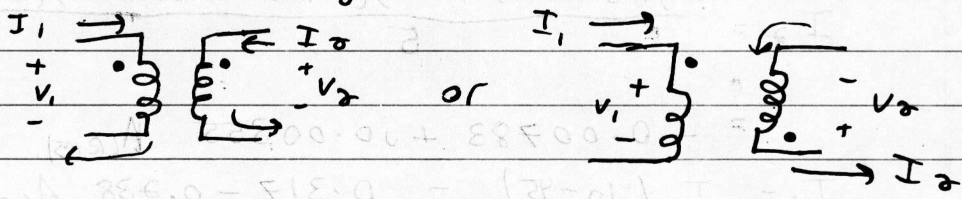
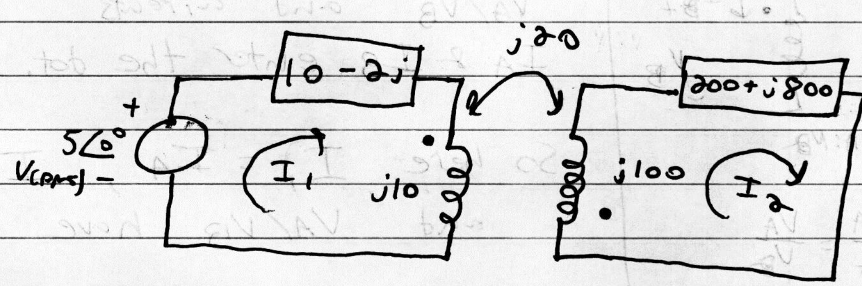
Transformers

Dot Notation: We define the current as entering the dotted terminals.



Note that really the current does not flow this way due to Lenz's Law which states that the induced flux (from Secondary) opposes change in flux (from the primary)

$\boxed{\text{Linear}}$

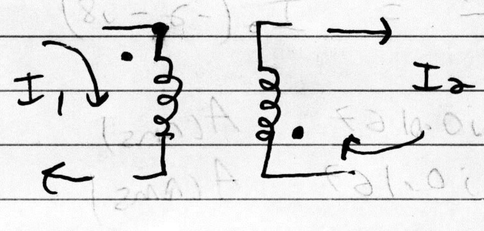


We will use the mesh current method, but first consider the inductors as uncoupled then account for mutual inductance

Node 1: $0 = -5\angle 0° + I_1(10-j2) + I_1(j10) \quad + I_2(j20)$

Since current enters dot we consider the secondary side with current entering $\leftrightarrow$ (Mutual Term)

Node 2: $0 = I_2(200+j800) + I_2(j100) \quad + I_1(j20)$



I_2 & I_1 both enter dot so Mutual term positive

$$\therefore I_1 = I_2\left(\frac{200 + j900}{-j20}\right) = I_2(j10 - 45)$$

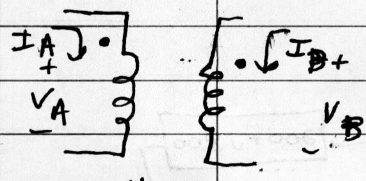
$$I_2 = \frac{j20 + (j10-45)(10-j2) + (j10-45)(j10)}{5}$$

$$= -0.00783 + j0.00355 \quad A(RMS)$$

$$I_1 = I_2(j10-45) = 0.317 - 0.238 \quad A(RMS)$$

If we replace it with an $\boxed{\text{ideal transformer}}$ with a turn ratio of 10:100

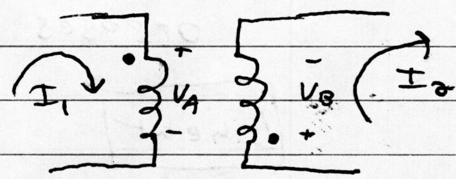
General Rule



$N_A : N_B$

$$\begin{cases} \dfrac{N_A}{N_B} = \dfrac{V_A}{V_B} \\ N_A I_A = -N_B I_B \end{cases}$$

Note that the dot is the + terminal of V_A/V_B and currents I_A & I_B enter the dot.



10:100

So here $I_1 = I_A$, $I_2 = I_B$ (entering) and V_A/V_B have opposite polarity

- $V_A = \underline{10x}$ and $V_B = \underline{100x}$ for some x
- $10 I_1 = -100 I_2 \quad \therefore I_1 = -10 I_2$

By MCM
$$\begin{cases} -5\angle 0^\circ + I_1(10-j2) + \underline{10x} = 0 \\ 100x + I_2(200 + j800) = 0 \end{cases}$$

$$\Downarrow$$

$$\begin{cases} -5\angle 0^\circ + I_2(j20 - 100) + 10x = 0 \\ 100x + I_2(200 + j800) = 0 \end{cases}$$

$$x = \frac{-I_2(200 + j800)}{100} = I_2(-2 - j8)$$

$$I_2 = -0.0333 + j0.0167 \quad A(RMS)$$

$$I_1 = 0.333 - j0.167 \quad A(RMS)$$