

BJT Device (H1)

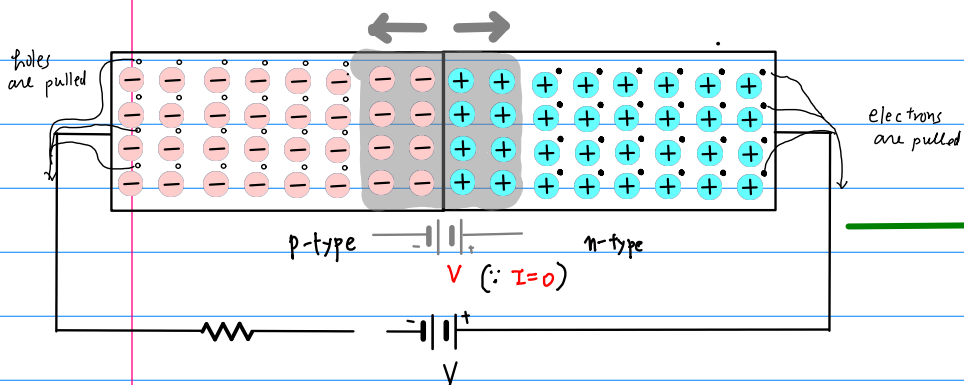
201704021-2

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Reverse Bias

- increase depletion region
- no current flowing

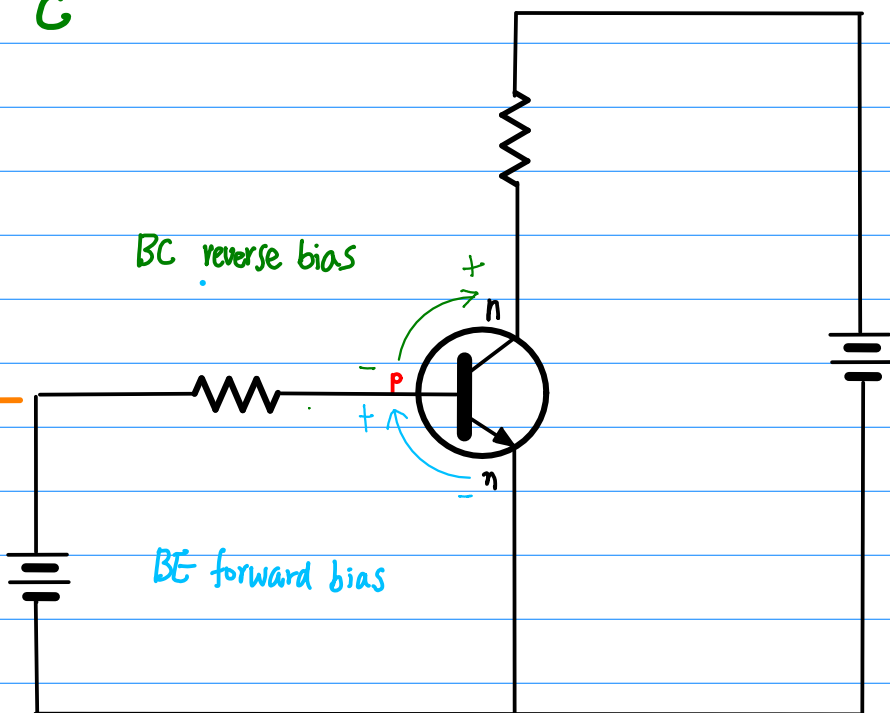


B

C

BC reverse bias

BE forward bias

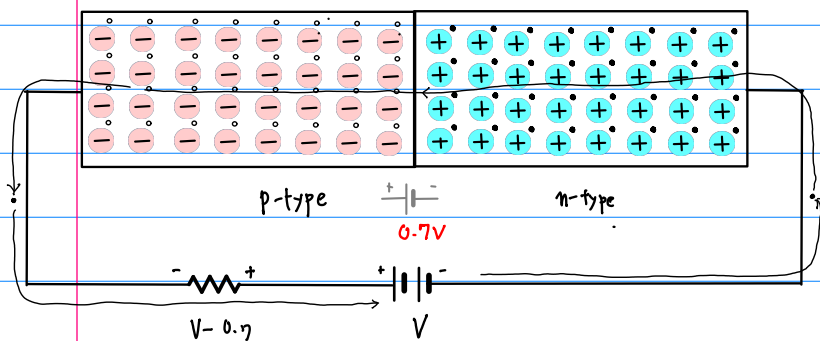


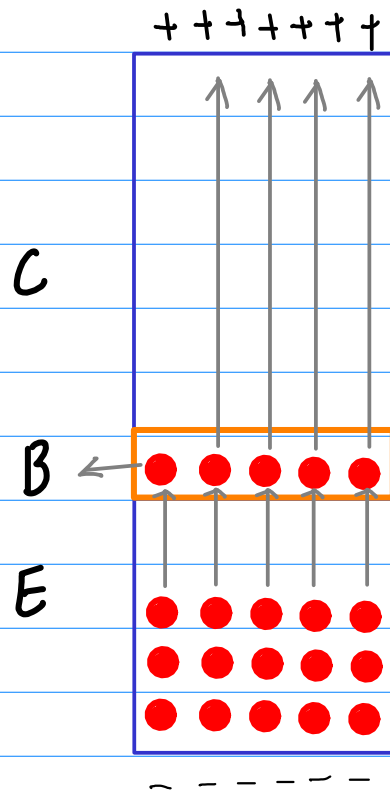
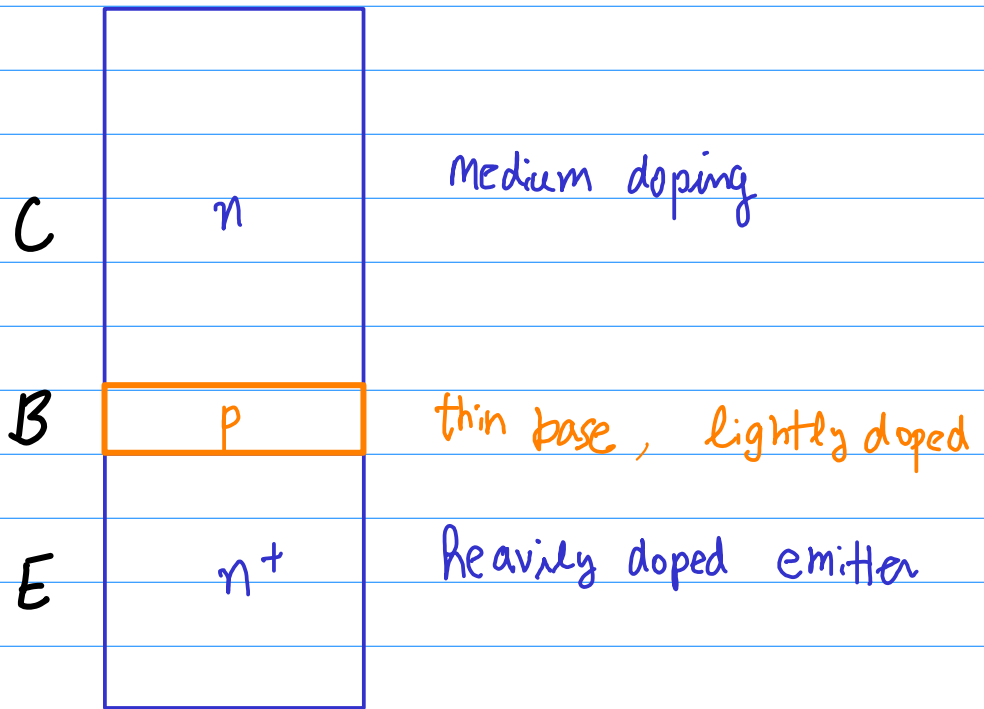
B

E

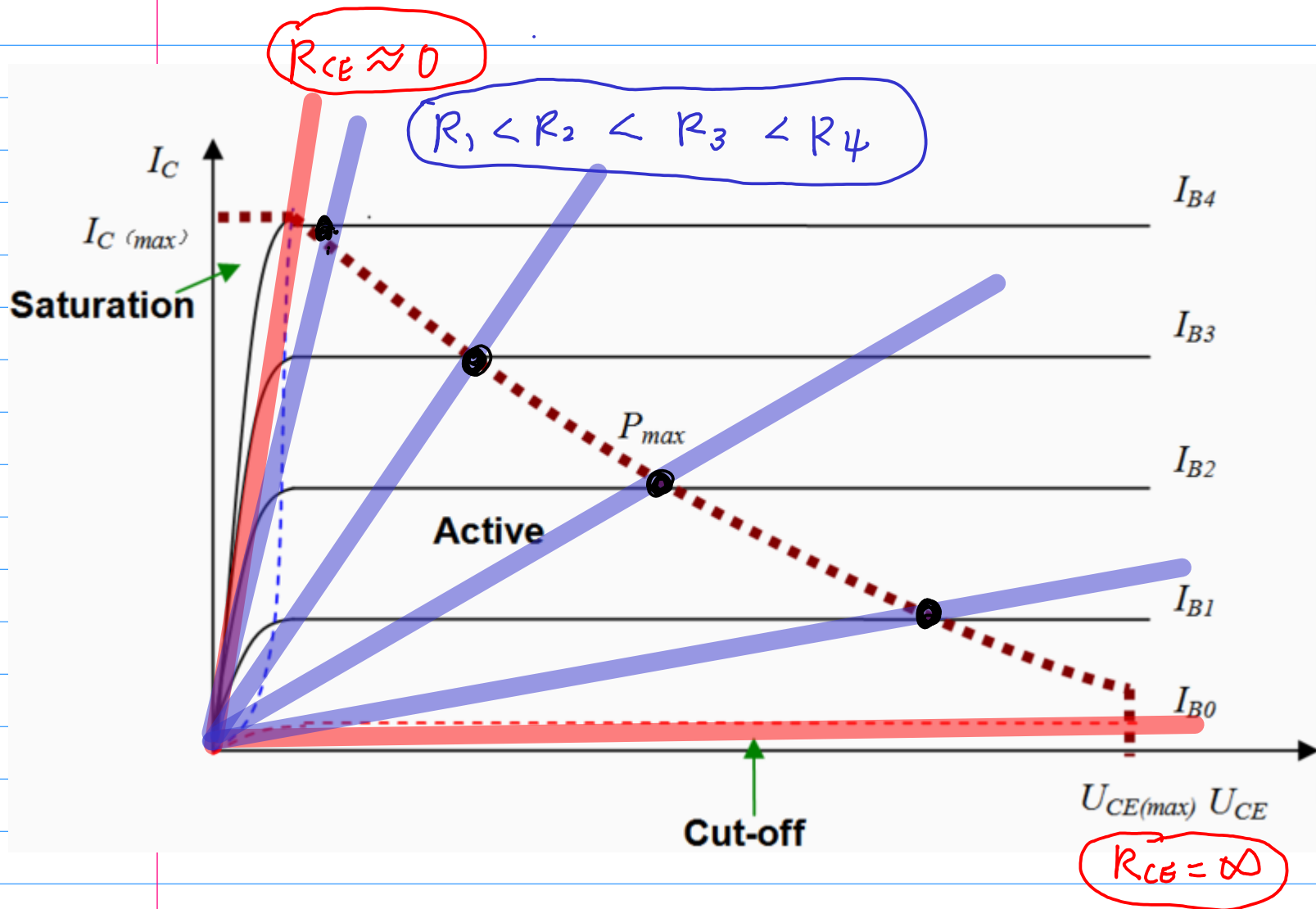
Forward Bias

- no depletion region
- continuous current flow





Trans + resistor

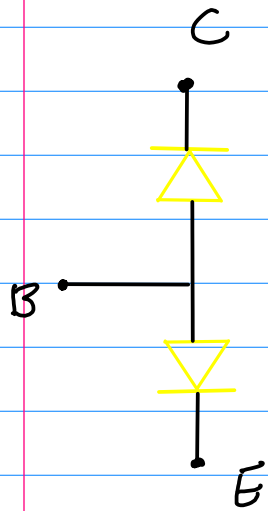


<https://en.wikipedia.org/wiki/>

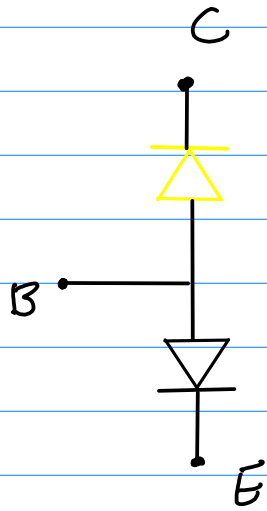
$$\text{slope} = \frac{I_C}{U_{CE}} = \frac{1}{R_{CE}}$$

$$I_B \uparrow \quad R_{CE} \downarrow \quad I_C \uparrow \quad U_{CE} \downarrow \quad (R = \frac{U}{I})$$

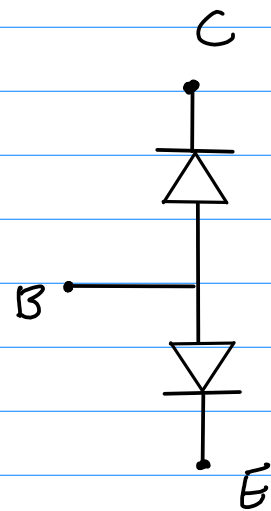
CUTOFF



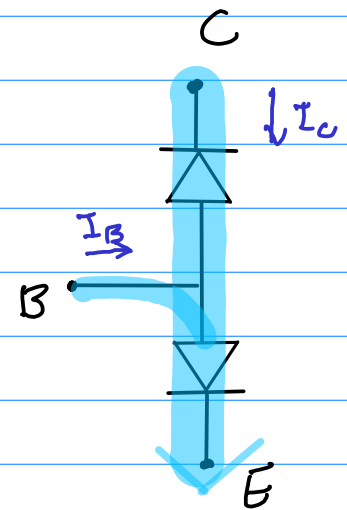
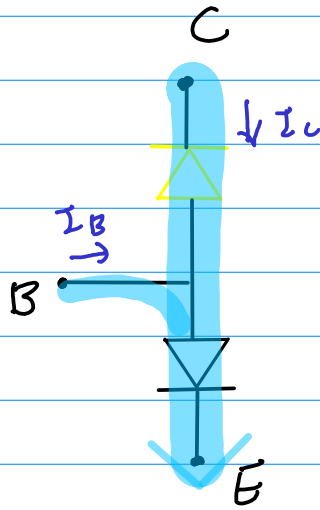
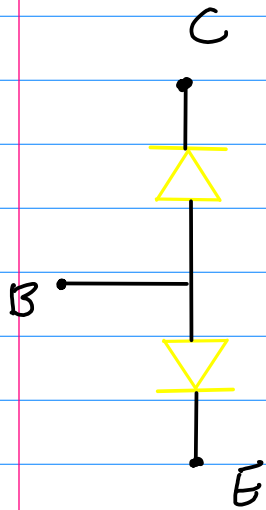
LINEAR



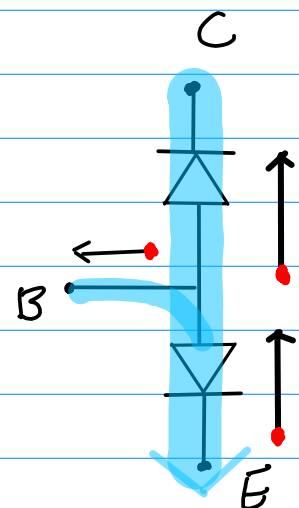
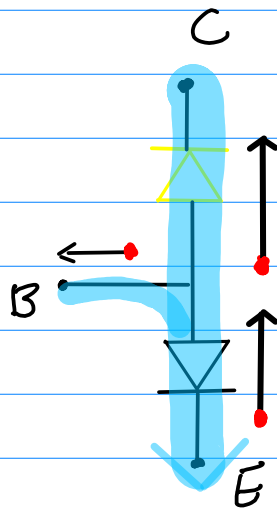
SATURATED



Current Flow



Electron Flow

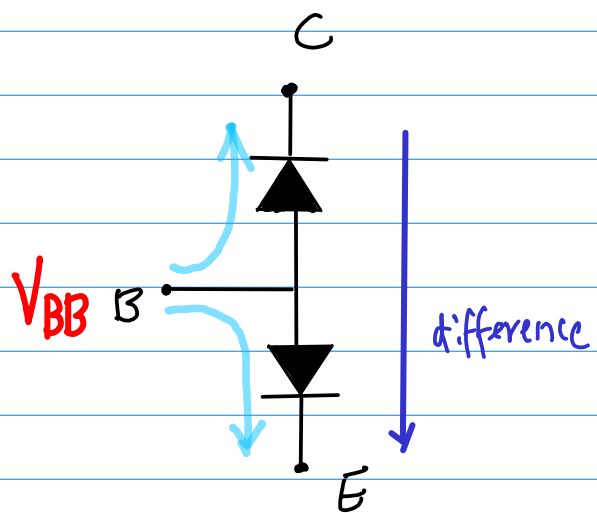
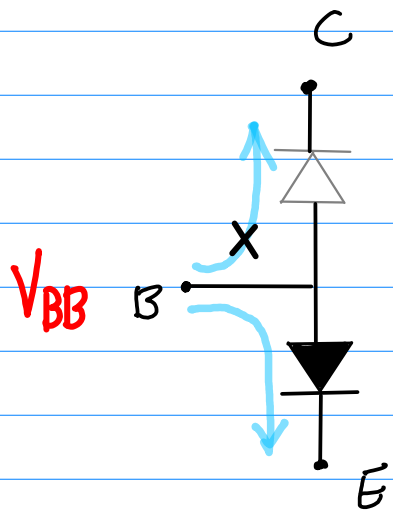
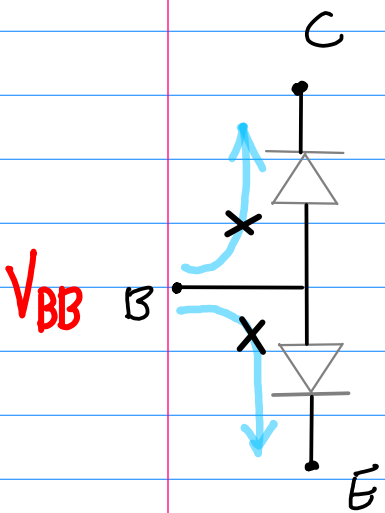


I_B

OFF

LIN

SAT

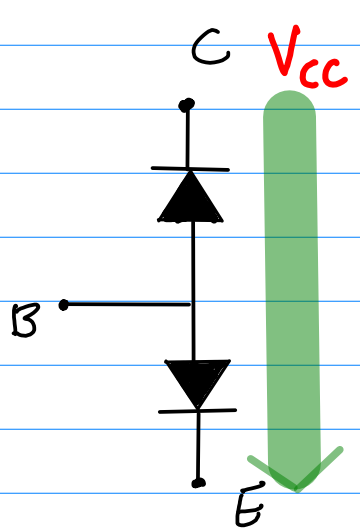
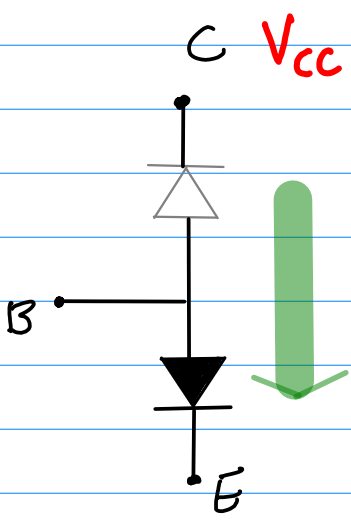
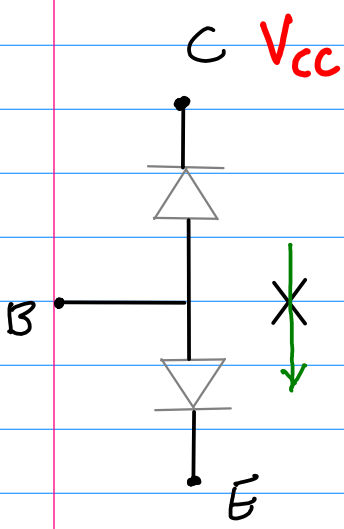


I_C

OFF

LIN

SAT



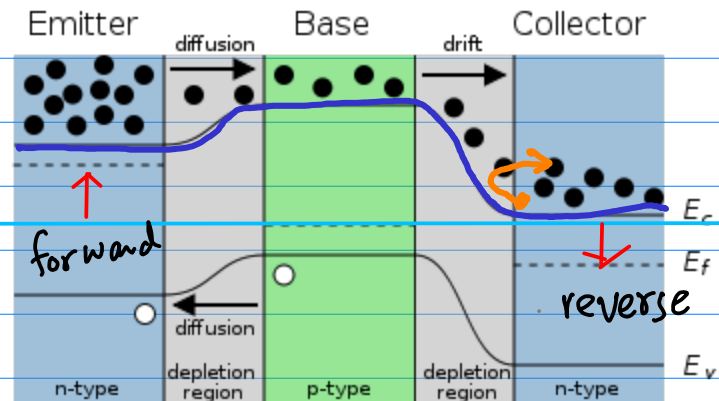
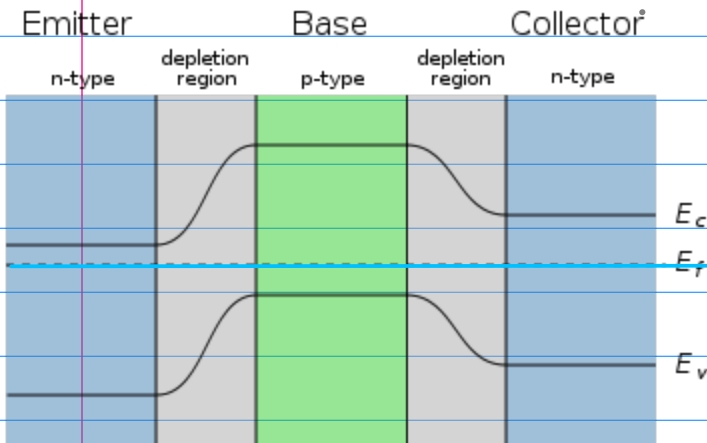
$R_{CE} \approx \infty$

$0 < R_{CE} < \infty$

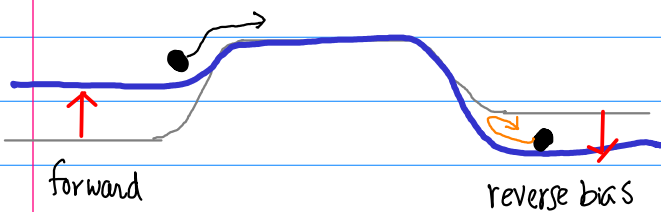
$R_{CE} \approx 0$

No Bias

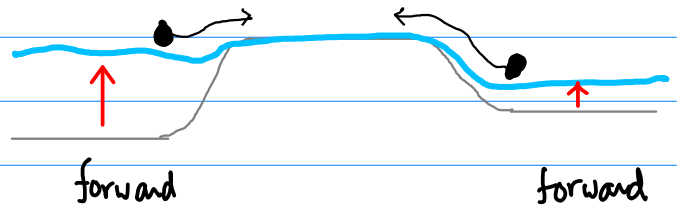
Linear



LINEAR

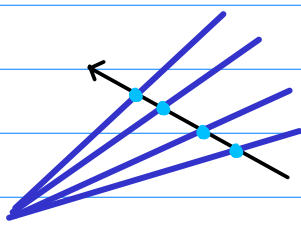


SATURATION

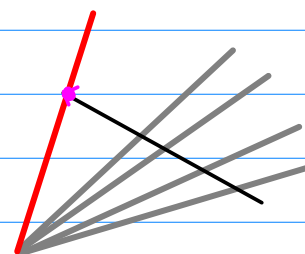


$V_{CE} \downarrow$
 $I_B \uparrow$
 $I_C \uparrow$ $R_{CE} \downarrow$

$V_{CE} \downarrow$
 $I_B \rightarrow$ fixed
 $I_C \rightarrow$ fixed R_{CE} fixed

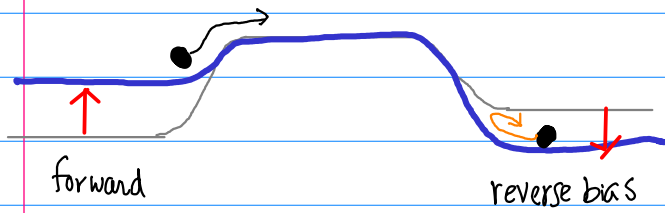


$$m = \frac{I_c}{V_{CE}} = \frac{1}{R_{CE}} \uparrow$$

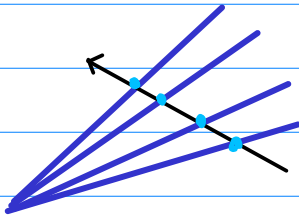
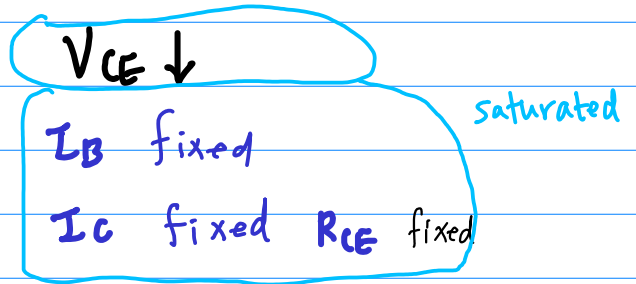
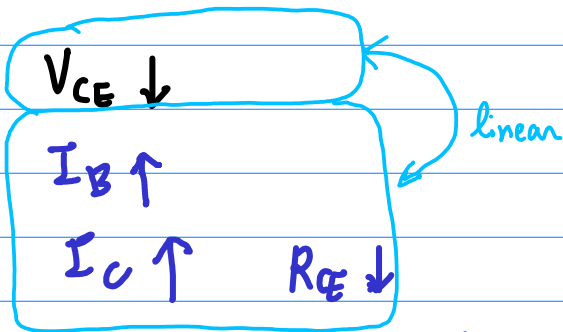
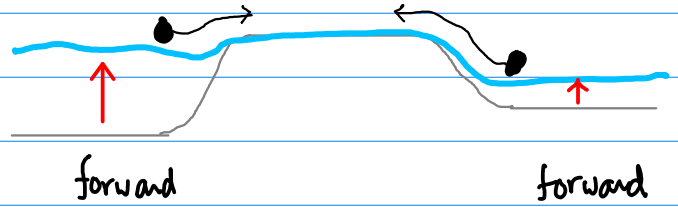


$$m = \frac{I_c}{V_{CE}} = \frac{1}{R_{CE}} = \text{fixed} \approx \infty$$

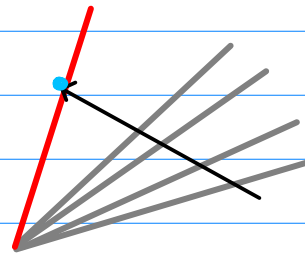
LINEAR



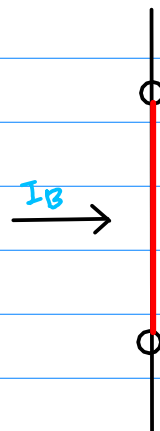
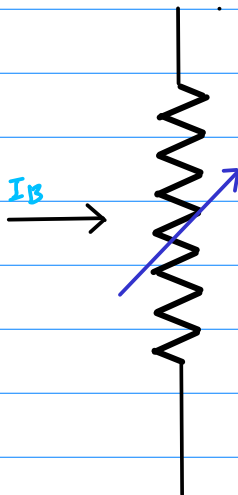
SATURATION



$$m = \frac{I_c}{V_{CE}} = \frac{1}{R_{CE}} \uparrow$$

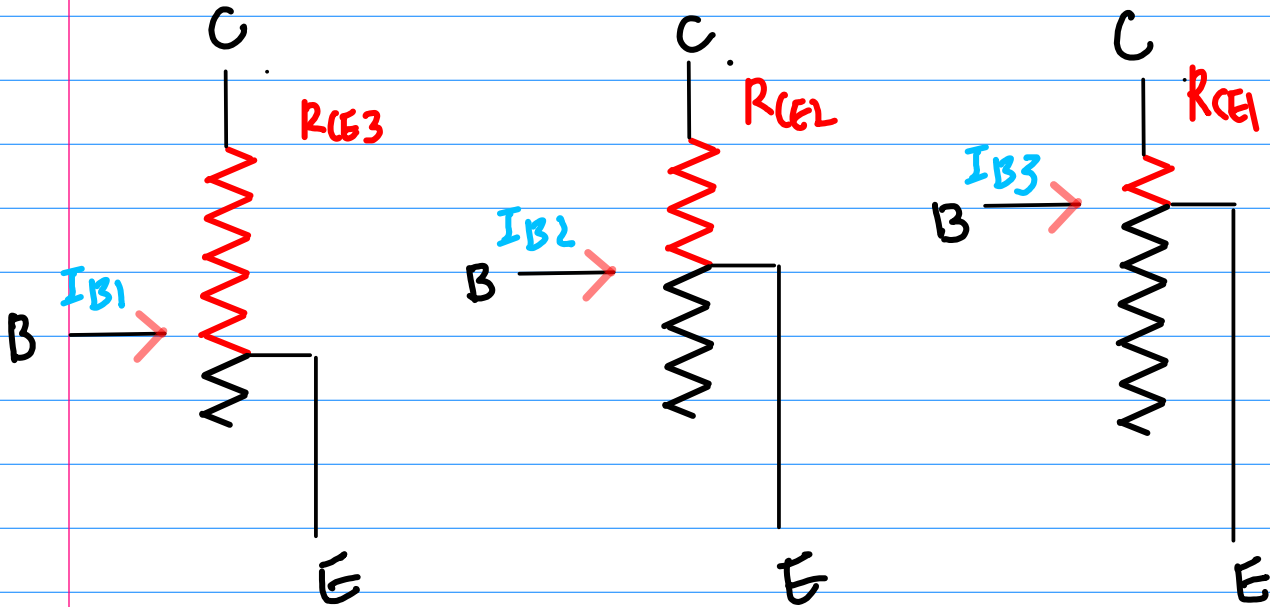


$$m = \frac{I_c}{V_{CE}} = \frac{1}{R_{CE}} = \text{fixed} \approx \infty$$

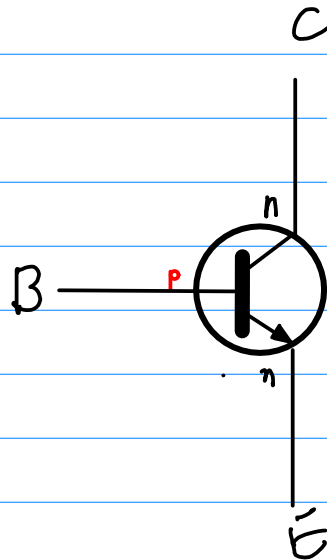
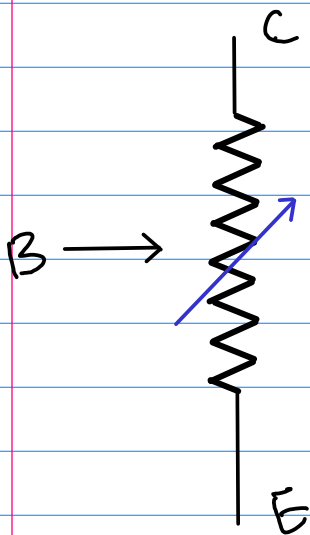


Variable Resistor Action

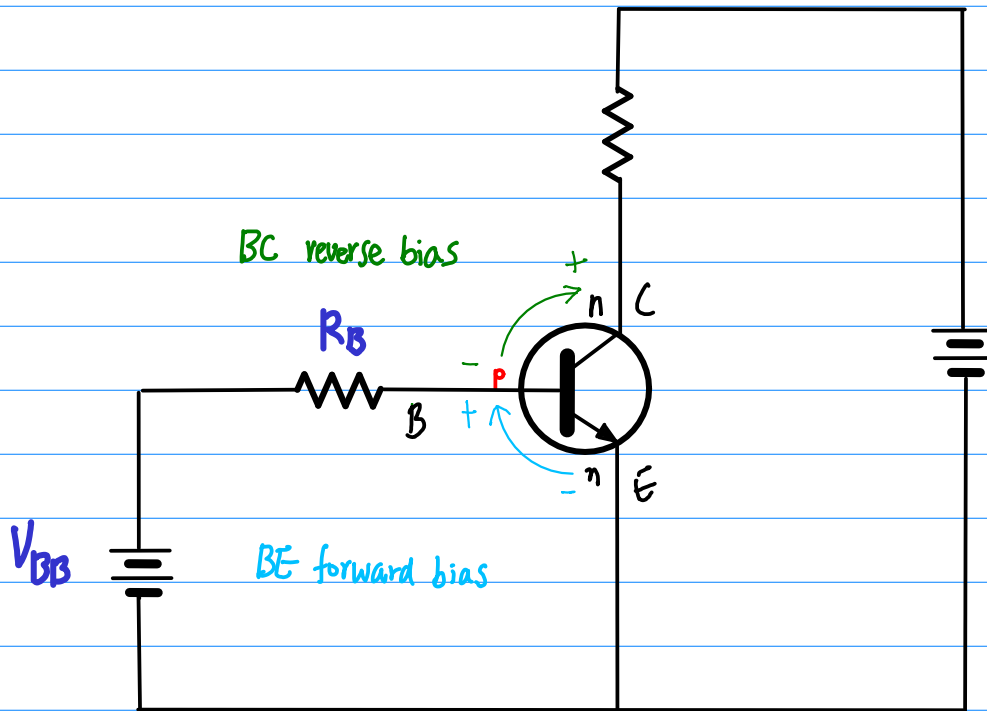
COOK'S



$$I_{B1} < I_{B2} < I_{B3}$$
$$R_{CE1} > R_{CE2} > R_{CE3}$$



To increase I_B



- ① Inc $V_{BB} \uparrow$
 - ② Dec $R_B \downarrow$
- } $I_B \uparrow$

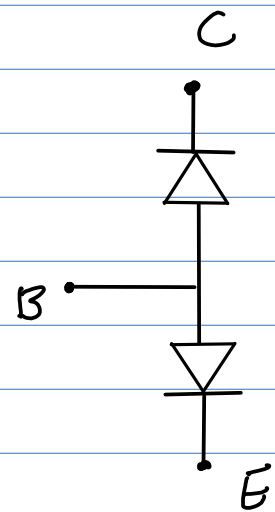
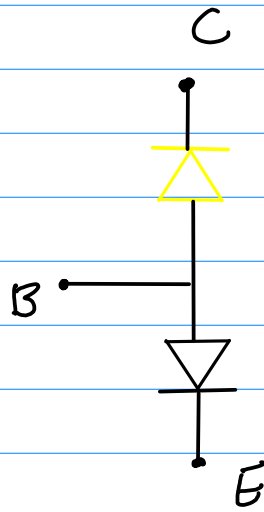
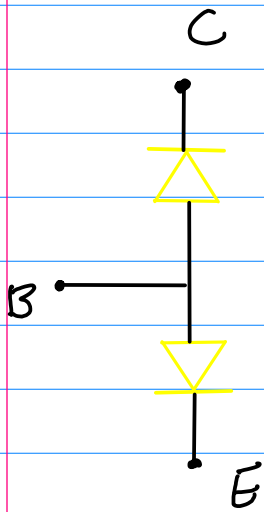
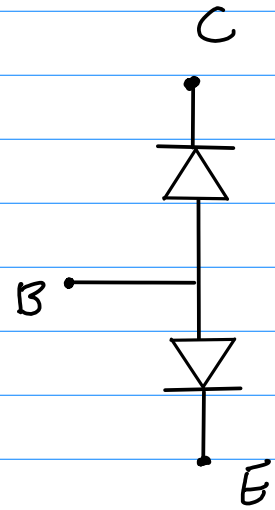
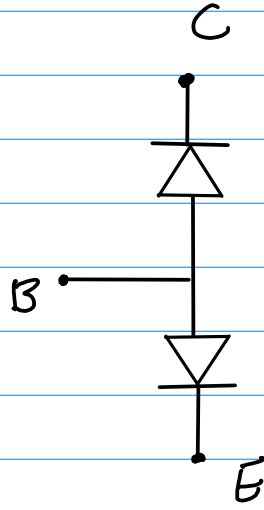
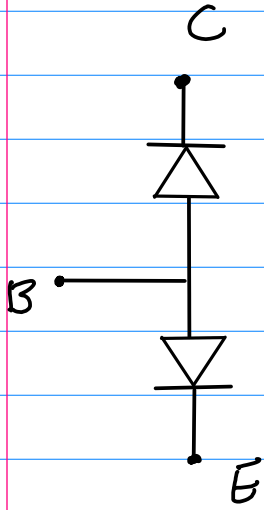
V_{BB}	→	R_{CE}
+5V	→	0
+4V	→	100 Ω .
+3V	→	10000 Ω (10 k Ω)
+2V	→	1000000 Ω (1 M Ω)
+1V	→	100000000 Ω (100 M Ω)
0V	→	∞ Ω

Current Controlled Device (I_B)

$$\begin{array}{l} I_B \uparrow \rightarrow R_{CE} \downarrow \\ I_B \uparrow \rightarrow I_C \uparrow \end{array} \left. \vphantom{\begin{array}{l} I_B \uparrow \rightarrow R_{CE} \downarrow \\ I_B \uparrow \rightarrow I_C \uparrow \end{array}} \right\} V_{CE} \downarrow$$

$$\begin{array}{ccc} V & = & I R \\ \downarrow & & \uparrow \downarrow \end{array}$$

$$\downarrow R = \frac{V \downarrow}{I \uparrow}$$

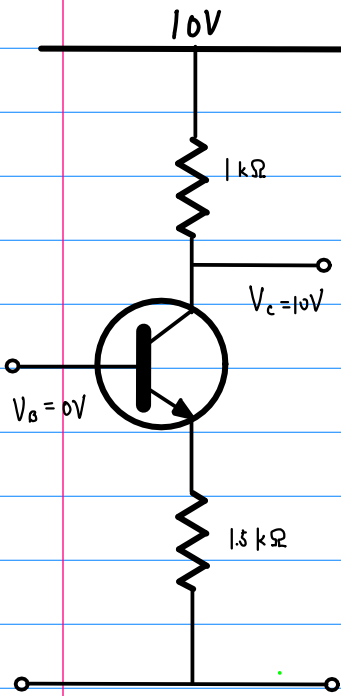


① cut off

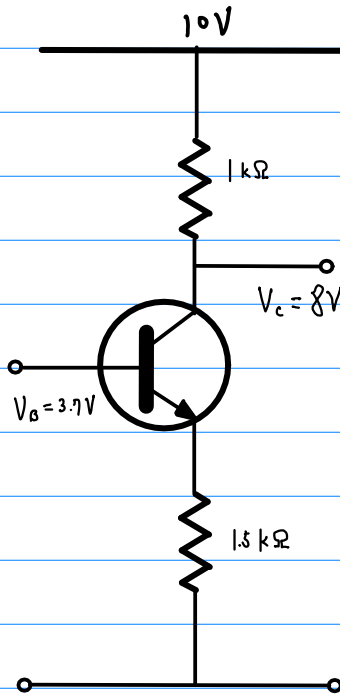
② Active

③ Saturation

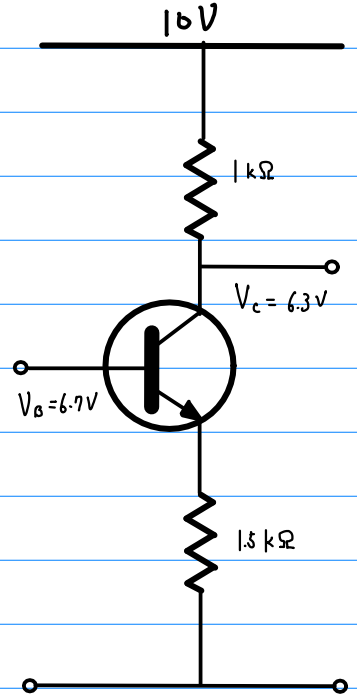
OFF



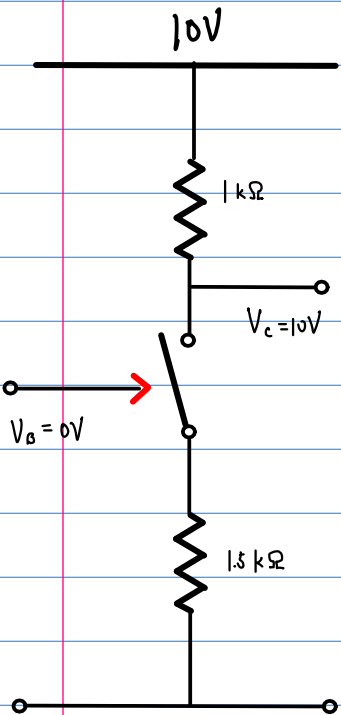
LIN



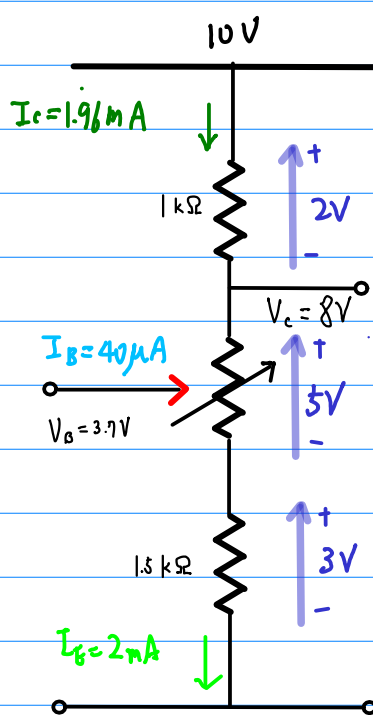
SAT



OFF



LIN



SAT

