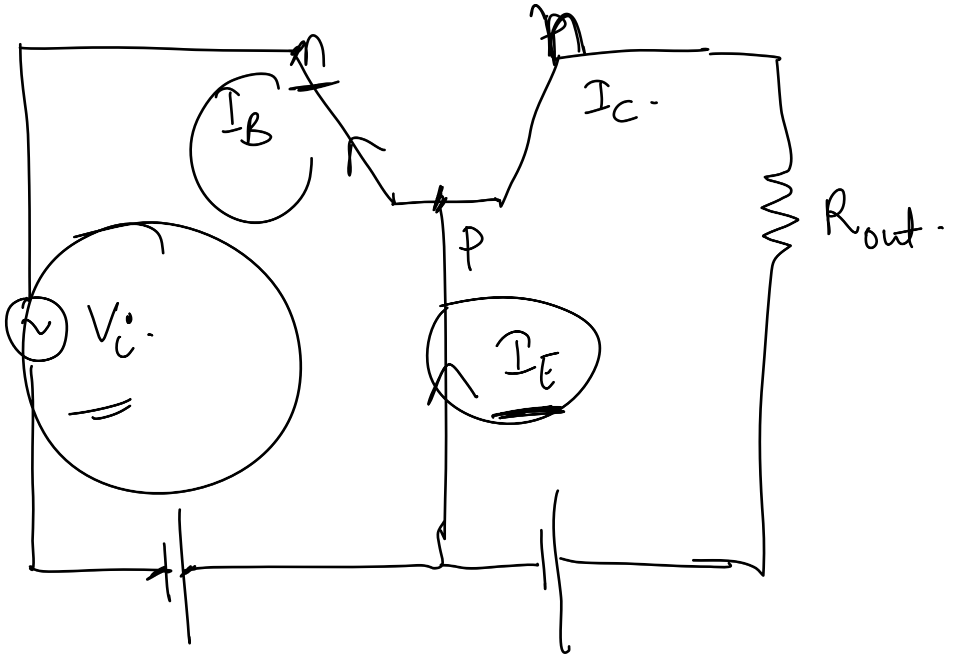
Transistor as a switch:

Cut off Region & Saturation Region:

Transistor as an amplifier: [Common Emitter]. Base → Input Signal.

Transistor as an amplifier works in the active region.

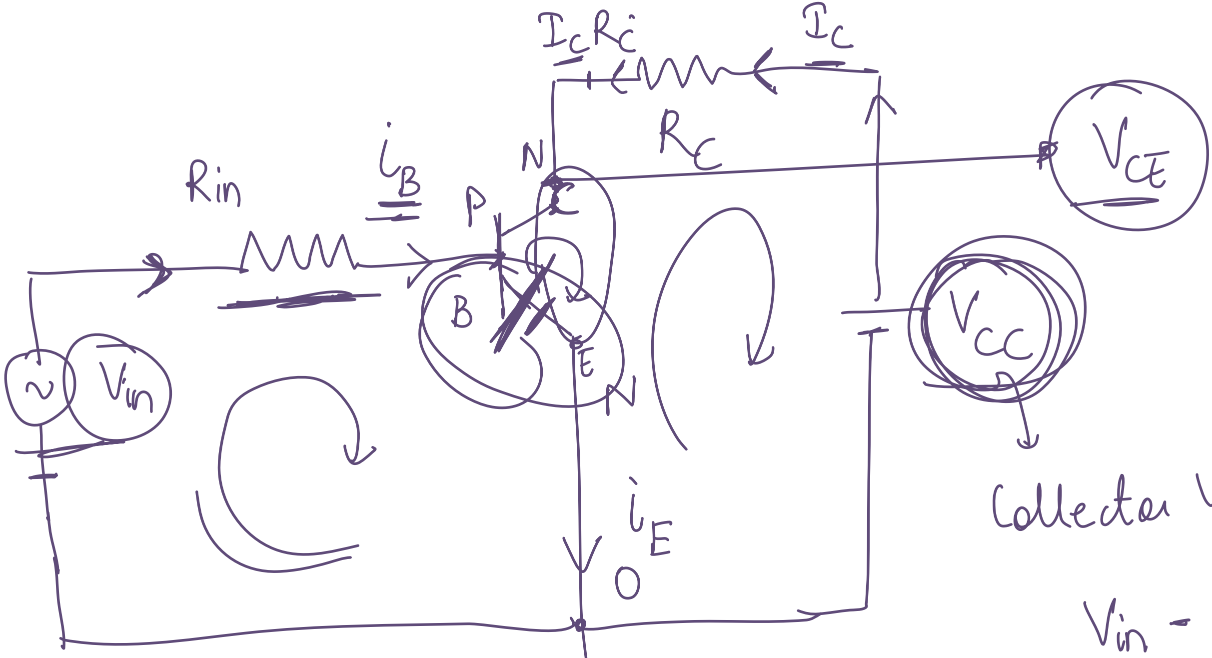
A transistor can take a very small weak signal through base junction and release the amplified signal



Base emitter junction is forward biased

Output circuit is reverse biased

A small change in signal voltage results in the change in the emitter current due to low resistance in the current.



Collector Voltage -

$$V_{in} - i_B R_B - V_{BE} = 0$$

$$V_0 = V_{CE} \Rightarrow V_{CC} - i_C R_C \quad \text{--- (1)}$$

$$V_{in} = i_B R_B + V_{BE}$$

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$$V_o = V_{CC} - i_c R_C$$

$$V_i = i_B R_B + V_{BE}$$

$$\Delta V_o = \Delta V_{CC} - \Delta i_c R_C$$

$\Delta V_{CC} \to 0$.

$$\Delta V_o = -\Delta i_c R_C \quad \text{——— (2)}$$

$$\Delta V_i = \Delta i_B R_B + \Delta V_{BE} \qquad \Delta V_{BE} \lll \Delta i_B R_B$$

$\Delta V_{BE} \to 0$.

$$\Delta V_i = \Delta i_B R_B . \quad \text{——— (1)}$$

$$\beta = \frac{\Delta i_C}{\Delta i_b} \qquad \Delta i_C \gg \Delta i_b.$$

$\beta > 1$.

Current Amplification factor

Current gain

Voltage gain : The gain in terms of voltage when there is change in input and output current is called voltage gain.

$$\frac{\Delta V_o}{\Delta V_i} = \frac{\Delta i_C R_C}{\Delta i_B R_B}$$

$$\frac{\Delta V_o}{\Delta V_i} = \beta \cdot \frac{R_C}{R_B} = \beta \frac{R_{out}}{R_{in}}$$

Power gain = $V_{gain} \, I_{gain}$

$$= \beta \frac{R_{out}}{R_{in}} \beta$$

$$\text{Power gain} \Rightarrow \beta^2 \frac{R_{out}}{R_{in}}$$

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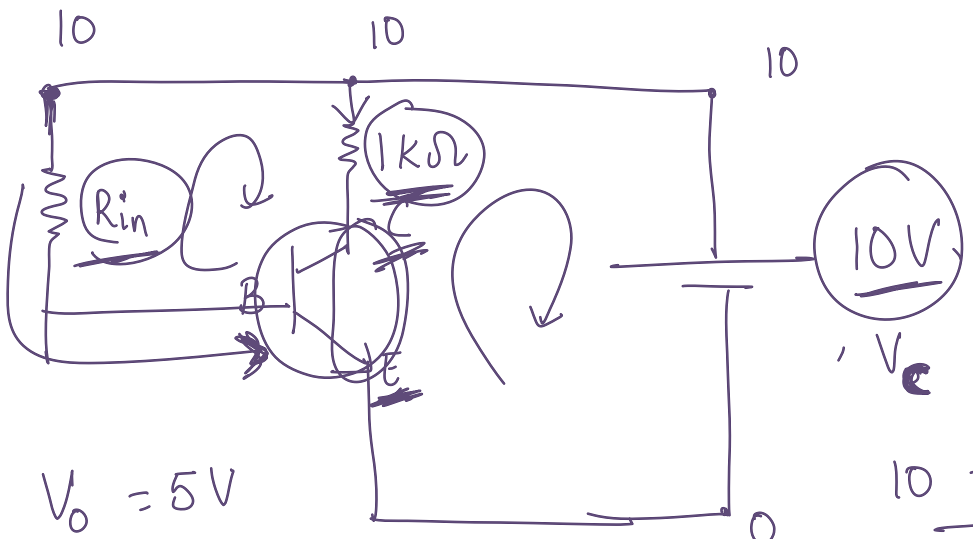
Ques.



$\beta = 100$

$R_{in} = ?$, $V_0 = 5V$

$V_{BE} = 0V$.

$V_c = i_c R_c + V_{CE}$.

$10 = i_c \times 1k\Omega + 5$.

$i_c = \frac{5}{1000} A = 5/1000 \, A$.

$10 = i_b R_{in} + V_{BE}$ ($V_{BE} = 0$).

$10 = i_b R_B$.

$\Rightarrow i_b = \frac{10}{R_B}$

$$\beta = \frac{i_c}{i_b}$$

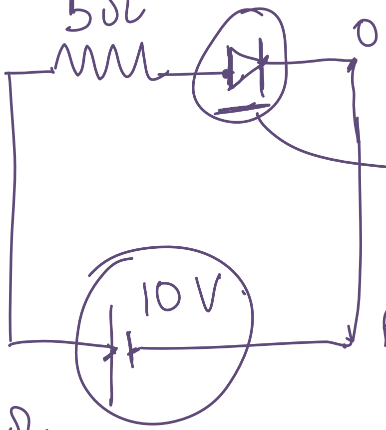
$$100 = \frac{\cancel{5}/1000}{\cancel{10}\,2/R_B}$$

$$100 \times 1000 = \frac{R_B}{2}$$

$$R_B = 200 \times 1000\ \Omega$$

$$= 200\ k\Omega$$

Ques Calculate the current flowing in the circuit.

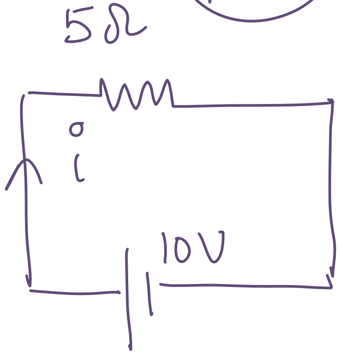


→ Forward Bias

$R \rightarrow 0$

Ideal diode, Forward bias

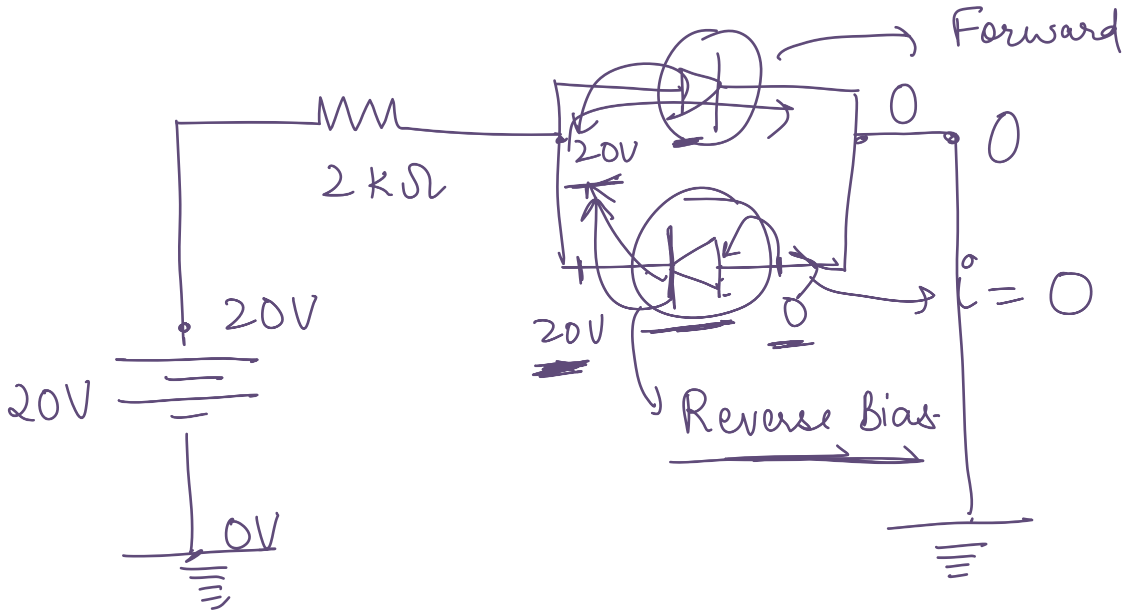
$R_{diode} = 0$



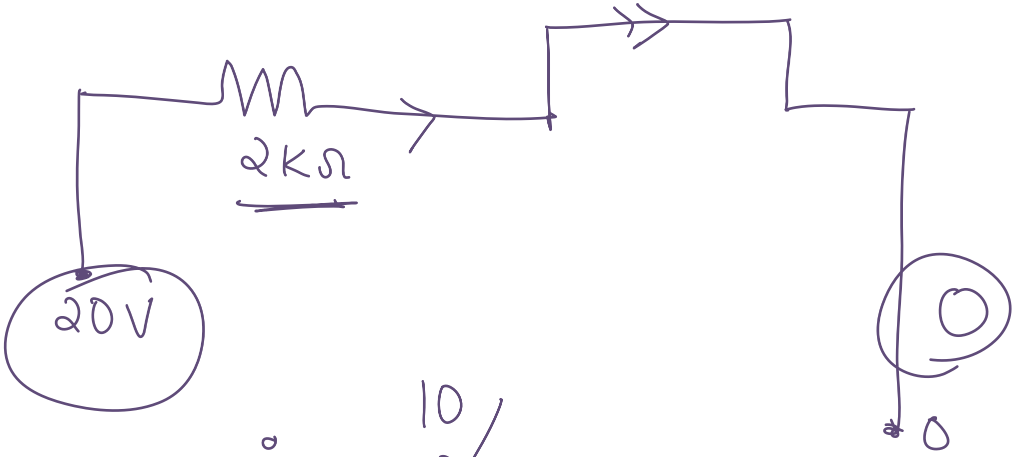
$$i = \frac{10}{5}$$

$$= 2A$$

Ques



Calculate current flowing in the circuit, assume resistance in forward bias = 0



D_2 is reverse biased.

So, '0' current

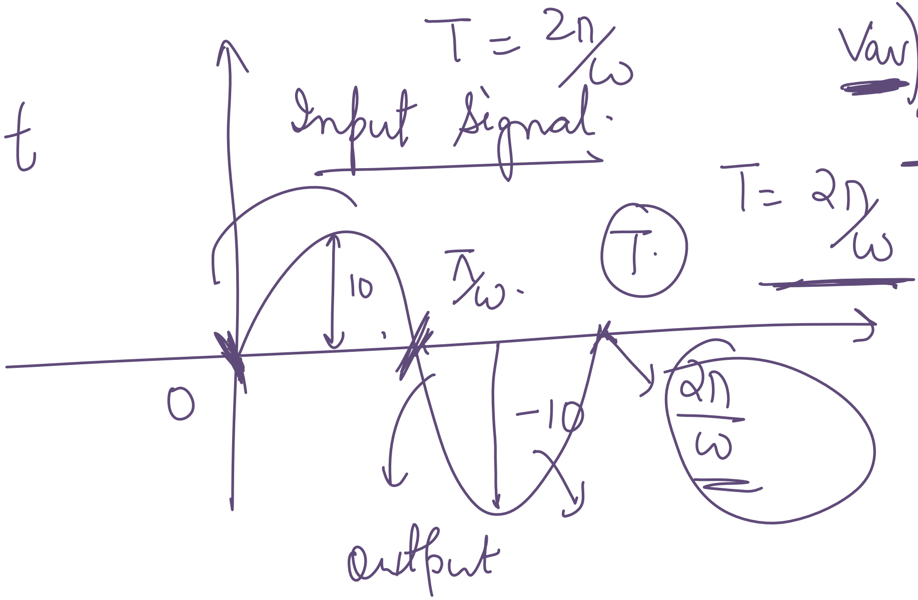
$$i = \frac{20 - 0}{2 \times 10^3}$$

$$= 10 \times 10^{-3}\ A = 10^{-2}\ A.$$

In half wave rectifier peak value of sinusodial signal is 10V

Determine the output voltage ---. (Average value).

$V_{in} = 10 \sin \omega t$



$$V_{av(out)} = \frac{\int_0^{\pi/\omega} V\,dt}{T}$$

$$T = \frac{2\pi}{\omega}$$

$$\Rightarrow \frac{\int_0^{\pi/\omega} 10 \sin\omega t \, dt}{2\pi/\omega}$$

$$\Rightarrow \frac{\overset{5}{\cancel{10}} \int_0^{\pi/\omega} \sin\omega t \, dt}{\cancel{2}\pi/\omega}$$

$$\Rightarrow \frac{5\omega}{\pi}\left[\frac{-\cos\omega t}{\omega}\right]_0^{\pi/\omega}$$

$$\Rightarrow \frac{5\cancel{\omega}}{\pi}\left[\frac{-\cos\cancel{\omega}\times\frac{\pi}{\cancel{\omega}} - (-\cos 0)}{\cancel{\omega}}\right]$$

$$\Rightarrow \frac{5}{\pi}\left[-\cos\pi + 1\right]$$

$$\Rightarrow \frac{5}{\pi}\left[-1(-1)+1\right]$$

$$\Rightarrow \frac{5}{\pi}(1+1) = \frac{10}{\pi}\ A.$$