ID: 12595 Date: 29/09/2020

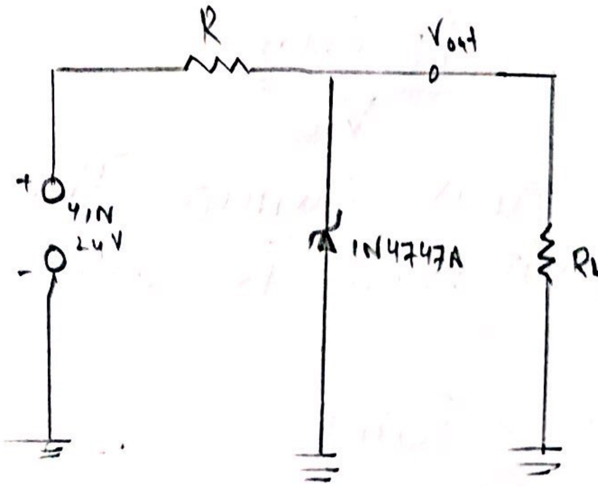
Q1 The 1N4747A Zener used in the regulator of figure is a 15V diode determine the following.

(a) Determine V_{out} at I_{ZK} and at I_{ZM}.

(b) Calculate the value of R that should be used.

(c) Determine the min value of RL that can be used

The electrical characteristics and value of V_Z, I_Z, I_{ZK}, Z_Z can be found in diode datasheet:-



Solution from the data sheet we can write of 1N4747A

$V_Z = 20$

~~IZ = 20~~

$I_Z = 12.5mA$

$Z_Z = 22$

$I_{ZK} = 0.25mA$

(9) Vout = ? at I_{zk} and I_{zM}

$V_{out} = V_Z - \Delta V_Z$ (for I_{zk})

$= V_Z - (I_z - I_{zk})$

$V_{out} = V_Z - (I_Z - I_{ZK}) Z_Z$

$V_{out} = 20 - (12.5 - 0.25) 22$

$V_{out} = 20 - (12.25) 22$

$V_{out} = 20 - 0.2495$

$V_{out} = 19.7305V$ for I_{ZK}

Now Vout for I_{ZM} First to I_{ZM}

$$I_{ZM} = \frac{P_D (Max)}{V_Z}$$

for Zener max current The max power dissipated is 1W

$I_{ZM} = 50mA$

Now Vout for I_{ZM}

$V_{out} = V_Z + \Delta V_Z$

$V_{out} = V_Z + (I_{ZM} - I_Z) Z_Z$

$$V_{out} = 20 + (50mA - 12.5mA)\,22\Omega$$

$$V_{out} = 20 + (37.5mA)\,22\Omega$$

$$V_{out} = 20.825V \text{ for } I_{ZM}$$

(b) $R = ?$

As we know that

$$V_{in(max)} = I_{ZM}R + V_{out}$$

$$\Rightarrow R = \frac{V_{IN} - V_{out}}{I_{ZM}}$$

$$= \frac{24 - 20.825V}{50mA}$$

$$R = 63.5\Omega$$

(c) minimum Load resistance $R_L = ?$

So

$$I_T = \frac{V_{in} - V_Z}{R}$$

$$= \frac{24 - 20}{63.5\Omega} = \frac{4}{63.5}$$

$$I_T = 63mA$$

Now to find I_L (max)

$$I_{L(max)} = I_T - I_{ZK}$$

$$= 63.75 mA$$

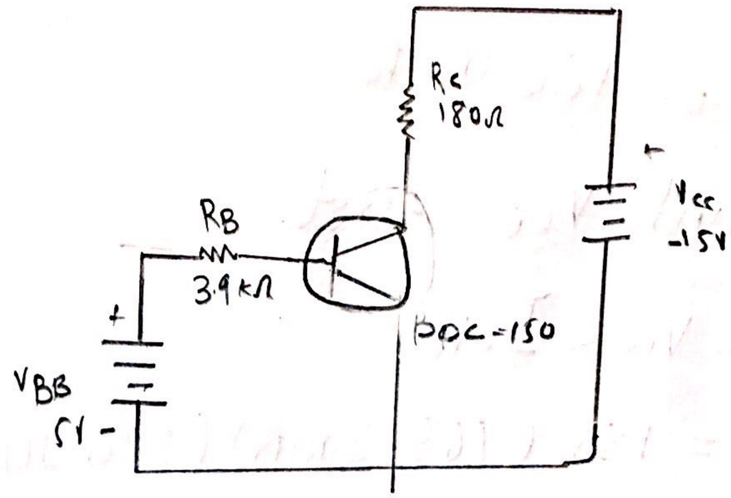
So

$$R_{L(min)} = \frac{V_Z}{I_{L(max)}}$$

$$= \frac{20}{63.75 mA}$$

$$R_{L(min)} = 318.72 \Omega$$

Q(2) Determin I_B, I_c, I_E, V_{BE}, V_{CE} and V_{CB} in the circuit



Solution

from the given figure we can write

$V_{BB} = 5V$, $R_B = 3.9K\Omega$, $R_C = 180\Omega$

$V_{CC} = 150$,

As I_B is given by $\beta_{DC} = 150$

$$I_B = \frac{V_{BB} - V_{BE}}{R_B}$$

$$= \frac{5V - 0.7V}{3.9K\Omega} = 1102\mu A$$

As we know

$$I_c = \beta_{DC} I_B$$

$$(150)(1102\mu A) = 165.3mA$$

$I_E = I_C + I_B$

$= 1653 mA + 1102 \mu A$

$I_E = 166.4 mA$

Now find Vce first

$V_{CE} = V_{CC} - I_C R_C$

$= 15V (165.3mA)(180 \Omega)$

$= 15V - 29.7V$

$= -14.7V$

Now

$V_{CB} = V_{CE} - V_{BE}$

$= -14.7V - 0.7V$

$= -15.4V$

Since collector is at a lower voltage than the base the collector case junction is forward biased.

Q3

Solution

BJTS can be used as amplifiers by using its "Active" Region of operation by acheiving forward biased mode of Junction (J_1) and by reverse biasing the Junction (J_2)

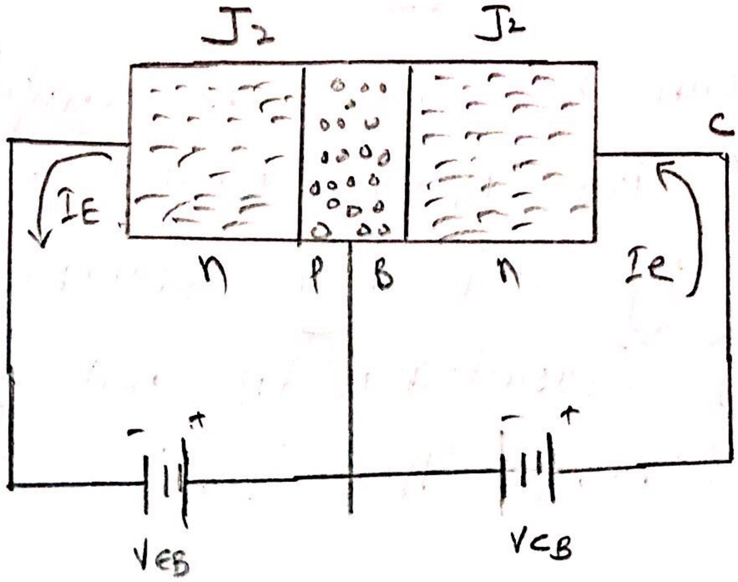
SNO	J_1	J_2	Region of operation	works as
1	F.B	R.B	Active	Amplifier
2	F.B	F.B	Saturation	ON switch
3	R.B	R.B	Cutt off	off/open circuit
4	R.B	F.B	Inverted	rarely used

The 4 modes the BJT can be used BJT to be used as an amplified

Schematic Diagram.

next page see

Diagram:



Above Diagram Shows The basic configuration for using a BJT in active region Thus active as an amplifier.

Q4 For a transistor to act as a Switch you need to Join each of The following condition on The left to ON or OFF State.

Solution

Transistor fully ON (ON)

Transis fully off (off)

Input and base are at 0V (OFF)

Collectors Current $I_c = 0$ (OFF)

$V_{CE} = V_{CC} =$ (OFF)

BC Junction is reverse bias (OFF)

BC Junction is reverse bias (OFF)

Max of Saturation Current I_c flows (ON)

BE Junction is forward bias (ON)

BC Junction is forward bias (ON)

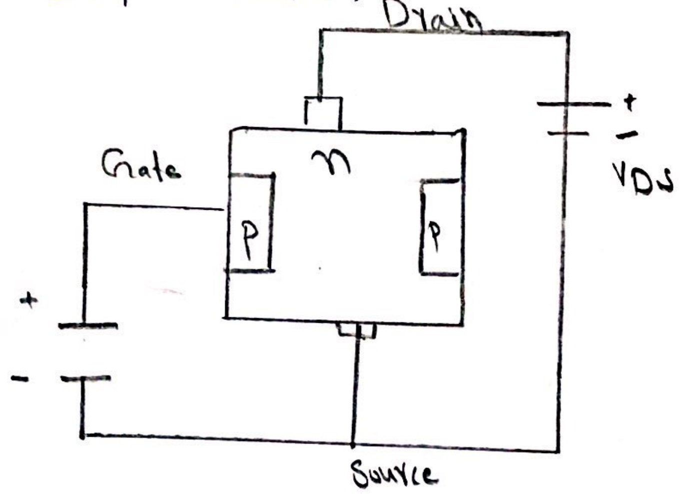
$V_{CE} = 0V$ (ON)

BE Junction is less Than 0.7V (OFF)

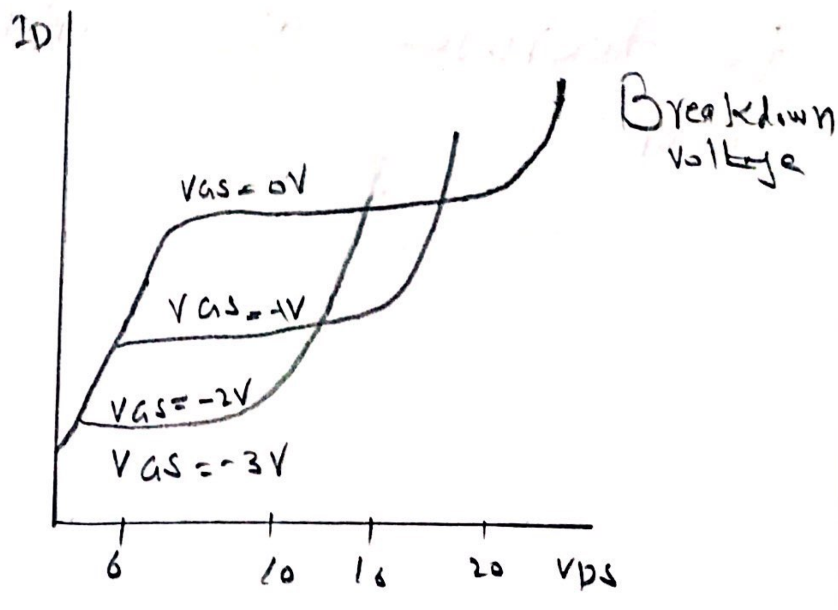
Q(5)

Solution:-

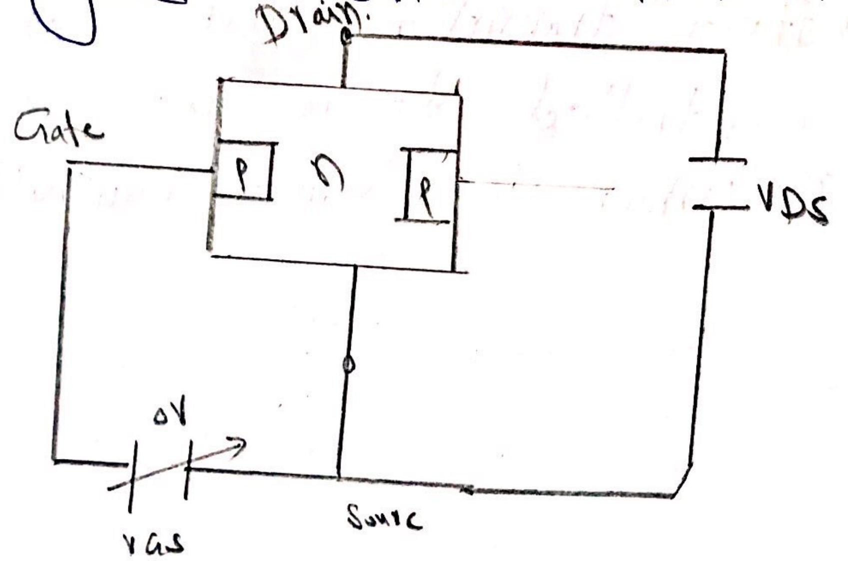
JFET is a type of Junction field effect transistor which as voltage controlled device as differ from BJT which is current controlled



Actually in FET the drain to Source current is controlled by the width of the channel the Electric field is produced by the gate to source voltage.

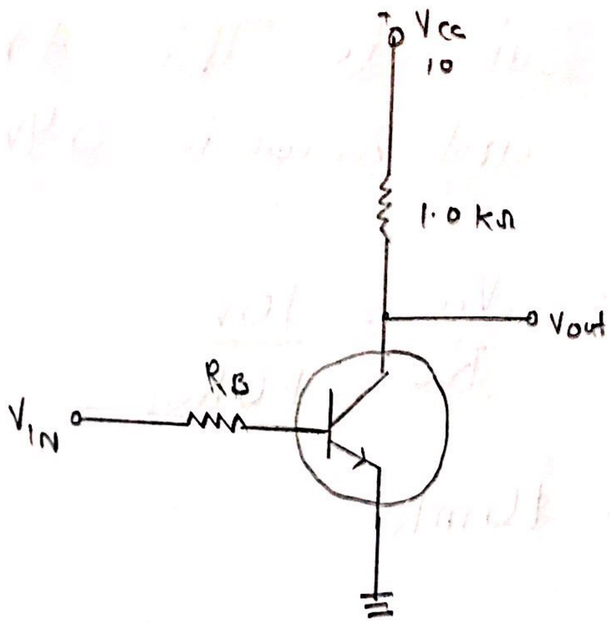


So if we see to the graph which the no voltage applied to the gate the current flows feely



The channel are wider and Drain current moves freely.
if we move VGS to negative value the channel width start to decreases at current cannot moves.

Q 6



Solution

(a) What is V_{CE} when $V_{IN} = 0V$?

(b) ~~Determine The~~

As we know that for $V_{in} = 0V$

The transistor will be in cutt off mode

V_{CE} = will be The Same as V_{cc}

$\Rightarrow V_{CE} = V_{cc} = 10V$

So

$V_{CE} = 10V$

(13) Determine The min value of I_B is required to Saturate This transistor if β_{DC} is 125 and $V_{CE(sat)}$ is 0.4V.

$$I_{C(sat)} = \frac{V_{CC}}{R_C} = \frac{10V}{1.0k\Omega}$$

$$= 10mA$$

So

$$I_{B(min)} = \frac{I_{C(sat)}}{\beta_{DC}}$$

$$= \frac{10mA}{125} = 0.08mA$$

The required min I_B to Saturate the transistor.