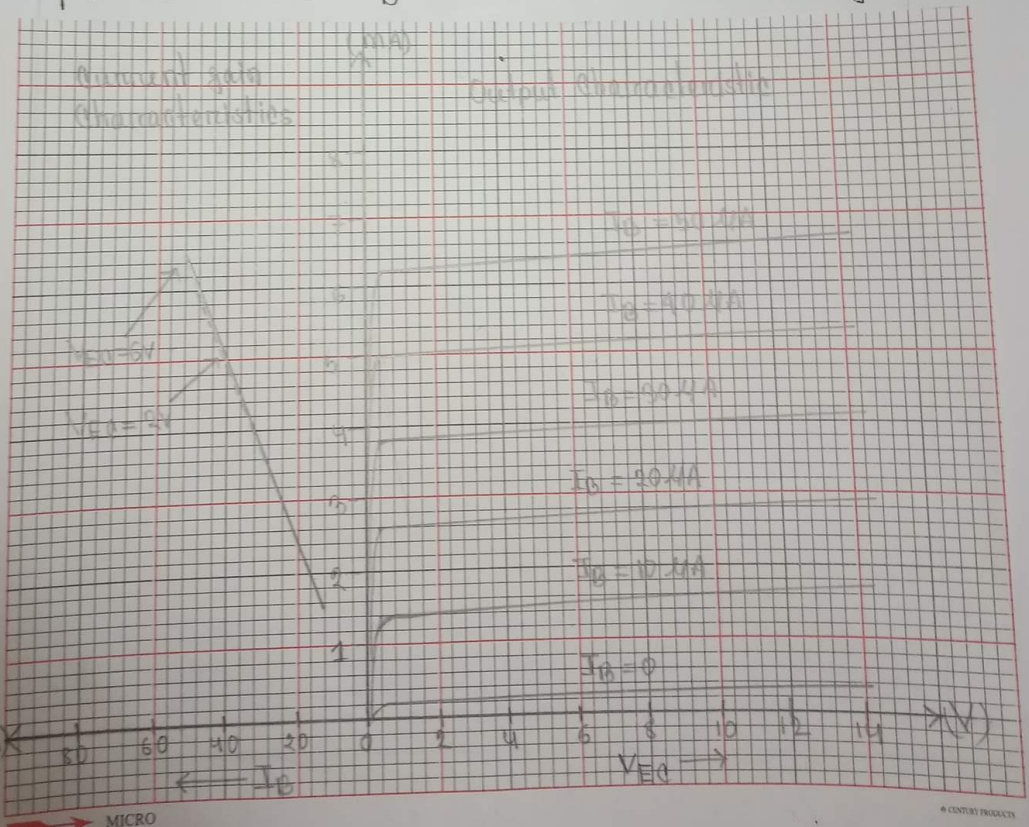
Common-Collector Output and Current Gain Characteristics

Typical representations of BJT common-collector output and current gain characteristics are shown in figure below. The output characteristics are a plot of the emitter current (I_E) versus the emitter-collector voltage (V_{EC}) for several constant levels of base current (I_B). The current gain characteristics are I_E plotted versus I_B at constant V_{EC} voltages.



Characteristic	Common Base	Common Emitter	Common Collector
Voltage gain	Medium	Medium	Low
Power gain	Moderate	Highest	Moderate
Phase shift between input and output	0°	180°	0°
Applications	As a input stage of multistage amplifier	For audio signal amplification	For impedance matching

These characteristics in details are written below:

Common-Base Characteristics

Common-Base Circuit:

When a diode (a two-terminal device) is investigated, several levels of forward or reverse voltages are applied and the corresponding current levels are measured. The characteristicts of the device are then drawn by plotting the graph of current versus voltage. Because a transistor is a three ter-

level. Voltage and current levels measured as are shown.

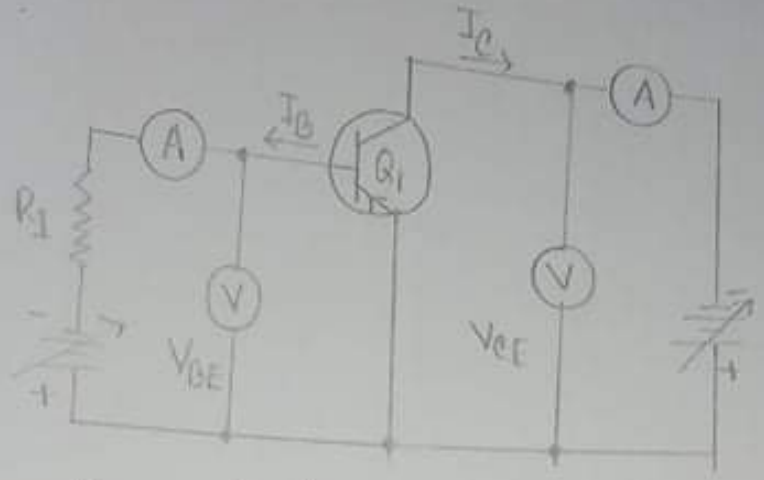


Figure: Circuit for investigating BJT common-emitter characteristics.

Common-Emitter Input Characteristics

To prepare a table of measured values for constructing the common-emitter input characteristics, V_{CE} is held constant, V_{BE} is set at convenient levels, and the corresponding I_B levels are recorded. I_B is then plotted versus V_{BE} as shown in figure below:

Common-Emitter Current Gain Characteristic

The common-emitter current gain characteristics are output current (I_C) plotted versus input current (I_B) for various fixed levels of V_{CE}. Like the common-base current gain circuit characteristic, they can be obtained experimentally or derived from the output characteristics. To prepare the table of I_B and I_C values, V_{CE} is held at a selected level, I_B is adjusted in steps, and the corresponding I_C level is recorded at each step.

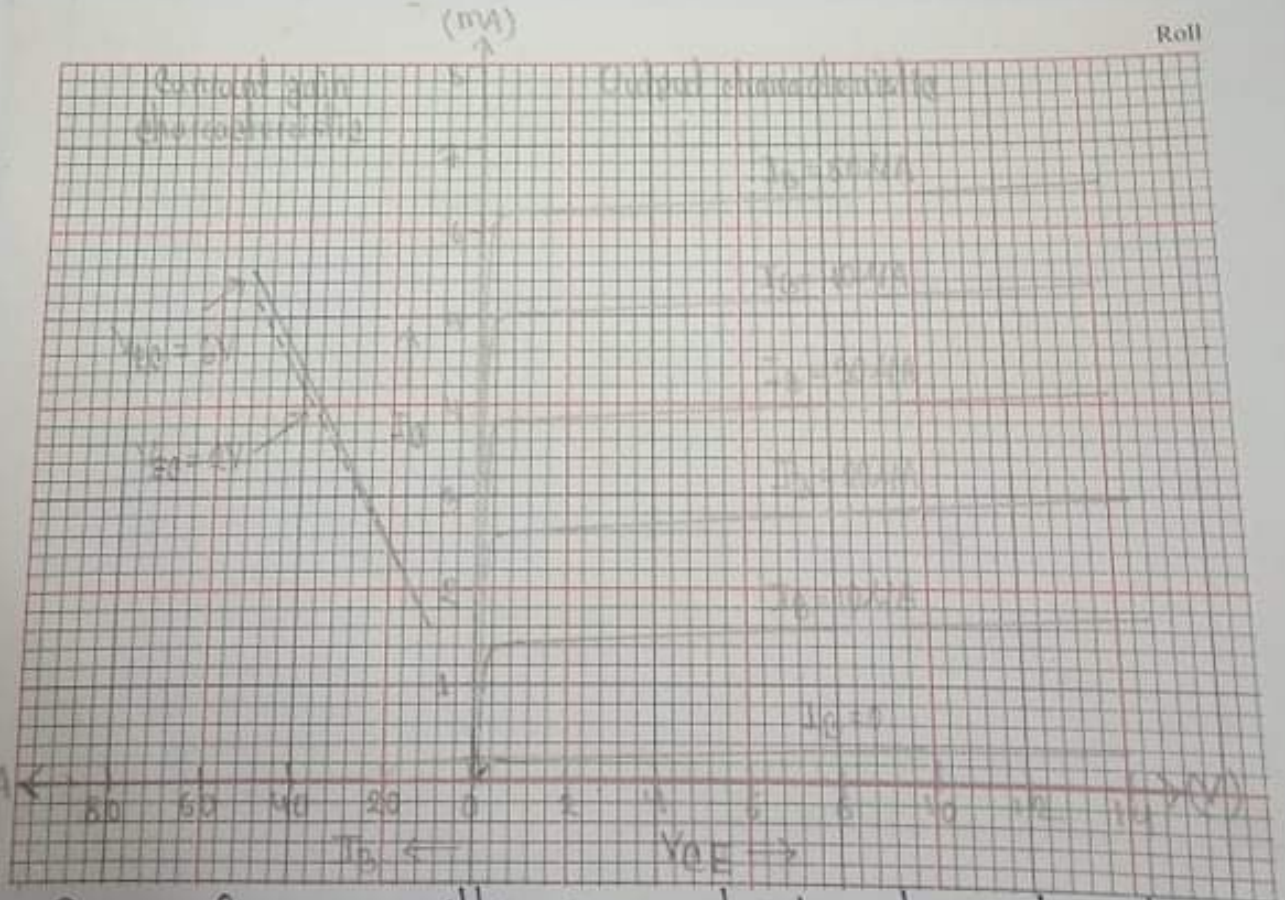


Figure: Common-emitter current gain characteristics

minals device. there are three possible connection arrangements (configurations) for investigating its characteristics. Three sets of characteristics may be constructed for each of these configurations.

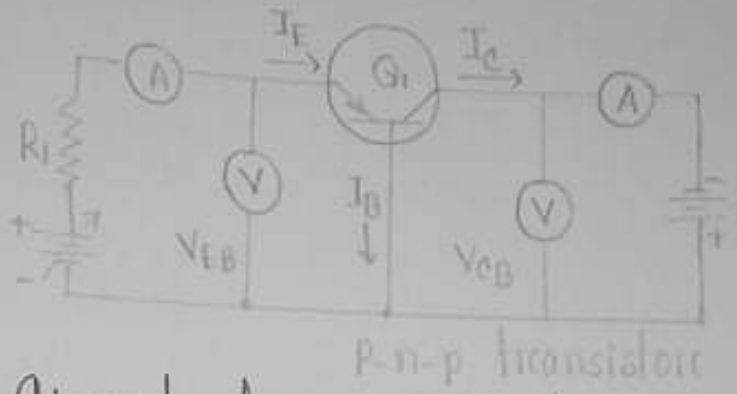


Figure: Circuit for investigating BJT common-base characteristics. The base is common to the input voltage (V_{EB}) and the output voltage (V_{CB})

Common-Base Input Characteristics

To investigate the input characteristics, the output voltage (V_{CB}) is kept constant, and the input voltage (V_{EB}) is set at several convenient levels. At each input voltage,

$$V_{EC} = V_{EB} + V_{BC}$$

or, $$V_{EB} = V_{EC} - V_{BC}$$

Increasing the level of V_{BC} with V_{EC} held constant reduces the base-emitter voltage (V_{EB}) and thus reduces I_B. This explains the slope of the cc input characteristics.

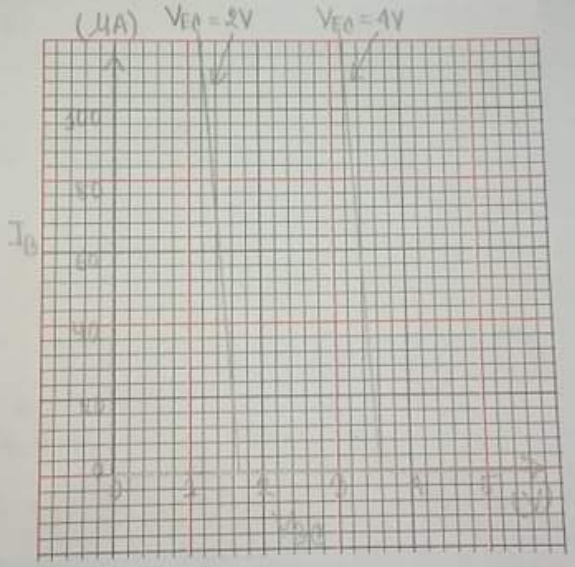


Figure: The common-collector input characteristic.

Transistor:

A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit.

A bipolar junction transistor (BJT) has three layers of semiconductor material. The central layer is called the base, one of the outer layers is termed the emitter, and the other outer layer is referred to as the collector. The emitter, base and collector are provided with terminals, which are appropiately labelled E. B. and C. Two pn-junctions exist in each transistor: the collector-base junction and the emitter-base junction. These are arranged either in npn (n-type — p-type — n-type) sequence or in pnp (p-type — n-type — p-type) sequence.

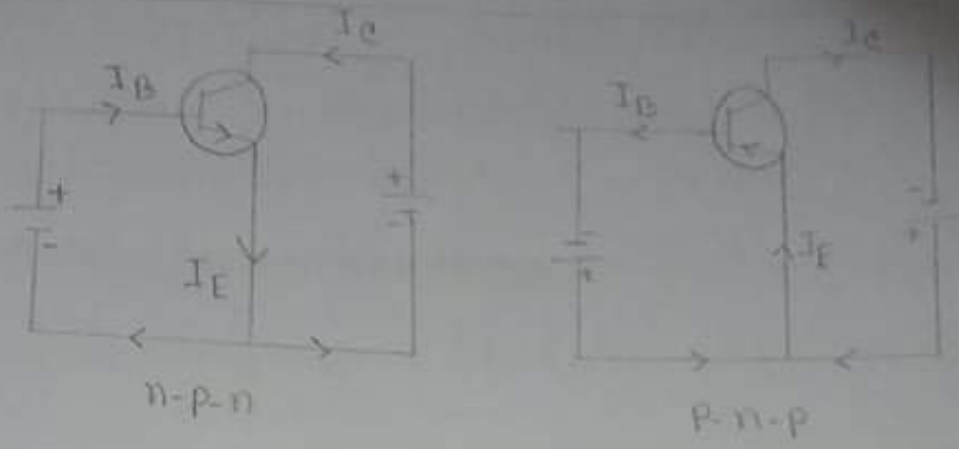


Fig: Supply voltage connection for common emitter transistor.

(b) Common-collector configuration: This is also called grounded-collector configuration. In this configuration the base is the input terminal, the emitter is the output terminal, and the collector is the common terminal.

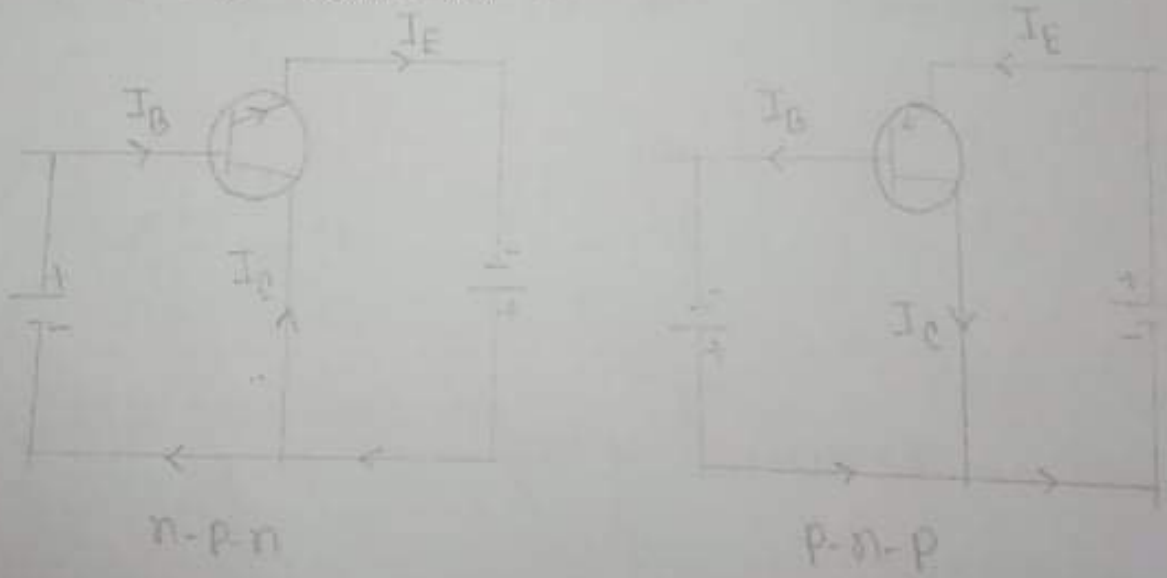


Fig: Supply voltage connection for common collector transistor.

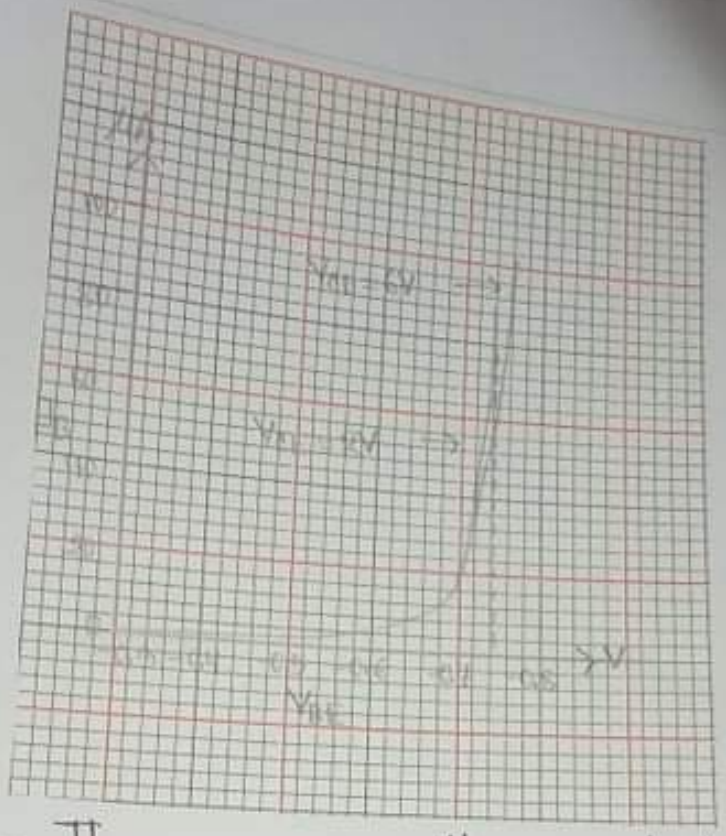


Figure: The common-emitter input characteristics

Common-Emitter Output Characteristic

To obtain a table of values for plotting the common-emitter output characteristics, I_B is maintained constant at several convenient levels. At each I_B level, V_{CE} is adjusted in steps and I_C is recorded at each V_{CE} step. The I_C values are plotted versus V_{CE} for each I_B level, to areal

the kind of output characteristics family shown in figure below. Noted that the V_{BE} and V_{CE} polarities are negative for the characteristics shown.

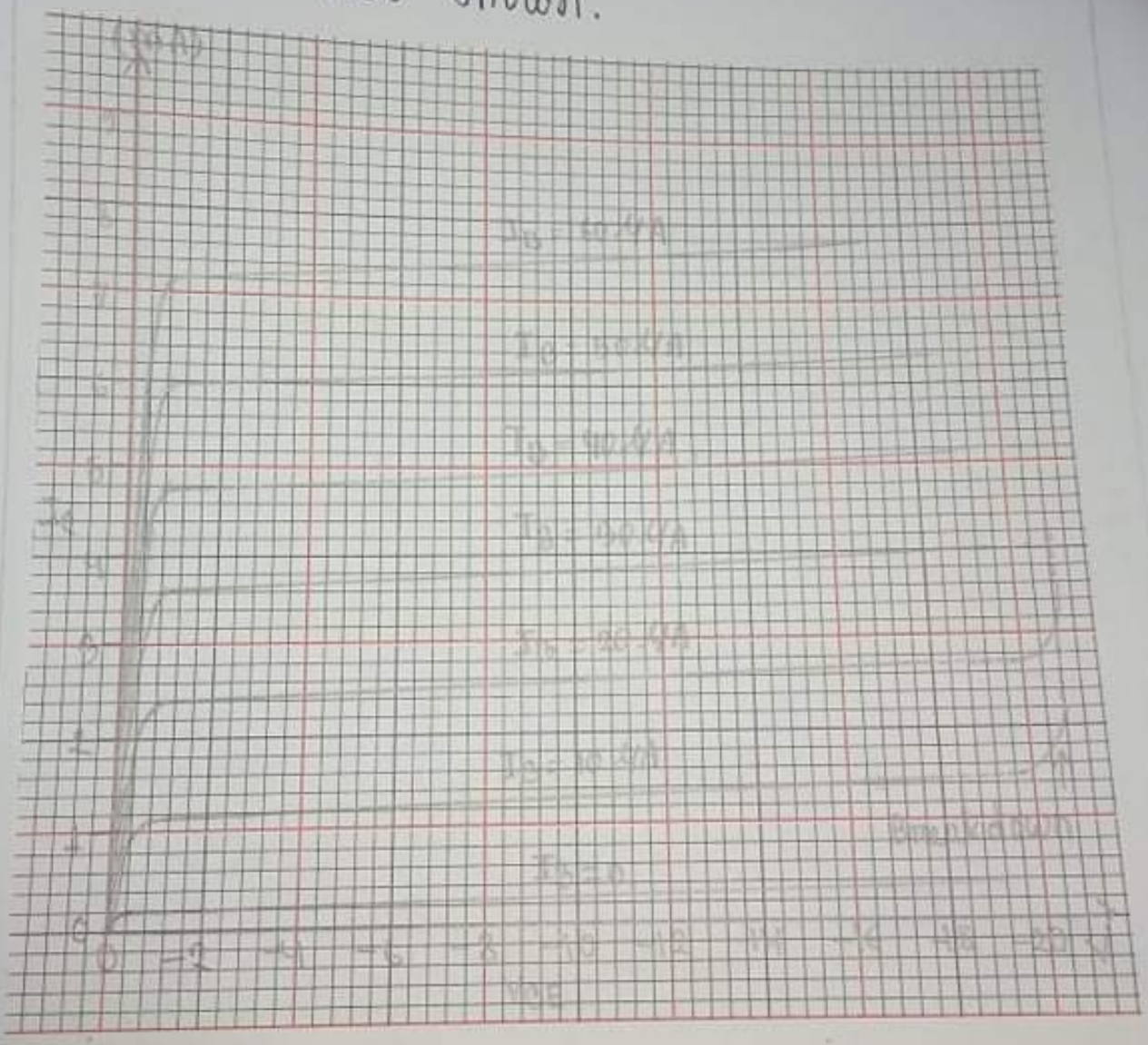


Figure: The common-emitter output characteristic

the corresponding input current (I_E) is recorded. The I_E and V_{EB} levels are then plotted to give the common-base input characteristics shown in figure below:

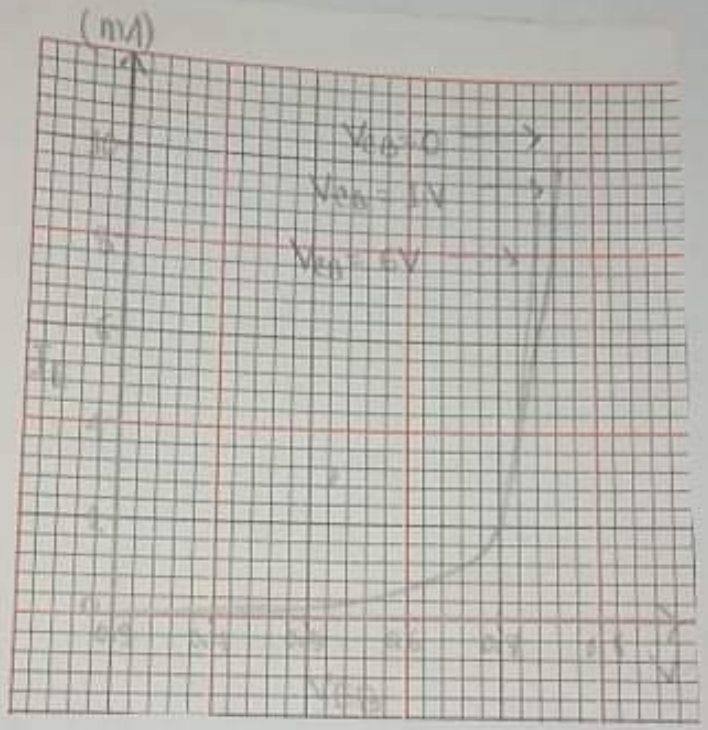


Figure: Common-base input characteristics.

Common-Base Output Characteristics

To prepare a table of readings for plotting the output characteristics, I_E is held constant at each of several fixed current levels, V_{CB} is adjusted in convenient steps,

and the corresponding values of I_C are recorded.

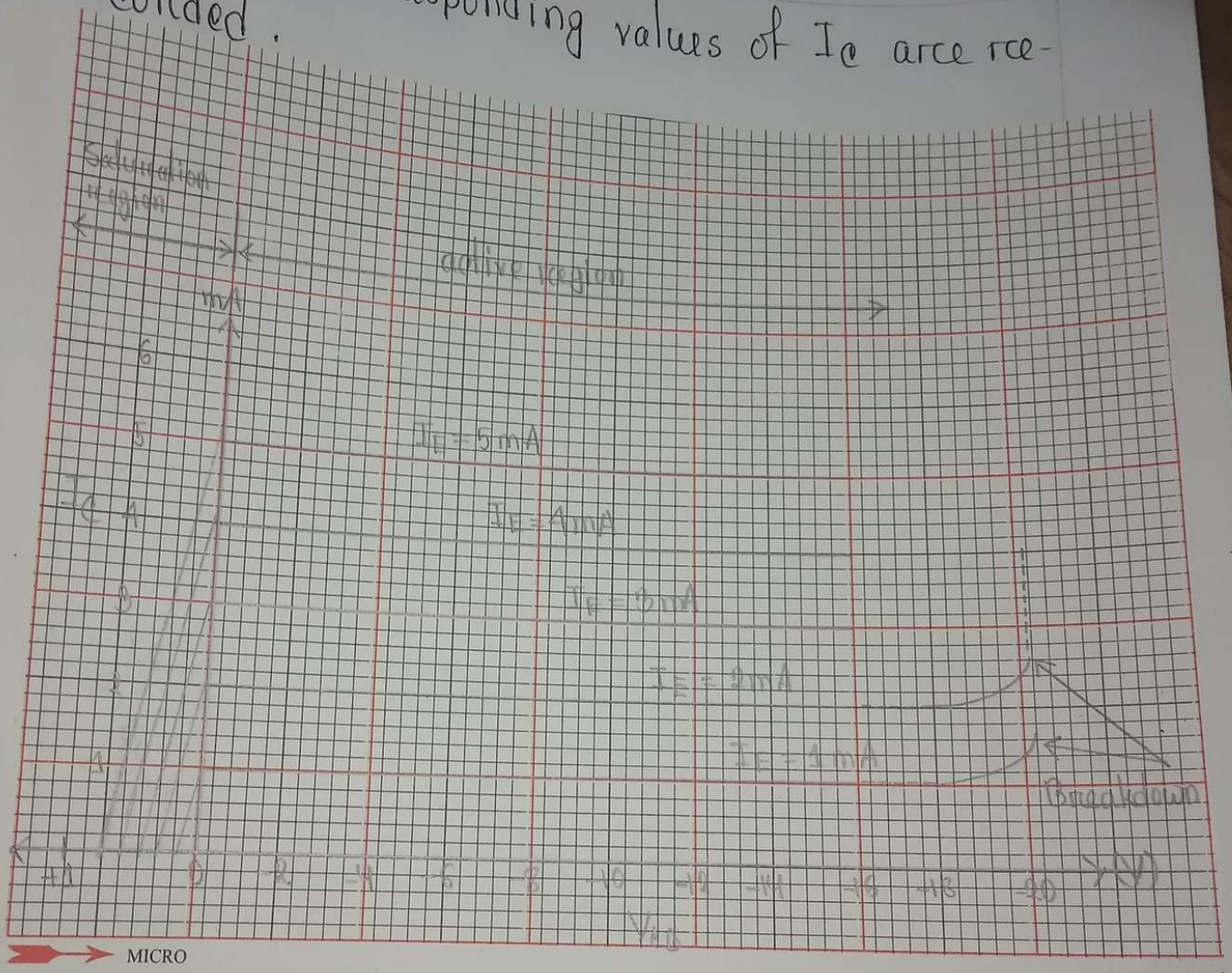


Figure: Common-base output characteristics

Common-Base Current Gain Characteristics

The common-base current gain characteristics can be derived from the common-base output charac-

COMMON-COLLECTOR CHARACTERISTICS

Common-collector Circuit

The figure has shown below is the arrrange ment of common-collector circuit.

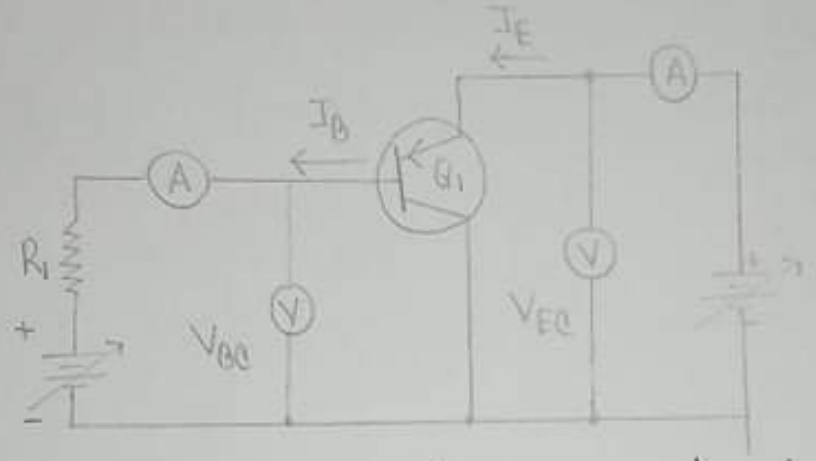


Figure: Common-collector circuit charcacterristics

Common-Collector Inpul Charcacterristics

The common-collector input charcacterristics shown in below figure is quite different from either common-base or common-emitter inpul characterristics. The difference is due to the fact that the input voltage (V_{BC}) is largely determined by the output voltage (V_{EC}). Referring to the previous figure we see that

There are three configuration in which a transistor is connected in a circuit. They are:

(1) Common-base configuration: This is also called grounded base configuration. In this configuration the emitter is the input terminal, the collector is the output terminal, and the base is the common terminal.

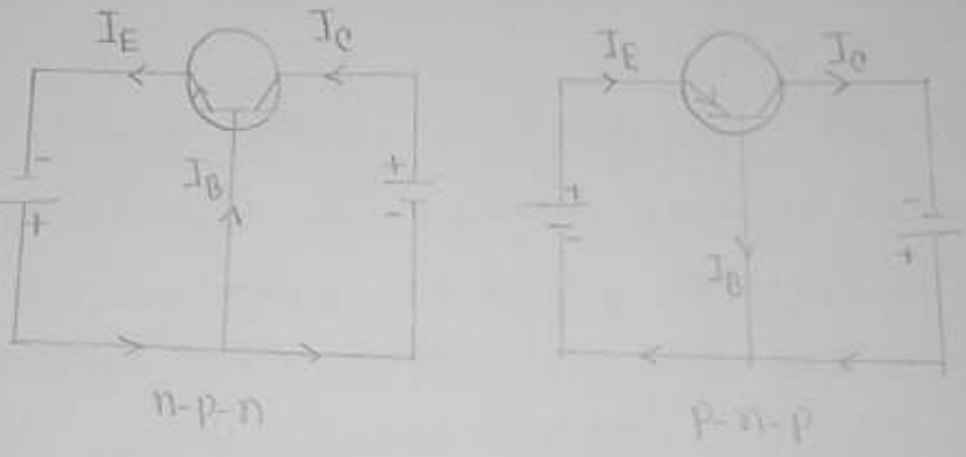


Fig: Supply voltage connections for common base transistor

(2) Common-emitter configuration: This is also called grounded emitter configuration. In this configuration the base is the input terminal, the collector is the output terminal, and the emitter is the common terminal.

teristic shown in figure below:

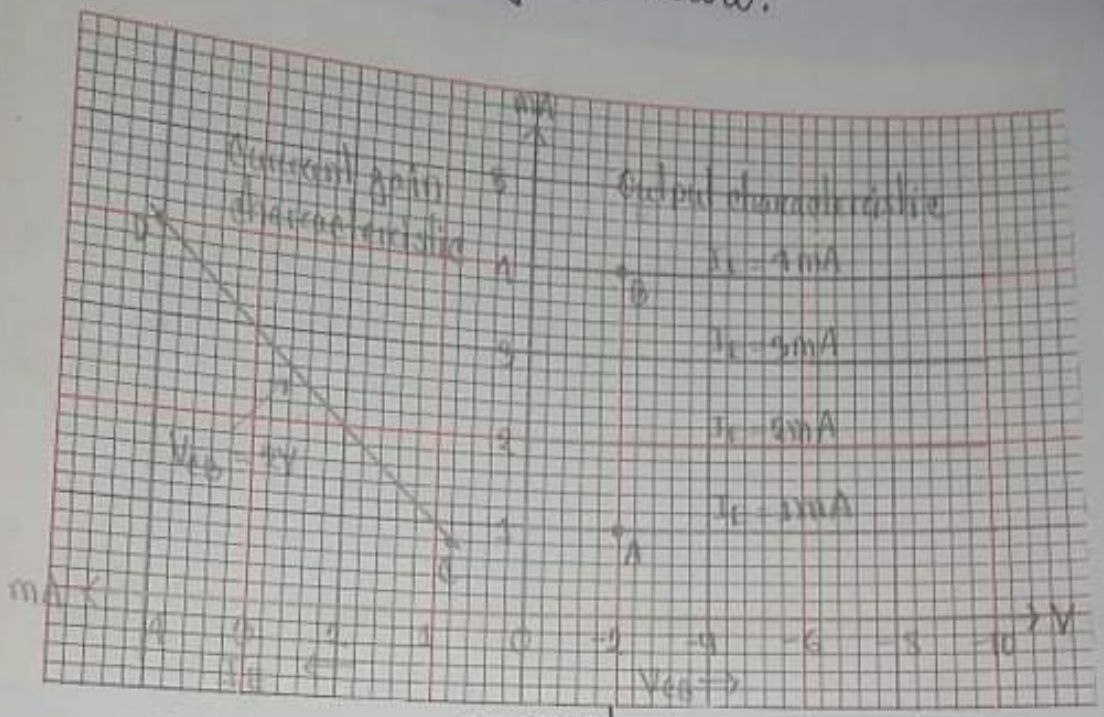


Figure: Common-Base current gain characteristicts

COMMON-EMITTER CHARACTERISTICS

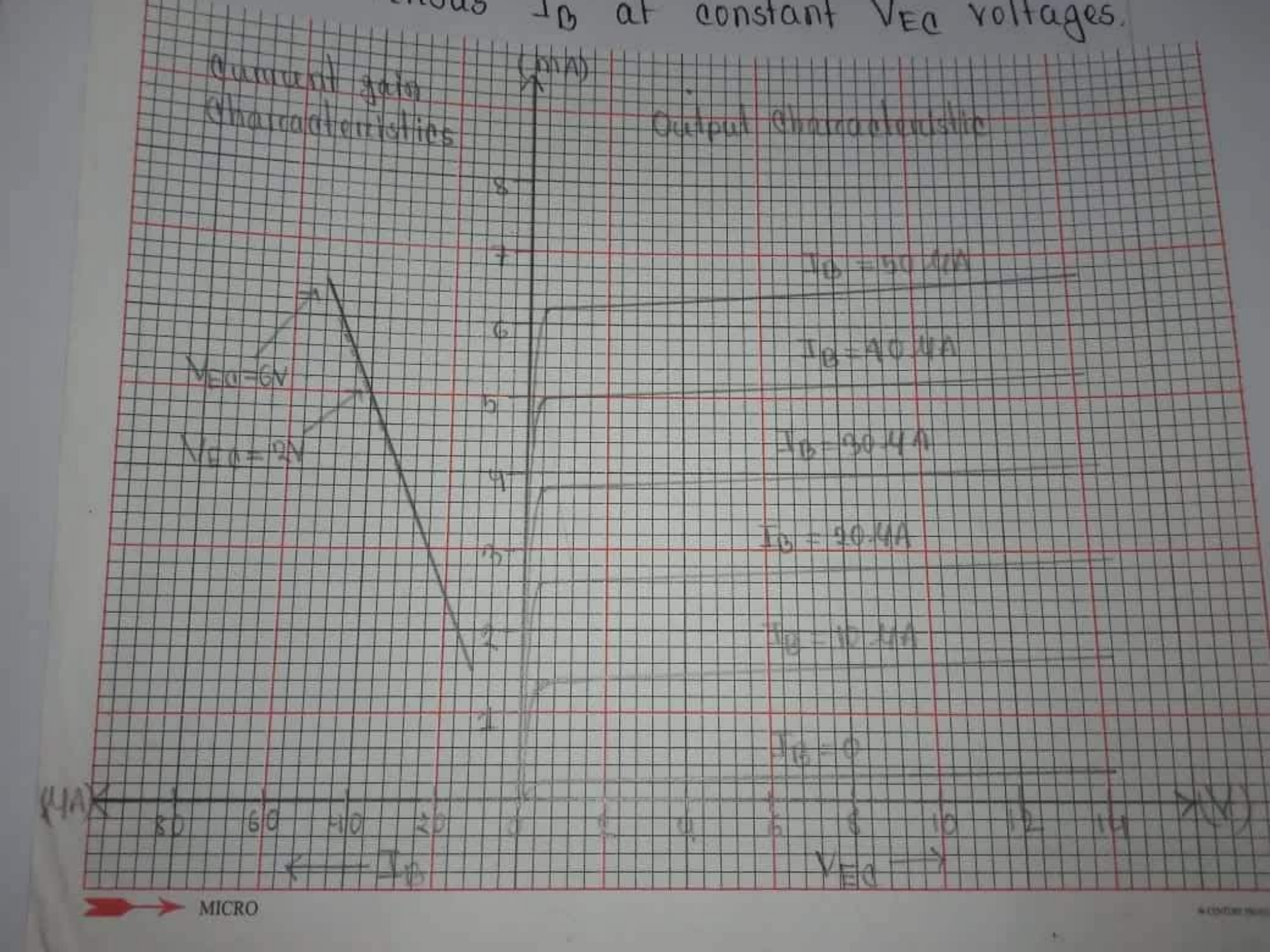
Common-Emitter Circuit

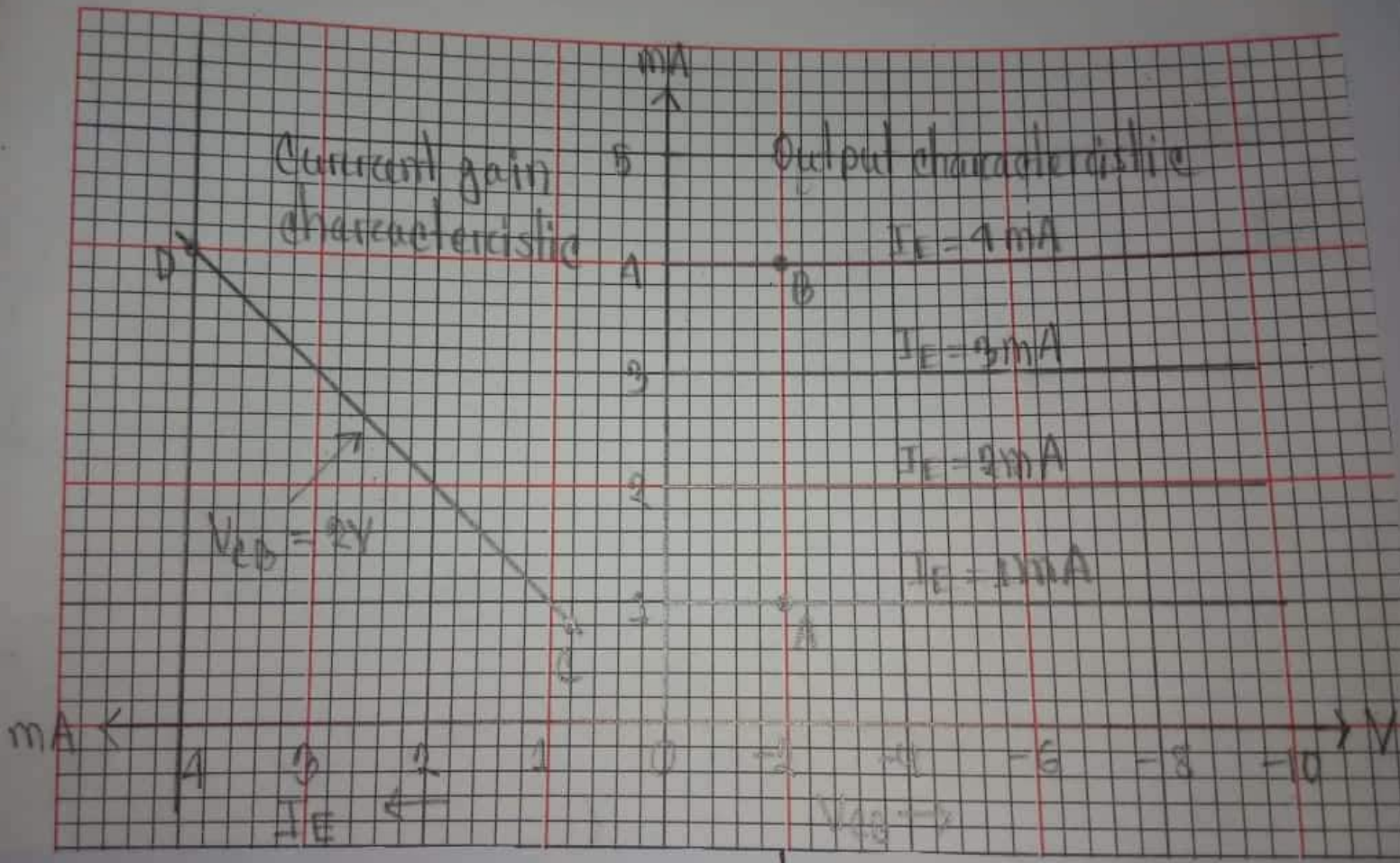
The input voltage is applied between the base and emitter terminals, and the output is taken at the collector and emitter terminals, so that the emitter terminals is common to both input and output. Resistor R_1 is included to help maintain the base current at a constant

Now the comparison of characteristic among Common-base, common-emitter and common transistor are given below:

Characteristic	Common Base	Common emitter	Common collector
Input resistance	Very low (20Ω)	Low (1 kΩ	High (500 kΩ)
Output resistance	Very high (1 MΩ	High (40 kΩ)	Low (50Ω)
Input current	I_E	I_B	I_B
Output current	I_C	I_C	I_E
Input voltage applied between	Emitter and Base	Base and Emitter	Base and Collector
Output voltage taken between	Collector and Base	Collector and Emitter	Emitter and Collector
Current amplification factor	$\alpha = \frac{I_C}{I_E}$	$\beta = \frac{I_C}{I_B}$	$\gamma = \frac{I_E}{I_B}$
Current gain	Less than unity	High (20 to few hundreds)	High (20 to few hundreds

Various I_B at constant V_{EC} voltages.





igure: Common-Base, gain characteristicts