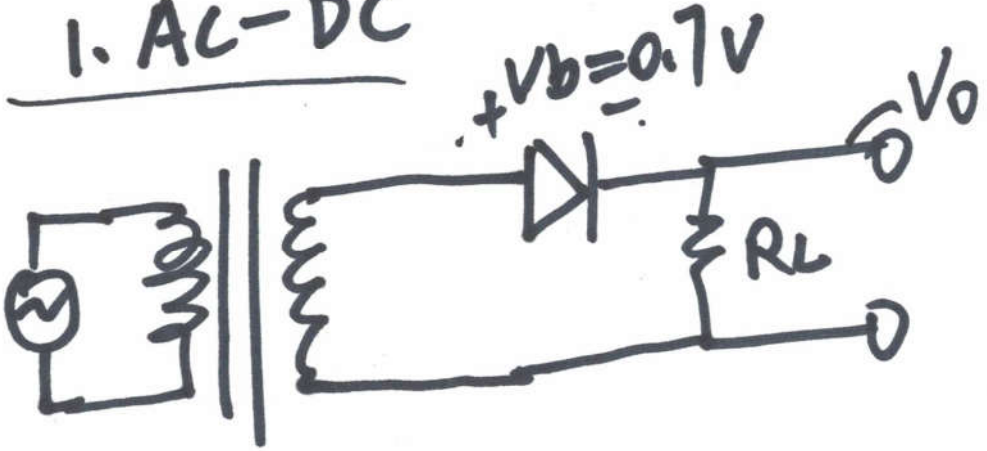
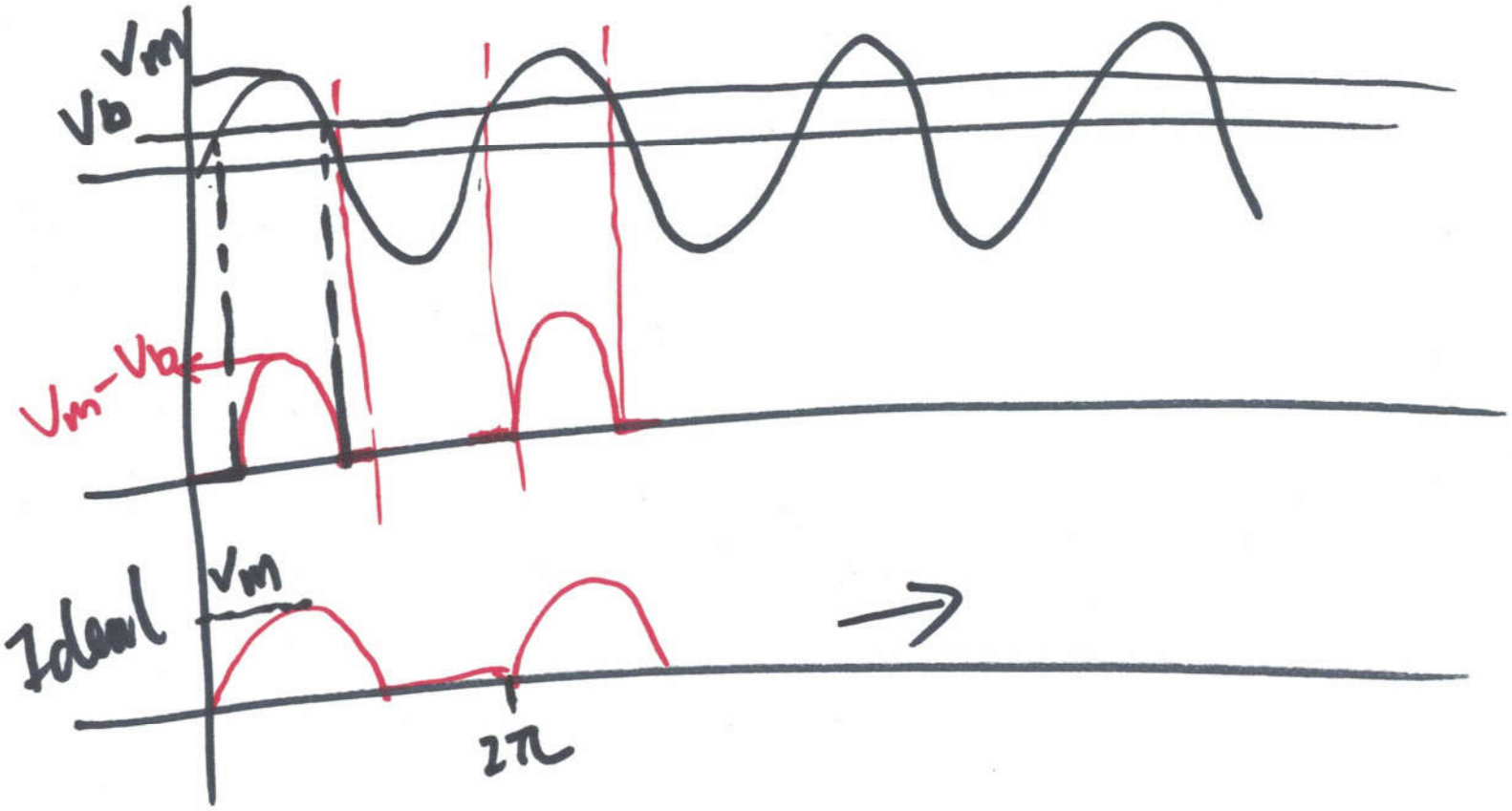
# 1. AC-DC




Half-wave rectifier



## rectified output:

$$V_{av} = \frac{1}{2\pi}\int_0^{2\pi} V_m \sin\omega t \, d\omega t$$

Average voltage output OR the rectified DC output voltage

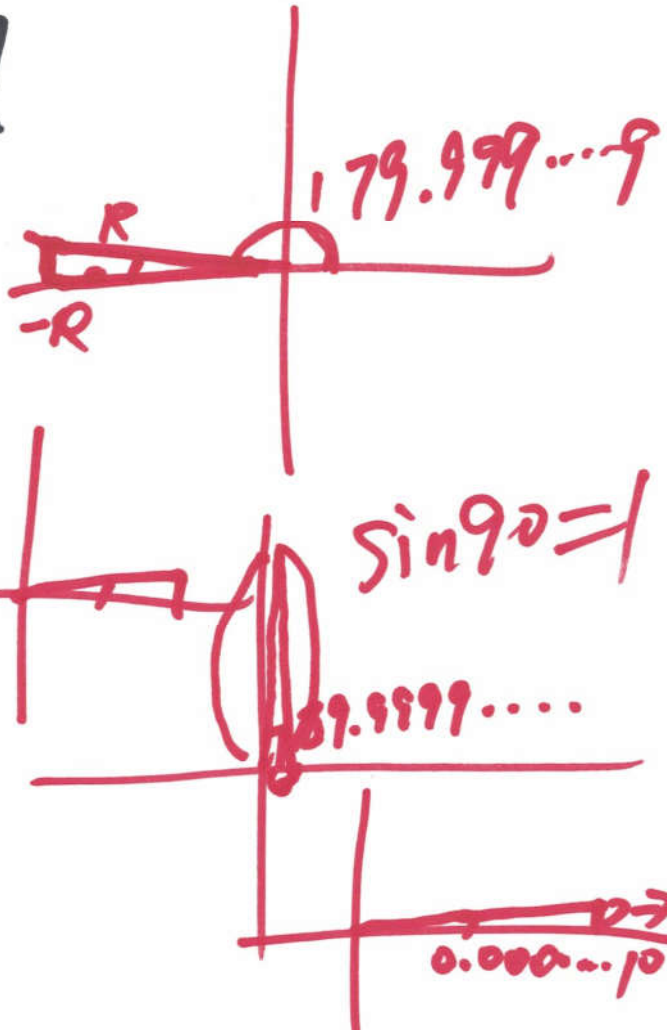
$$= \frac{1}{2\pi}\left(\int_0^{\pi} V_m \sin\omega t \, d\omega t + \int_{\pi}^{2\pi} \cancel{V_m \sin\omega t \, d\omega t}^{\,0}\right)$$

$$= \frac{V_m}{2\pi}\int_0^{\pi} \sin\omega t \, d\omega t$$

$$= \frac{V_m}{2\pi}\left(-\cos\omega t\right)\Big|_0^{\pi}$$

$$= \frac{V_m}{2\pi}\left(-(-1)-(-1)\right)$$

?




(2)

$$= \frac{-V_m}{2\pi} (\cos \omega t) \Big|_0^{\pi}$$

$$= \frac{-V_m}{2\pi} (\cos \pi - \cos 0)$$

$$= \frac{-V_m}{2\pi} (-1 - 1)$$

$$= \frac{-V_m}{2\pi} \cdot (-2) = \boxed{\frac{V_m}{\pi} = V_{av}}$$

$$\boxed{I_{av}} = \frac{V_{av}}{R_L} = \frac{V_m}{\pi} / R_L = \frac{V_m}{R_L} / \pi = \boxed{\frac{I_m}{\pi}}$$

RMS current at the Output

$$I_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi} I_m^2 \sin^2 \omega t \, d\omega t}$$

$$= \sqrt{\frac{1}{2\pi}\left(\int_0^{\pi} I_m^2 \sin^2 \omega t \, d\omega t + 0\right)}$$

$$= \sqrt{\frac{I_m^2}{2\pi}\int_0^{\pi} \sin^2 \omega t \, d\omega t}$$

$$= \sqrt{\frac{I_m^2}{2\pi}\int_0^{\pi} \frac{1}{2}(1-\cos 2\omega t) \, d\omega t}$$

$$= \sqrt{\frac{I_m^2}{4\pi}\int_0^{\pi} (1-\cos 2\omega t) \, d\omega t}$$

$\begin{cases} \cos 2\theta = \cos^2\theta - \sin^2\theta \\ 1 = \cos^2\theta + \sin^2\theta \end{cases}$

$1 - \cos 2\theta = 2\sin^2\theta$

$\sin^2\theta = \frac{1}{2}(1-\cos 2\theta)$

$$= \sqrt{\frac{I_m^2}{4\pi}\left(\pi - \int_0^{\pi} \cos 2\omega t \, d\omega t\right)}$$

$$= \sqrt{\frac{I_m^2}{4\pi}\left(\pi - \left(\frac{1}{2}\sin 2\omega t \Big|_0^{\pi}\right)\right)}$$

$\sin 2\omega t = 0$

$$= \sqrt{\frac{I_m^2}{4}} = \frac{I_m}{2} = I_{rms}$$

$$V_{rms} = I_{rms} \cdot R_L = \frac{I_m}{2} \cdot R_L = \frac{V_m}{2}$$

$V_m$

(5)