# Transistor Amplifier Simplified

This presentation tries to clear the concept of a **Transistor Amplifier.**

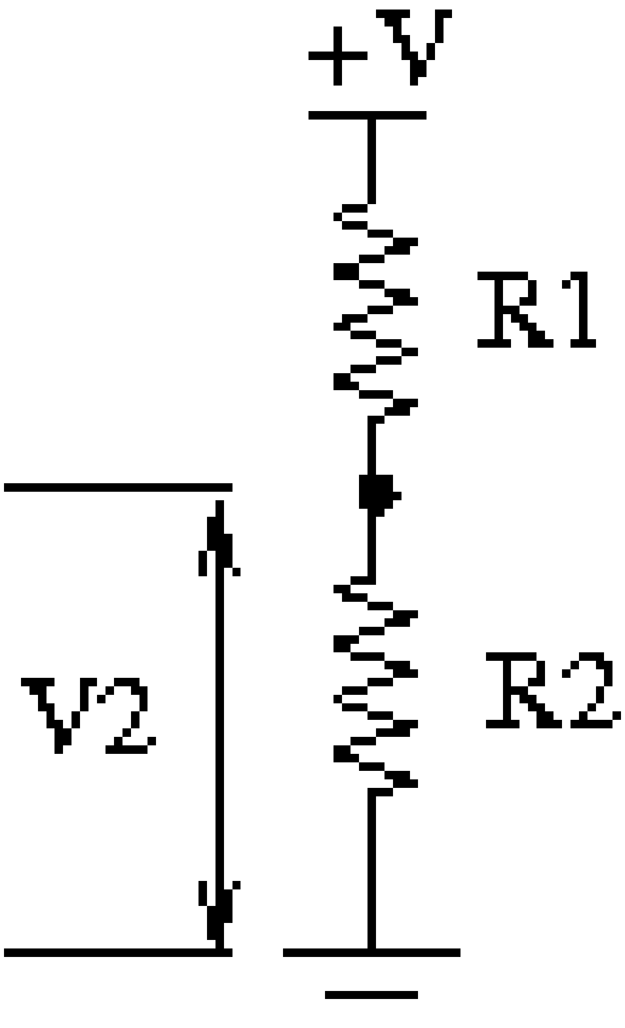
*Please Note: Some ideas are over-simplified to understand the main concept.*

**Author: Prasad Mehendale**



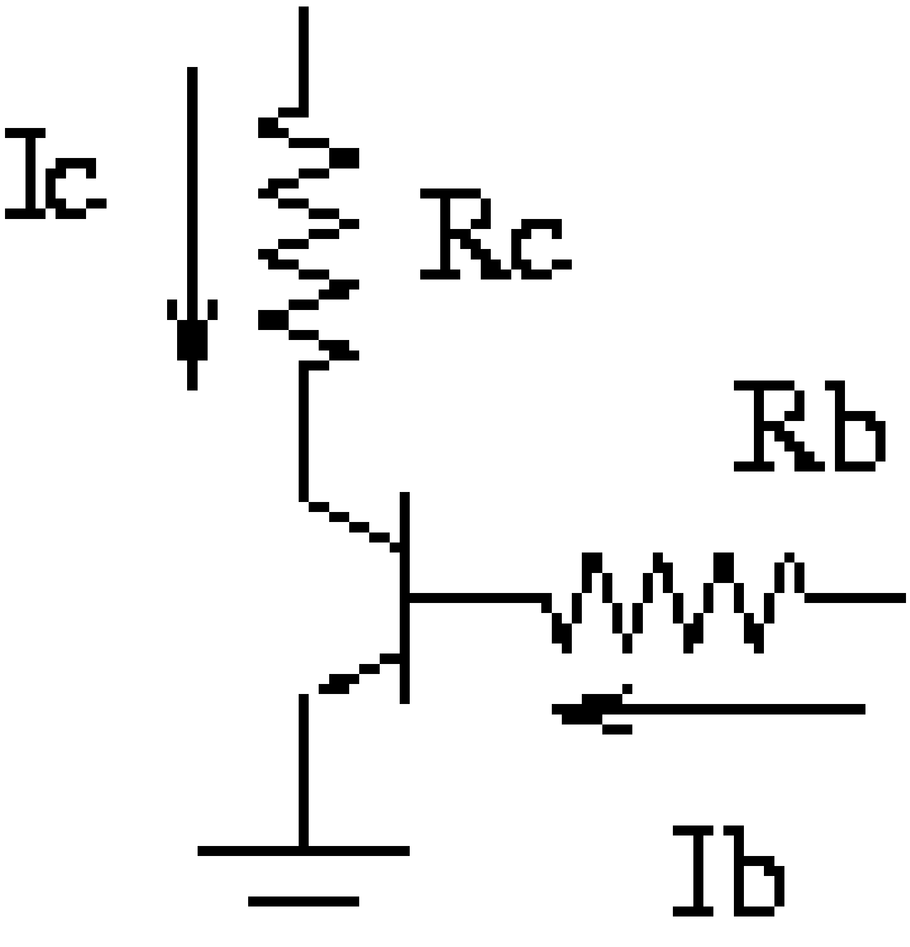
**Your questions and suggestions are welcome.**

# Resistance Potential Divider



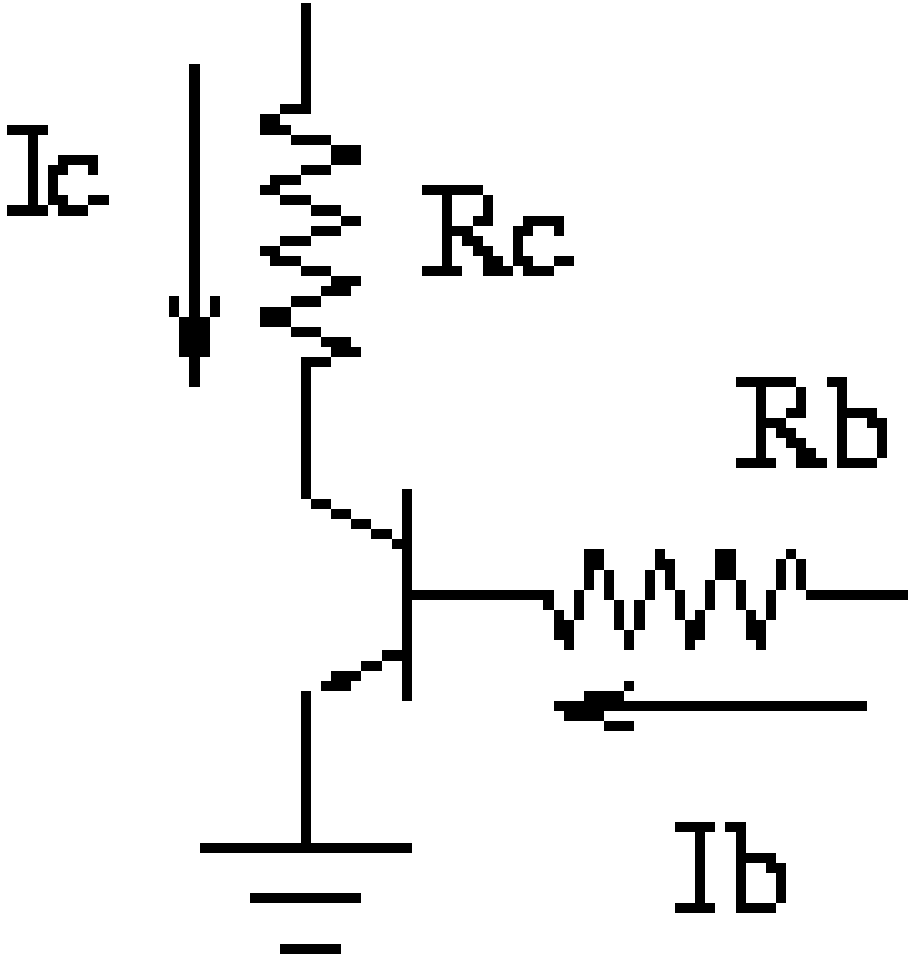

- V2= (V * R2)/(R1+R2)
- So, more is the value of R2, more is the voltage drop across it.

# Transistor: Transferred Resistor-1



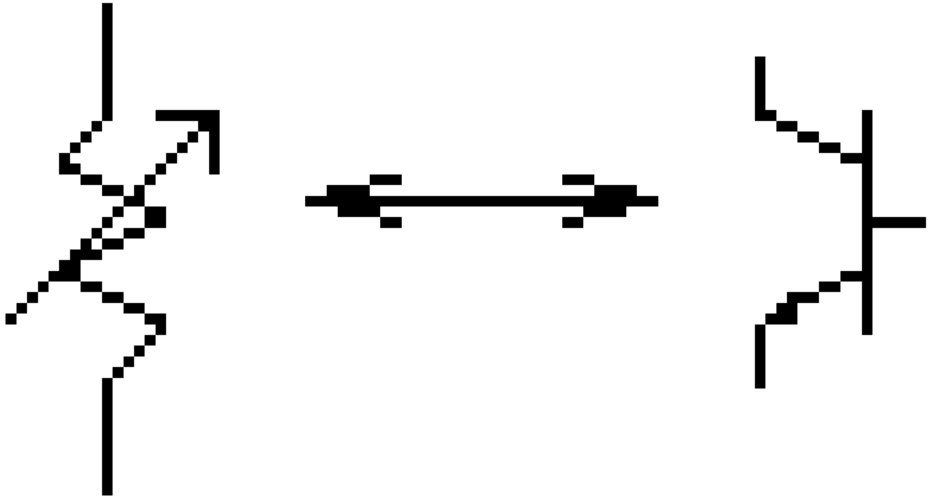

- When you increase the base current, collector to emitter current increases
- It means, Collector to emitter resistance decreases.

# Transistor: Transferred Resistor-2



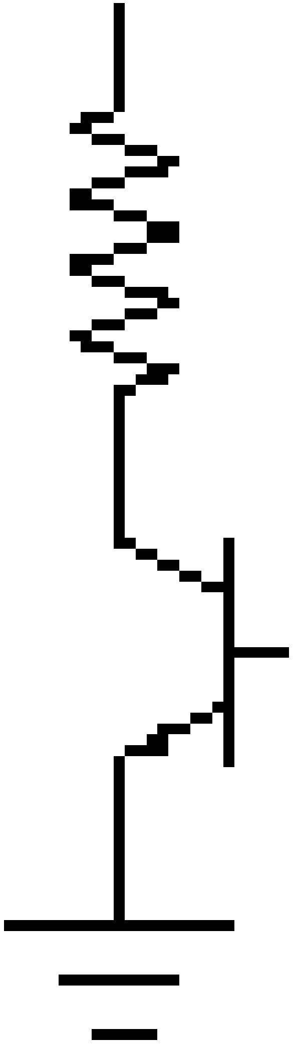

- When base current decreases, collector current also decreases.
- It means, Collector to Emitter resistance increases.

# Transistor: Electrically Variable Resistor



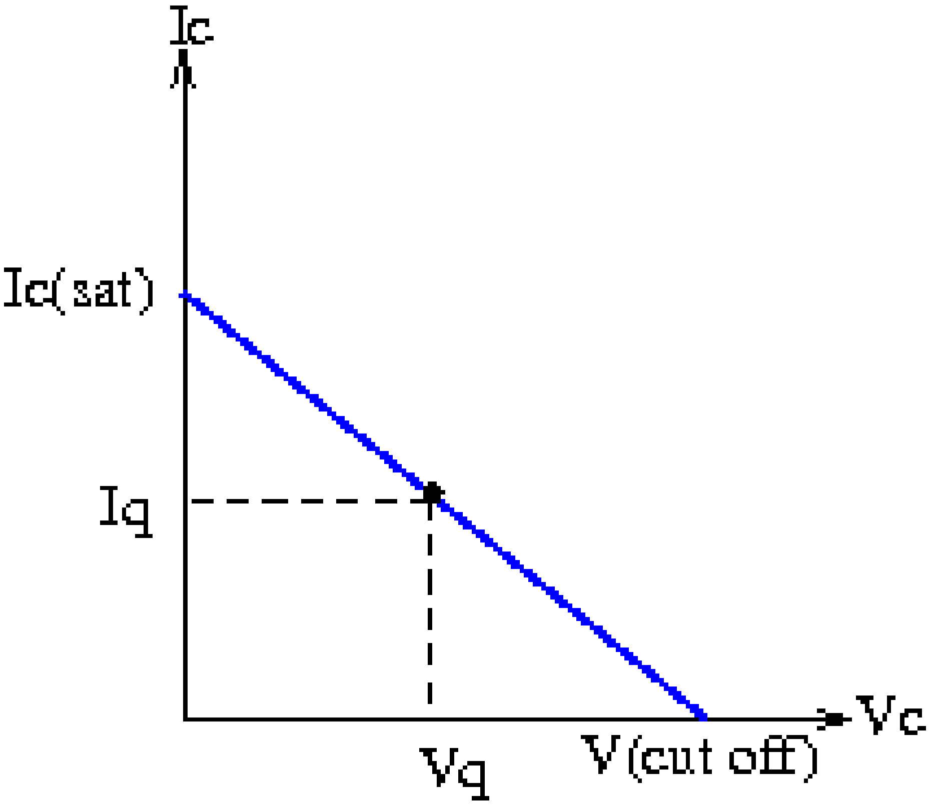
- So transistor can be considered as an electrically variable resistor.
- More is the base current, lesser is the resistance of CE region and vice versa.

# Potential Divider (again...)



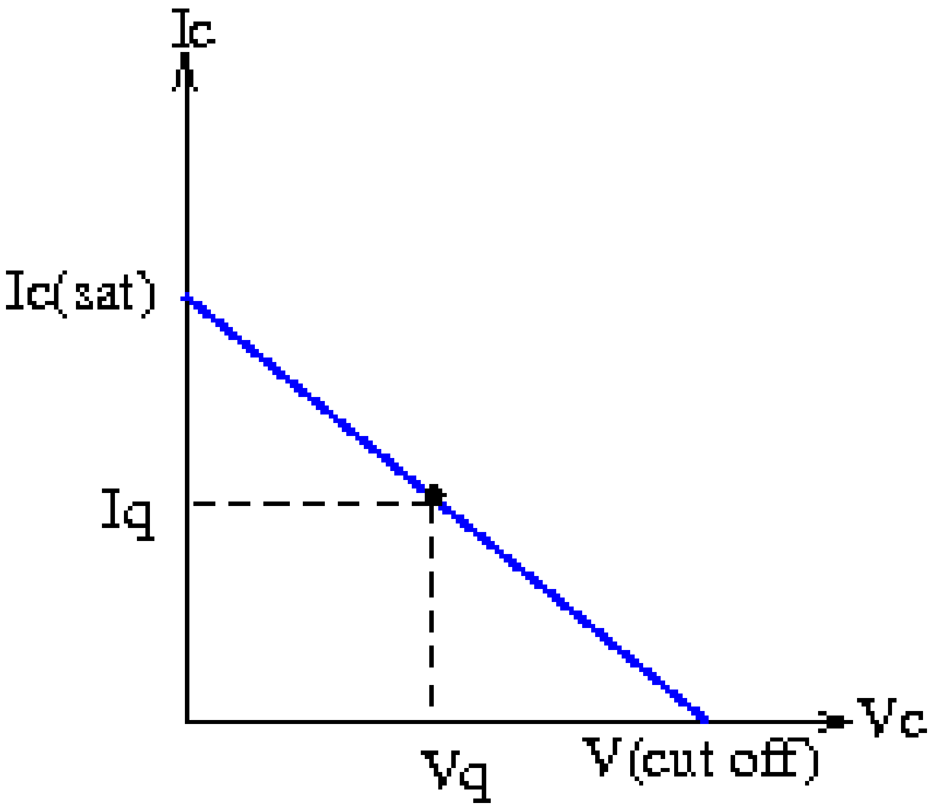
- Imagine the transistor in series with the collector-emitter resistor.
- The resistance and the transistor now form the potential divider

# The “Load Line” - 1



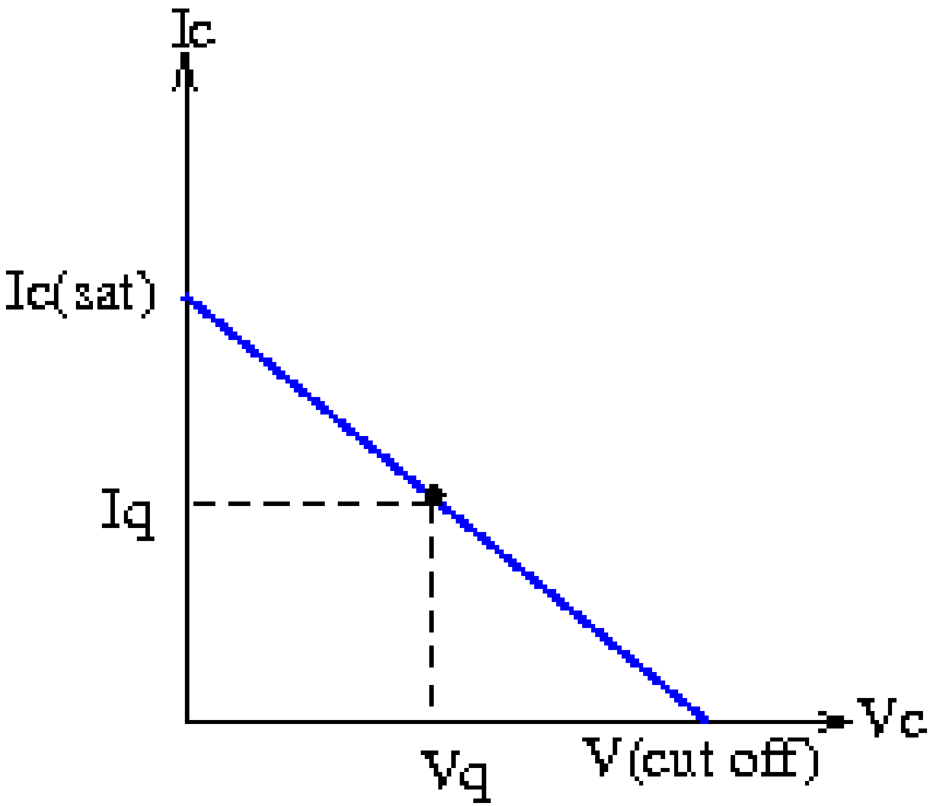

- When transistor is full of majority carriers, it is saturated with the majority carriers.
- So “saturated” current flows through the transistor, from collector to emitter.
- This is **Ic(sat)**

# The “Load Line” - 2




- When no current is injected in to the base, there are no majority carriers in the collector-emitter region so the transistor is open.
- Collector voltage is maximum.
- This is cut-off condition

# The “Load Line” - 3

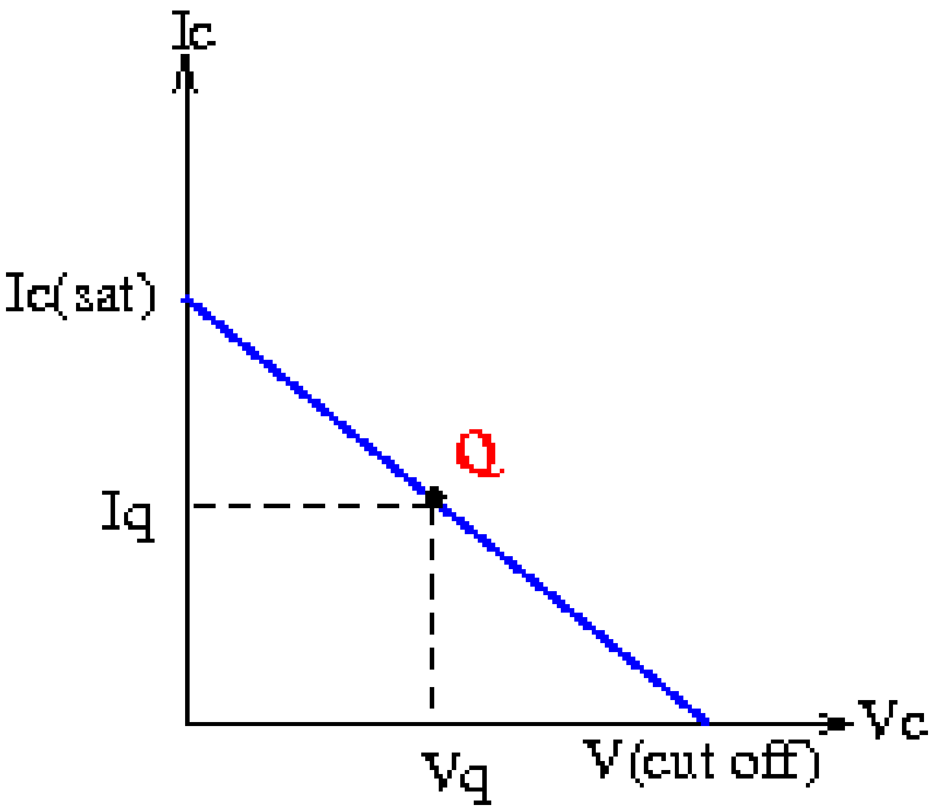



- Straight line between Ic(sat) and V(cut-off) is known as

  **The “Load Line”**

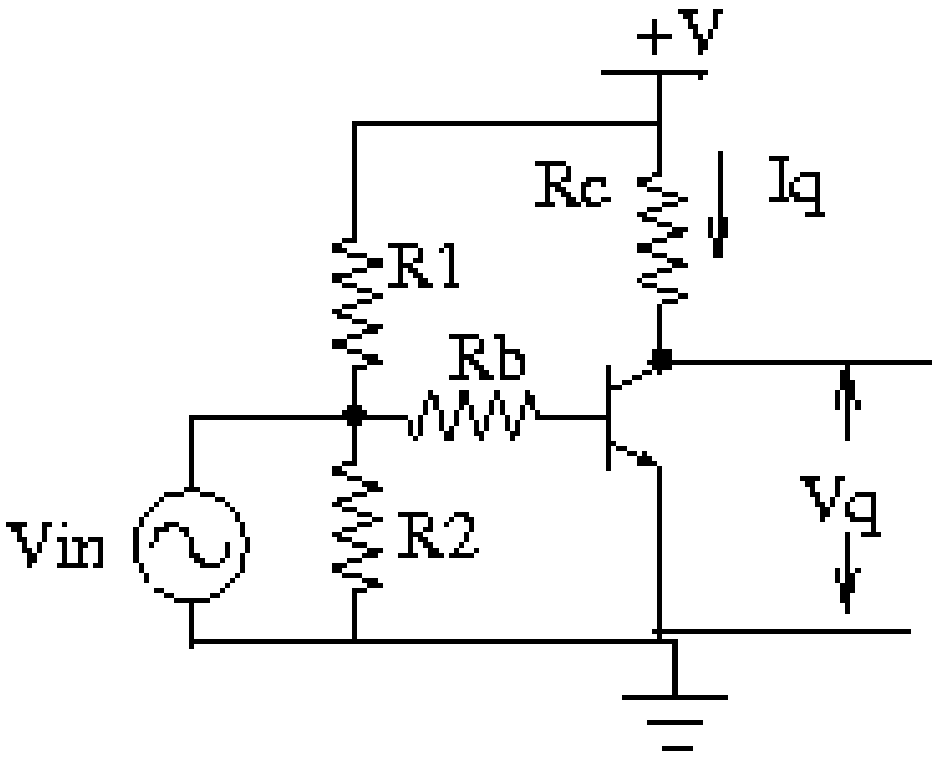
- **The point on the load line with co-ordinates (Vq,Iq) is called the Quiescent point.**

# The "Quiescent Point"



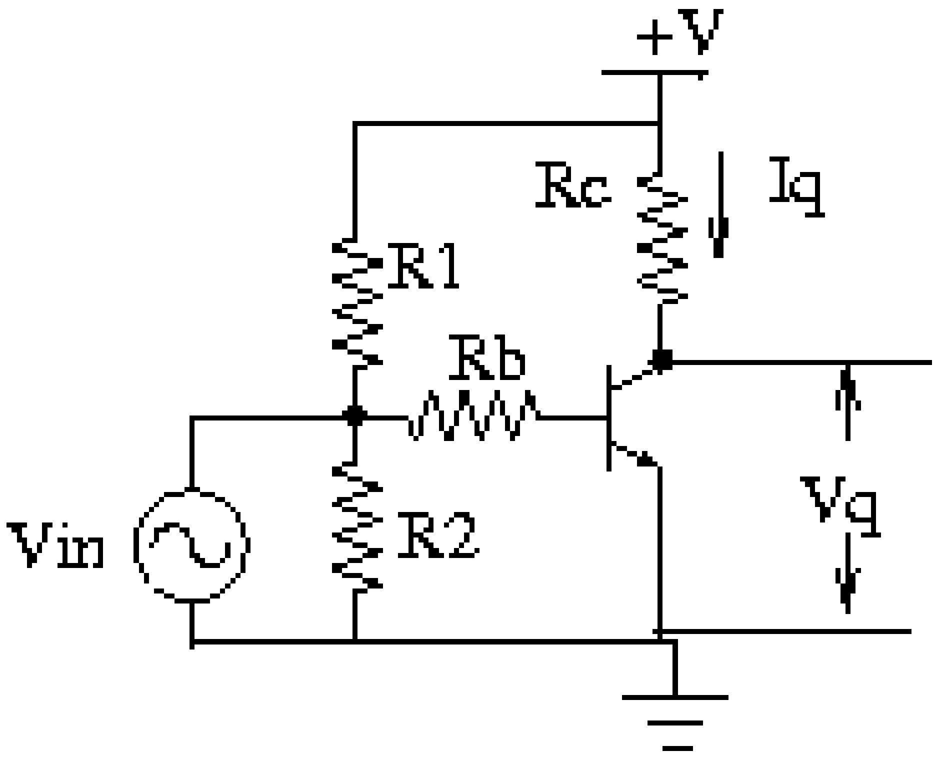

- Quiescent means QUIET.
- At the transistor base, no ac signal is applied
- Only the biasing voltage exists
- Iq and Vq are fixed, so the state is "**quiet**"

# The Transistor **Signalled** ! -1



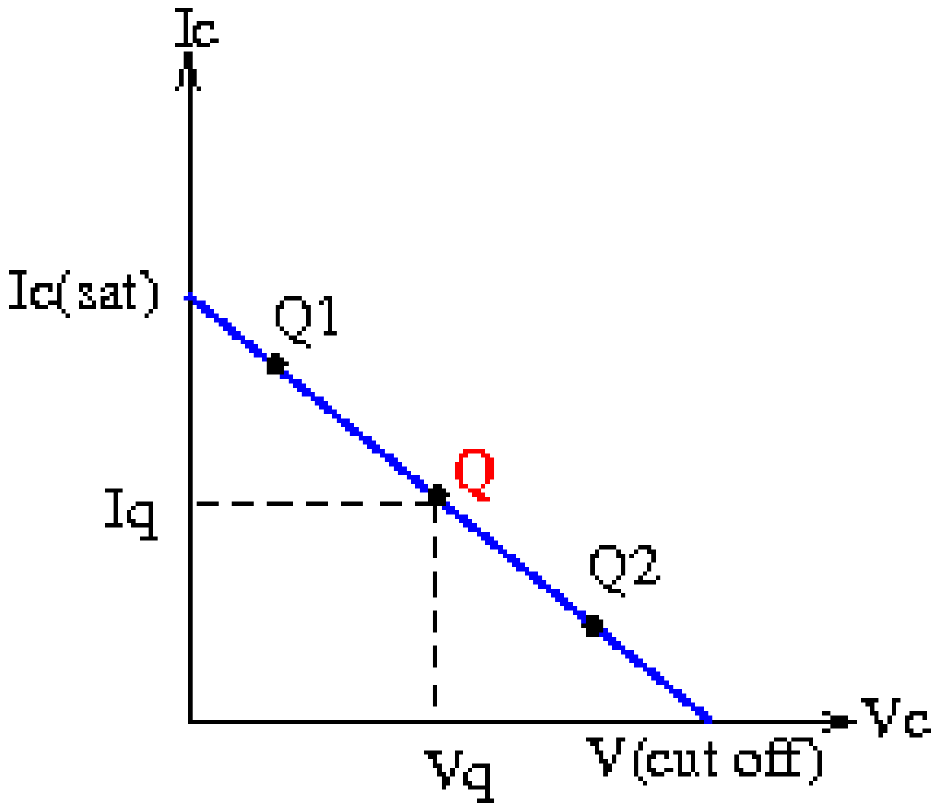

- R1-R2 is potential divider biasing circuit.
- Voltage across R2 is such that it injects current Ib through Rb to draw collector current Iq & Collector voltage = Vq
- Vin is the external ac signal applied.

# The Transistor **Signalled** ! - 2



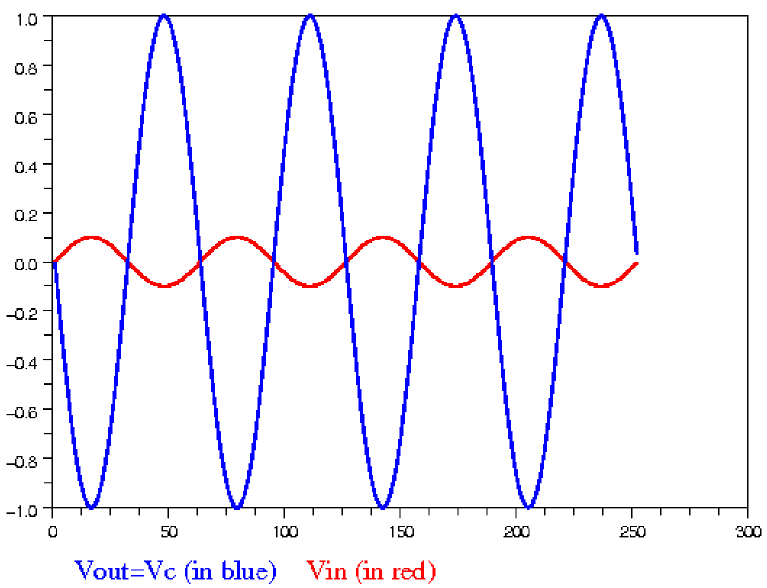

- Vin changes w.r.t. Time.
- This changes Ib
- Continuous change in Ib results in change in Iq and Vq.

# The Transistor **Signaled** ! - 3



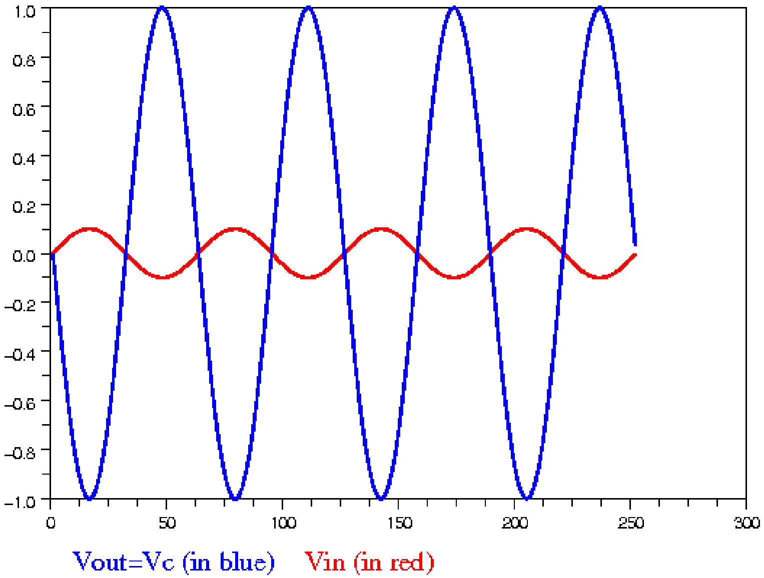

- When Ib increases, point Q changes to Q1. It can go up to Ic(sat).
- When Ib decreases, point Q changes its position to Q2. It can go down to V(cut off)
- As the Vin signal changes continuously, The Q point can take a journey from Ic(sat) to V(cut off) and back.

# Amplification -1



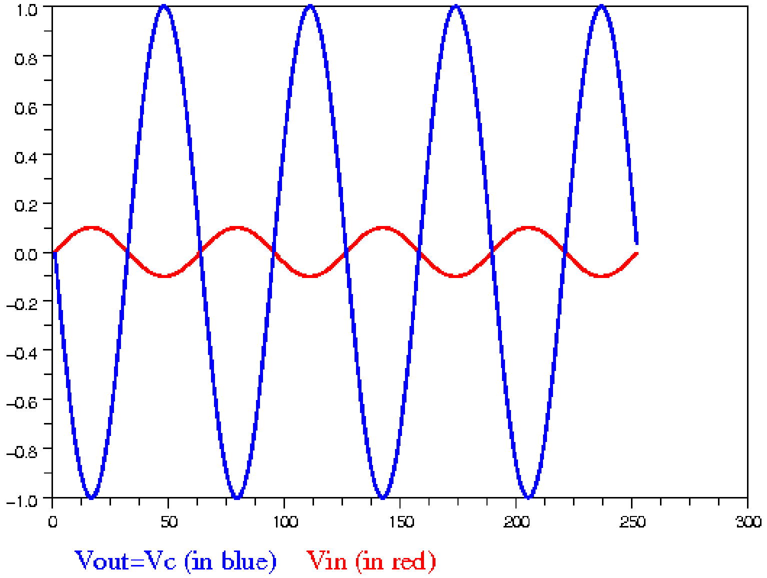

- Small changes in Vin are in mV.
- This results in the change the Vq such that Vq changes from 0 to V(cut-off). V(cut-off) is in volts.
- Thus small change in Vin results in large change in Vc, keeping the wave shape the same.
- V(in) is in red
- V(out)=Vc in blue

# Note the following:




- Vin is small
- Vc=Vout is large
- Vc lags behind Vin by 180 deg because, when Ib increases, “resistance” between collector and emitter decreases.
- V(in) is in red
- V(out)=Vc in blue

# Note the following:




- Amplifier increases the magnitude of input voltage
- Amplifier maintains the wave shape for the output
- Output wave-shape is shifted by 180 deg.