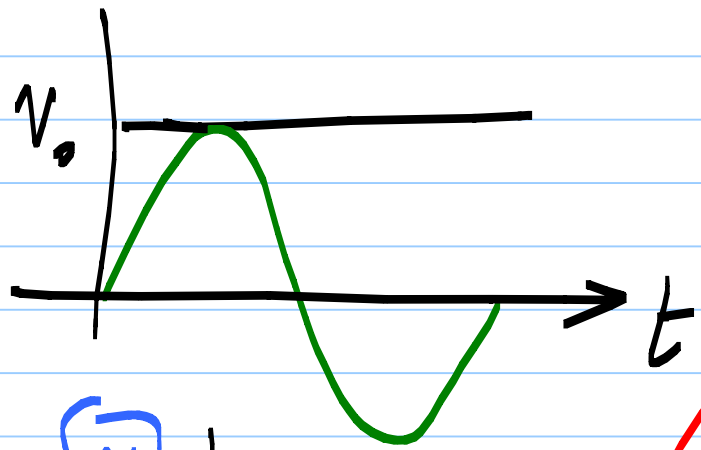
EE 2015

17/10/2017

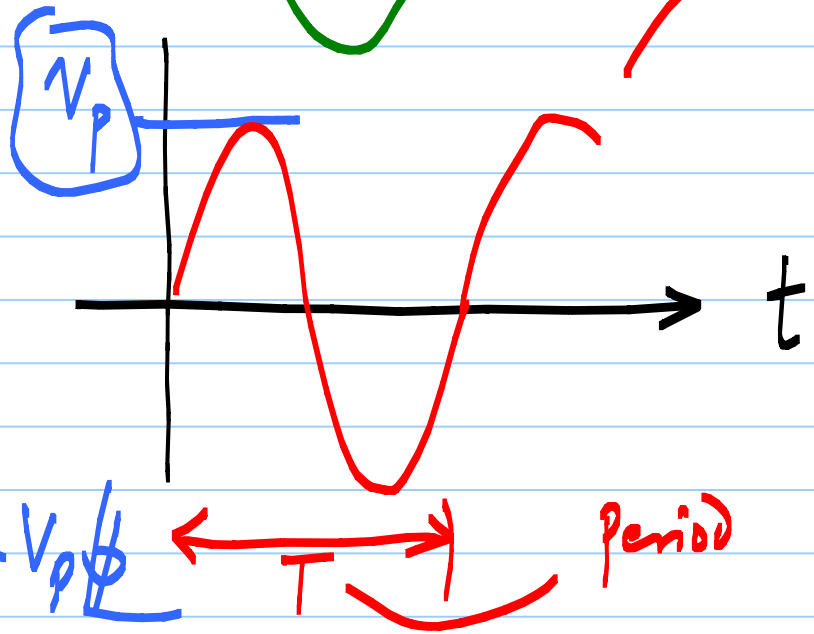
dc

direct current



ac

alternating current



$V_p \cos(\omega t + \phi)$

$V_p \angle \phi$

$p(\theta)$: periodic with period 2π

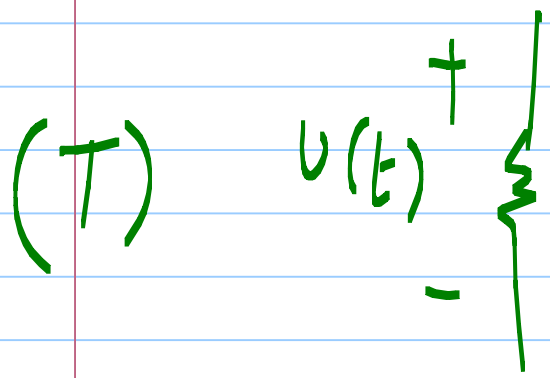
$\theta = \omega t + \phi$

$= \frac{2\pi t}{T} + \phi$

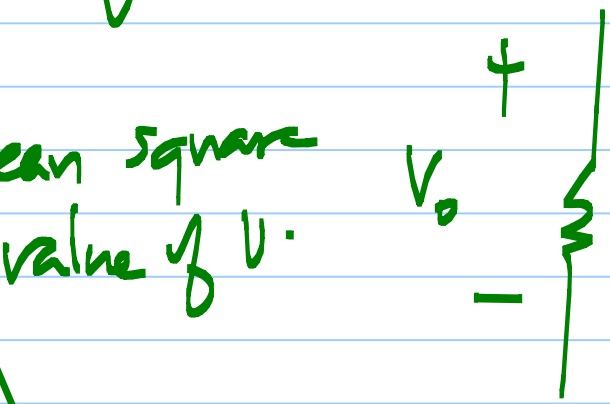
$f\,(Hz) = \frac{1}{T}$

$\omega\,(rad/s) = \frac{2\pi}{T}$

Periodic signal $v(t)$ — $\overline{v^2}$ — dc: V_0



mean square value of v.



$$p_R = \frac{v^2(t)}{R}$$

$$p_R = \frac{V_0^2}{R}$$

$$p_{R,Av}\Big|_T = \frac{1}{R}\cdot\frac{1}{T}\int_{-T/2}^{T/2} v^2(t)\cdot dt = \frac{V_0^2}{R}$$

Root mean square (rms) value:

$$V_{rms} = \sqrt{\frac{1}{T}\int_0^T v^2(t)\,dt}$$

$$\text{Avg.} = \frac{1}{T}\int_0^T v(t)\,dt$$

$$= \left[\quad\right]_0^T$$

$$= 0$$

$v_p(\cos(\omega t + \phi))$: $V_{rms} = V_p/\sqrt{2}$

$V_{rms} = V_p/\sqrt{3}$

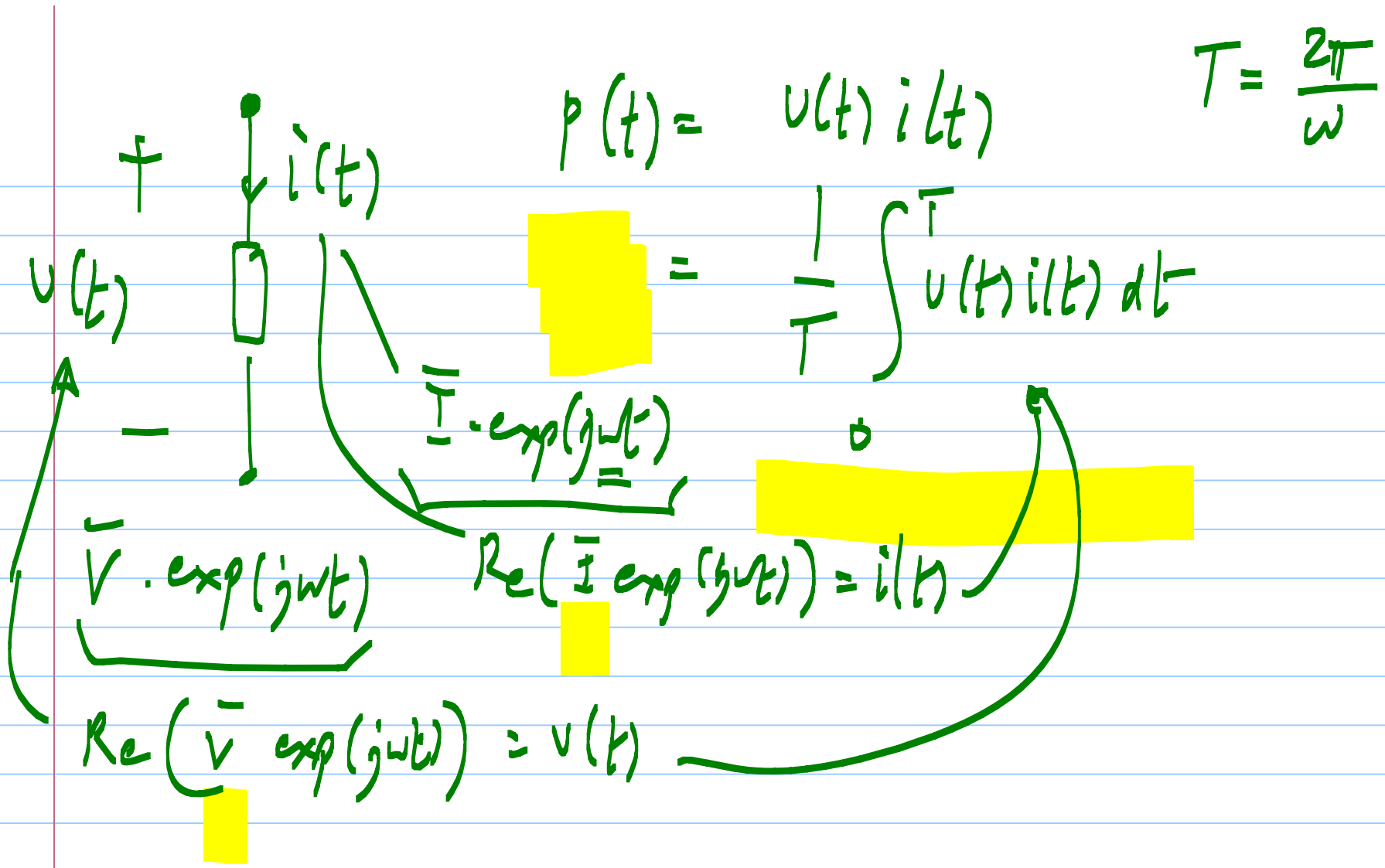
$V_{rms} = V_p$

$f = 50\text{Hz}$; $\omega = 100\pi \text{ rad/s}$

rms: 230V ; peak $= 230\sqrt{2}\text{ V} \simeq 312\text{V}$

$\bar{V}_R = \underbrace{230}_{\text{rms}} \angle \phi$

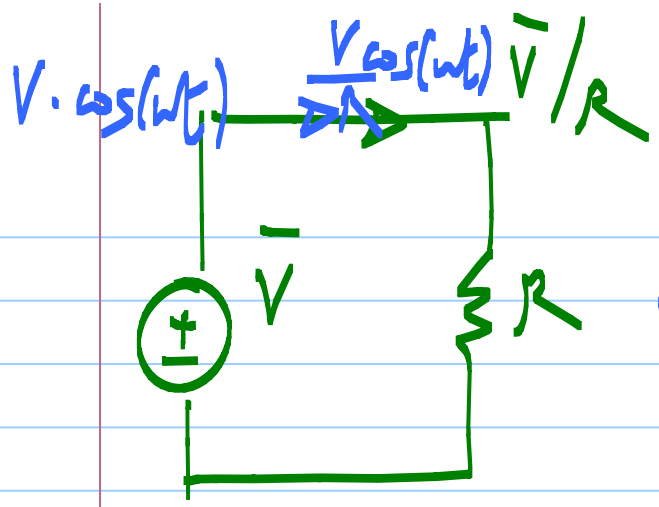
$\underbrace{230\sqrt{2}}\exp(j\phi)$


$T = \frac{2\pi}{\omega}$
$p(t) = v(t)\, i(t)$
$= \frac{1}{T} \int_0^T v(t)\, i(t)\, dt$
$+$
$i(t)$
$v(t)$
$-$
$\bar{I} \cdot \exp(j\omega t)$
$\bar{V} \cdot \exp(j\omega t)$
$\mathrm{Re}(\bar{I} \exp(j\omega t)) = i(t)$
$\mathrm{Re}(\bar{V} \exp(j\omega t)) = v(t)$

$$\frac{1}{T}\int_0^T \underbrace{\frac{\bar{V}\exp(j\omega t)+\bar{V}^*\exp(-j\omega t)}{2}\cdot\left(\frac{\bar{I}\cdot\exp(j\omega t)+\bar{I}^*\exp(-j\omega t)}{2}\right)}_{v(t)}\cdot dt$$

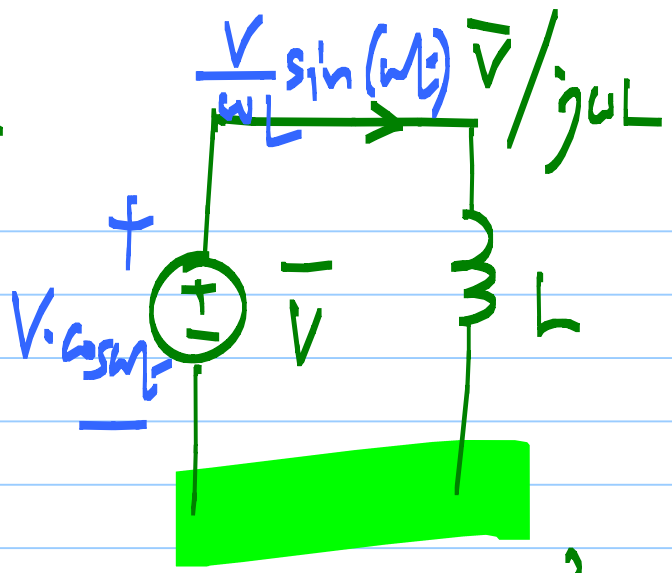
$$P_{av}=\frac{\bar{V}\cdot\bar{I}^*}{4}+\frac{\bar{V}^*\bar{I}}{4}=\underbrace{\frac{1}{2}Re\left(\bar{V}\bar{I}^*\right)}$$

$$\bar{P}=\frac{\bar{V}\bar{I}^*}{2}=P_r+jP_i$$



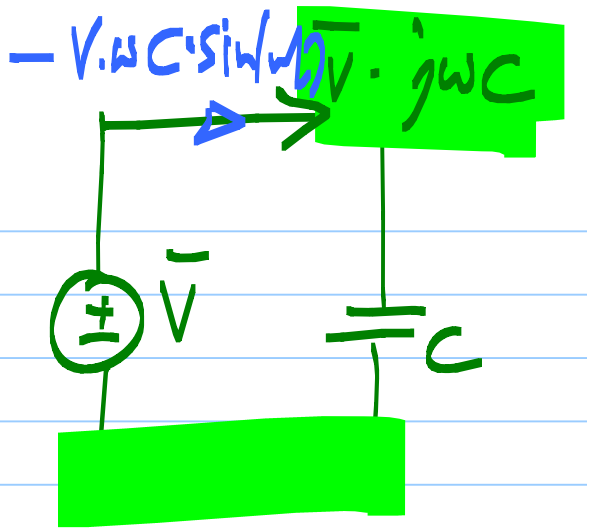
$$\bar{P} = \frac{|\bar{V}|^2}{2R}$$

$$P_{av} = \frac{|\bar{V}|^2}{2R}$$



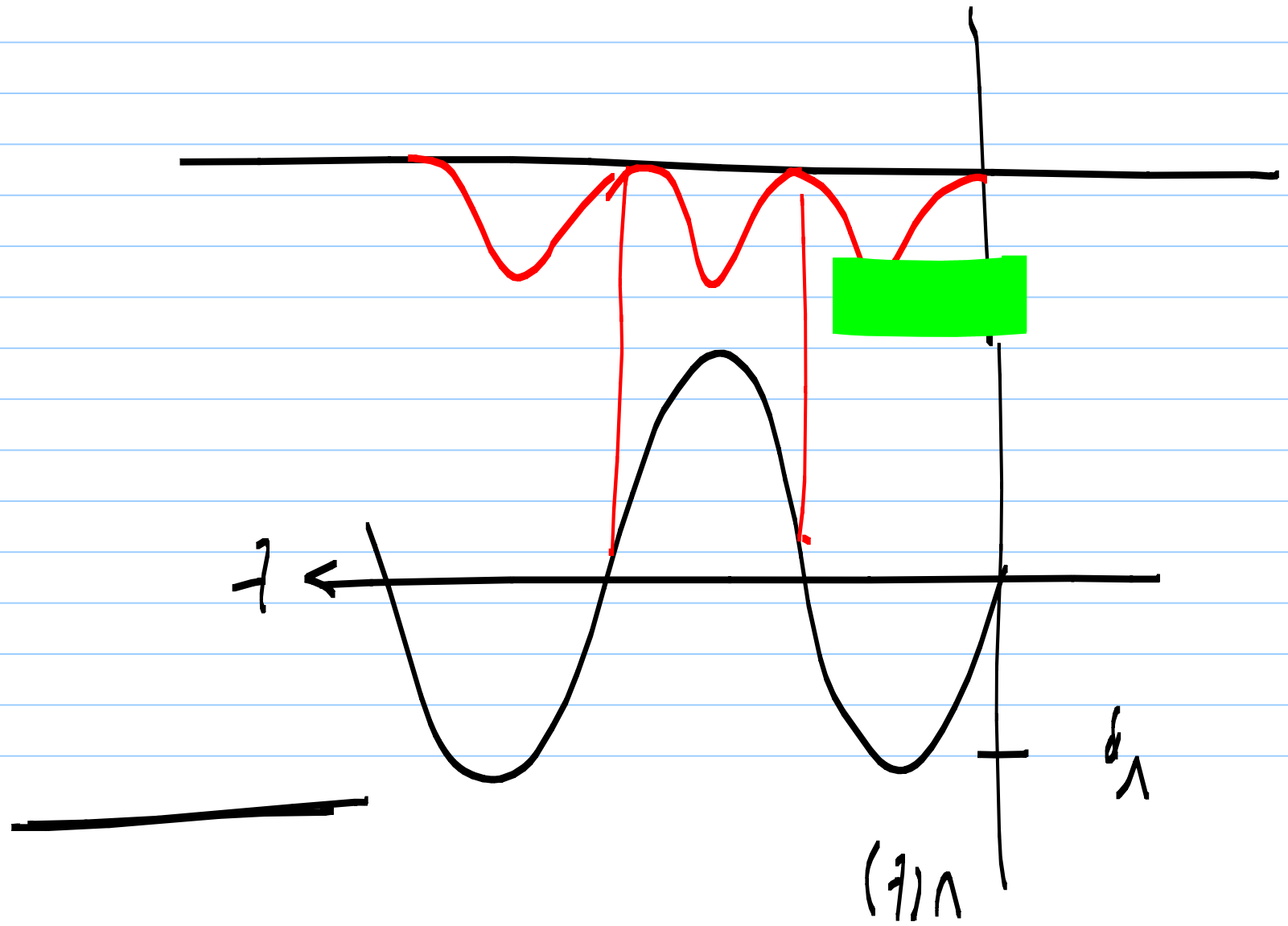
$$\bar{P} = j\frac{|\bar{V}|^2}{2\omega L}$$

$$P_{av} = 0$$



$$\bar{P} = -j\frac{|\bar{V}|^2\cdot\omega C}{2}$$

$$P_{av} = 0$$



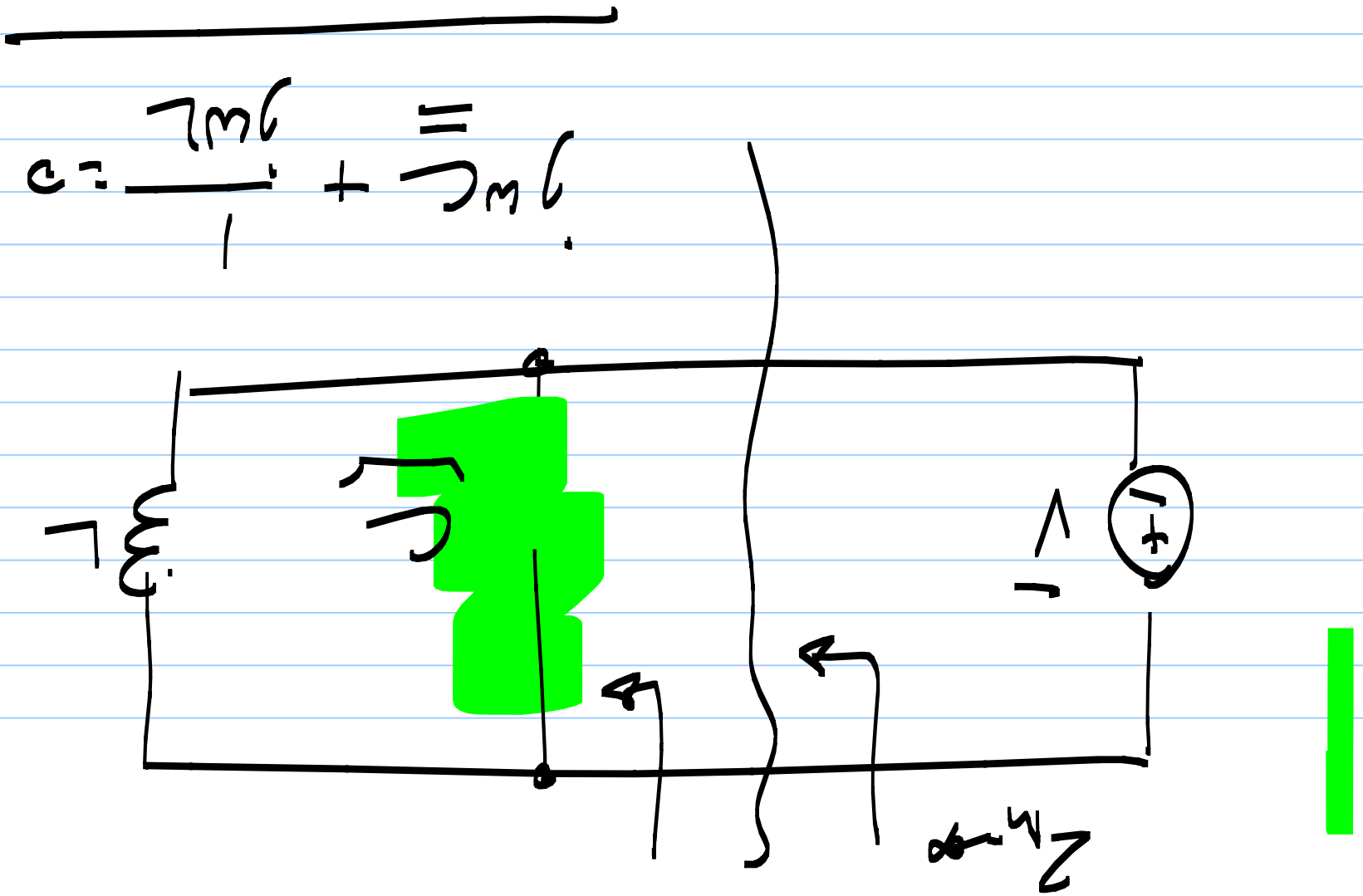
$$\bar{P} = \frac{\bar{V}\,\bar{I}^*}{2}$$: Apparent power (Volt-amperes, V.A)

$230\sqrt{2}\,V,\ 10\sqrt{2}\,A$

$2300\ VA$

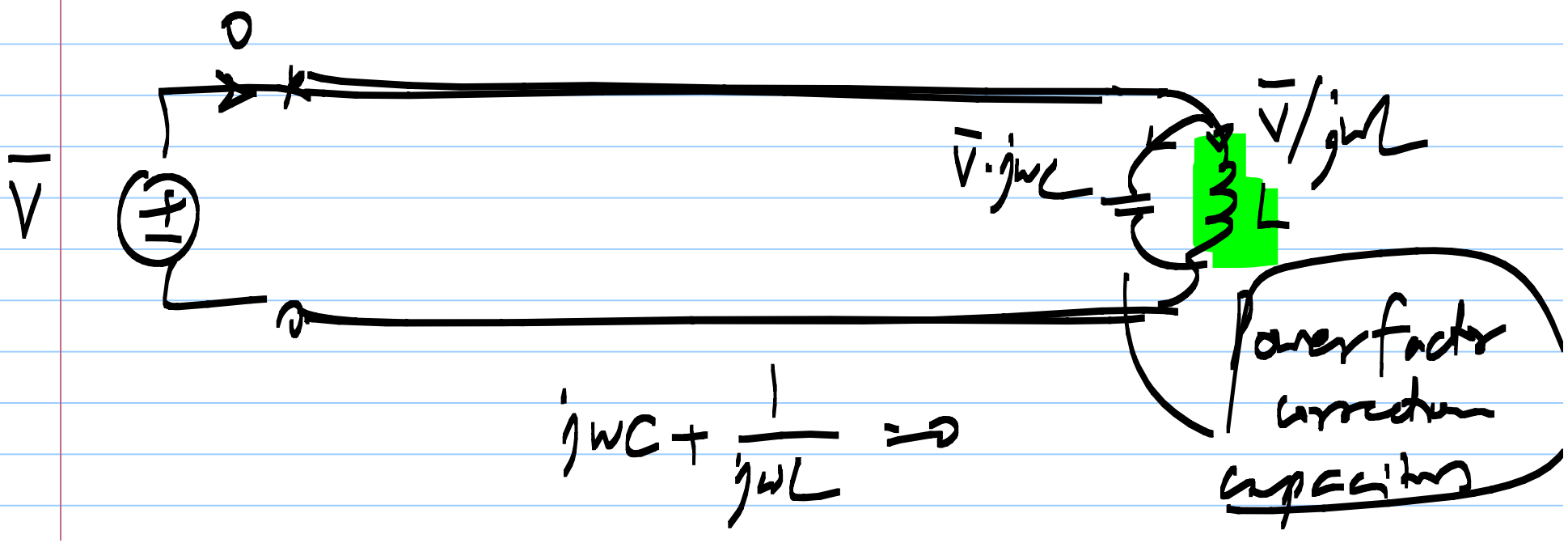
$P_r = Re[\bar{P}]$: Real power (W)

$P_i = Im(\bar{P})$: Reactive power (VA)



$$\frac{\text{Real power}}{\text{Apparent power}} = \text{Power factor} = \frac{\mathrm{Re}\left(\bar{V}\bar{I}^{*}/2\right)}{\bar{V}\bar{I}^{*}/2}$$

pf



$$j\omega C + \frac{1}{j\omega L} = 0$$

$$\underbrace{\mathrm{Re}\left[\frac{\bar{V}\,\bar{I}^{*}}{2}\right]}$$

$$\frac{V \cdot I}{2}\cos(\phi - \theta)$$

$$v(t) = V \cdot \cos(\omega t + \phi)$$

$$i(t) = I \cos(\omega t + \theta)$$

$$\bar{V} = V \cdot \angle\phi$$

$$\bar{I} = I \cdot \angle\theta$$