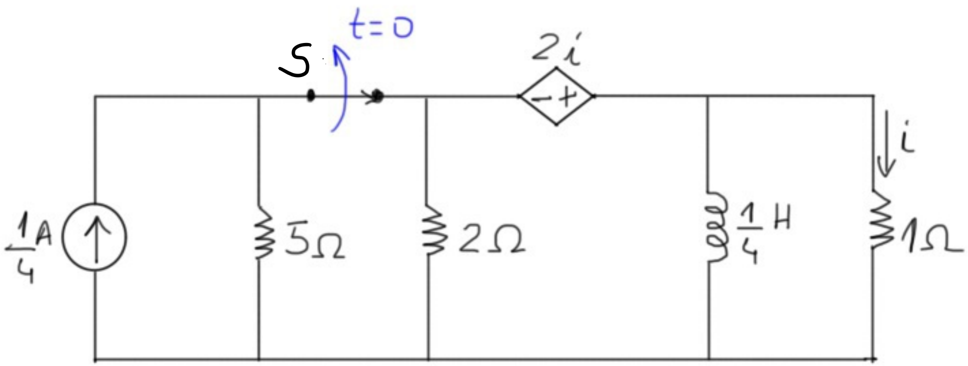
CIRCUITOS DE PRIMEIRA ORDEM

CIRCUITOS COM INDUTORES



No circuito acima, a chave S foi mantida fechada até o circuito atingir o regime permanente. Calcular a corrente i, com a chave S aberta (a partir de $t=0$).

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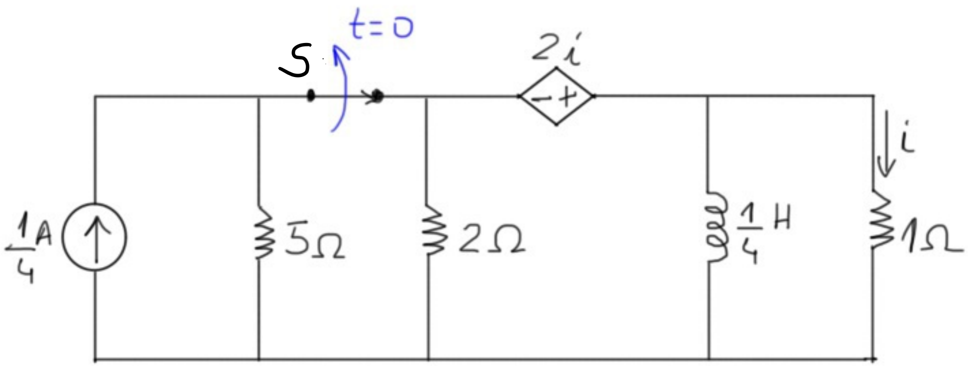

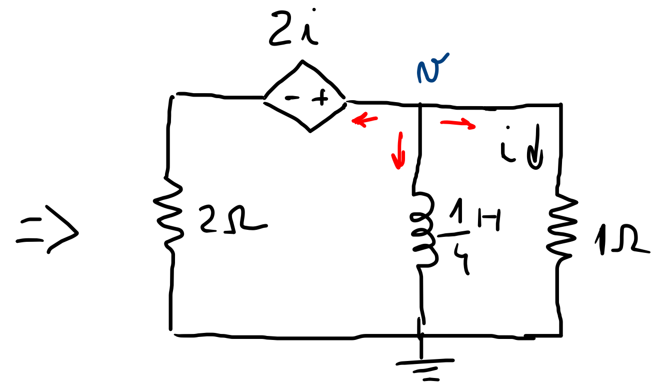

$$\frac{v - 2i}{2} + \frac{v}{1} + \frac{1}{1/4}\int v\,dt = 0$$

Mas: $i = \frac{v}{1} = v$

$$\frac{v}{2} + 4\int v\,dt = 0$$

$$\frac{1}{2}\frac{dv}{dt} + 4v = 0$$

$$\boxed{\frac{dv}{dt} + 8v = 0}$$

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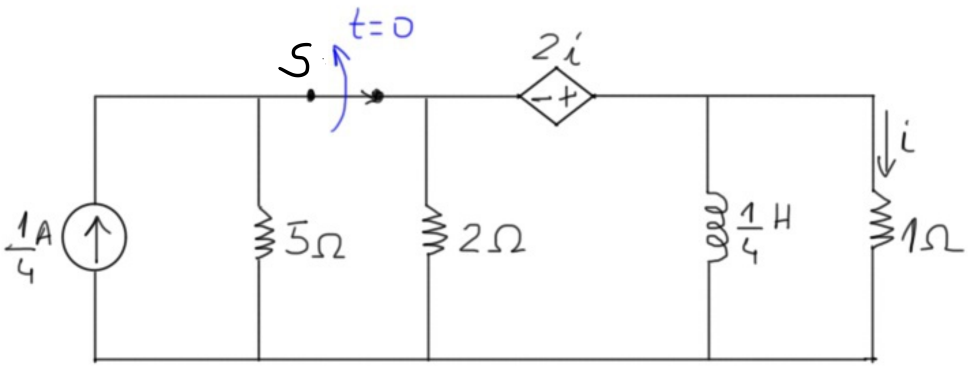
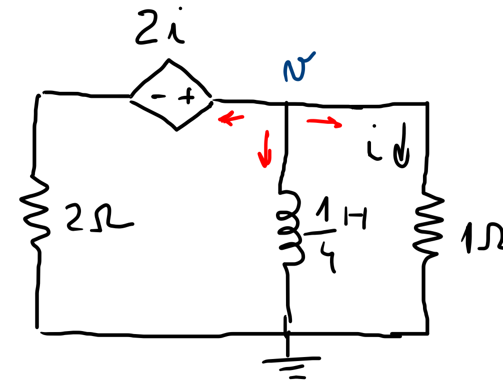


$\Rightarrow$



$$\frac{dv}{dt} + 8v = 0$$

$$v(t) = v_n(t) + \cancel{v_f(t)}^{\,0}$$

$$\underline{v(t) = K e^{pt}}$$

P:

$$p + 8 = 0$$

$$\underline{p = -8}$$

$$v(t) = K e^{-8t}$$

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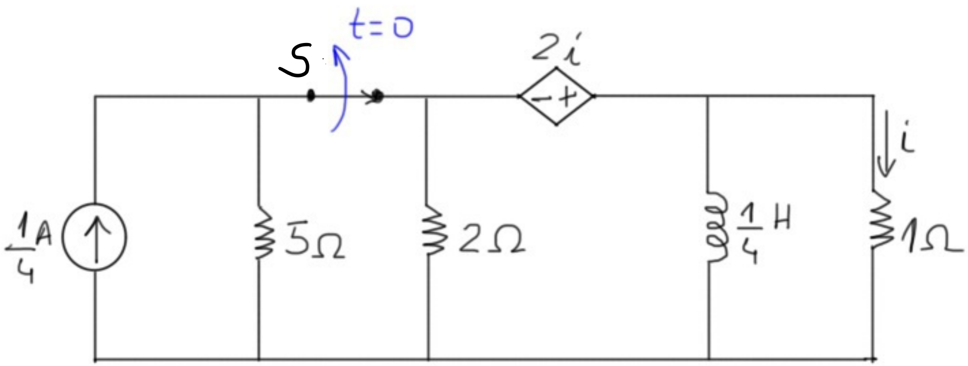
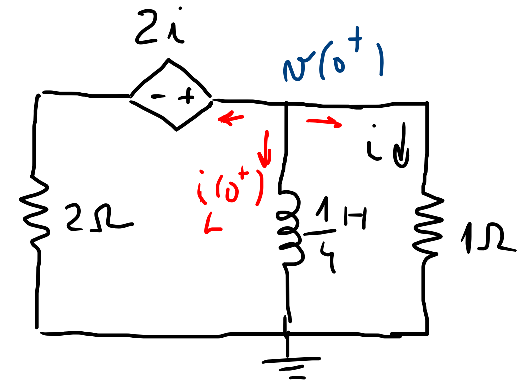


$\Rightarrow$



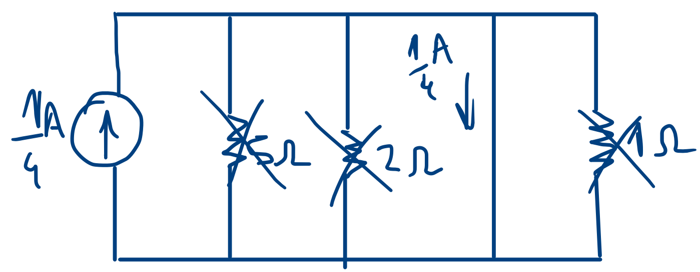
$$\frac{dv}{dt} + 8v = 0$$

$$v(t) = v_n(t) + \cancel{v_f(t)}^{\,0}$$

$$v(t) = K e^{pt}$$

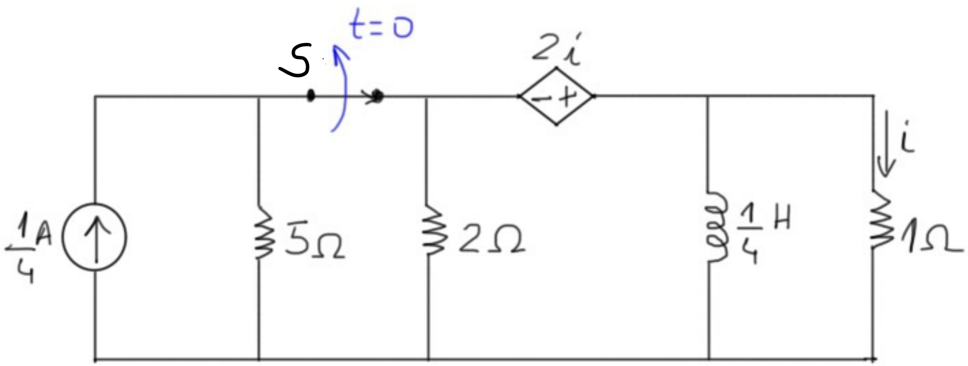
Cálculo de K:

$$i_L(0^-) = i_L(0^+) = \frac{1}{4}\,A$$

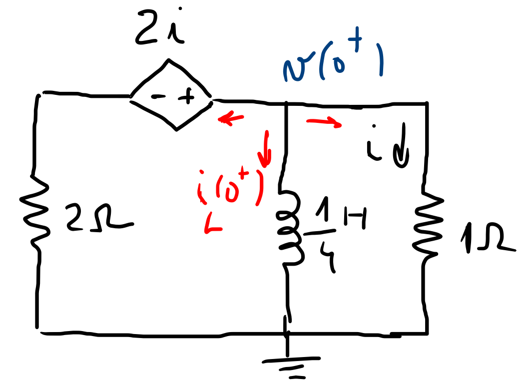


CIRCUITOS DE PRIMEIRA ORDEM

CIRCUITOS COM INDUTORES



$\Rightarrow$



$$\frac{dv}{dt} + 8v = 0$$

$$v(t) = v_n(t) + \cancel{v_f(t)}^{\,0}$$

$$\underline{v(t) = K e^{pt}}$$

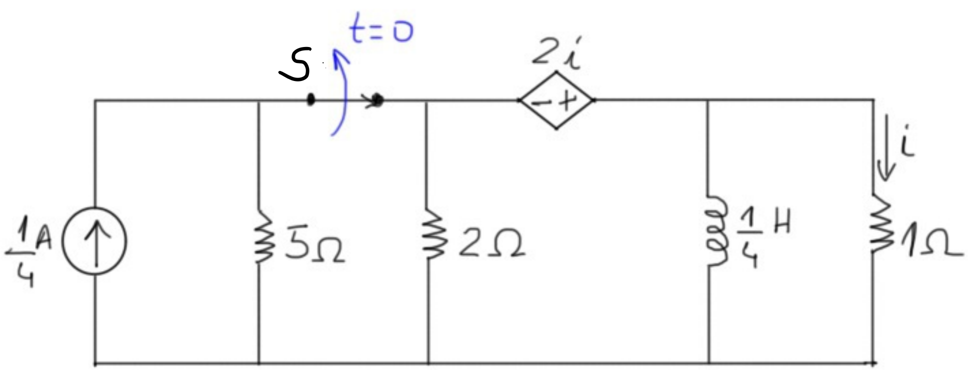
Cálculo de K:

$$\frac{v(0^+) - 2v(0^+)}{2} + \frac{1}{4} + \frac{v(0^+)}{1} = 0$$

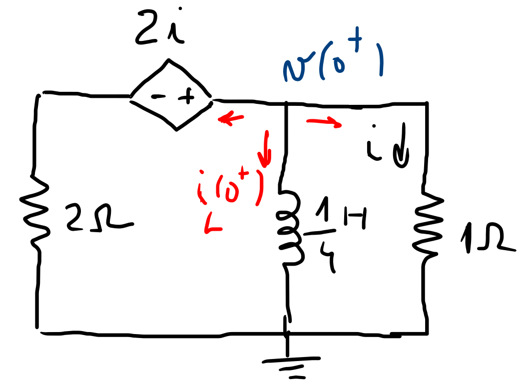
$$\underline{v(0^+) = -\frac{1}{2}\,V}$$

CIRCUITOS DE PRIMEIRA ORDEM

CIRCUITOS COM INDUTORES



$\Rightarrow$



$$\frac{dv}{dt} + 8v = 0$$

$$v(t) = v_n(t) + \cancel{v_f(t)}^{\,0}$$

$$\underline{v(t) = K e^{pt}}$$

Cálculo de K:

$$v(0) = K \rightarrow \underline{K = -\frac{1}{2}}$$

CIRCUITOS DE PRIMEIRA ORDEM

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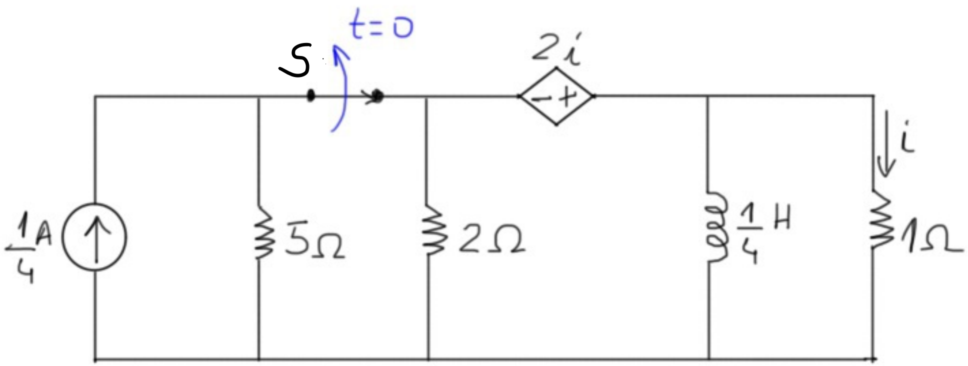
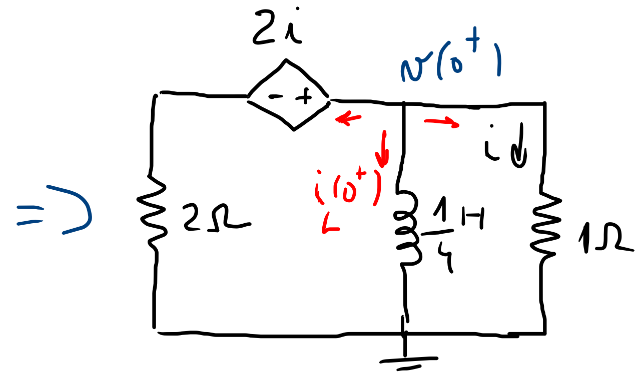


$\Rightarrow$



$$\frac{dv}{dt} + 8v = 0$$

$$v(t) = v_n(t) + \cancel{v_f(t)}^{\,0}$$

$$\underline{v(t) = K e^{pt}}$$

Resposta:

$$v(t) = -\frac{1}{2} e^{-8t} \cdot u(t)$$

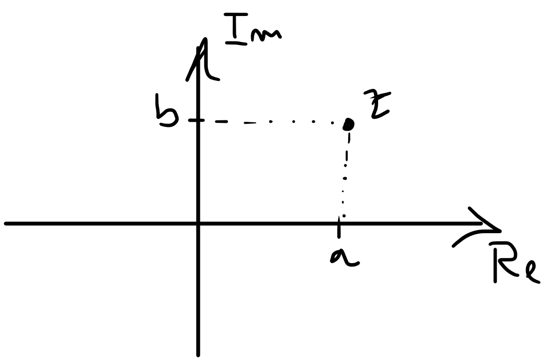
$$i(t) = \frac{v(t)}{1} = -\frac{1}{2} e^{-8t} \cdot u(t)$$

Revisão - Números Complexos

→ Formas de Representação

A) Forma Retangular ou algébrica

$$\boxed{z = a + jb}$$



$\sqrt{-4} = 2\sqrt{-1}$; $\sqrt{-16} = 4\sqrt{-1}$

j : unidade imag.

$$j = \sqrt{-1}$$

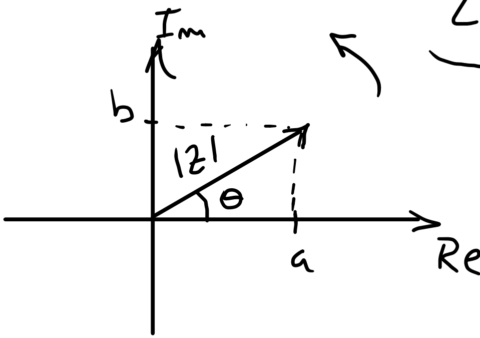
$$j^2 = -1$$

$$j^3 = j \cdot j^2 = -j$$

$$j^4 = j^2 \cdot j^2 = 1$$

$\vdots$

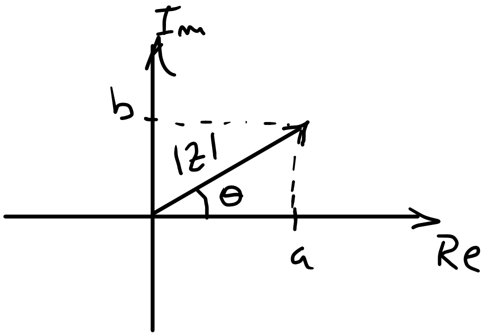
B) Forma Polar



$$\underbrace{Z = |z| \angle \theta}$$

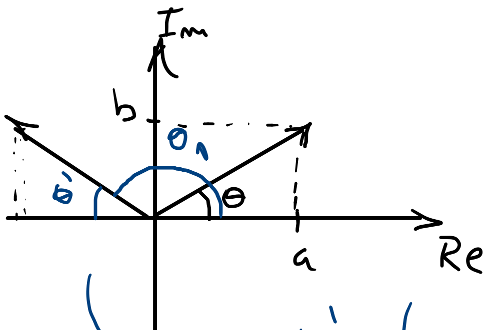
→ Transformações

1) Retangular p/ Polar



$$z = a + jb \rightarrow |z|\angle\theta$$

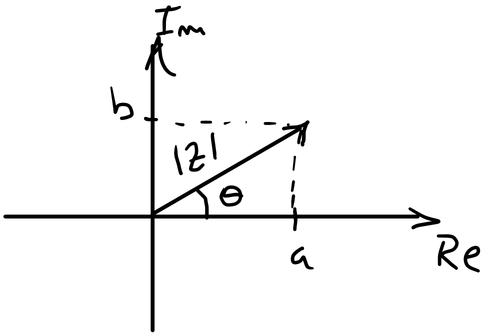
$$\begin{cases} |z| = \sqrt{a^2 + b^2} \\ \theta = \tan^{-1}\left(\dfrac{b}{a}\right) \end{cases}$$



$$\theta' = \tan^{-1}\left(\frac{b}{a}\right) \rightarrow \underbrace{\theta_1 = 180^\circ - \theta'}$$

→ Transformações

2) Polar p/ Retangular



$$z = |z|\angle\theta \rightarrow z = a + jb$$

$$\begin{cases} a = |z|\cos\theta \\ b = |z|\operatorname{sen}\theta \end{cases}$$

$$* \; z = |z|\cos\theta + j\cdot|z|\operatorname{sen}\theta = |z|\underbrace{\left(\cos\theta + j\operatorname{sen}\theta\right)}_{e^{j\theta}}$$

$$\underline{z = |z|\,e^{j\theta}}$$

→ Operações com números complexos

1) Soma e Subtração

$z_1 = a_1 + jb_1$; $z_2 = a_2 + jb_2$; $z_1 + z_2 = (a_1 + a_2) + j(b_1 + b_2)$

$|z_1| \angle \theta_1$; $|z_2| \angle \theta_2$

2) Multiplicação

$z_1 = |z_1| e^{j\theta_1}$; $z_2 = |z_2| e^{j\theta_2}$; $z_1 = |z_1| \angle \theta_1$; $z_2 = |z_2| \angle \theta_2$

$$\begin{cases} z_1 \cdot z_2 = |z_1| e^{j\theta_1} \cdot |z_2| e^{j\theta_2} \\ z_1 \cdot z_2 = |z_1| . |z_2| e^{j(\theta_1 + \theta_2)} \end{cases} \longrightarrow z_1 . z_2 = |z_1| . |z_2| \angle \theta_1 + \theta_2$$

$z_1 = a_1 + jb_1$; $z_2 = a_2 + jb_2$

$$z_1 \cdot z_2 = (a_1 + jb_1)(a_2 + jb_2) = a_1a_2 + ja_1b_2 + ja_2b_1 + j^2 b_1b_2 =$$
$$= \underbrace{a_1a_2 - b_1b_2} + j\underbrace{(a_1b_2 + a_2b_1)}$$

3) <u>Divisão</u>

$z_1 = |z_1| e^{j\theta_1}$; $z_2 = |z_2| e^{j\theta_2}$; $z_1 = |z_1| \angle \theta_1$; $z_2 = |z_2| \angle \theta_2$

$$\left\{ \begin{array}{l} \dfrac{z_1}{z_2} = \dfrac{|z_1| e^{j\theta_1}}{|z_2| e^{j\theta_2}} \\[2ex] \dfrac{z_1}{z_2} = \dfrac{|z_1|}{|z_2|} e^{j(\theta_1 - \theta_2)} \end{array} \right. \rightarrow \quad \frac{|z_1| \angle \theta_1}{|z_2| \angle \theta_2} = \frac{|z_1|}{|z_2|} \angle \theta_1 - \theta_2$$

$$\frac{a_1+jb_1}{a_2+jb_2}\cdot\frac{(a_2-jb_2)}{(a_2-jb_2)}=\frac{a_1a_2-ja_1b_2+ja_2b_1-j^2b_1b_2}{a_2^2-\cancel{ja_2}b_2+\cancel{ja_2}b_2-j^2b_2^2}\ ;\ \underbrace{j^2=-1}_{=}$$

$$=\frac{a_1a_2+b_1b_2+j(a_2b_1-a_1b_2)}{a_2^2+b_2^2}$$

→ Conjugado de z:

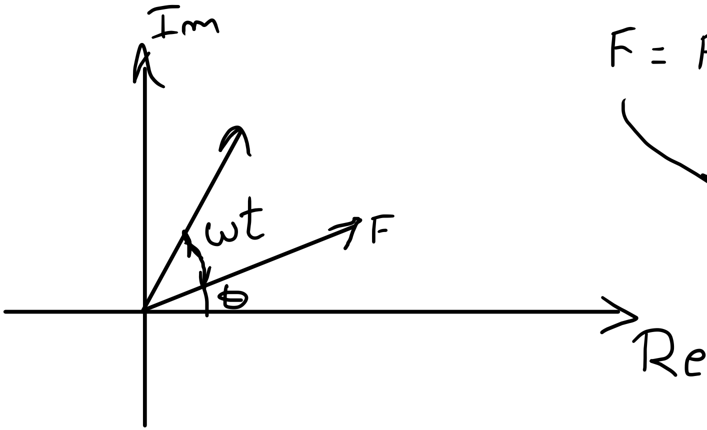
$$\boxed{\bar{z}=z^*=a-jb}$$

$z=a+jb$

$$*\ \frac{1}{j}\cdot\frac{j}{j}=\frac{j}{j^2}=-j$$

$$\underbrace{\frac{1}{j}=-j}$$

* FASORES



$$F = F_m e^{j\theta} \rightarrow F e^{j\omega t} \rightarrow \begin{cases} [Re]: F_m \cos(\omega t + \theta) \\ [Im]: F_m \operatorname{sen}(\omega t + \theta) \end{cases}$$

$$\boxed{F_m \cos(\omega t + \theta) \longleftrightarrow \bar{F}_m \angle \theta}$$