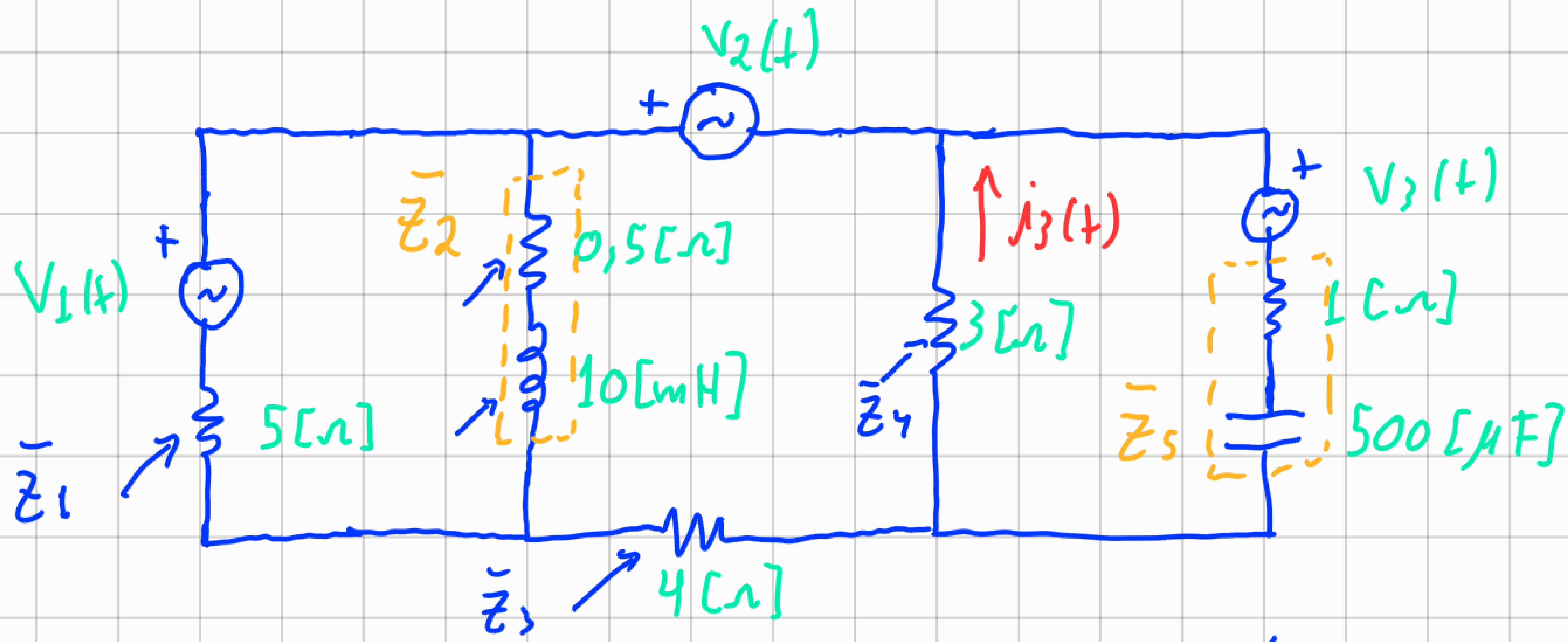
Ex: Determine $i_3(t)$ no circuito abaixo.



Dados: $v_1(t) = 10 \cdot \sqrt{2} \cos(377t + 5^\circ)$ [V]

$V_2(t) = 20 \cdot \sqrt{2} \cos(377t + 0^\circ)$ [V]

$V_3(t) = 5 \cdot \sqrt{2} \cos(377t - 15^\circ)$ [V]

Solução:

1) Transformar o circuito utilizando fasores e impedâncias.

$$\dot{V}_1 = \frac{10 \cdot \cancel{\sqrt{2}}}{\cancel{\sqrt{2}}} e^{j5^\circ} = 10 \angle 5^\circ \text{ [V]}$$

$$\dot{V}_2 = 20 \angle 0^\circ \text{ [V]}$$

$$\dot{V}_3 = 5 \angle -15^\circ \text{ [V]}$$

$\bar{Z}_1 = 5 \quad [\Omega]$

$\bar{Z}_2 = 0,5 + j\omega L$, $\omega = 377$ rad/s

$\omega = 2\pi \cdot \boxed{60} \rightarrow f\ [Hz]$

$$\boxed{\bar{Z}_2 = 0,5 + j377 \cdot 10 \cdot 10^{-3} = 0,5 + j3,77\ [\Omega]}$$

Na forma polar:

$$\bar{Z}_2 = \sqrt{0,5^2 + 3,77^2} \angle tg^{-1}\frac{3,77}{0,5}$$

$$\bar{Z}_2 = 3,803 \angle 82,45° \ [\Omega]$$

$\bar{Z}_3 = 4\ [\Omega]$

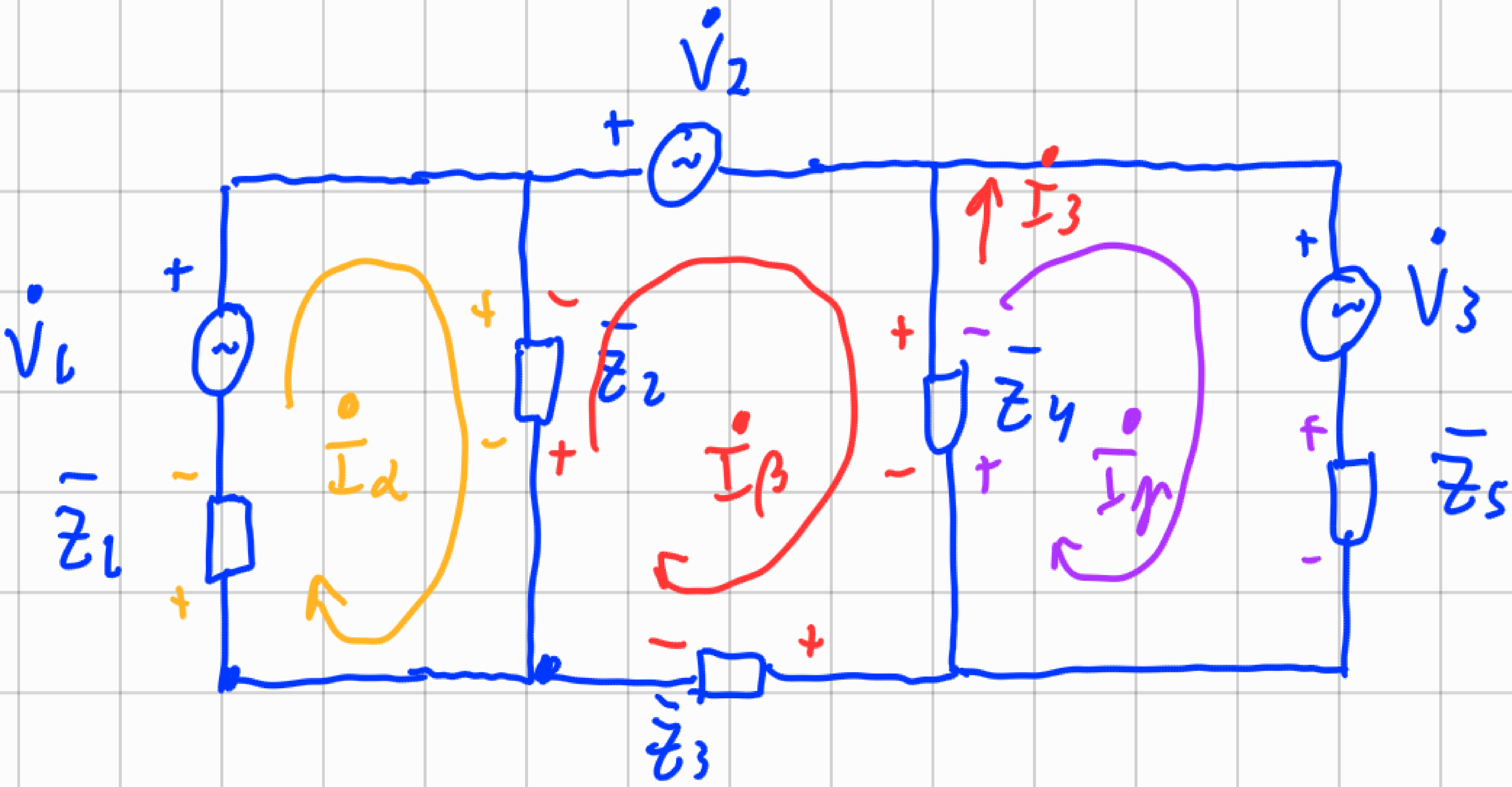
$\bar{Z}_4 = 3\ [\Omega]$

$$\bar{Z}_5 = 1 - j\frac{1}{\omega C} = 1 - j\frac{1}{377 \cdot 500 \cdot 10^{-6}}$$

$$\bar{Z}_5 = 1 - j5,305\ [\Omega]$$

$$\boxed{\bar{Z}_s = \frac{1 \cdot (-j5,305)}{1 + (-j5,305)} = \frac{-j5,305}{1 - j5,305}}$$

$$\bar{Z}_s : 0,966 - j0,182\ [\Omega]$$



Malha α:

$$-\bar{Z}_1 \dot{I}_\alpha + \dot{V}_1 - \bar{Z}_2 \dot{I}_\alpha + \bar{Z}_2 \dot{I}_\beta = 0$$

$$(\bar{Z}_1 + \bar{Z}_2)\dot{I}_\alpha - \bar{Z}_2 \dot{I}_\beta = \dot{V}_1$$

Malha β:

$$-\bar{Z}_2 \dot{I}_\beta + \bar{Z}_2 \dot{I}_\alpha - \dot{V}_2 - \bar{Z}_4 \dot{I}_\beta + \bar{Z}_4 \dot{I}_\gamma - \bar{Z}_3 \dot{I}_\beta = 0$$

$$-\bar{Z}_2 \dot{I}_\alpha + (\bar{Z}_2 + \bar{Z}_4 + \bar{Z}_3)\dot{I}_\beta - \bar{Z}_4 \dot{I}_\gamma = -\dot{V}_2$$

Malha γ:

$$-\bar{Z}_4 \dot{I}_\gamma + \bar{Z}_4 \dot{I}_\beta - \dot{V}_3 - \bar{Z}_5 \dot{I}_\gamma = 0$$

$$-\bar{Z}_4 \dot{I}_\beta + (\bar{Z}_4 + \bar{Z}_5)\dot{I}_\gamma = -\dot{V}_3$$

Sistema matricial:

$$\underbrace{\begin{bmatrix} \bar{Z}_1 + \bar{Z}_2 & -\bar{Z}_2 & 0 \\ -\bar{Z}_2 & \bar{Z}_2 + \bar{Z}_4 + \bar{Z}_3 & -\bar{Z}_4 \\ 0 & -\bar{Z}_4 & \bar{Z}_4 + \bar{Z}_5 \end{bmatrix}}_{A} \underbrace{\begin{bmatrix} \dot{I}_\alpha \\ \dot{I}_\beta \\ \dot{I}_\gamma \end{bmatrix}}_{x} = \underbrace{\begin{bmatrix} \dot{V}_1 \\ -\dot{V}_2 \\ -\dot{V}_3 \end{bmatrix}}_{b}$$

$$Ax = b$$
$$x = A^{-1} \cdot b$$

$$\begin{bmatrix} 5,5 + j3,77 & -0,5 - j3,77 & 0 \\ -0,5 - j3,77 & 7,5 + j3,77 & -3 \\ 0 & -3 & 4 - j5,305 \end{bmatrix} \begin{bmatrix} \dot{I}_\alpha \\ \dot{I}_\beta \\ \dot{I}_\gamma \end{bmatrix} = \begin{bmatrix} 10\angle 5^\circ \\ -20\angle 0^\circ \\ -5\angle -15^\circ \end{bmatrix}$$

$$\begin{bmatrix} \dot{I}_\alpha \\ \dot{I}_\beta \\ \dot{I}_\gamma \end{bmatrix} = \begin{bmatrix} 1,4183\angle -82,32^\circ \\ 2,2823\angle 162,90^\circ \\ 1,7828\angle -143,23^\circ \end{bmatrix} [A]$$

P/ $\dot{I}_3$:

$$\dot{I}_3 = \dot{I}_\gamma - \dot{I}_\beta$$

$$\dot{I}_3 = 1,7828\angle -143,23^\circ - 2,2823\angle 162,90^\circ$$

$$\boxed{\dot{I}_3 = 1,8945\angle -66,57^\circ \ (A)}$$

$i_3(t) = 1{,}8945 \cdot \sqrt{2}\cos(377t - 66{,}57°)\ (A)$

$$\boxed{i_3(t) = 2{,}68\cos(377t - 66{,}57°)\ (A)}$$