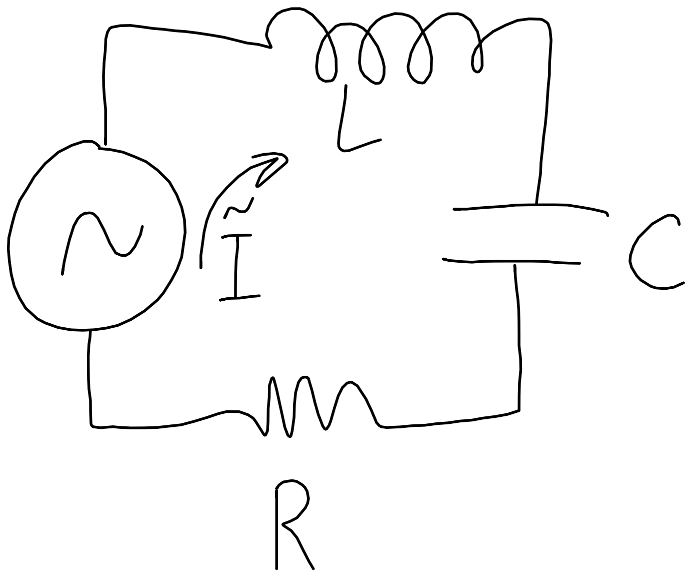


$$Z_{total} = R + i\omega L - \frac{i}{\omega C}$$
$$= R + i\left(\omega L - \frac{1}{\omega C}\right)$$

$$\tilde{I} = \frac{V_{in}}{Z_{total}} = \frac{V_p e^{i\omega t}}{R + i\left(\omega L - \frac{1}{\omega C}\right)} * \frac{R - i\left(\omega L - \frac{1}{\omega C}\right)}{R - i\left(\omega L - \frac{1}{\omega C}\right)}$$

$$= \frac{V_p e^{i\omega t}\left[R - i\left(\omega L - \frac{1}{\omega C}\right)\right]}{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

$$\mathrm{Re}(\tilde{I}) = \frac{V_p R}{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

$$\mathrm{Im}(\tilde{I}) = \frac{-V_p\left(\omega L - \frac{1}{\omega C}\right)}{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

$$\phi_{\tilde{I}} = \tan^{-1}\left(\frac{\mathrm{Im}(\tilde{I})}{\mathrm{Re}(\tilde{I})}\right)$$

Assume $R = 50\,\Omega$ $\omega L = 100\,\Omega$

$$\frac{1}{\omega C} = 50\,\Omega$$

$$Z_{total} = 50 + i50$$

$$\tilde{I} = \frac{V_p e^{i\omega t}(50 - i50)}{5000} = \frac{V_p}{100} e^{i\omega t}(1 - i)$$

$$= \frac{\sqrt{2}\, V_p}{100} e^{i\omega t} \left(\frac{1-i}{\sqrt{2}} \right)$$

$$\tilde{I} = \frac{\sqrt{2}\, V_p}{100} e^{i\left(\omega t - \frac{\pi}{4}\right)}$$

For each element

$$V_R = \tilde{I} R \quad , \quad V_c = \tilde{I} Z_c \quad , \quad V_L = \tilde{I} Z_L$$

$$V_R = \frac{\sqrt{2}\, V_p}{2} e^{i(\omega t - \pi/4)}$$

$$V_c = \tilde{I}\,\frac{-i}{\omega C}$$

$$= \frac{\sqrt{2}V_p}{100}(50)\, e^{i(\omega t - \pi/4)} (-i)$$

$$= \frac{\sqrt{2}V_p}{2}\, e^{i(\omega t - \pi/4)}\, e^{-i\pi/2}$$

$$= \frac{\sqrt{2}V_p}{2}\, e^{i\left(\omega t - \frac{3\pi}{4}\right)}$$

$$\tilde{V}_L = \tilde{I} Z_L = \tilde{I}(i100)$$

$$= \frac{\sqrt{2}V_p}{100}(100)\, e^{i(\omega t - \pi/4)} e^{i\pi/2}$$

$$= \sqrt{2}V_p\, e^{i(\omega t + \pi/4)}$$

Refer to attached (or nearby) "phasor" diagram

KVL:

$$\tilde{V}_{in} - \tilde{V}_L - \tilde{V}_c - V_R = 0 \quad (\text{Ignore } e^{i\omega t})$$

(consider $t=0$)

Go to real space ($\hat{i}$ & $\hat{j}$)

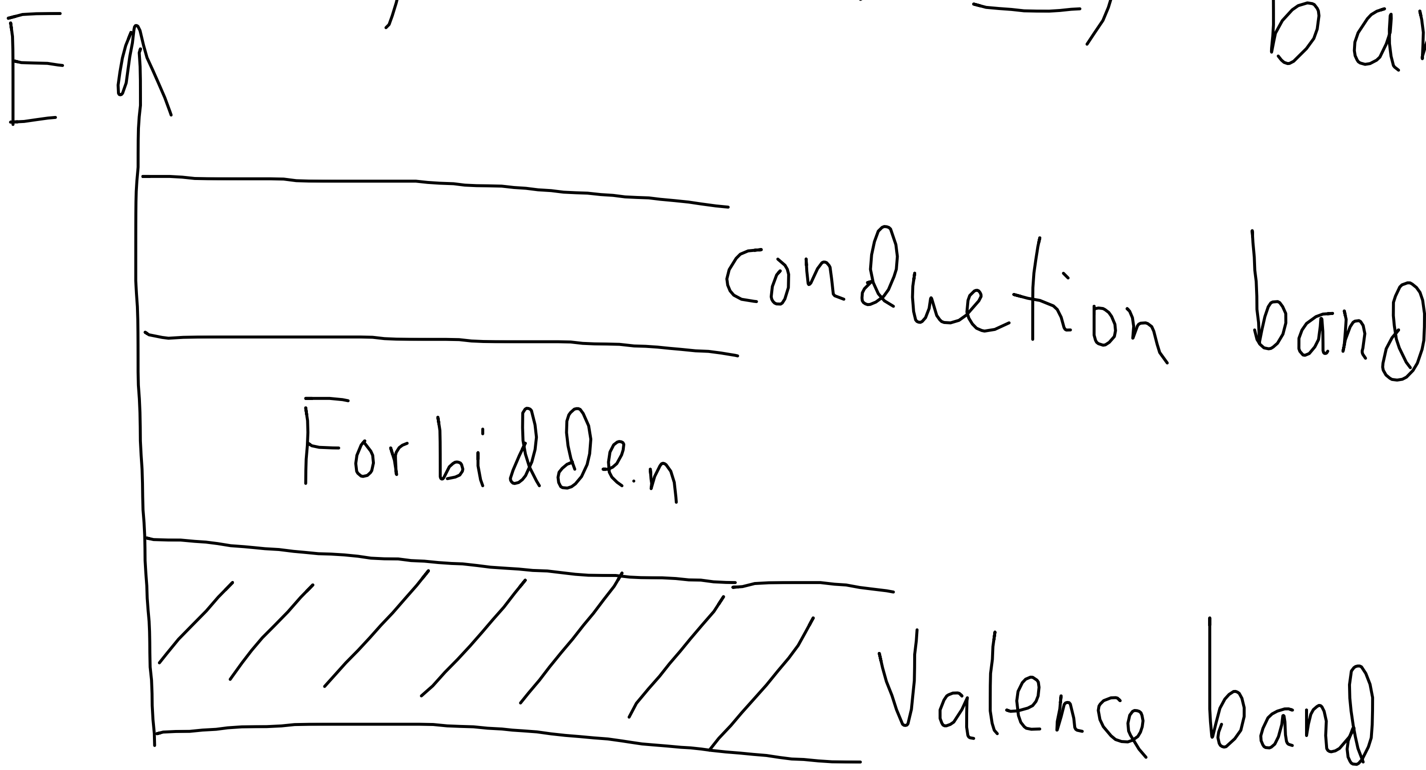
$$\cancel{V_p}\,\hat{i} - \left(\cancel{V_p}\,\hat{i} + \cancel{V_p}\,\hat{j}\right) - \left(-\frac{\cancel{V_p}}{2}\hat{i} - \frac{\cancel{V_p}}{2}\hat{j}\right)$$

$$- \left(\frac{\cancel{V_p}}{2}\hat{i} - \frac{\cancel{V_p}}{2}\hat{j}\right) \stackrel{?}{=} 0 \quad \checkmark$$

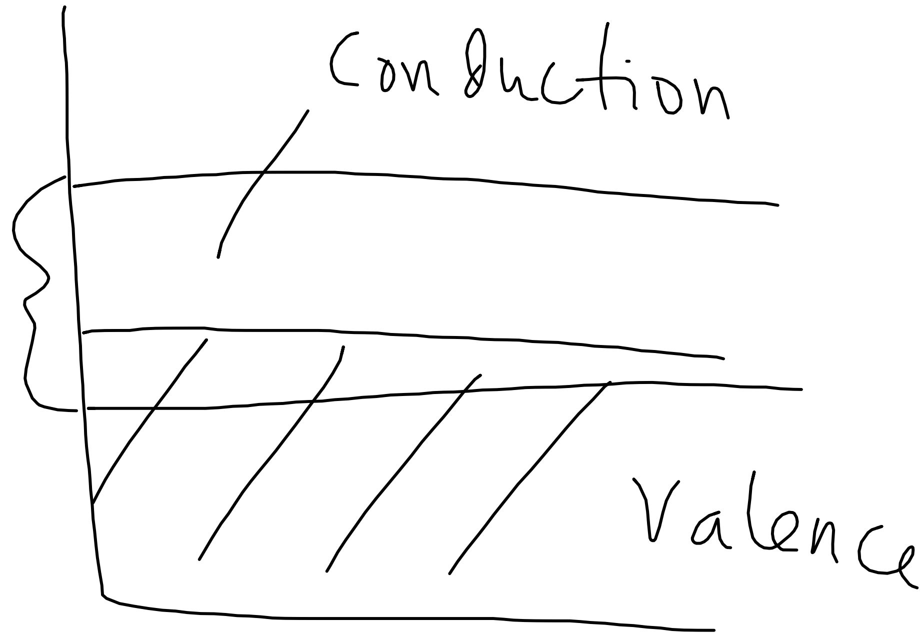
Diodes (but first, some SS physics)

Start from atoms ⇒ quantum energy levels

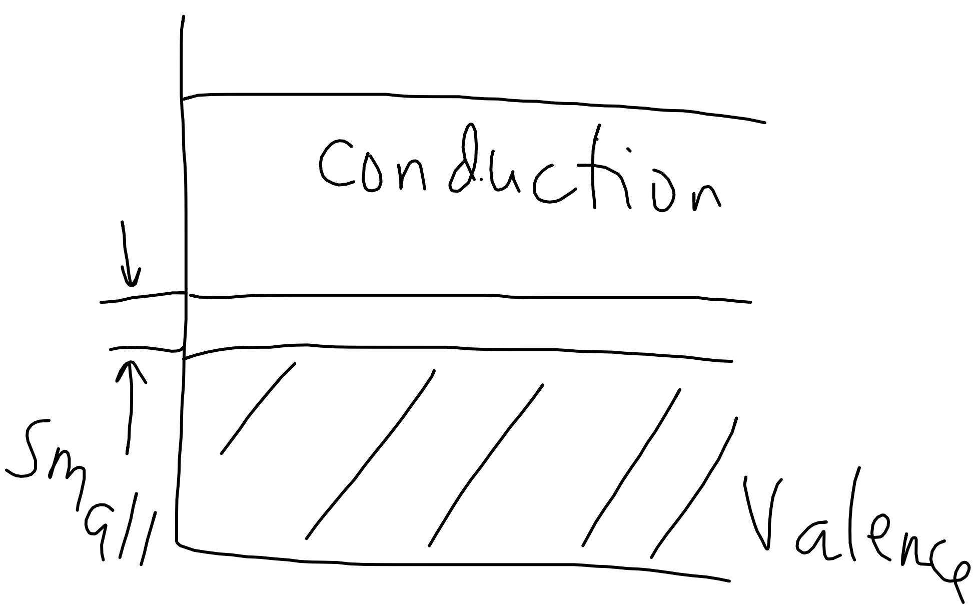
single levels ⇒ "bands"



This is picture for insulators

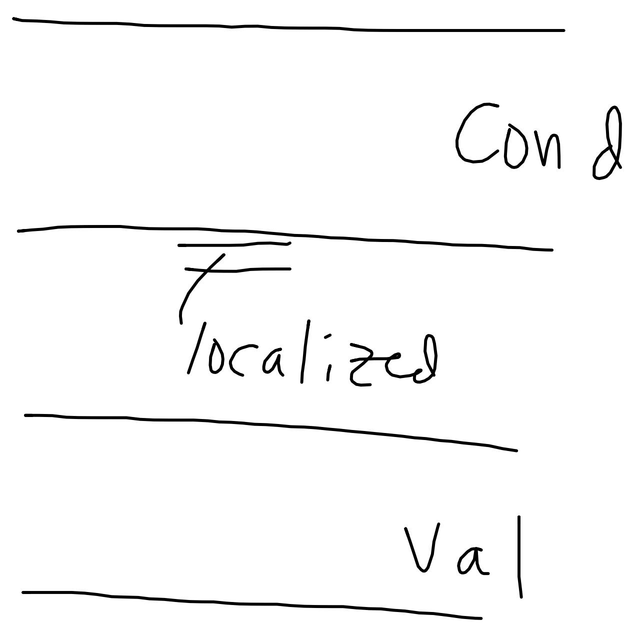


conductor



semi-conductor

not good enough



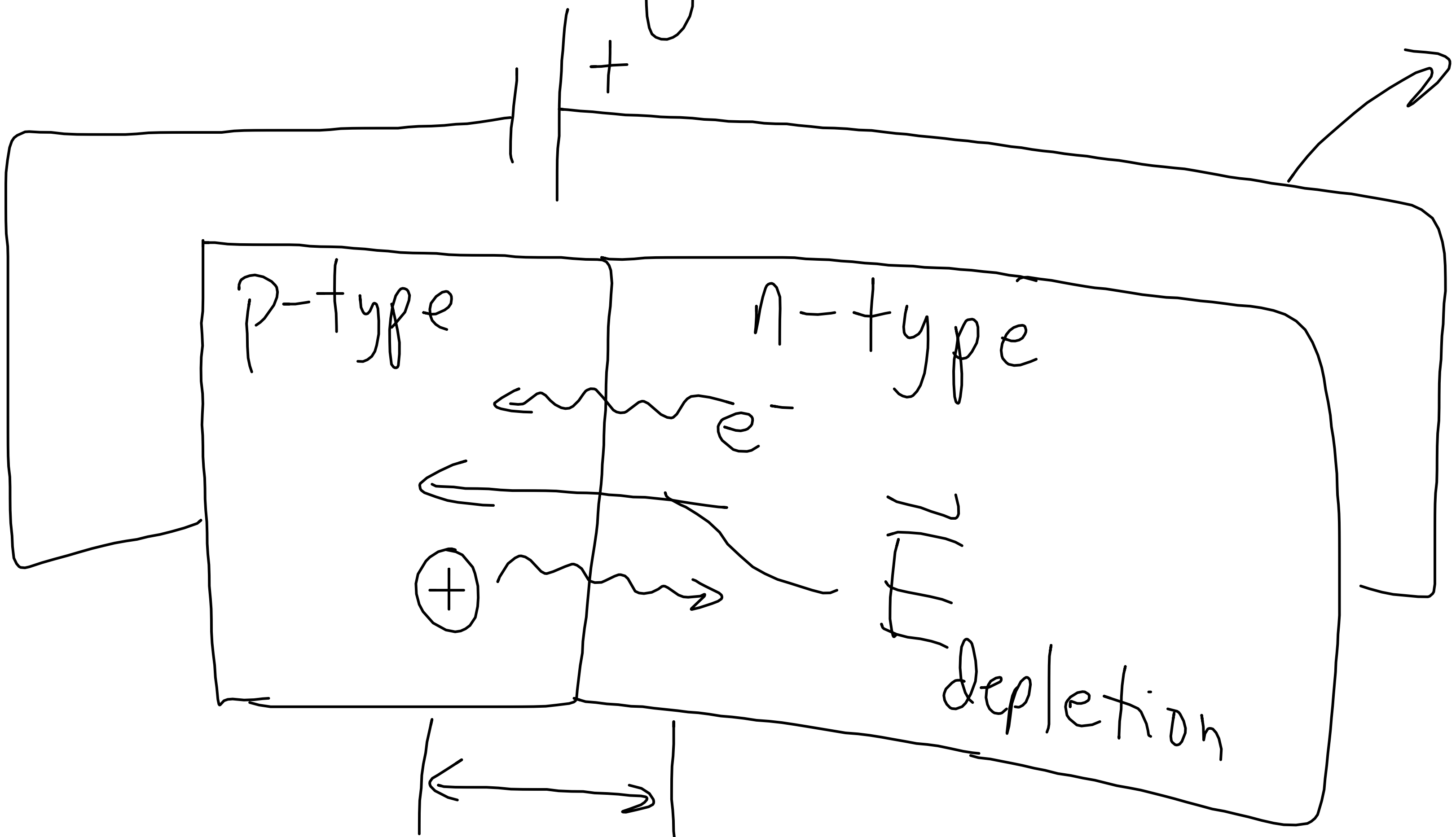
As $\Rightarrow$ 5 val. e^-

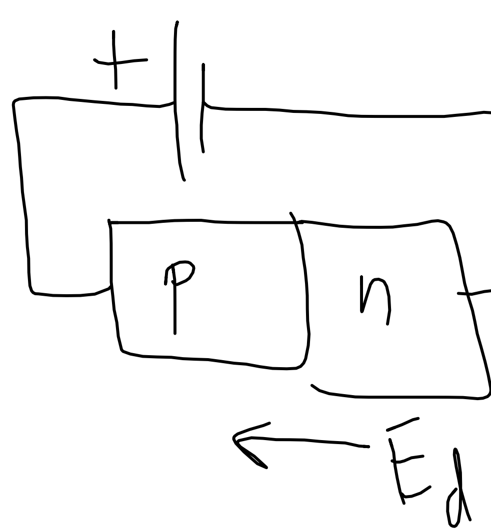
n-type doping

Bo $\Rightarrow$ 3 val e^-

p-type

Make a junction

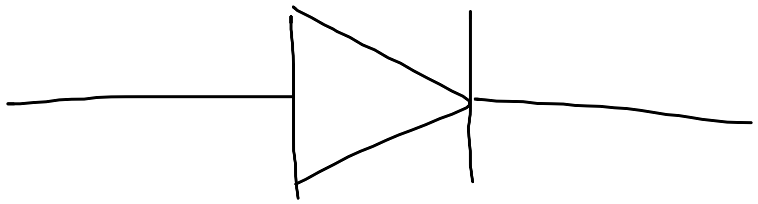


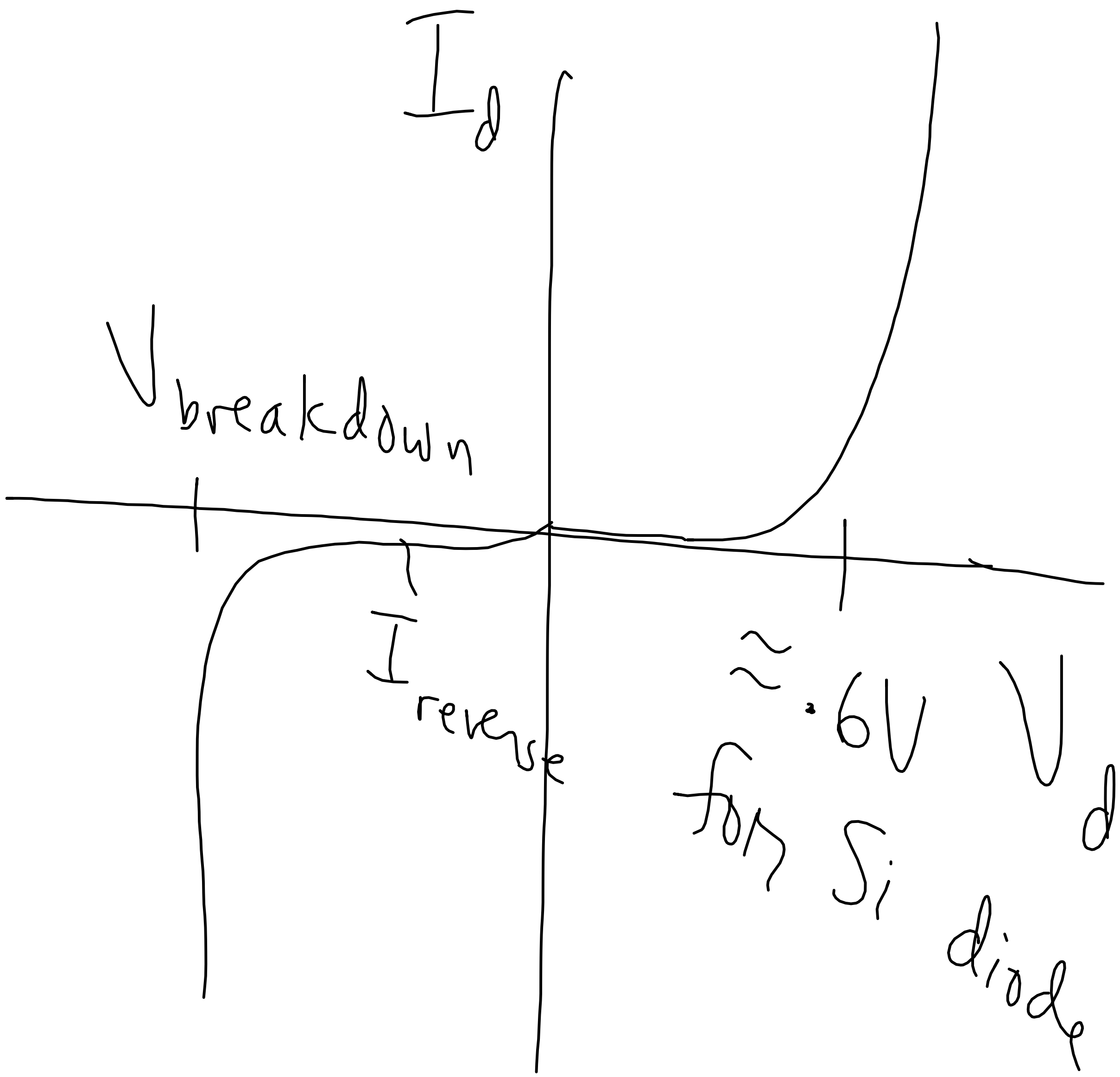


If $E_{battery} > E_d$

I get current

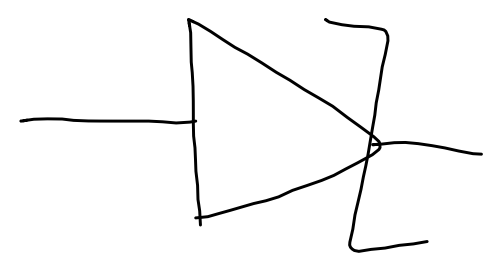
$\Rightarrow$ forward bias

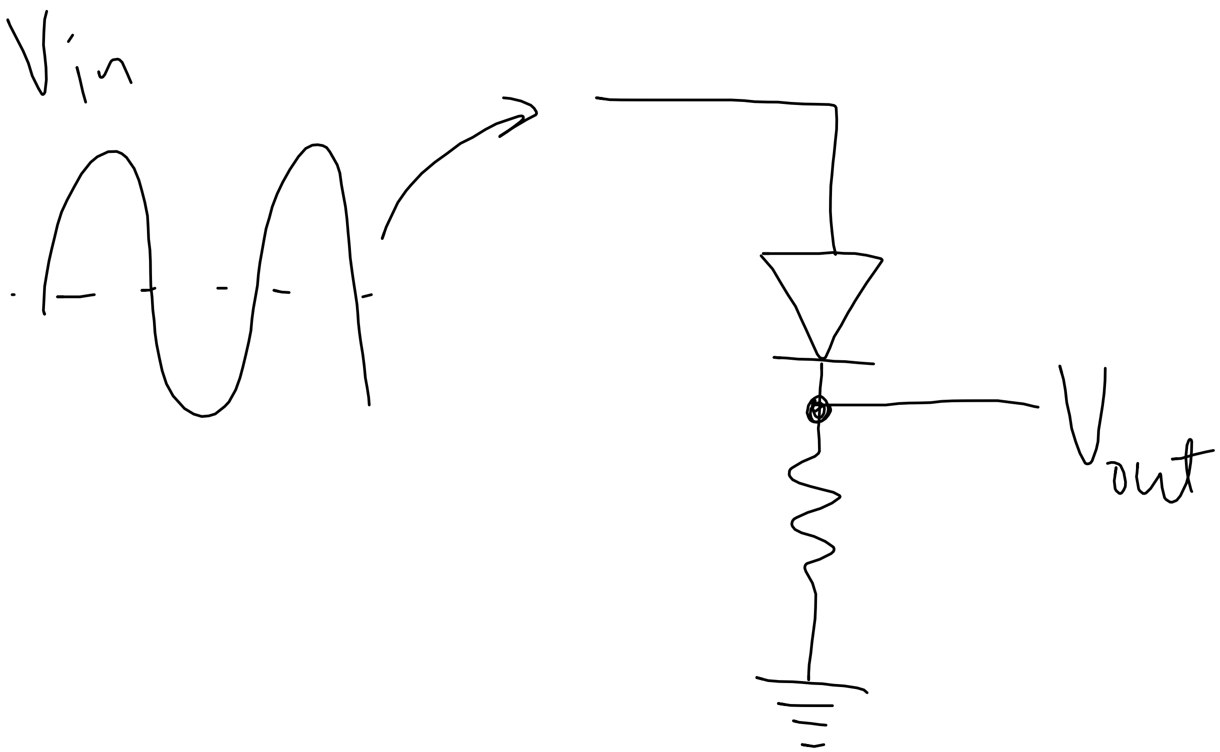


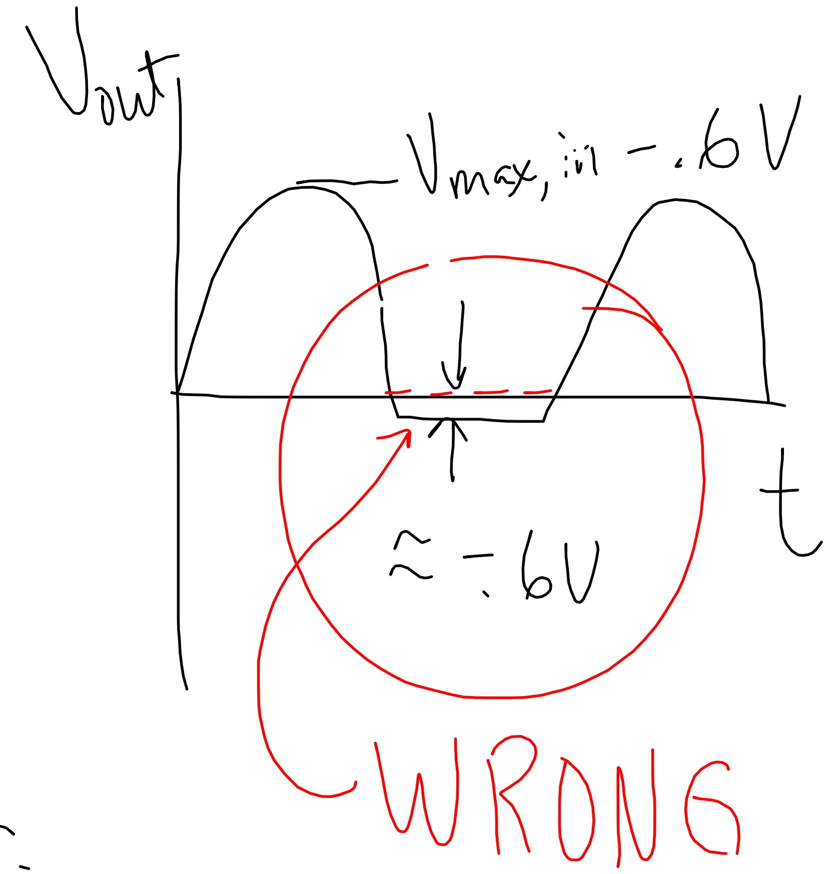


If breakdown is intentional

$\Rightarrow$ Zener diode

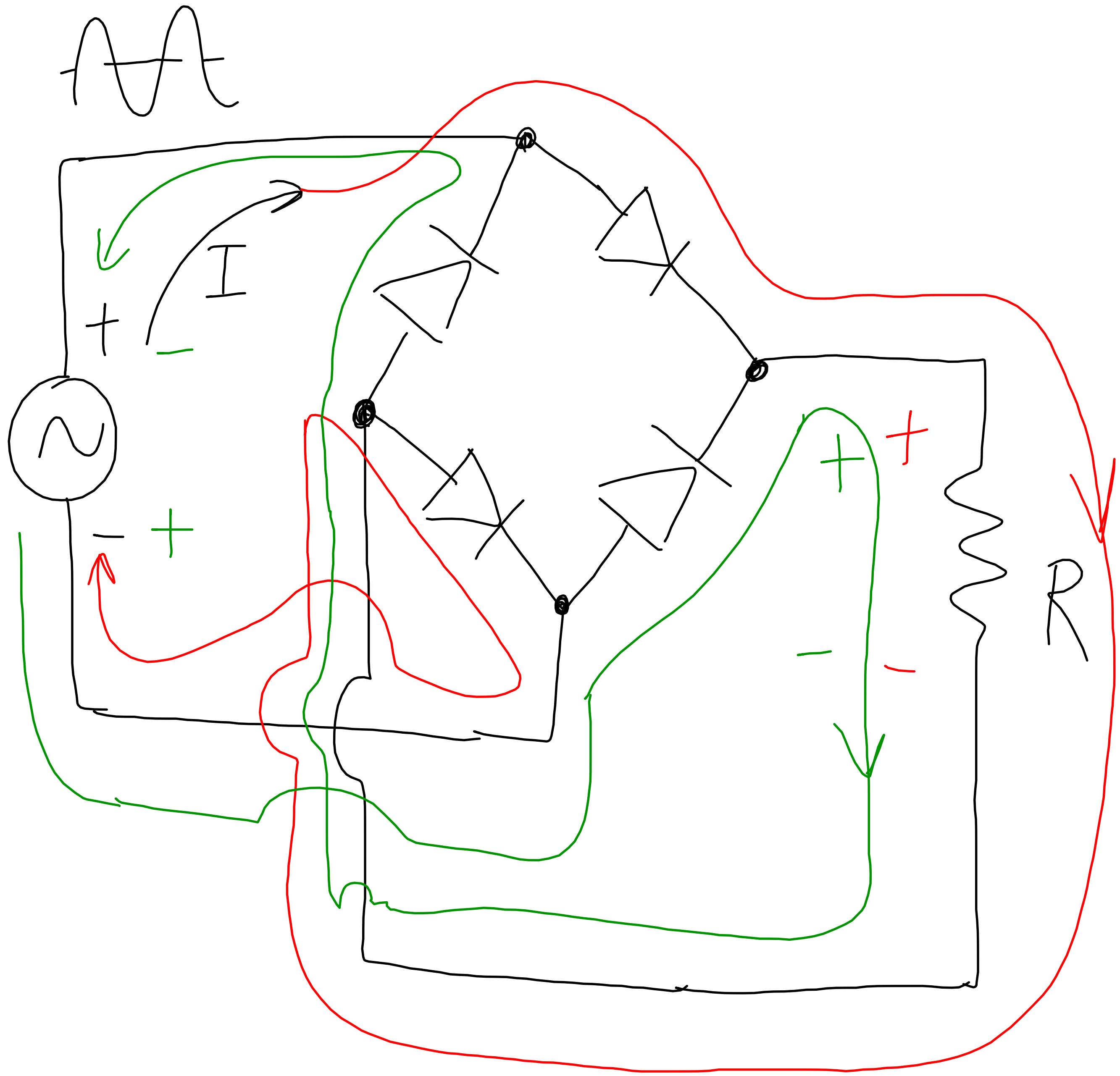






Half-wave rectifier

need full wave rectifier for best power


I
+
-
+
-
+
+
-
-
R