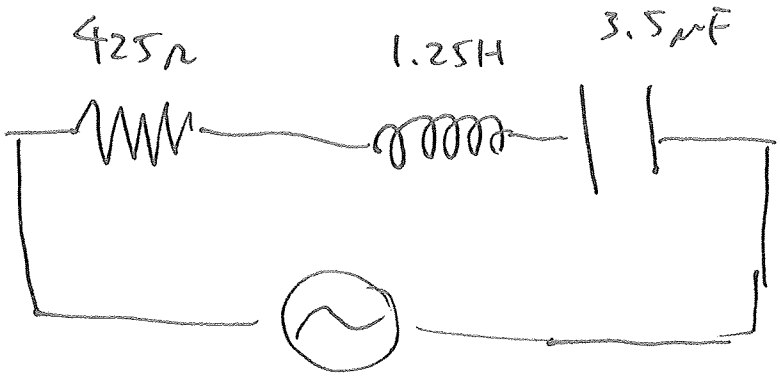


$V(t) = 150 \cos \omega t$

$\Delta V_{MAX} = 150V \quad 60Hz$

a) DETERMINE THE MAGNITUDE OF IMPEDANCE

b) FIND MAXIMUM CURRENT

c) ~~FUR~~ FIND THE PHASE ANGLE

$$\omega = ? = 2\pi f = 2\pi (60Hz) = 377\ s^{-1}$$

$$Z_{TOTAL} = R + i\omega L + \frac{1}{i\omega C}$$

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

$$\left| Z_{TOTAL} \right| = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

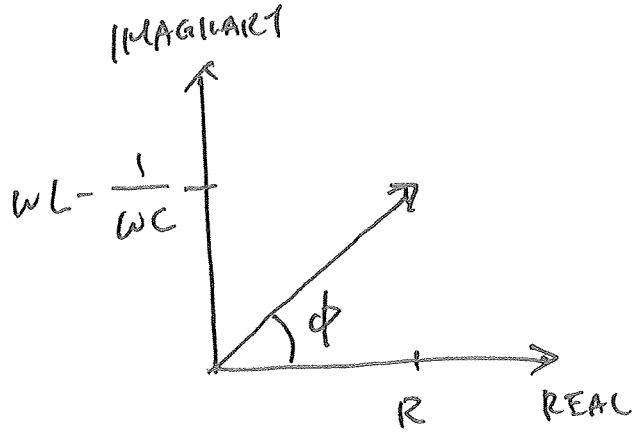
$R = 425\Omega \quad L = 1.25H \quad C = 3.5\mu F$

$\omega = 377\ s^{-1}$

$= 513\Omega$

b) $I_{MAX} = \frac{V_{MAX}}{|Z|} = \frac{150V}{513\Omega} = 0.292A$

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



$I(t) = I_{MAX}\cos(\omega t - \phi)$

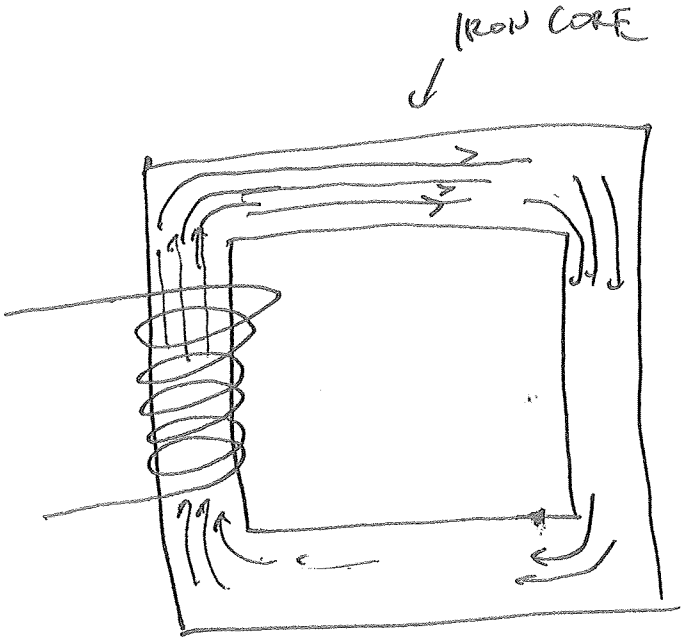
$\phi = \tan^{-1}\left(\frac{\omega L - \frac{1}{\omega C}}{R}\right)$

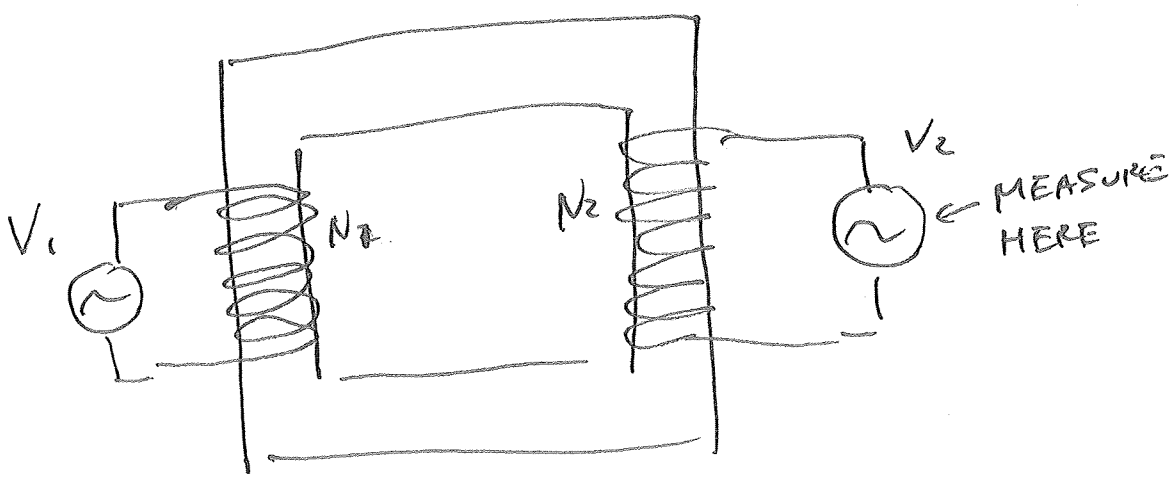
$\phi = -34^{\circ}$

RMS: $P_{AVERAGE} = I_{RMS}^2 R$

$I_{RMS} = \frac{I_{MAX}}{\sqrt{2}}$

$= \frac{I_{MAX}^2 R}{2}$





$$V_1 = -N_1 \frac{d\Phi_B}{dt} \qquad V_2 = -N_2 \frac{d\Phi_B}{dt}$$

$$\frac{d\Phi_B}{dt} = -\frac{V_1}{N_1}$$

$$V_2 = -N_2\left(-\frac{V_1}{N_1}\right)$$

$$V_2 = \frac{N_2}{N_1} V_1$$

$N_2 > N_1$: STEP UP TRANSFORMER

$N_1 > N_2$: STEP DOWN TRANSFORMER

EXAMPLE ON WHY WE NEED TRANSFORMERS

20 MW POWER PLANT

PRODUCES ~~[illegible]~~ ELECTRICITY AT 20kV (RMS)

STEPPED UP TO 200kV FOR TRANSMISSION (RMS)

RESISTANCE OF 1 km OF WIRE IS 2R

ENERGY COSTS ~ 10 ¢/kWhr

WHAT IS THE ENERGY LOST TO WIRES?

$P_{AVERAGE} = I_{RMS} \times V_{RMS}$

$20\,MW = (200 \times 10^3\,V)\, I_{RMS}$

$I_{RMS} = 100\,A$

$P_{WIRES} = I_{RMS}^2 R = (100A)^2 \cdot 2 = 20kW$

~~[illegible]~~ IN 24hrs

U_{WIRES} (ENERGY LOST) $= 24hr \cdot 20kW$

$= 480\,kWhr$

$480\,kWhr \times 10¢/kWhr = \$48$

WHAT HAPPENS IF YOU TRANSMIT AT 20kV?

$20\,MW = (20kV)\, I_{RMS}$

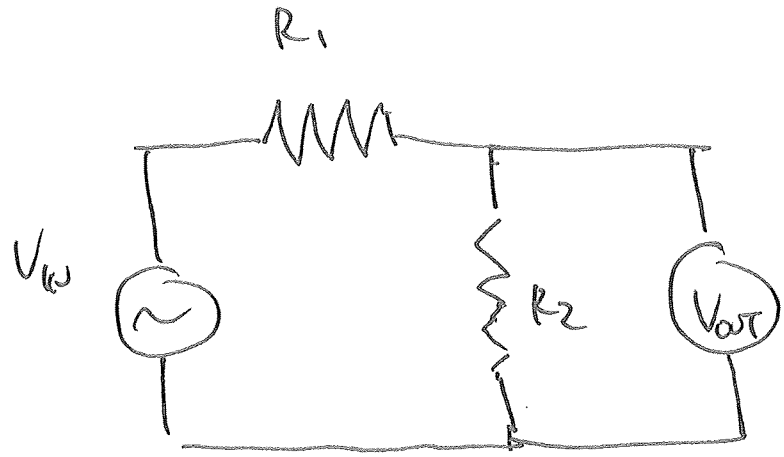
$I_{RMS} = 1000A$

$P_{WIRES} = (1000A)^2 \cdot .2 = 2MW$

$U_{WIRES\ in\ 24hrs} = 48\ MWhr$

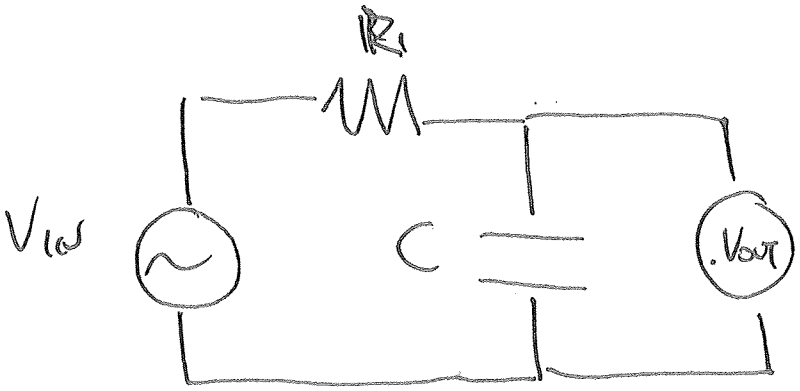
$COST = 48\ MWhr \times 0.1/kWhr$

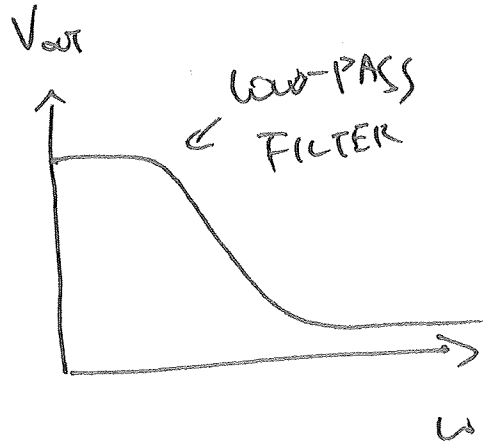
$= \$\ 14800$



$$I_{TOTAL} = \frac{V_{IN}}{R_1 + R_2}$$

$$V_{OUT} = \frac{V_{IN}}{R_1 + R_2} \cdot R_2 = V_{IN} \frac{R_2}{R_1 + R_2}$$





$$Z_C = \frac{1}{i\omega C}$$