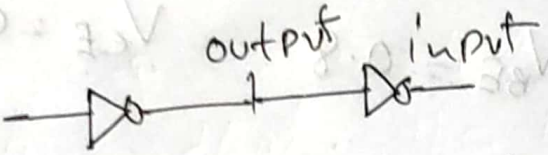
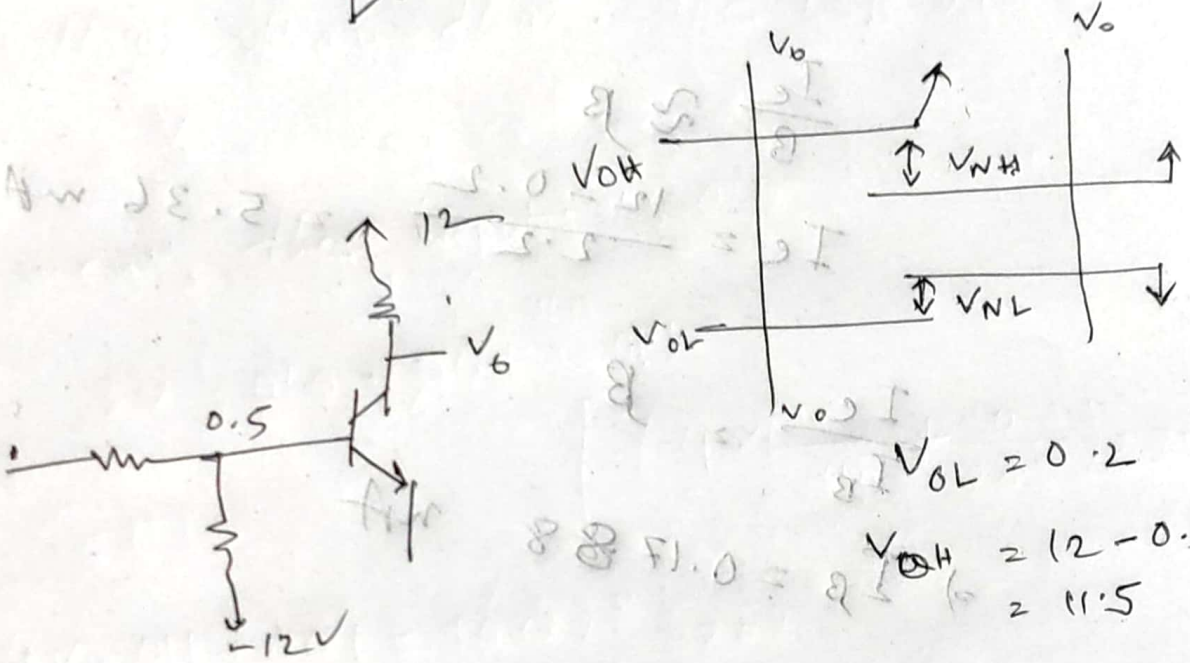
# Home work-3

## Noise margin:




$V_{OL} = 0.2$

$V_{OH} = 12 - 0.5$
$= 11.5$

$V_{IL}$ calculation, Think of 'input' when calculation of $V_{IL}$

$V_{BE} = 0.5V$ cutoff $I_C = I_B = I_E = 0$

$V_{BE} = 0.5$

$V - 0.5 = -0.125 \times 15$

$V_i = 0.5 + 15 \times 0.125$

$= 2.375$

$I_1 = I_2$

$\frac{0.5 - (-12)}{100} = I_2$

$\Rightarrow I_2 = 0.125$

## $V_{2H}$

### saturation.

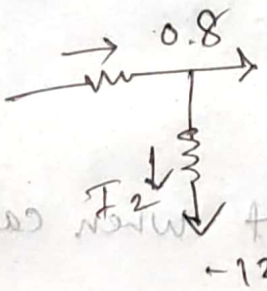
$V_{BE} = 0.8$ $V_{CE} = 0.2$

$$\frac{I_c}{B} \approx \beta$$

$$I_c = \frac{12 - 0.2}{2.2} = 5.36 \text{ mA}$$

$$\frac{I_c}{I_B} = \beta$$

$$\Rightarrow I_B = 0.1788$$




$$I_2 = \frac{0.8 + 12}{100}$$

$$= 0.128$$

$$I_1 = 0.128 + 0.1788$$

$$= 0.3068 \text{ mA}$$

$$0.3068 \times 15 = V_i - 0.8$$

$$\Rightarrow 0.3068 \times 15 + 0.8 = V_i$$

$$\therefore V_{IH} = 5.4018$$

$V_{NH} = 11.5 - 5.4018 = 6.098$

$V_{NL} = 2.375 - 0.2 = 2.175$

So, noise margin $= \min(V_{NH}, V_{NL}) = 2.175$