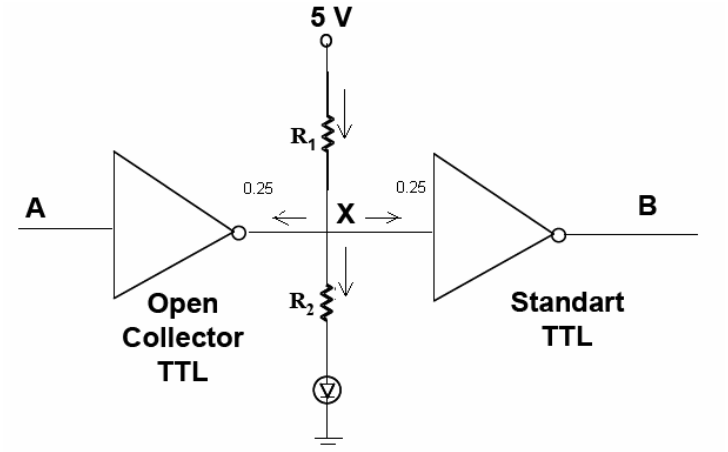
$I_{r1} = \frac{5-0,4}{1000}$ = 4,6 mA

I_{r1} + N I'_{ILmax} = I_{OLmax}

4,6 + 2 * N = 20

N= 7

High X case :



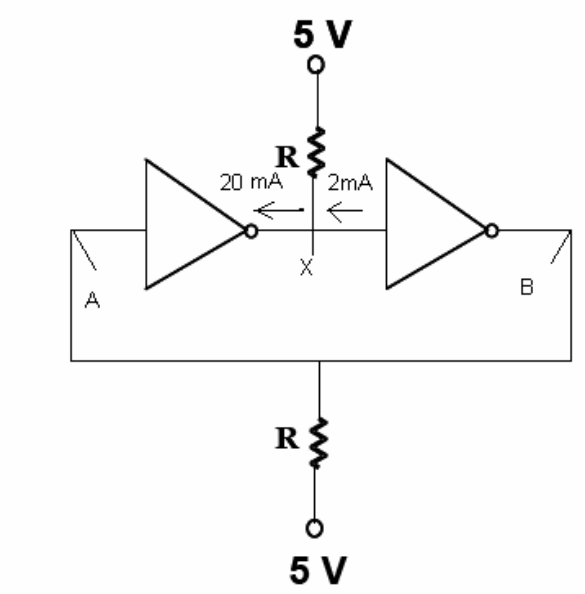
$I_{r1} = \frac{5-2}{1000} = 3\ mA$; $I_{r2} = \frac{2-0,9}{500} = 2.2\ mA$

$I_{r1} = 0.25 + N\ 0.25 + I_{r2}$

$3 = 0.250 + 2.2 + N\ 0.25$

$\underline{N = 2}$

2)



Case 1 :

A is high ; X low and B is high.

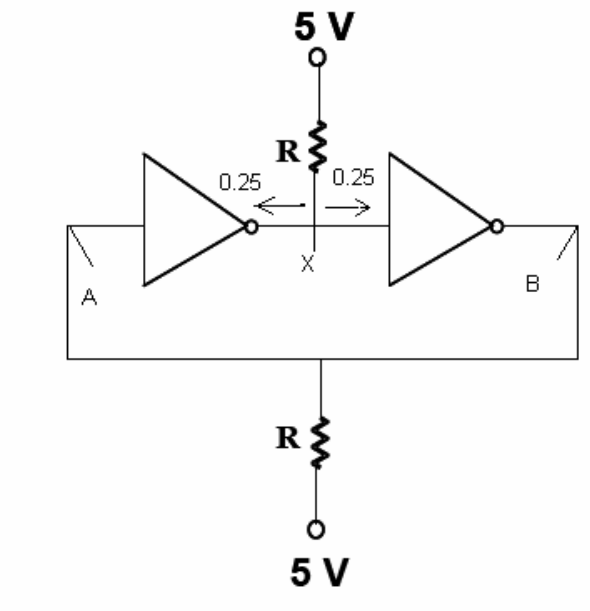
$V_{OL\ max} = 0.4\ V$

$I_R = I_{OLmax} - I_{ILmax} = 20 - 2 = 18\ mA$

$R \geq \frac{5-0.4}{18} = 255,56\ \Omega$

Case 2 :

A is low ; X high and B is low.



$I_R = I_{OHmax} + I_{Ihmax} = 0.25 + 0.25 = 0.5$ mA

$Vx = V_{IH\ min} = 2$ V

$$R \leq \frac{5-2}{0.5} = 6\ \text{k}\ \Omega$$

Therefore the interval of R should be ;

$255{,}56\ \Omega \leq R \leq 6000\ \Omega$

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