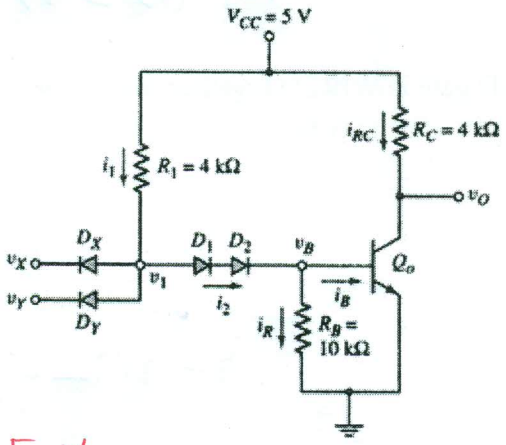
Quiz 2

Name ID:

a) Calculate the current i_1, i_2, i_R, i_B, i_{RC}. Determine the total power dissipation of the following DTL gate. Given, **$V_x=V_y=$ 5V (Logic high) and $V_x=V_y=0{\cdot}2V$ (Logic low)**. Given, **$V_{(Diode)on}=0{\cdot}7V$; $V_{BE\,(SAT)}=0{\cdot}8V$ and $V_{CE\,(SAT)}=0{\cdot}2V$.** [10]



For $V_X = V_Y = 5$ V;

i) $V_1 = V_{D1} + V_{D2} + V_{BE(Q0)} = 0{\cdot}7 + 0{\cdot}7 + 0{\cdot}8 = 2{\cdot}2$V

ii) $i_1 = \dfrac{V_{CC} - V_{B1}}{R_1} = \dfrac{5 - 2{\cdot}2}{4} = 0{\cdot}7$mA

iii) $i_2 = i_1 = 0{\cdot}7$mA

iv) $i_R = \dfrac{V_{BE(Q0)}}{R_B} = \dfrac{0{\cdot}8}{10} = {\cdot}08$mA

v) $i_B = i_2 - i_R = (0{\cdot}7 - 0{\cdot}08) = 0{\cdot}62$mA

vi) $i_{RC} = \dfrac{V_{CC} - V_O}{R_C} = \dfrac{5 - 0{\cdot}2}{4} = 1{\cdot}2$mA

vii) Power = $V_{CC}(i_1 + i_{RC})$

High = $5(0{\cdot}7 + 1{\cdot}2)$

$P_{high} = 9{\cdot}5$mW

For $V_x = V_y = 0.2V$, $V_1 = V_{Dx} + V_x = 0.7 + 0.2 = 0.9V$

$P_{low} = V_{cc} \times i_1 = V_{cc}\left(\frac{V_{cc} - 0.9}{4}\right) = 5 \times \frac{4.1}{4}$

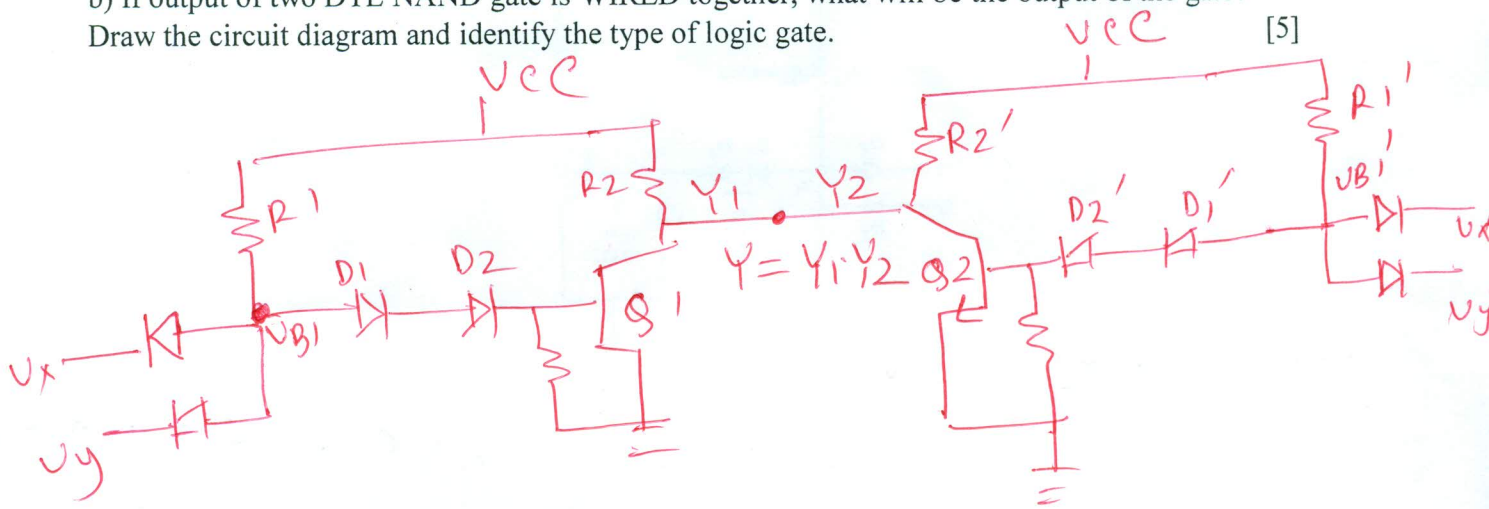
Total power = $P_{high} + P_{low}$, $= 5.125mW$

$= 9.5 + 5.125$

$= 14.625mW$

$i_2 = i_R = i_B = i_{RC} = 0$

b) If output of two DTL NAND gate is WIRED together, what will be the output of the gate? Draw the circuit diagram and identify the type of logic gate. [5]



AND gate.

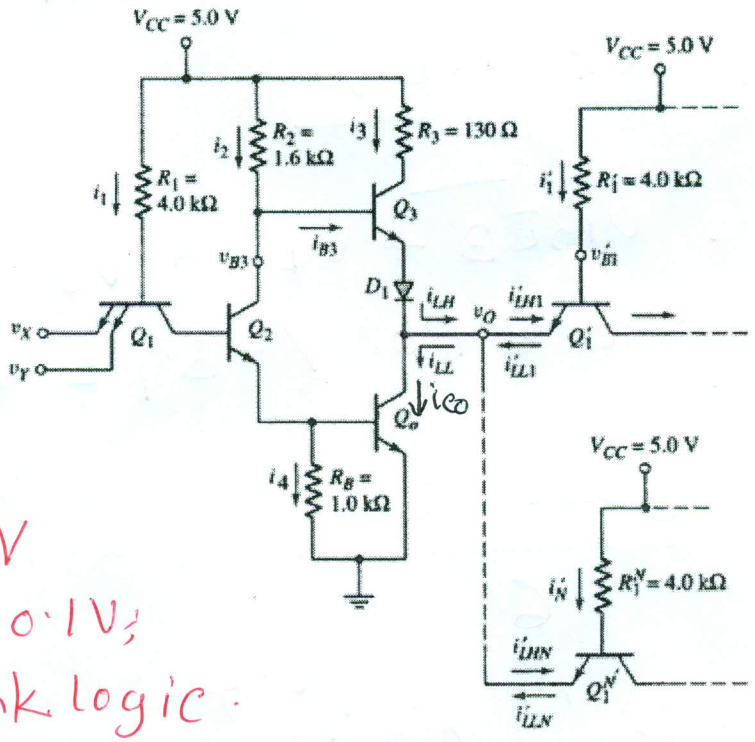
$Y = 1$ if both Y_1 & Y_2 are 1

For all other case $Y = 0$

Quiz 3

Name ID:

1. In the TTL circuit below, the transistors parameters is β =25, β_R=0.2. Calculate the maximum fan out for (a) Vx=Vy=5V and (b) V_X=V_Y=0.1V and V_0=3.1 V. Given rated maximum collector current, $I_{CO(rated)}$ = 16mA. $V_{BC(ON)}$= 0.7V, $V_{BE(sat)}$= 0.8V, $V_{CE(SAT)}$= 0.1V, $V_{D1(ON)}$= 0.7V. [15]



i) $V_X = V_Y = 5\,V$

ii) V_O = low = 0.1V; current sink logic.

iii) $i_1' = i_{LL1}'$

iii) $N \cdot i_{LL1}' = i_{CO}(rated)$

$$N = \frac{i_{CO}}{i_{LL1}'}$$

iv) $$i_{LL1}' = \frac{V_{CC} - V_{B1}'}{R_1'} \quad (V_{B1}' \rightarrow 0.8 + 0.1)$$

$$= \frac{5 - (0.8 + 0.1)}{4}$$

$$= 1.025\,mA$$

v) $$\therefore N = \frac{16}{1.025} \approx 15$$

ii) For $V_X = V_Y = 0.1V$

o/p high, current source Logic.

i) $i_{LH} = i_{E3} = N \cdot i_{LH1}'$

ii) $\therefore N = \dfrac{i_{E3}}{i_{LH1}'} = \dfrac{i_{B3}[1+\sigma \cdot \beta]}{i_{LH1}'}$

iii) $i_{B3} = \dfrac{V_{CC} - V_{B3}}{R_2}$

iv) $V_{B3} = V_{BE3} + V_{D1} + V_0$

$\therefore V_{B3} = 0.8 + 0.7 + 3.1 = 4.6V$

v) $i_{B3} = \dfrac{5 - 4.6}{1.6} = 0.25mA$

vi) $i_{LH1}' = i_{E1}' = \cancel{\alpha \beta_R} \cdot i_1$ (1, 0.2)

$i_1' = \left[\dfrac{V_{CC} - V_{B1}'}{R_1'}\right] \times 0.2 = \dfrac{5 - (0.7 + 0.8 + 0.8)}{4}$ (Q_1' R. Active)

$i_1' = \left(\dfrac{5 - 2.3}{4}\right) \times 0.2 = 0.675 = 0.135mA$

vii) $N = \dfrac{0.25[1 + (25 \times .85)]}{.135}$ ($25 \times .85 = 21.25$)

$= \dfrac{\cancel{.0425}}{\cancel{.135}} \approx \cancel{.39}$ $= \dfrac{5.56}{.135} = 41$