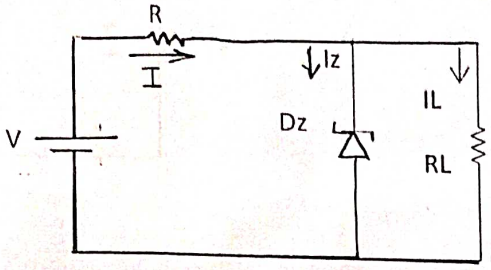
Sheet four

1. In the shown figure, V=300V, Vz=220V, the value of the zener current is 15mA, and the value of the load current is 25mA.
   (a) Calculate the value of R which must be used.
   (b) If the load current decreases by 5mA, what will be the zener current.
   (c) The load is as in part (a). If the supply voltage changes to 340V, what is Iz?
   (d) The normal operating range of the avalanche diode is from 3 to 50mA. If R=1.5KΩ and V=340V, over what load current can output be varied?



Sol% -

- U = 300 V
- Vz = 220V
- Iz = 15mA
- IL = 25mA

a]

$U > U_Z \longrightarrow$ regulator

$$R = \frac{U - U_Z}{I} = \frac{U - U_Z}{I_Z + I_L} = \frac{300 - 220}{15 + 25} = 2\,k\Omega$$

b]

I_L decrease by 5m A

$I_L = 25 - 5 = 20$ mA

$I = I_Z + I_L = 40$mA

$$40mA = \frac{U - U_Z}{R}$$

$\therefore I_Z = 15 + 5 = 20$ mA

U, Uz not changed
decrease in IL mean increase at Iz by the same value

c]

$$R_L = \frac{U_z}{I_L}$$

$$I = \frac{U - U_z}{R} = \frac{340 - 220}{2} = 60\,mA$$

$$I_z = I - I_L = 60 - 25 = 35\,mA$$

d]

$U = 340V$

$R = 1.5\,K\Omega$

$I_z = 3$ to $50mA$

↑ min ↑ max

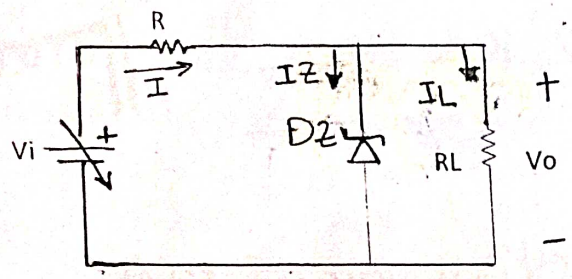
$? \leq I_L \leq ?$

$$I = \frac{U - U_z}{R} = \frac{340 - 220}{1.5} = 80\,mA$$

I_L from $(80 - 3)$ to $(80 - 50)$

$I_L \rightarrow 77mA$ to $30mA$

2. For the voltage regulator shown, assume that Vo =20 V, R=20Ω, rz=0, and RL =200Ω. Voltage Vi varies between 24 and 30V.
   (a) Specify the maximum and minimum current rating for the zener diode.
   (b) Determine the maximum power dissipated in resistance R and in zener diode.



Solⁿ –

- $V_o = 20V$
- $R = 20\,\Omega$
- $r_z = 0$
- $R_L = 200\,\Omega$
- $24 < V_i < 30V$

a] $V_o = V_Z = 20V$

$$I_L = \frac{V_Z}{R_L} = \frac{20}{200} = 0.1A$$

⇒ at 24 V for Vi

$$I_{min} = I_{Zmin} + I_L$$

$$\frac{V_i - V_Z}{R} = I_{Zmin} + 0.1$$

$$I_{Zmin} = \frac{24-20}{20} - 0.1 = 0.1A$$

⇒ at 30V for Vi

$I_{max} = I_{Zmax} + I_L$

$I_{Zmax} = \frac{30-20}{20} - 0.1 = 0.4\,A$

$\longrightarrow I_{max} = 0.5$

$I_Z \rightarrow 0.1$ & 0.4

b]

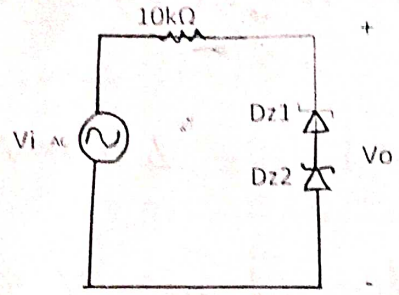
$P_{max\,R} = I^2_{max}\,R$

$= (0.5)^2 * 20 = 5$ watt

$P_{max\,Z} = I_{Zmax}\,V_Z$

$= 0.4 * 20 = 8$ watt

3. For the circuit shown, Determine Vo for all voltage levels if Vz1 =5V, Vz2=6V, Vγ=0V and Vi=20sinωt.



Solg-

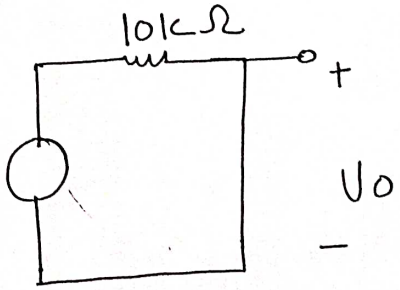
In Zener Diode if Voltage applied on diode less than Vz Diode be in normal reverse mode [o-c]

D_{z1} D_{z2}		D_{z1} or D_{z2}		D_{z1} & D_{z2}
ON	0	Reverse	11	break down regulator
Region ①		Region ②		Region ③

*Region ①

D_{z1} ON D_{z2} ON

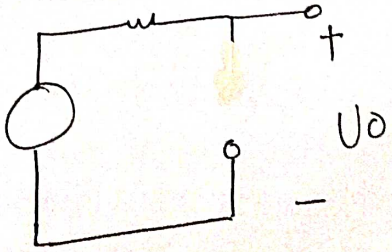
V_o = zero v



* Region ②

D_{z1} or D_{z2} reverse

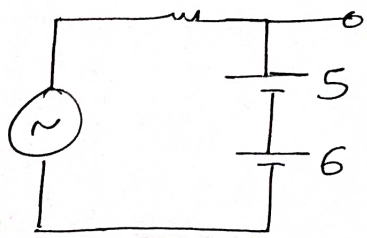
$V_o = V_i$

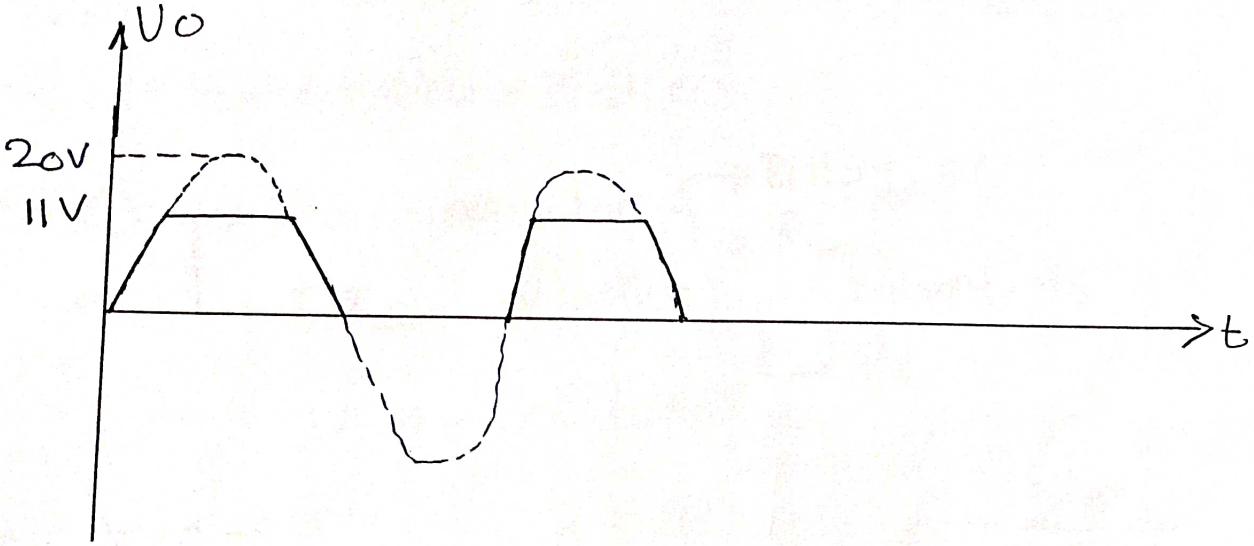


* Region (3)

D_{Z1} and D_{Z2} break down

$V_o = 5 + 6 = 11\ V$





ثم بحمد الله