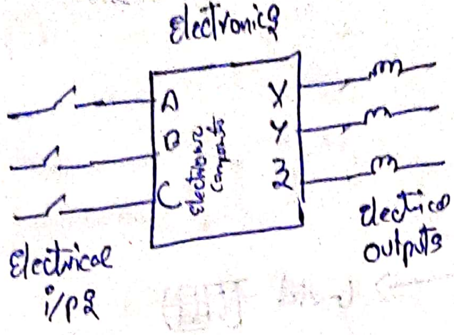
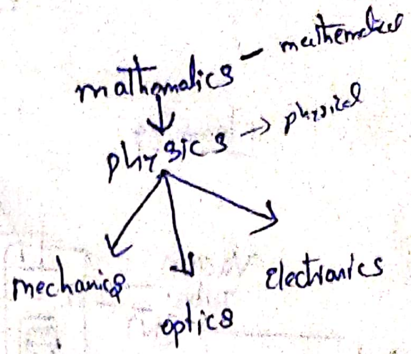
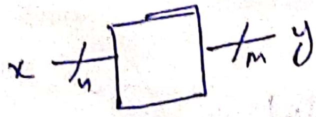
Electronics

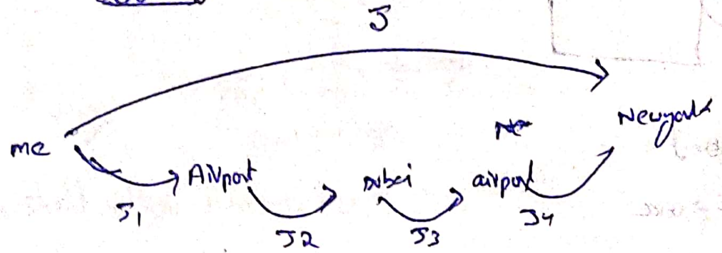


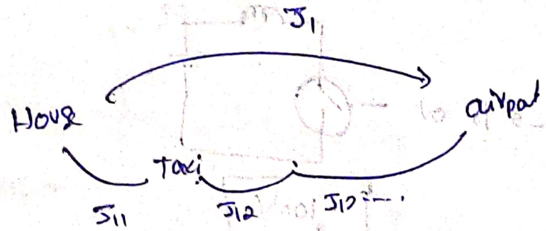




$y = f(x)$

Journey

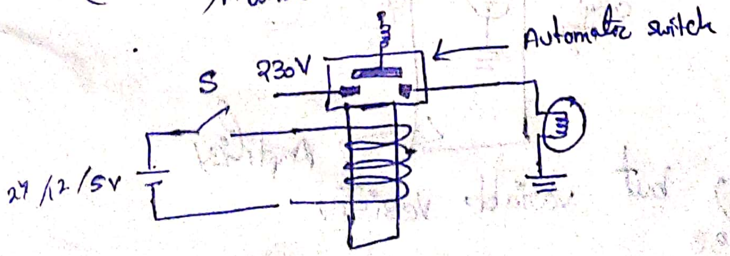




Control

(electrico) Manual

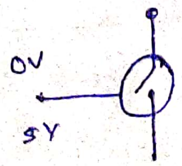
Automatic (electronics)



Disadvantage
- slow
- contact damage
- spring

} wear & Tear

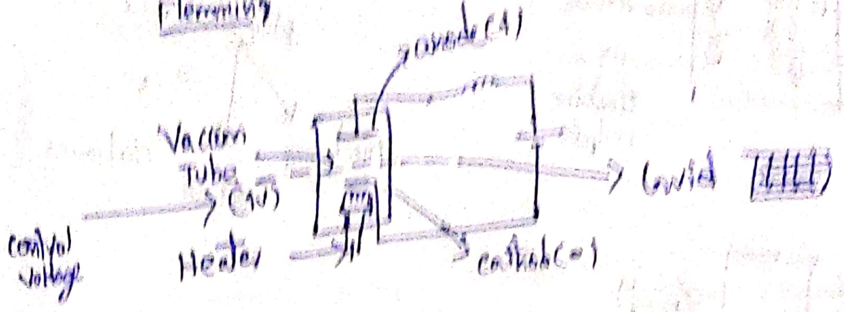
electro magnetic switch (Relay)



Electrons, $\boxed{\text{Electron}}$

the science controlling electrons

Fleming

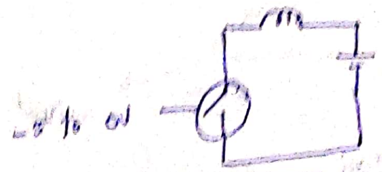


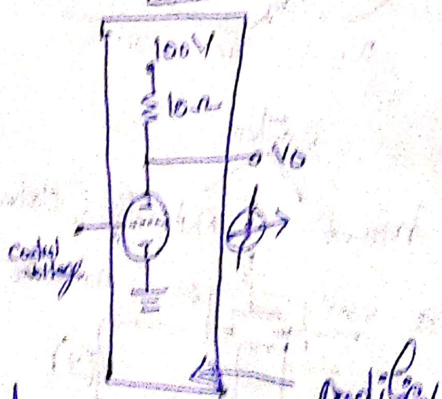
Lee de Forest

First electronic component is Triode

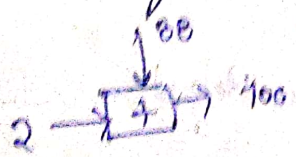
Graham bell (Telephone)

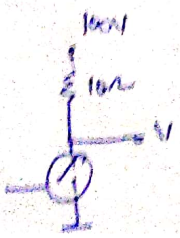
voice → electrical   electrical → voice

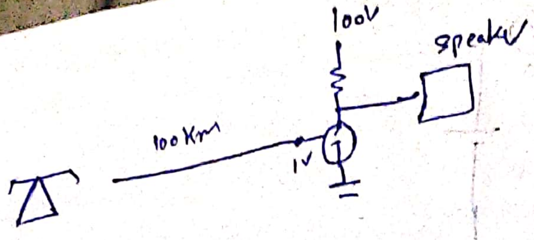




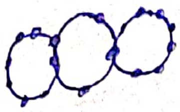
Amplifier is nothing but variable resistor







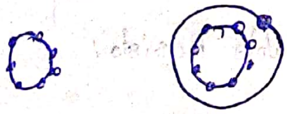
Germanium



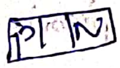
Limited so,

P metal material → Boron (3) — silicon — phosphor (5) → N material

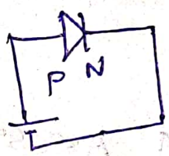
3, 5 valency Electrons



(or) Threshold voltage (voltage require to move electron)

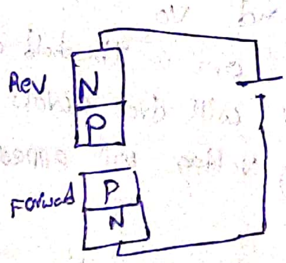


Reverse bias

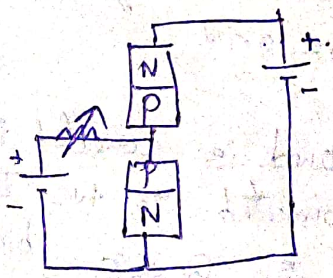


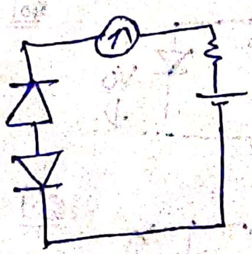
Forward bias

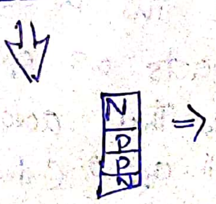
Break Even (max voltage)
voltage

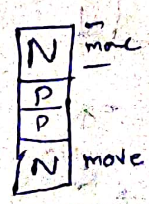


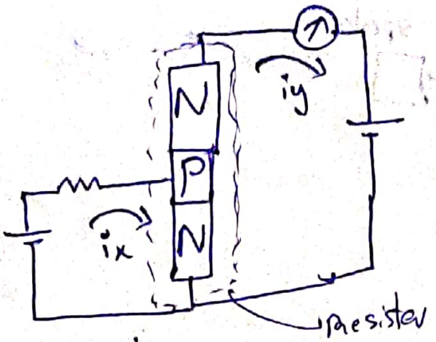
No flow











$\frac{iy}{ix}$

Transfer Resistor → Transister

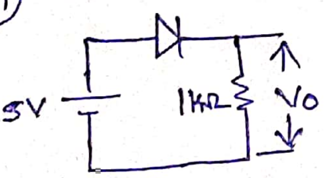
Transistor is nothing but variable Resistor

silicon — Boron → P, phospho → N → Diode → NPN Transistor

Base → control
Emitter → emitting electron
Collector → collecting electron

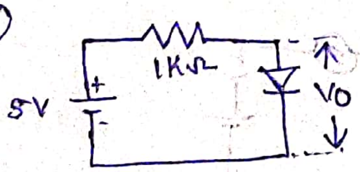
Electronic components Diode - 1 Assessment

(01)



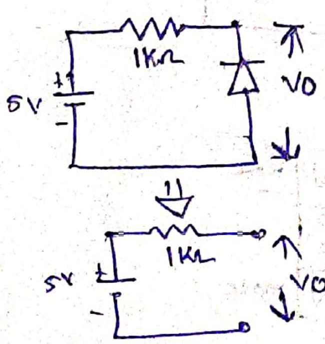
Sol To find Vo
W.K.T. 0.7 is threshold or cut in voltage for diode
so 0.7V will drop across diode so
remaining voltage will appear across 1KΩ

(2)



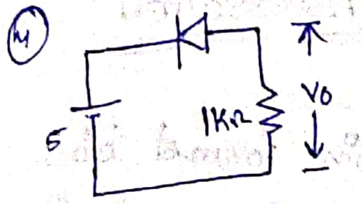
Sol W.K.T above, voltage drop across diode is 0.7V
so, Vo = 0.7V

(3)



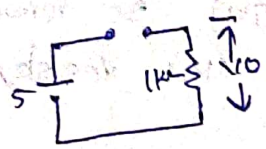
Sol Here anode is connected to -ve Terminal & cathode connected to +ve Terminal
so, diode in Reverse bias,
so, it acts as open circuit,
we know that across two terminals 5V will appear (due to open ckt)

(4)

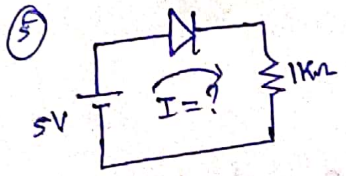


Sol here anode is connected to $-ve$ terminal & cathode to $+ve$, so Diode is in Reverse bias,

so, $V_o = 0$,



(5)



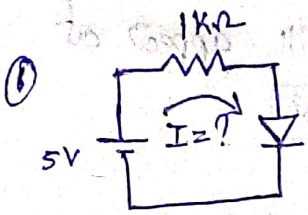
Sol Here again diode is connected in forward bias so voltage drop is 0.7

By ohm's law

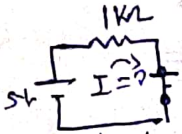
$$I = \frac{V_{source} - V_{diode}}{R} = \frac{5-0.7}{1K}$$

$$\boxed{I = 4.3\ mA}$$

(6)



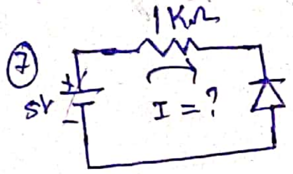
Sol ckt becomes as



here same as above approach just interchanged R & diode but they are in series so, nothing change

$$\boxed{I = 4.3\ mA}$$

(7)

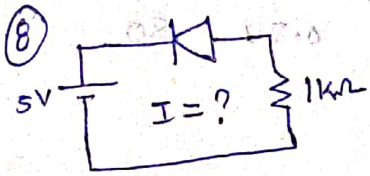


Sol Here diode connected as Reverse bias acts as open circuit

w.k.T current across in open circuit is zero

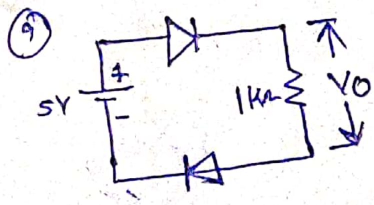
$$\boxed{I = 0}$$

(8)



Sol Here same as above acts as open circuit so, $\boxed{I = 0}$

(9)



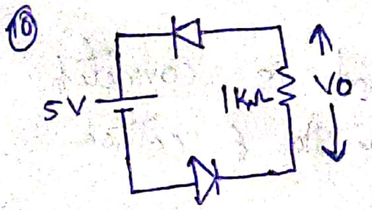
Sol Here both diodes are connected in Forward bias so they conduct & drops 0.7V individually

so $D_1 + D_2 = 0.7 + 0.7 = 1.4$

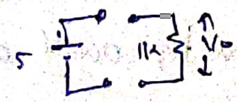
so, remaining voltage will appear across R

$V_o = 5 - 1.4 = \boxed{3.6V}$

(10)



Sol Here both diodes are connected in Reverse bias so, circuit becomes open in both sides (top & bottom)



so $\boxed{V_o = 0}$

Electronic components diode - 2 Assessement

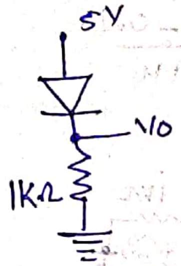
①

sol Here $V_{Total} = 5$
Diode is connected in forward bias
so, it drops voltage (0.7V) so remaining
Voltage appears across 1KΩ resistor

i.e. $V_o = 5 - 0.7$

$\boxed{V_o = 4.3V}$

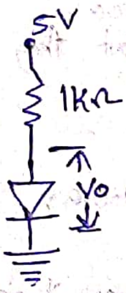
②



sol here $V_{Total} = 5$
Diode connected in Forward bias so,
same voltage drop across it 0.7V
so. remaining voltage will appear at

$V_o = 5 - 0.7 \Rightarrow \boxed{4.3V}$

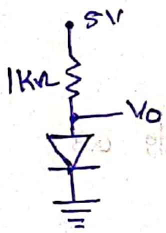
③



sol Here $V_{TOTAL} = 5$
Diode connected in Forward bias,
No matter where connected voltage drop
across it always 0.7V

$\boxed{V_o = 0.7V}$

④



sol Here $V_{TOTAL} = 5$
Diode connected in Forward bias
so, drop across it 0.7V so
remaining (V)

$I = \frac{4.3V}{1K\Omega} = 4.3mA$

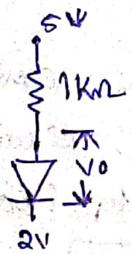
$V_{(1K\Omega)} = I \cdot R$
$= 4.3mA \times 1K$

$\boxed{V_{(1K\Omega)} = 4.3V}$

$V_o = 5 - V_{(1K\Omega)}$
$= 5 - 4.3$

$\boxed{V_o = 0.7}$

⑤



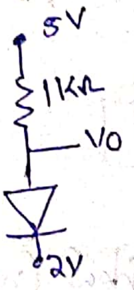
sol here Diode anode is connected
to 5V through 1KΩ Resistor & cathode
connected to 2V

here voltage across anode is > voltage across
cathode

diode is forward bias

so voltage drop is always $\boxed{0.7V}$ only

(6)



Sol Here diode is connected ~~is conn~~ in forward bias ($V_{C(Anode)} > V_{C(cathode)}$)

so, $V_o = 2 + V_{(diode)}$

$= 2 + 0.7$

$\boxed{V_o = 2.7}$

(or)

By KVL

$5V - (I \times 1K\Omega) - V_{Diode} - 2V = 0.$

w.K.T

$V_{Diode} = 0.7$

$5 - (I \times 1K\Omega) - 0.7 - 2 = 0$

$5 - (I \times 1K\Omega) = 2.7$ (or) $5 - 2.7 - (I \times 1K\Omega) = 0$

$\Rightarrow 2.3 - (I \times 1K) = 0$

$2.3 = I \times 1K$

$I = \frac{2.3}{1K\Omega} = 2.3mA$

$V_{1K\Omega} = IR$

$= 2.3m \times 1K$

$= 2.3V$

$V_o = 5 - V_{1K\Omega}$

$\boxed{V_o = 2.7V}$

(7)

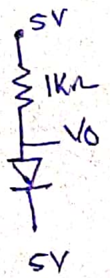
Sol Here we can see that anode is connected to 5V through 1KΩ Resistor & cathode is connected to 5V directly

so $V_{cathode} \geq V_{anode}$

So diode is ~~open~~ ideal so voltage drop across it is zero

$V_o = 0$

(8)



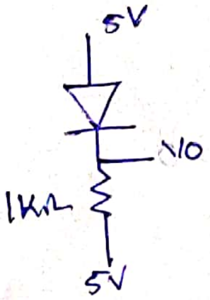
Sol Here again diode connected in ~~Reverse~~ bias ideal case

so circuit is open but we measures Vo above diode upto that 5V appears

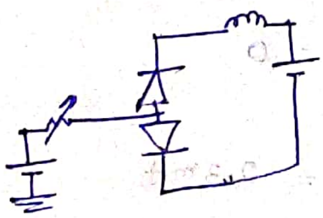
(due to open ckt (non conducting) no current will flow so no voltage drop across 1KΩ resistive)

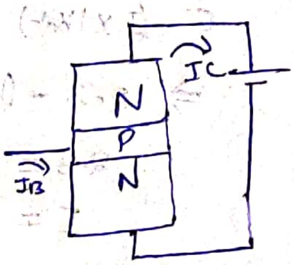
(8) 

Sol Here same as previous one but interchanged so,
Diode is ideal (non conducting)
so $I = 0$ ✓
so $V_{1K\Omega} = I \times R$
$= 0 \times 1K$ $\boxed{= 0\,V}$

(10) 

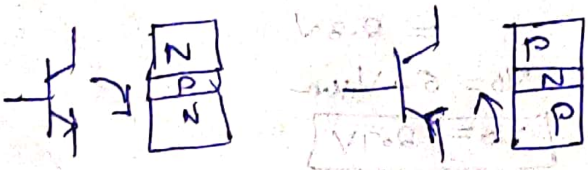
Sol Here same diode is ideal (non conducti
So $I = 0$
$V_{1K\Omega} = 0$ ✓
so = 5V appears across Vo
$\boxed{V_o = 5V}$

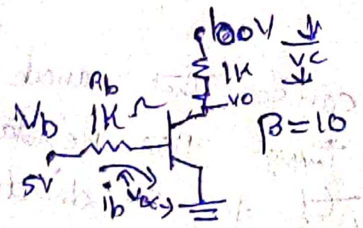




$\frac{i_c}{i_b} = \beta$

β – amplification factor



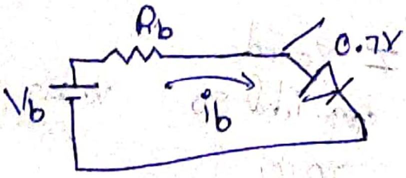


$\beta = 10$

$i_b = \frac{V_b - V_{BE}}{R_B}$

$= \frac{5 - 0.7}{1K}$

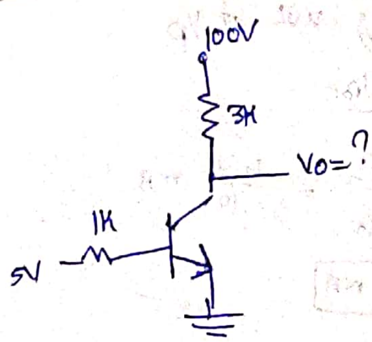
$\boxed{i_B = 4.3\,mA}$

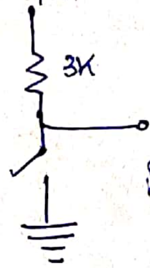


(2) $I_C = \beta I_B = 10 \times 4.3\,mA \Rightarrow 43\,mA$

(3) $V_C = I_C \times R_C \Rightarrow 43m \times 1K \Rightarrow 43V$

(4) $V_o = 100 - V_C$
$= 100 - 43$
$=$





(0V – 100V)

If we on (close)

max I = 33mA

off

$i_{cmax} = \frac{V_{cc}}{R_c}$

cutoff

saturation

Variable Resistor

Active

0 < ic < icmax

If ic > imax

then ic = icmax

Cutoff   Saturation

switch

⇒ Gate ⇒ Digital electronics

↓ Logic functions

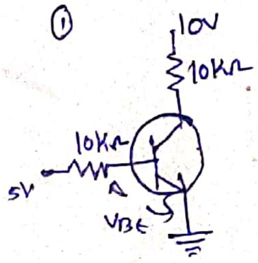
⇒ amplifier → analog electronics

← Amplifier, voltage regulators

Variable resistor

Transistor Characteristics

①

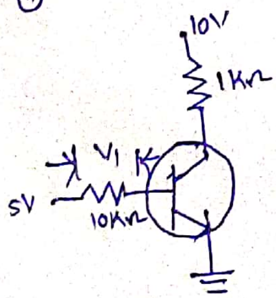


Sol ~~apply KVL at i/p side~~

~~5 – V1 – 0~~ Don't need w.r.t

that $V_{BE} = 0.7$ directly for silicon

②



Sol apply KVL at i/p side

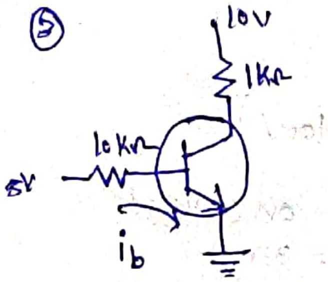
$5V - V_1 - V_{BE} = 0$

$5V - V_1 - 0.7 = 0$

$V_1 = 5V - 0.7$

$\boxed{V_1 = 4.3V}$

(3)



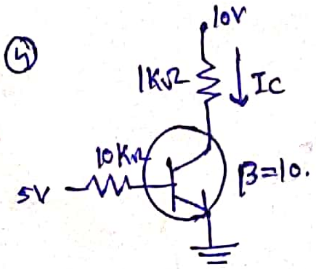
Sol W.K.T by using KVL at I/P

$i_b = \frac{5 - V_{BE}}{10K}$

$= \frac{5 - 0.7}{10K} = \frac{4.3}{10}$ mA

$\boxed{i_b = 0.43\,mA}$

(4)



Sol W.K.T

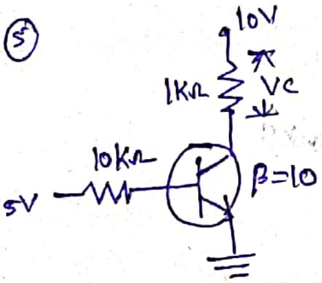
$i_B = 0.43mA$

$I_B = \frac{I_C}{\beta}$,

$I_C = \beta I_B \Rightarrow 10 \times 0.43m$

$\boxed{I_C = 4.3\,mA}$

(5)



Sol W.K.T.

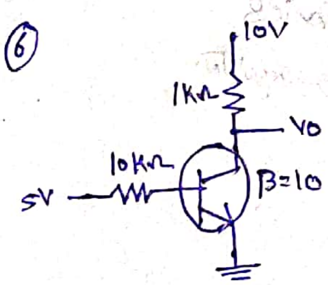
$I_C = 4.3mA$

$V_C = I_C \times R_C$

$= 4.3m \times 1K$

$\boxed{V_C = 4.3V}$

(6)



Sol W.K.T.

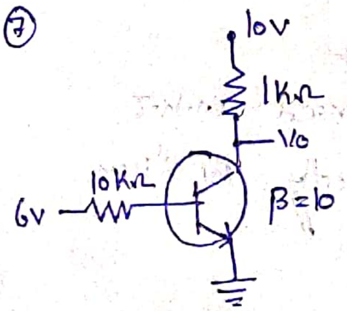
$V_C = 4.3V$

$V_O = 10V - V_C$

$= 10 - 4.3$

$\boxed{V_O = 5.7V}$

(7)



Sol $I_B = \frac{6 - 0.7}{10K}$

$I_B = 0.53mA$

$I_C = \beta I_B$

$= 10 \times 0.53mA$

$I_C = 5.3mA$

$V_C = I_C \times R_C$

$= 5.3mA \times 1K$

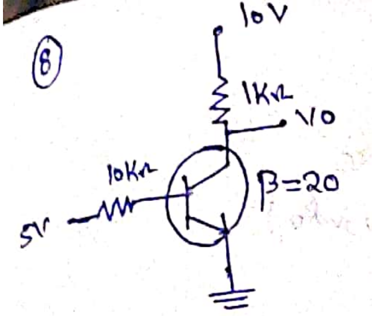
$V_C = 5.3V$

$V_O = 10 - V_C$

$= 10 - 5.3$

$\boxed{V_O = 4.3V}$

(8)



sol

$I_B = \frac{5-0.7}{10K} = 0.43mA$

$I_C = \beta I_B$

$= 20 \times 0.43m$

$I_C = 8.6mA$

$V_C = I_C \times R_C$

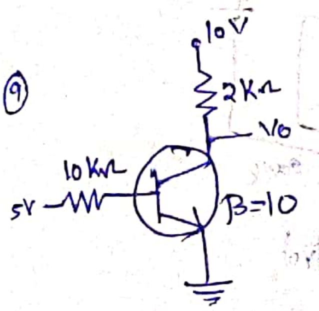
$= 8.6m \times 1K$

$V_C = 8.6V$

$V_o = 10 - V_C \Rightarrow 10 - 8.6$

$\boxed{V_o = 1.4V}$

(9)



sol w.k.t

$I_B = 0.43mA$

$I_C = \beta I_B$

$= 10 \times 0.43m$

$\boxed{I_C = 4.3mA}$

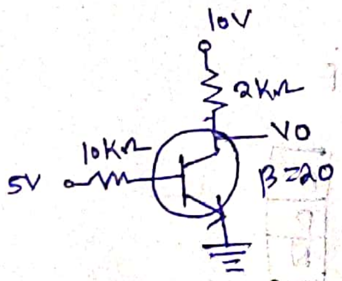
$V_C = I_C R_C \Rightarrow 4.3m \times 2K$

$V_C \Rightarrow 8.6V$

$V_o = 10 - 8.6$

$\boxed{V_o = 1.4V}$

(10)



sol

$I_B = \frac{5-0.7}{10K} = 0.43mA$

$I_C = \beta I_B$

$= 20 \times 0.43mA$

$I_C = 8.6mA$

$V_C = I_C R_C$

$= 8.6m \times 2K$

$V_C = 17.2$

$V_o = V_{CC} - V_C$

$= 10 - 17.2$

$V_o = -7.2$

here -ve sign indicates it is in saturation, generally in active ~~Vo should~~ Vo should be in b/w (0 to Vcc) only.

because

$I_C >> I_{Cmax}$

So it drives into saturation mode

$I_{Cmax} = \frac{V_{CC} - V_{CE(sat)}}{R_C} = \frac{10-0.2}{2K}$

$I_{Cmax} = \frac{9.8V}{2K\Omega} = 4.9mA$

$\boxed{\therefore I_C >> I_{Cmax}}$ this condition makes $I_C = I_{Cmax}$

$V_C = I_C \times R_C \Rightarrow 4.9m \times 2K$

$V_C = 9.8V$

$V_o = V_{CC} - V_C \Rightarrow 10 - 9.8$

$= 0.2V$

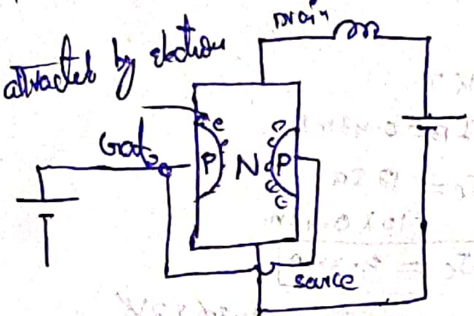
Type of Transistors

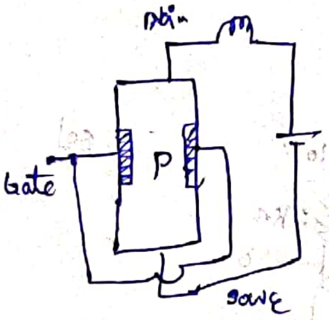
Voltage controlled device

current controlled device
(Bipolar ~~controller~~ junction)

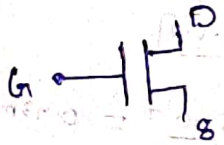
$$Si_{4} + B_{3} = P_{7}$$

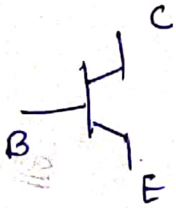
$$Si_{4} + P_{5} = N_{9}$$



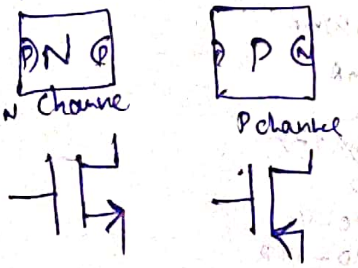


By applying voltage at the gate I_D is control

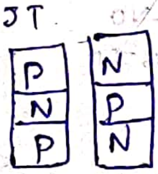




Field effect Transistor



BJT



∴ BJT faster Than FET (due to capacitance charging and discharge time more)

perfect insulator we use (SiO_2) in MOSFET

MOSFET ← metal oxide semiconductor field effect Transistor