15.03.2011

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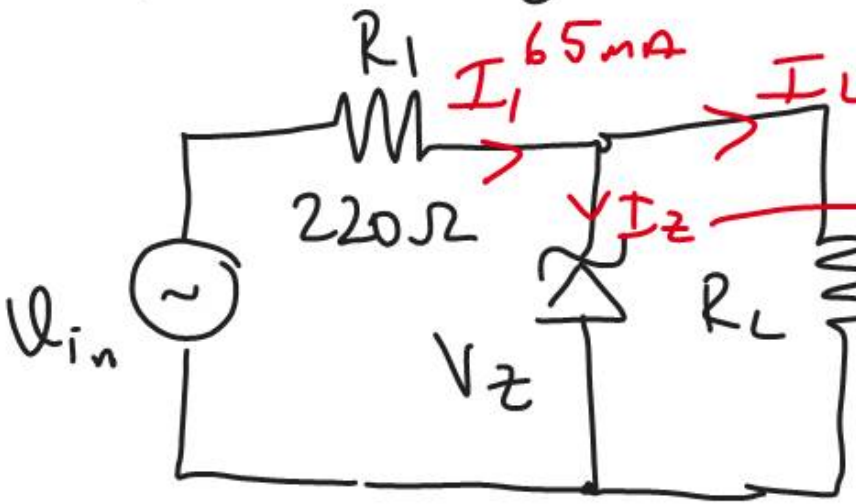
<Z>

example: $V_z = 5V$, $I_{zmax} = 60mA$ } are given

(1) In the circuit given below determine $V_{in\,min}$, $V_{in\,max}$



$I_L = 5mA = \frac{V_z}{R_L} = \frac{5V}{1K} = \frac{5}{10^3} = 5\times10^{-3}A$

$I_1 = 65mA$

$I_{zmax} = 60mA$ given

$U_0 = 65\times10^{-3}\times220 + 5 = 19,3V$

$U_{in\,max} = I_{1\,max} \cdot R_1 + V_z = 19,3V$

$I_{1\,max} = I_{zmax} + I_L = 60mA + 5mA = 65mA$

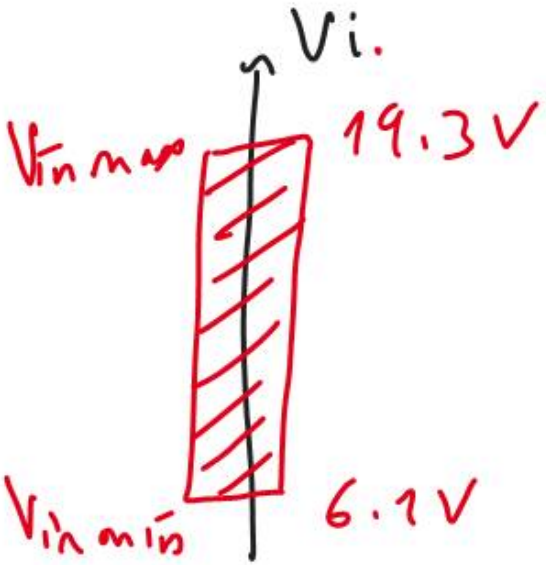
$U_{in\,min}$:

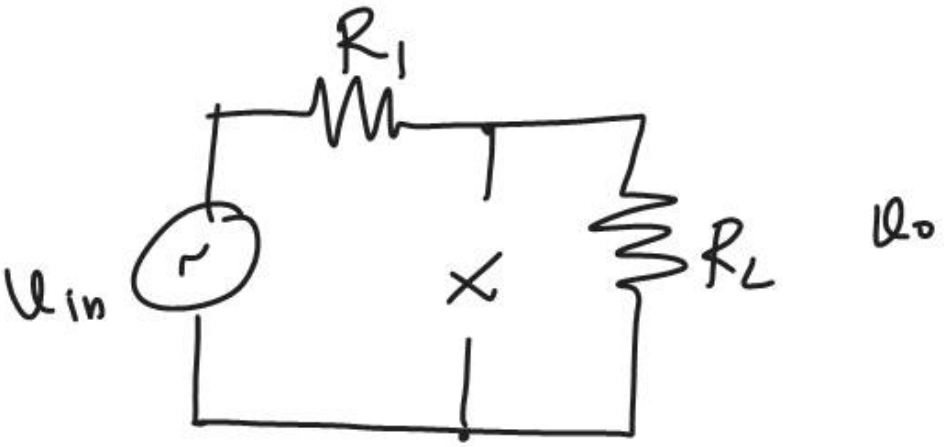
$U_{in\,min} = \frac{V_z}{R_L}(R_1 + R_L)$

$\frac{U_{in}}{R_1 + R_L} \cdot R_L \geq V_z$

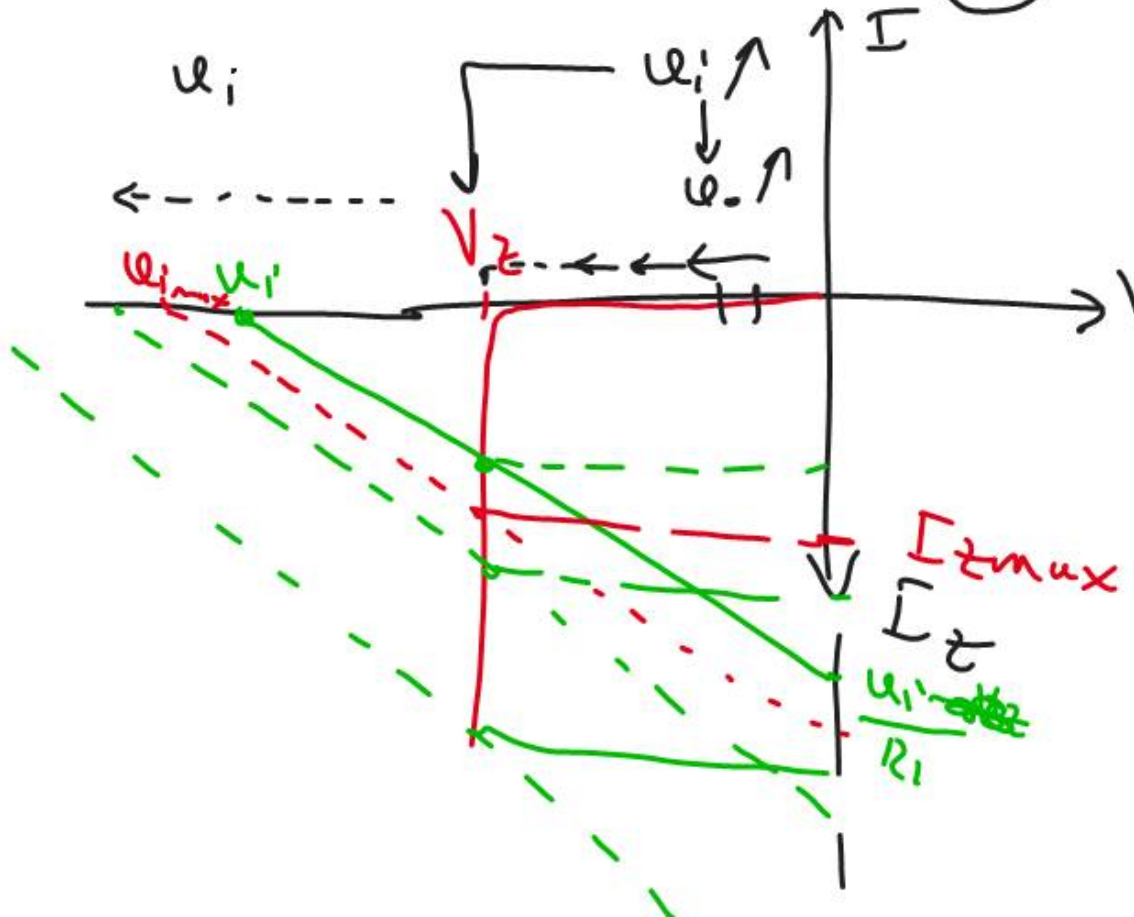
$U_{in\,min} = \frac{5}{1\times10^3}(1\times10^3 + 220)$

$U_{in\,min} = 6.1V$





$$U_o = \frac{U_{in}}{R_1 + R_L} \cdot R_L$$

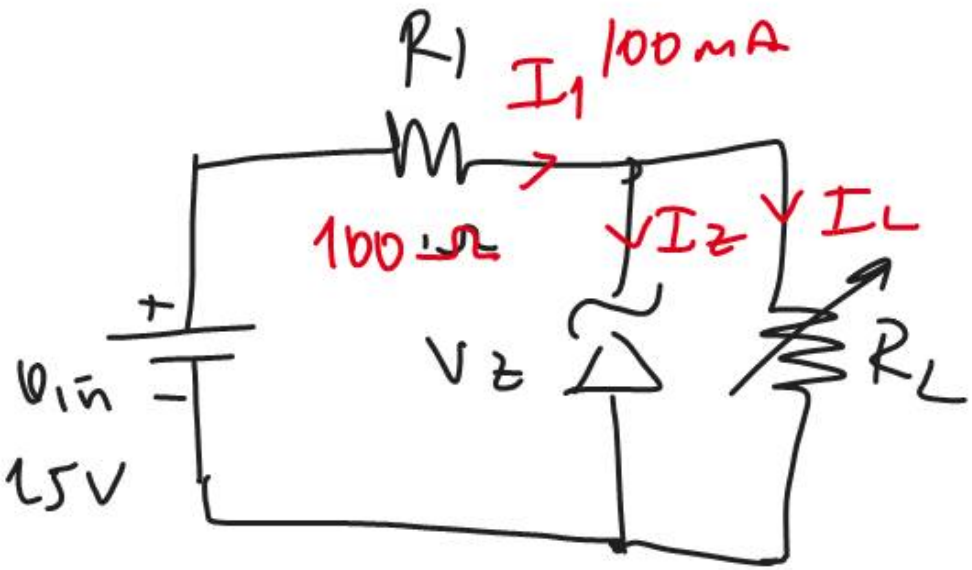


(2) determine $R_{L\min}$ and $R_{L\max}$ if $V_{in} = 15V$ constant

LOAD REGULATION

$R_1 = 100\,\Omega$

$I_{Z\max} = 60mA$



$V_o = V_Z = 5V$ (in regulation)

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

$$I_1 = \frac{V_{in} - V_Z}{R_1} = \frac{15-5}{100} = \frac{10}{100} = 0.1 = 100\,mA$$

$I_{Z\max} = 60mA$ $\quad I_1 = 100mA = 60mA + I_L$

$I_{L\min} = 40mA$ $\quad R_{L\max} = \frac{V_Z}{I_{L\min}} = \frac{5V}{40\times10^{-3}} = 125\,\Omega$

$R_{L\,min}$:

$$\frac{V_{in}}{R_1+R_L}\cdot R_L \geq V_z$$

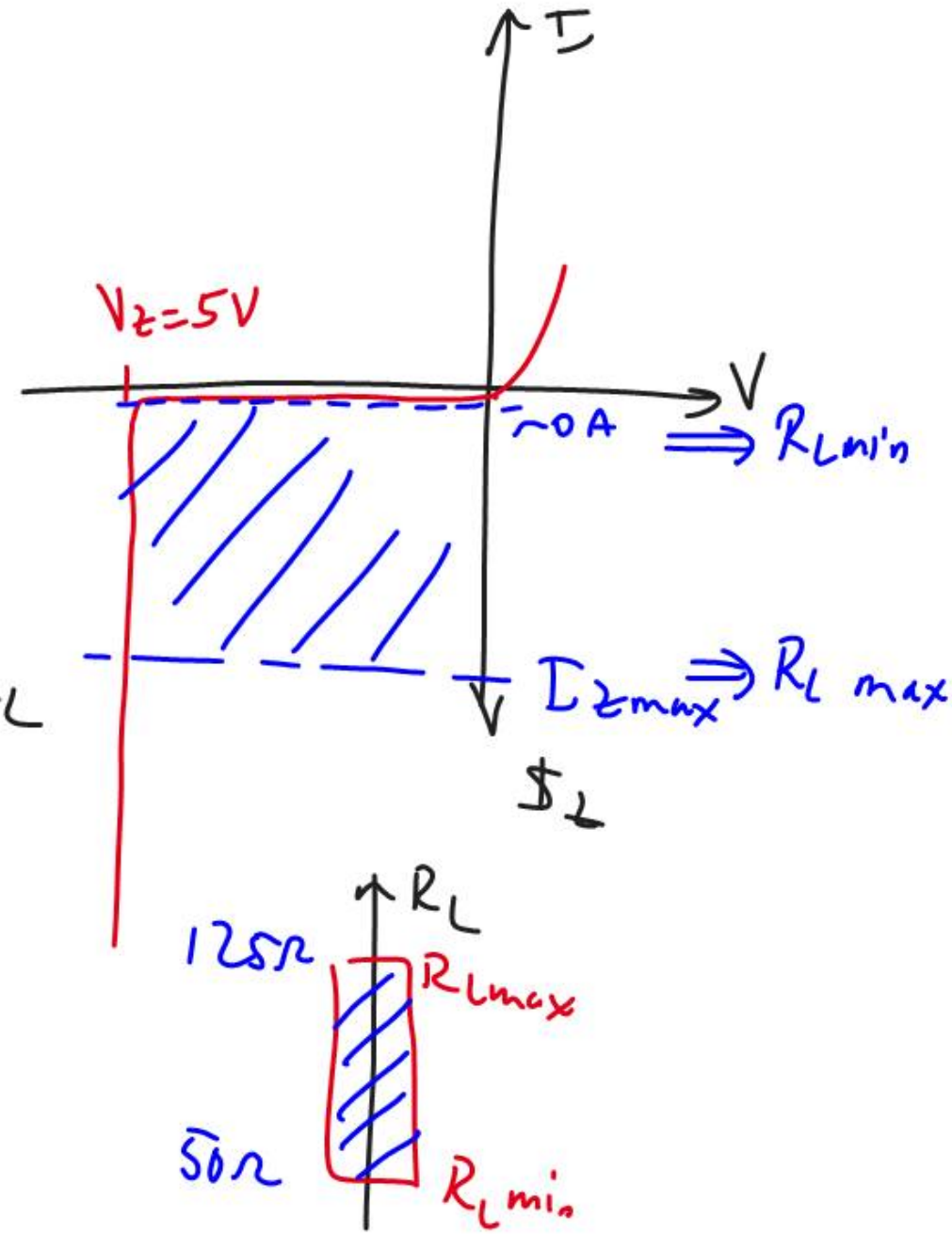
$$\frac{15\,V}{R_1+R_L}\,R_L = V_z$$

$$R_L \cdot 15 = V_z \cdot R_1 + V_z \cdot R_L$$

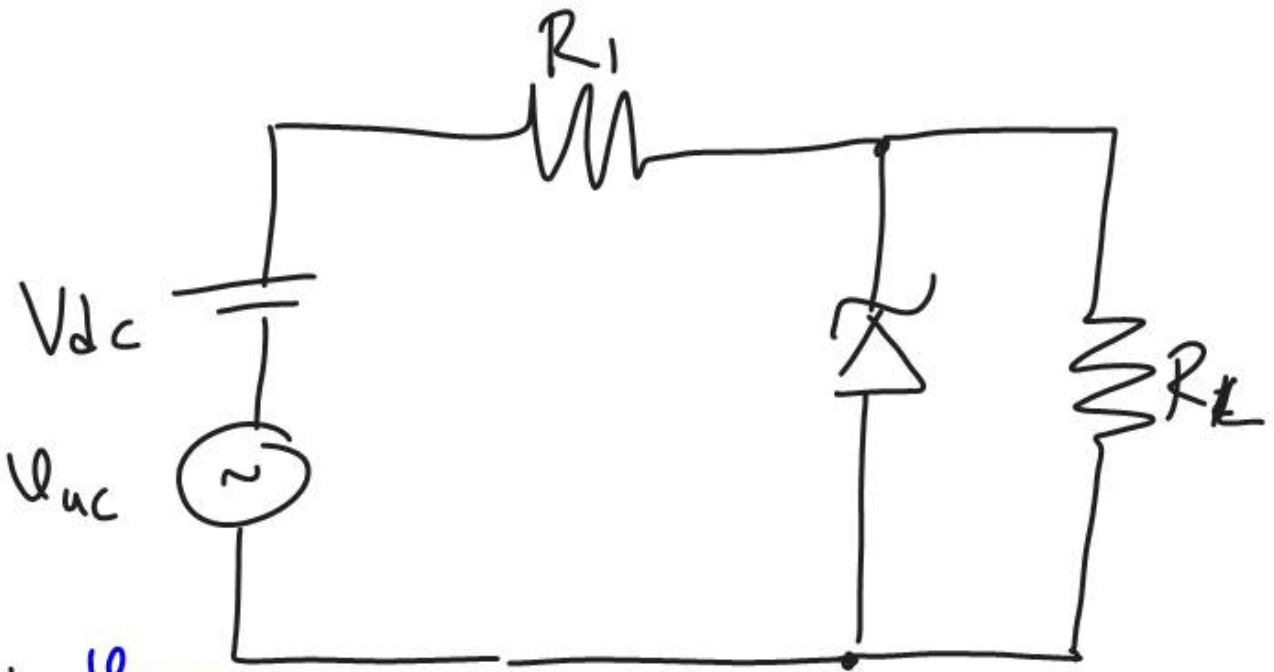
$$R_L(15-V_z) = V_z \cdot R_1$$

$$R_L(18-5) = 5 * 100$$

$$R_{L\,min} = \frac{5\times 100}{10} = \underline{50\,\Omega}$$



ex:

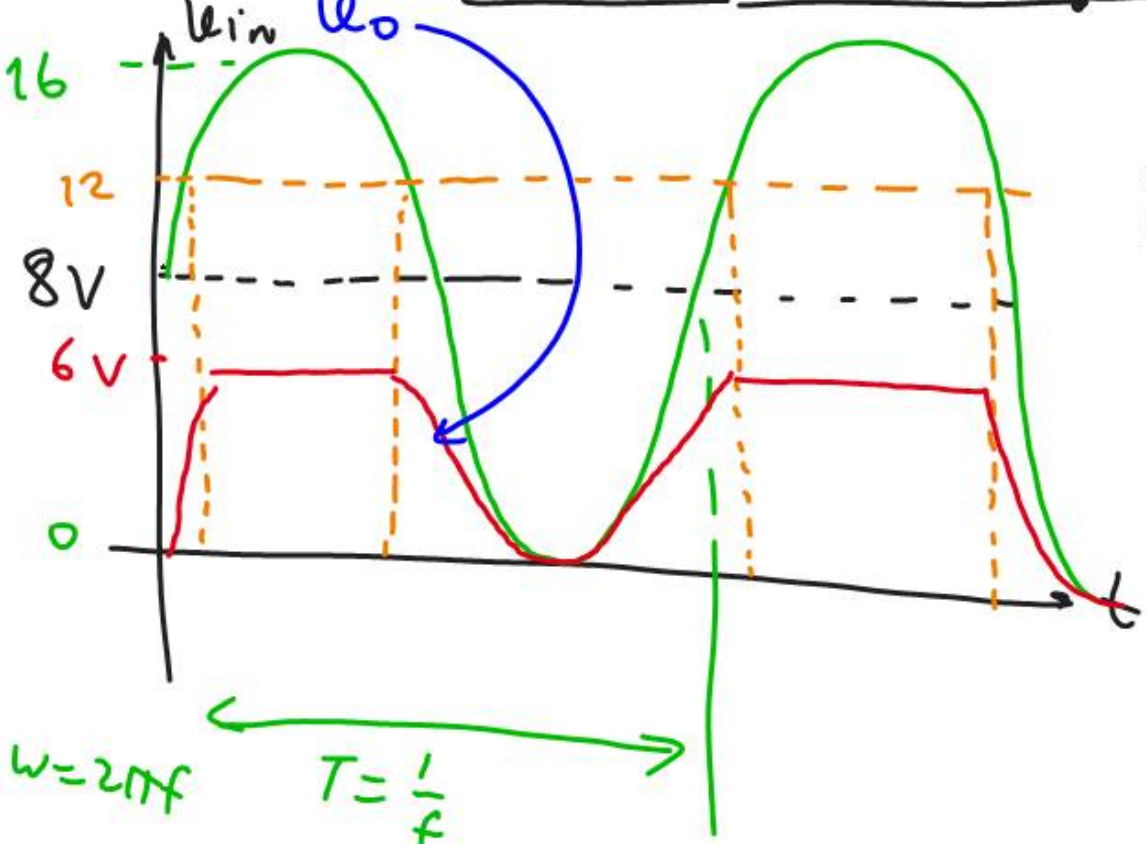


$V_z = 6V$

$R_1 = R_L$

$v_{in} = 8.0V(1+\sin\omega t)$

$v_o = ?$



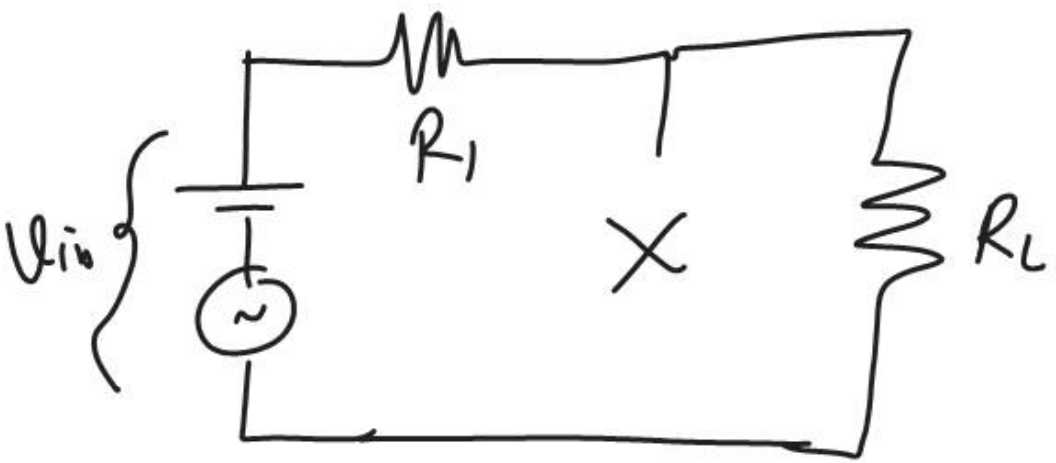
$$\frac{v_{in}}{R_1+R_L}\cdot R_L \geq V_z$$

$$\frac{v_{in}}{2} \geq V_z$$

$$V_{in} \geq 2V_z$$

$v_{in} = 12V \Rightarrow v_o = V_z$

When $V_{in} < 12V$

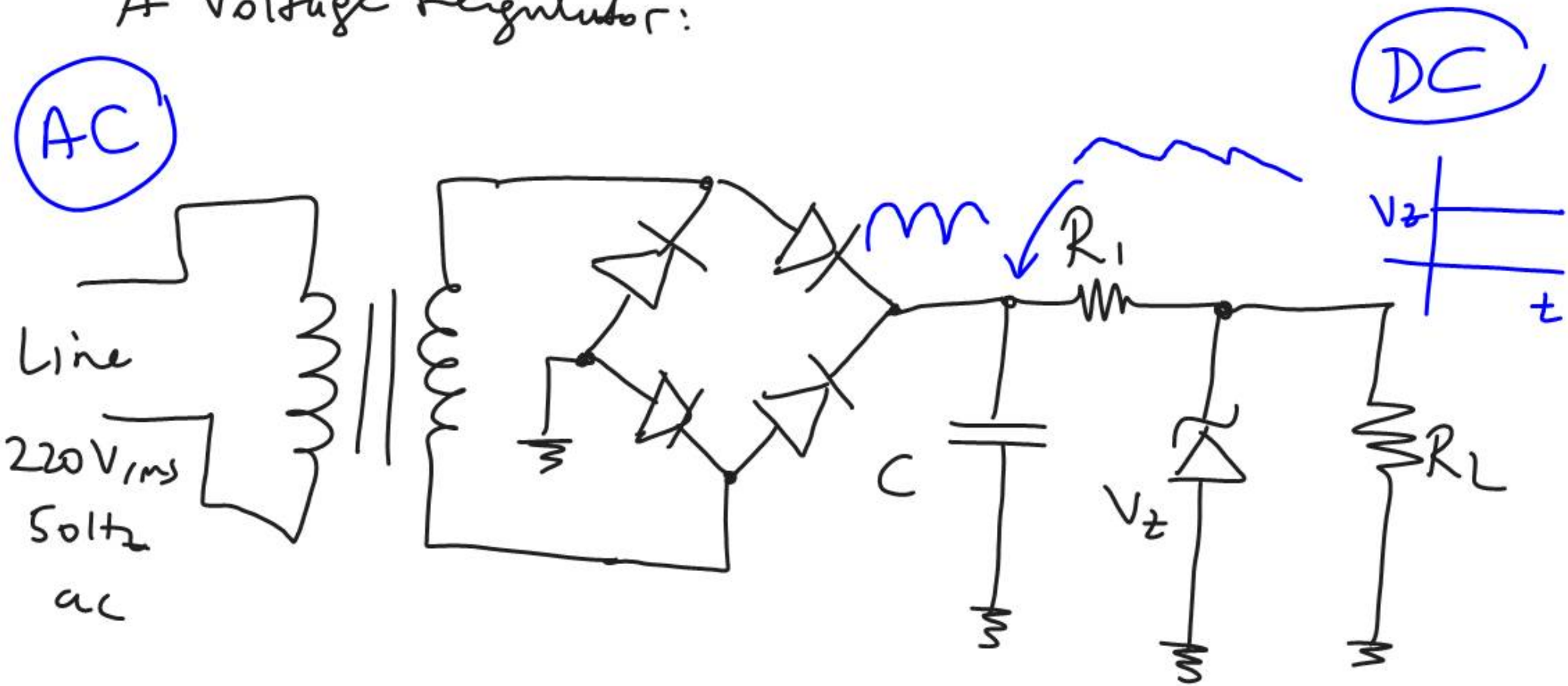


V_o

$$V_o = \frac{V_{in}}{R_1 + R_L} \cdot R_L$$

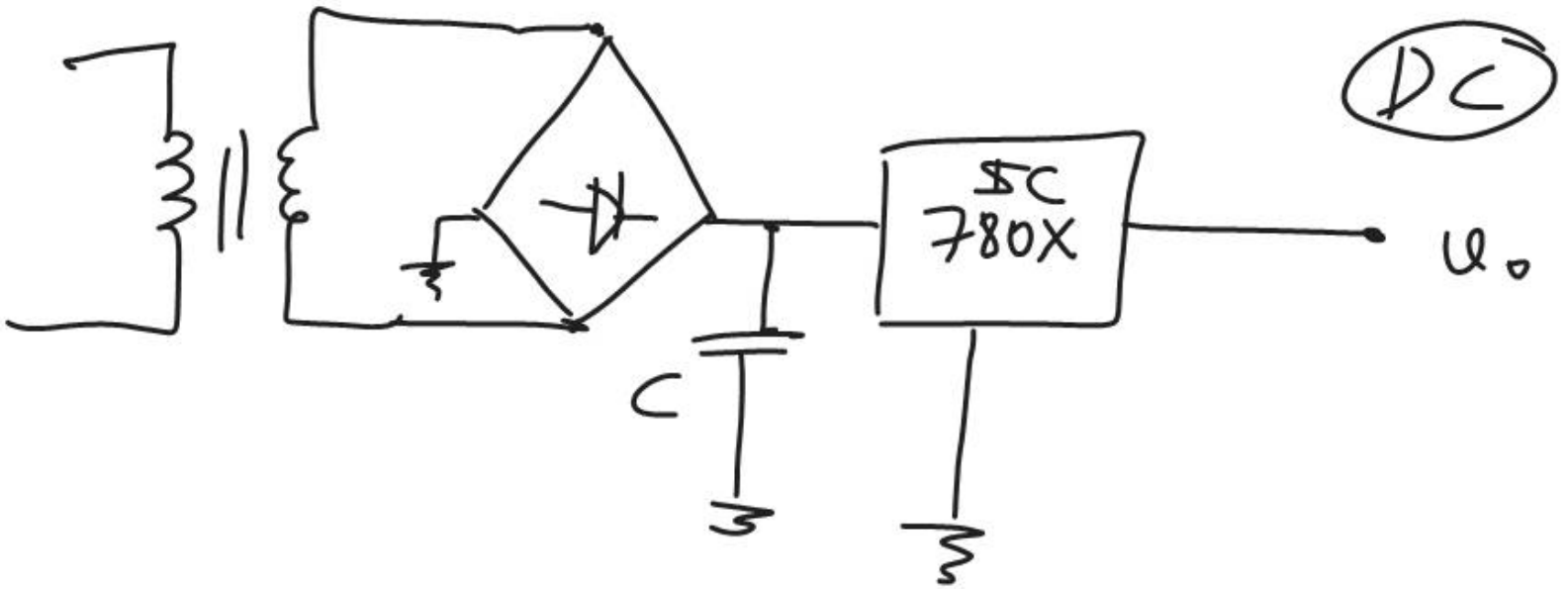
$$V_o = \frac{V_{in}}{2}$$

A voltage Regulator:



Integrated Circuit Regulators

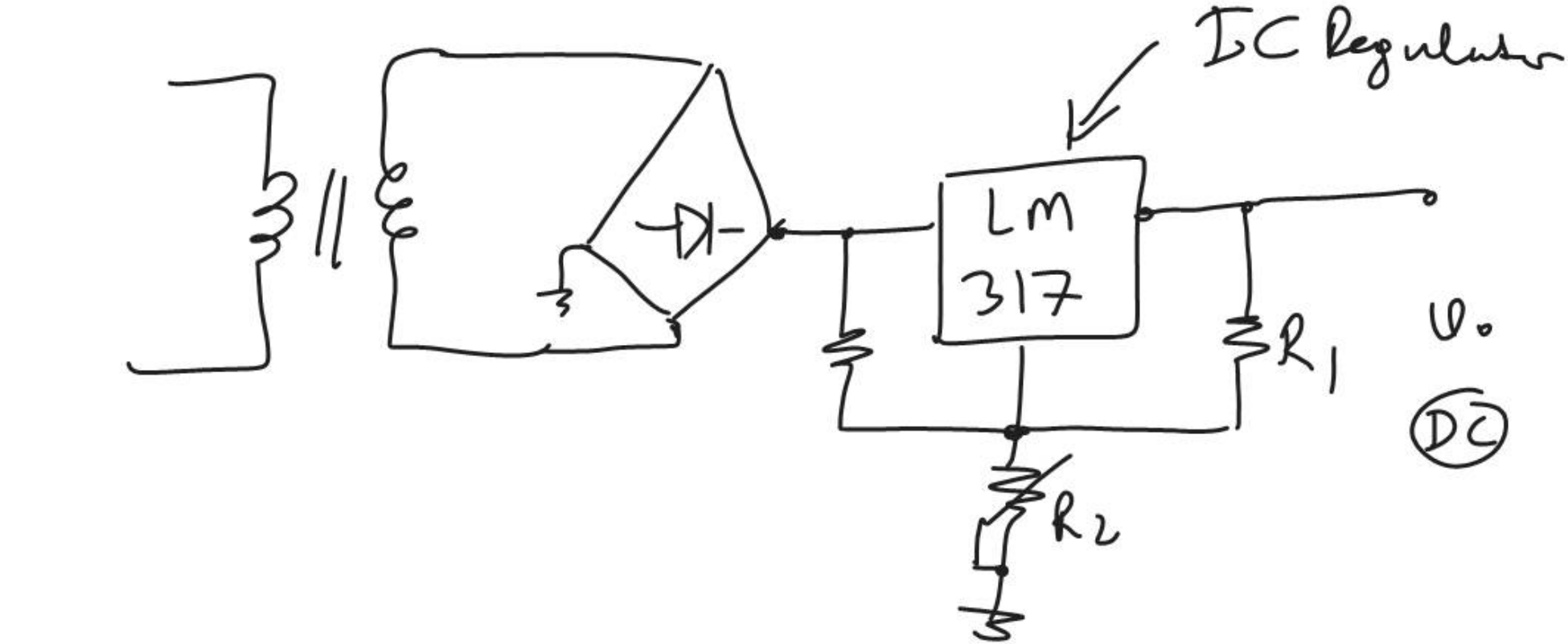
(IC)



7805 → 5V

7807 → 7V

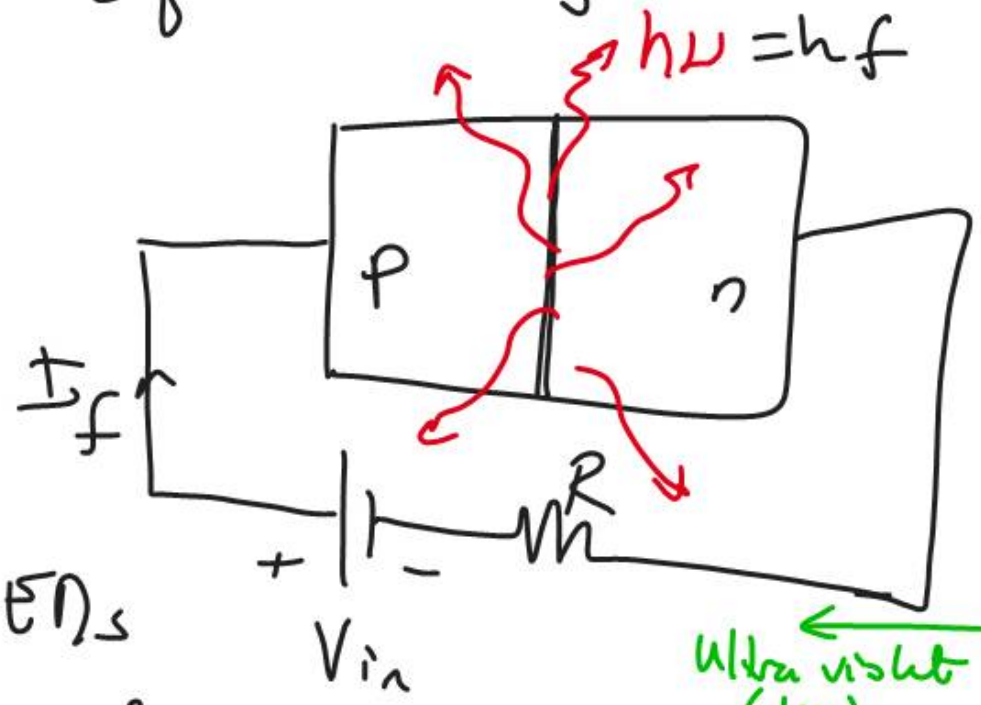
790X → −X V.



→ SWITCHING REGULATORS

OTHER DIODES

- Light Emitting Diode (LED)

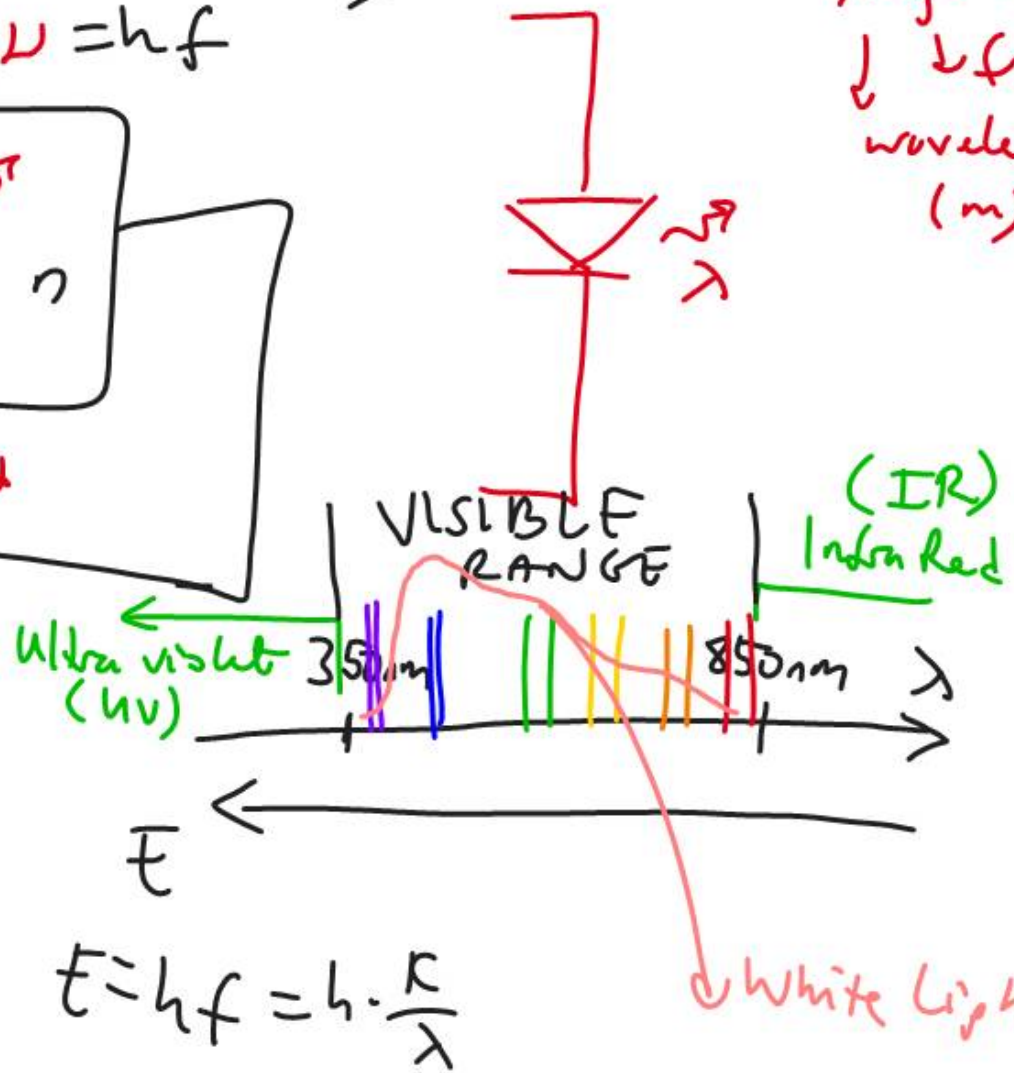


LEDs are forward biased.

$\lambda = \frac{c}{f}$ 3×10^8 m/s speed of light

$\lambda \cdot f = c$ (m/s)

↓ wavelength (m) ↓ frequency ($\frac{1}{s}$)

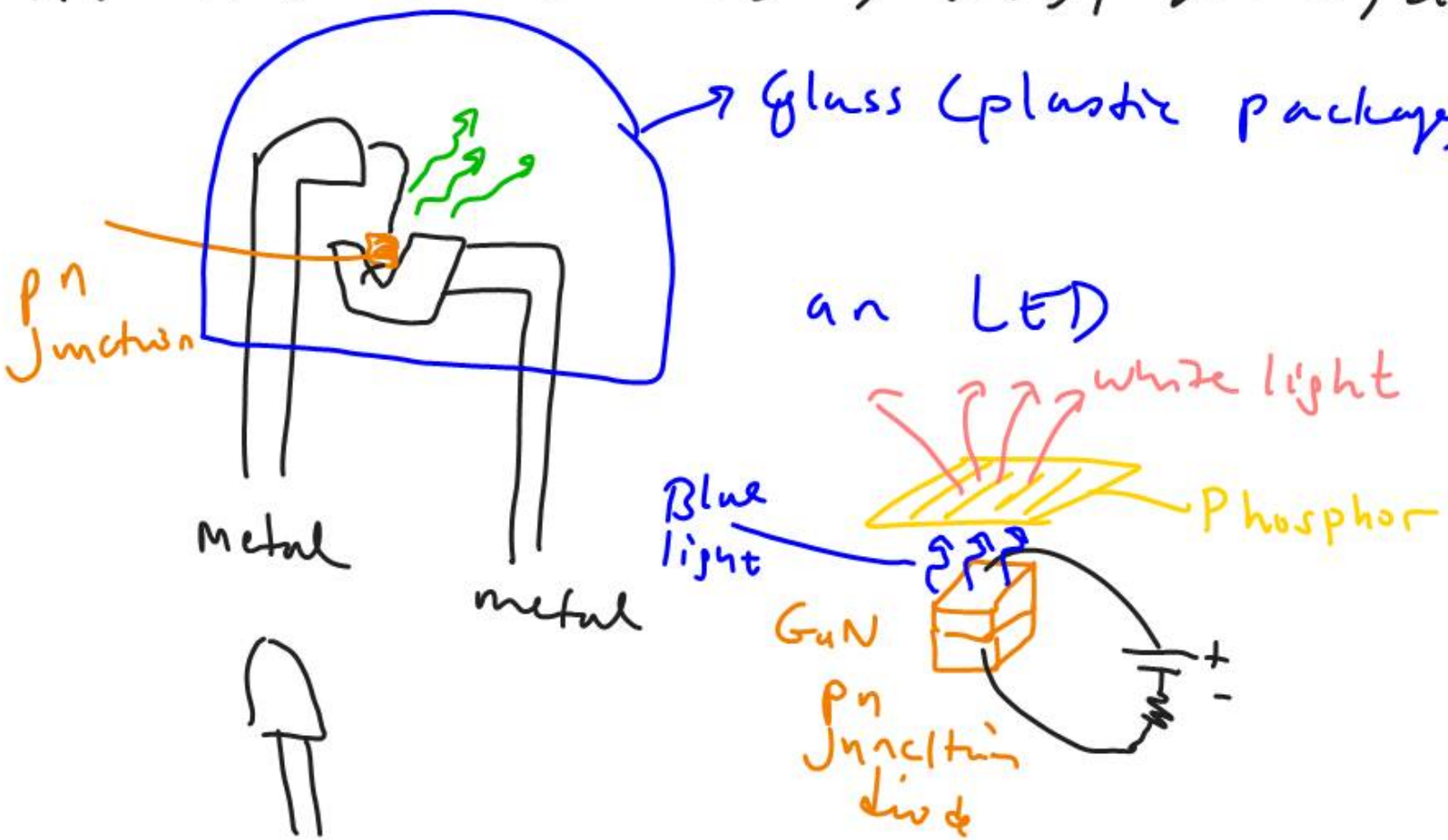


$E = hf = h \cdot \frac{c}{\lambda}$

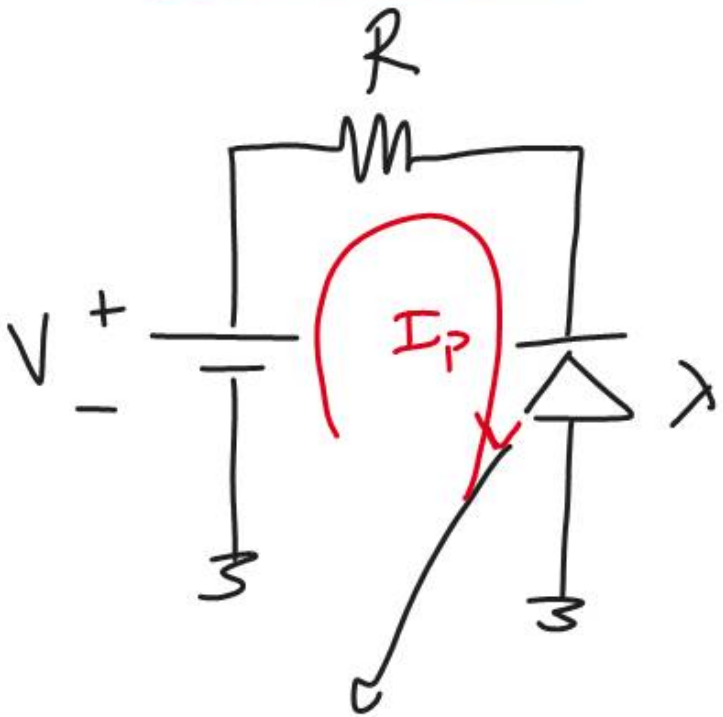
GaAs LED → will emit RED light

GaN LED → " " BLUE "

AlGaAs – GaAs LEDs → RED, yellow, amber

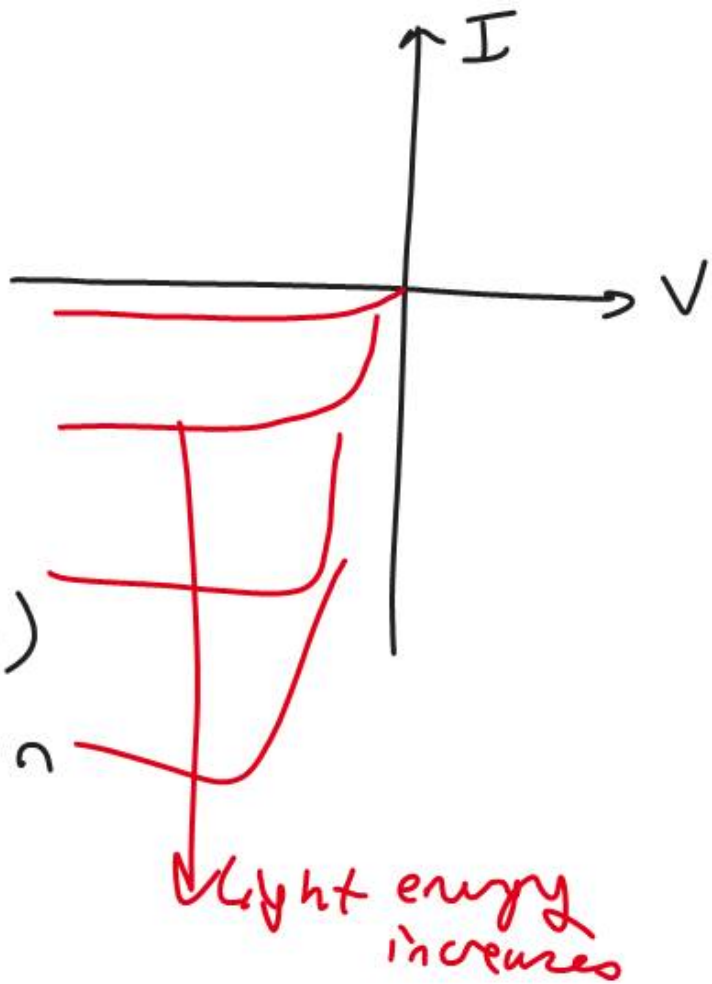


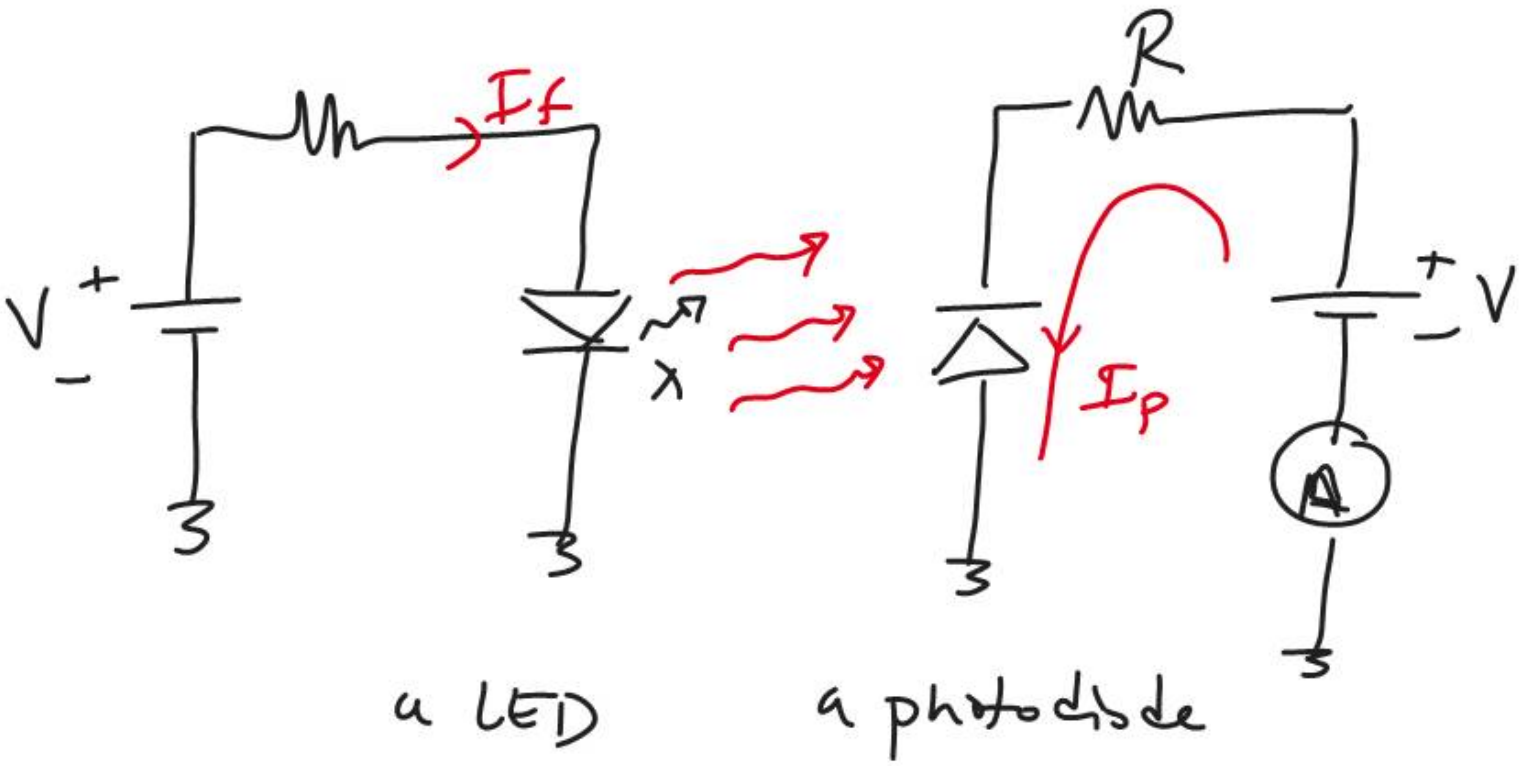
A PHOTODIODE



a photodiode generates current (I_p) when a proper photon falls on it.

Photodiodes are always Reverse-biased





a LED a photodiode