Øving 3

Oppgave 1)

a)

Gitt at:

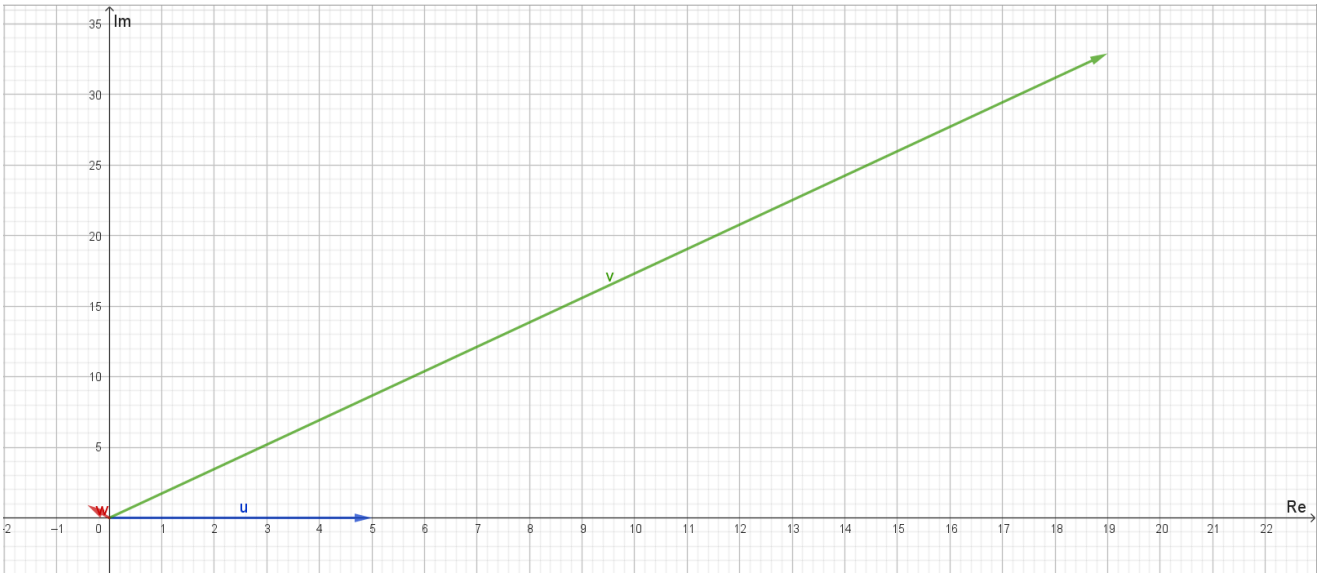
$$a\cos(\omega t+\phi)=\mathrm{Re}\{ae^{j(\omega t+\phi)}\}\implies A=ae^{j\phi}$$

Får vi at:

$$5\cos(3\pi t)=\mathrm{Re}\{5e^{j3\pi t}\}\implies A=5$$

$$38\cos\left(2.5\pi t+\frac{\pi}{3}\right)=\mathrm{Re}\{38e^{j\pi/3}\cdot e^{j2.5\pi t}\}\implies A=38e^{j\pi/3}$$

$$\cos(8t+2)=\mathrm{Re}\{e^{j2}\cdot e^{j8t}\}\implies A=e^{j2}$$



b)

Får utrykkene:

$$\mathrm{Re}\{7e^{j(\omega t+\pi)}\}=7\cos(\omega t+\pi)$$

$$\mathrm{Re}\{3e^{j(\omega t+4.3\pi)}\}=3\cos(\omega t+4.3\pi)$$

$$\mathrm{Re}\{Ce^{j(\omega t+\beta)}\}=C\cos(\omega t+\beta)$$

$$\mathrm{Re}\{(4+j4)e^{j\omega}\}=4\sqrt{2}\cos\left(\omega t+\frac{\pi}{4}\right)$$

c)

$$A)\ A = 1.5$$

$$B)\ A = 2e^{j\frac{\pi}{2}}$$

$$C)\ A = \frac{1}{2}e^{-j\frac{\pi}{2}}$$

$$D)\ A = \frac{1}{2}e^{j\pi}$$

Oppgave 2)

$$x(t) = 10\cos(\omega t + 0.42) + 4.2\cos(wt - 1.3) - 6\sin(wt + 0.38)$$

$$x(t) = 10e^{j(wt+0.42)} + 4.2e^{j(\omega t-1.3)} - 6e^{j(\omega t+0.38+3\pi/2)}$$

$$x(t) = (10e^{j0.42} + 4.2e^{-j1.3} - 6e^{j0.38+3\pi/2}) \cdot e^{j\omega t}$$

$$x(t) = (8.0289 + 5.6026j) \cdot e^{j\omega t}$$

$$x(t) = 9.7904e^{j0.6093} \cdot e^{j\omega t} = 9.7904\cos(\omega t + 0.6093)$$

Oppgave 3)

a)

Gitt:

$$x(t) = a\cos(\omega t)$$

Da blir:

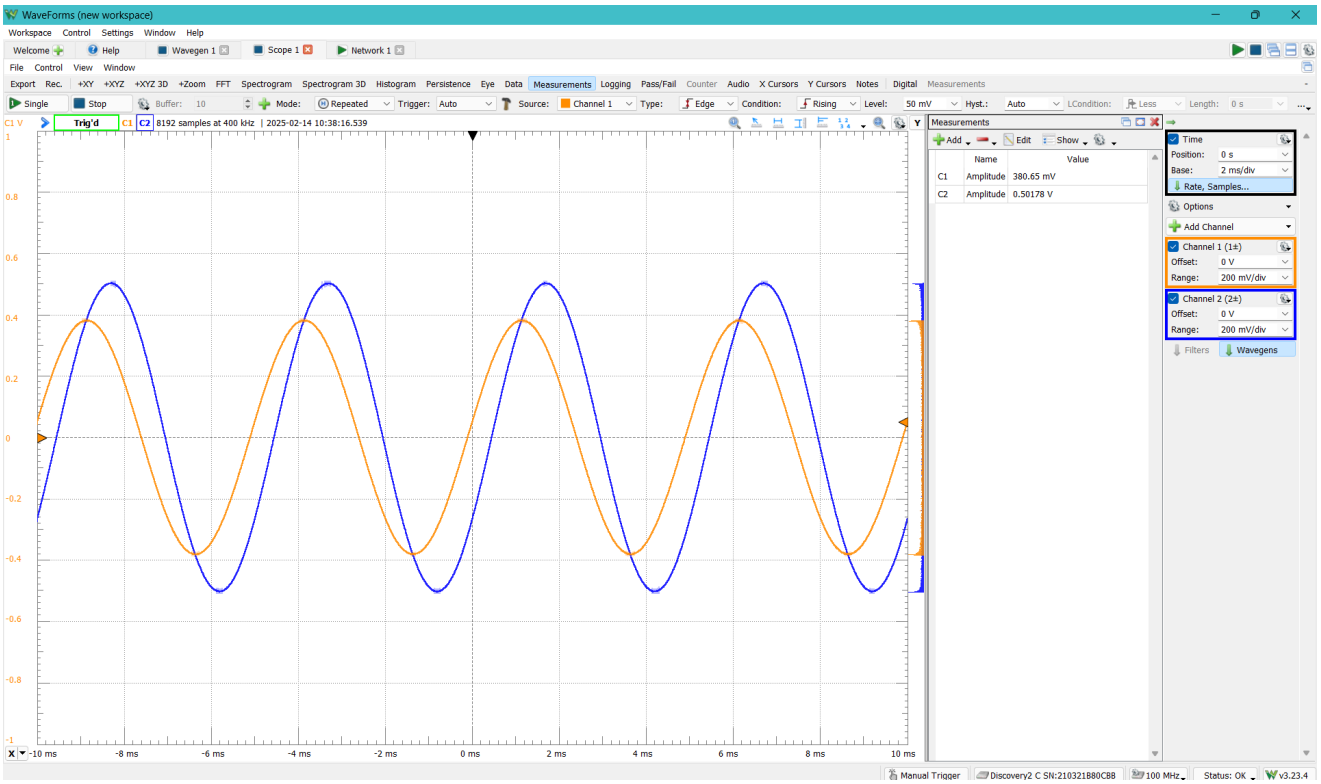
$$x(t - \Delta t) = a\cos(\omega \cdot (t - \Delta t)) = a\cos(\omega t - \omega\Delta t) \implies \Delta\phi = -\omega\Delta t$$

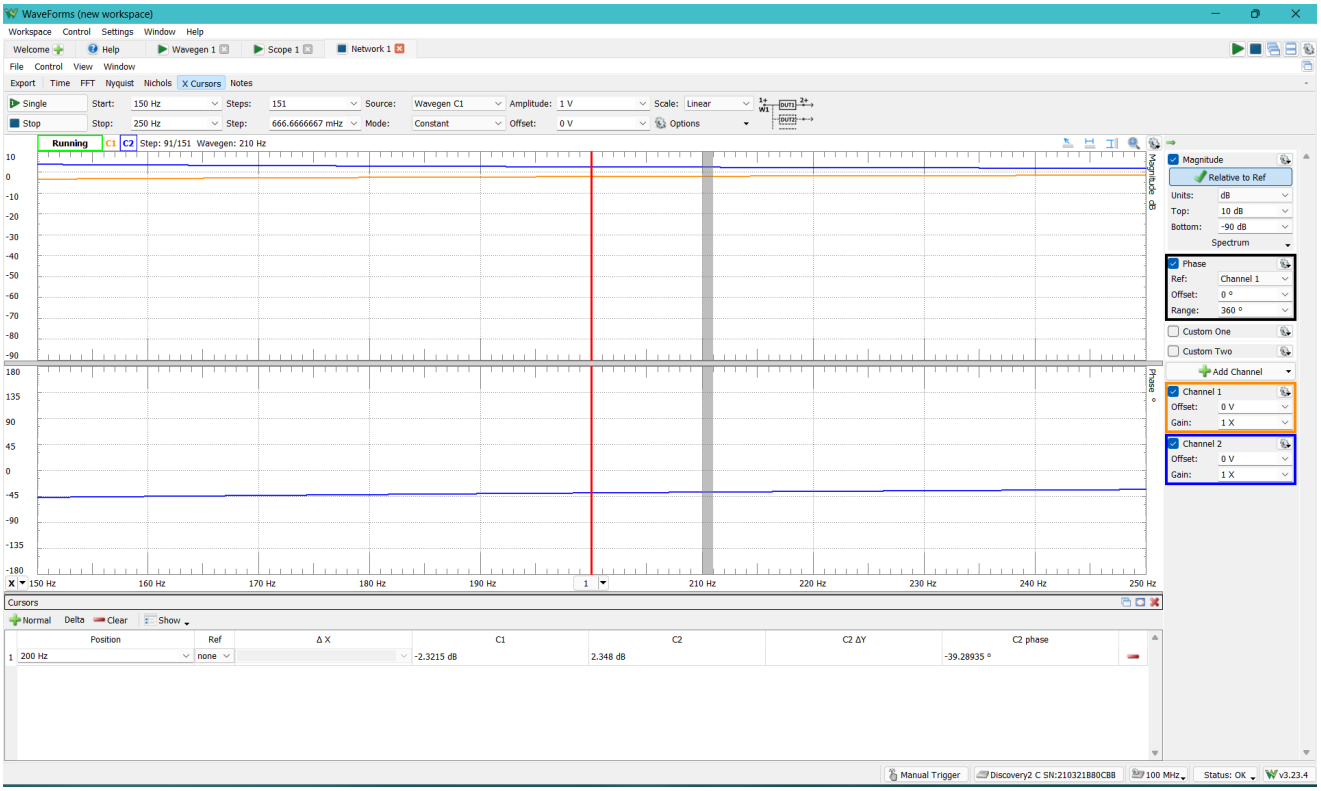
b)

Gitt at:

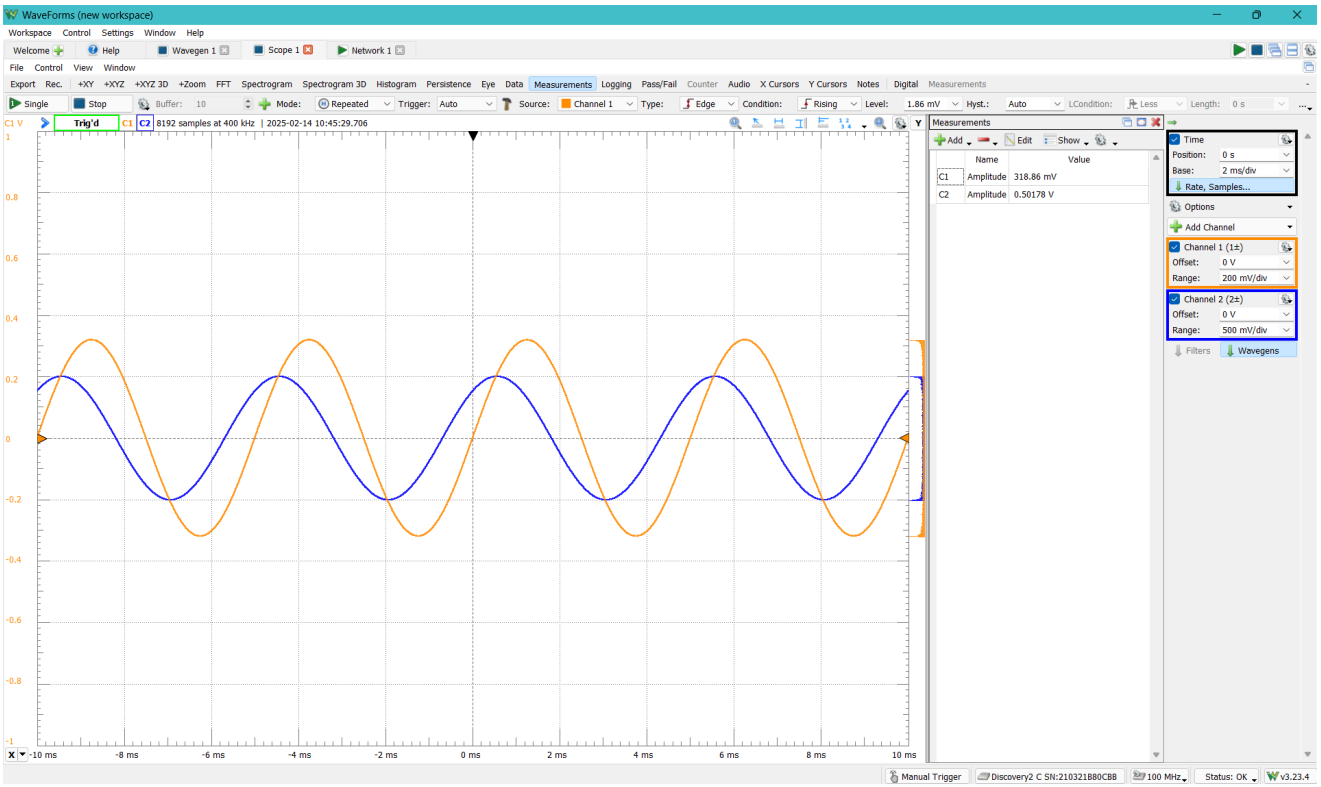
$$V_0 = 0.5\cos(2\pi \cdot 200t)$$

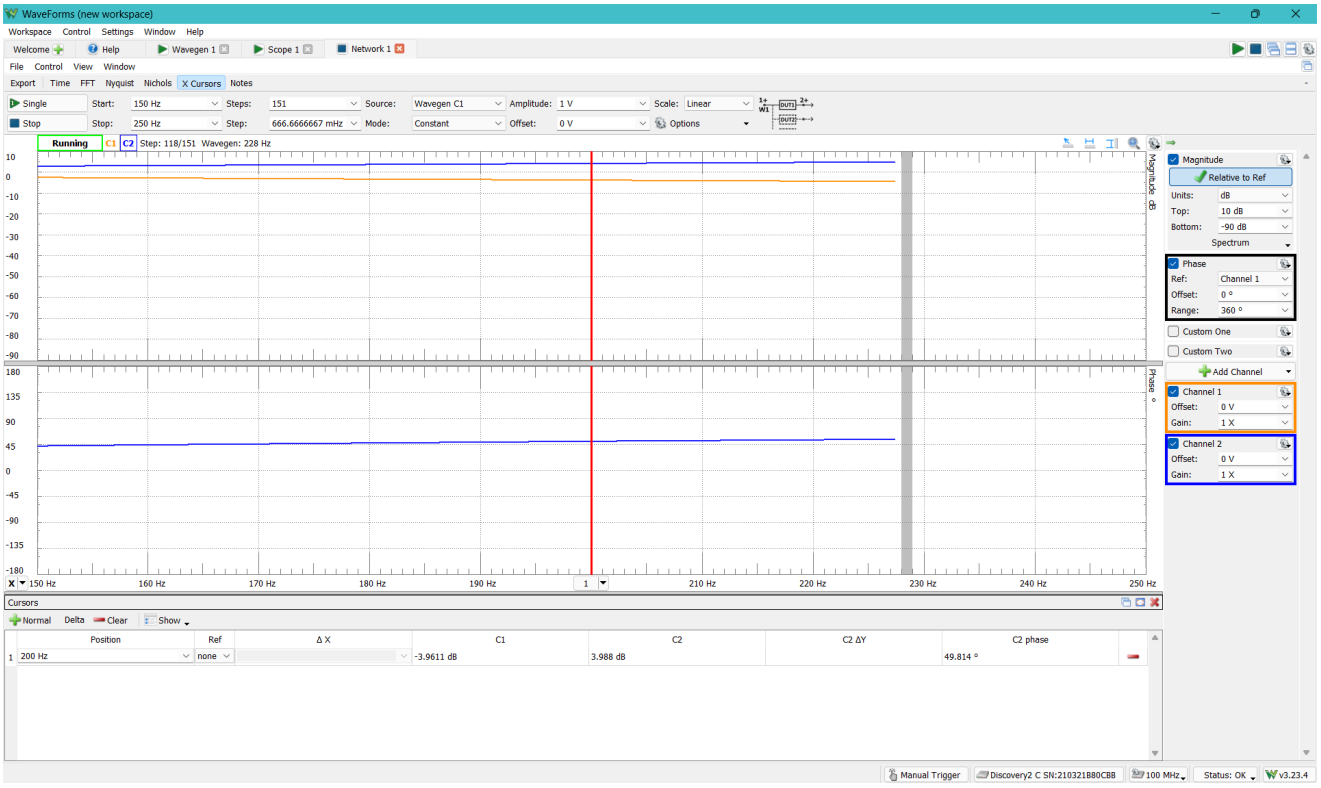
Som gir oss at vi må generere et signal med 0.5V amplitude og 200Hz for V_0 som er på kanal 2 i bildene under:





V_1 er tilnærmet -39.2 (-0.6841 radianer) graders fase forskyvning og amplitude $\approx 380mV$





V_2 er 49.8 (0.8691) graders fase forskyvning og amplitude $\approx 319mV$
Slik at:

$$V_0 = 0.5$$

$$V_1 \approx 380 \cdot 10^{-3} \cdot e^{-j0.6841}$$

$$V_2 \approx 319 \cdot 10^{-3} \cdot e^{j0.8691}$$

Kan så regne med Kirchoffs spenningslov:

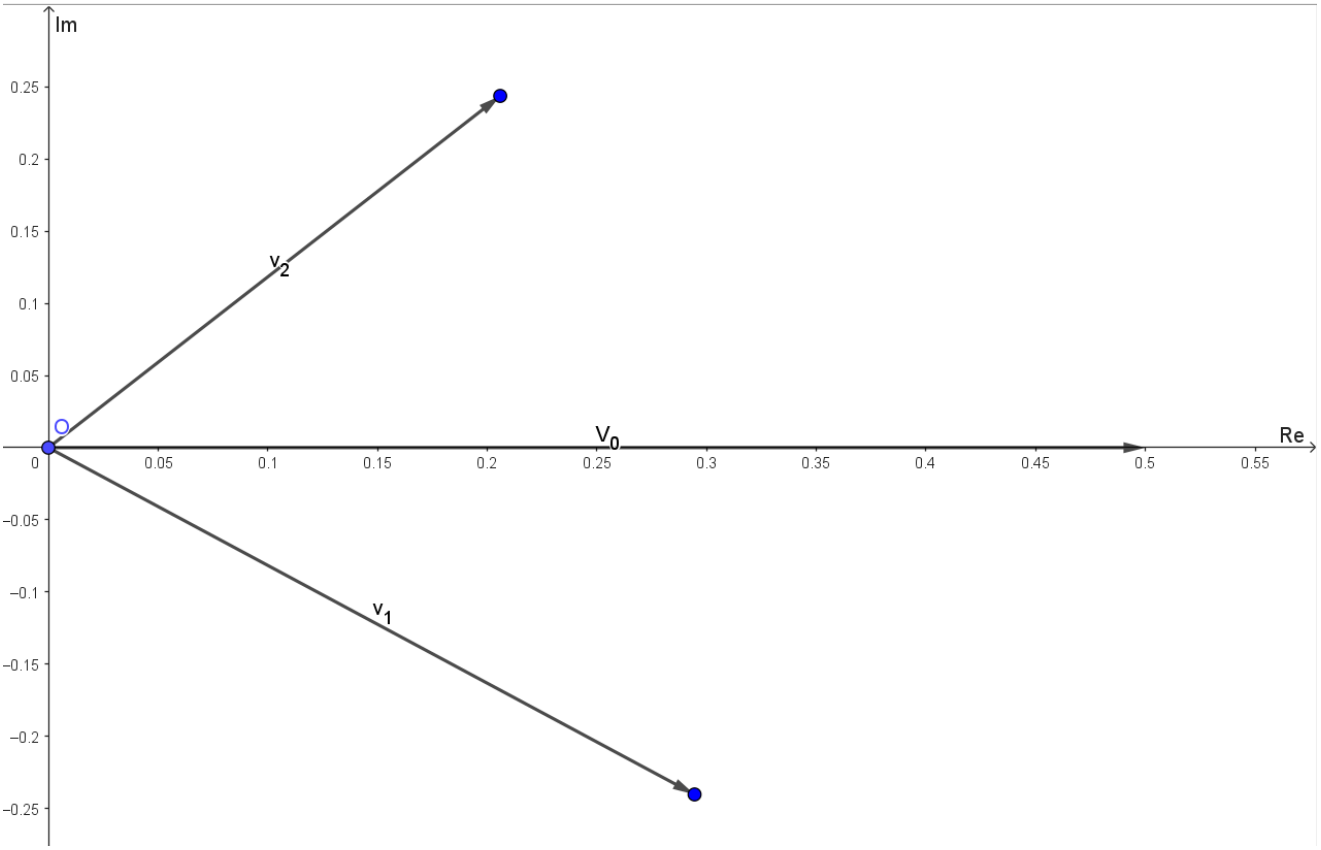
$$V_0 = V_1 + V_2$$

$$V_0 = 380 \cdot 10^{-3} \cos(-0.6841) + 380 \cdot 10^{-3} j \sin(-0.6841)$$

$$+319 \cdot 10^{-3} \cos(0.8691) + 319 \cdot 10^{-3} j \sin(0.8691)$$

$$V_0 = 500 \cdot 10^{-3} + 3i \cdot 10^{-3} \approx 500mV$$

Tegner opp de komplekse amplitudene og ser at dette stemmer nokså bra.



Oppgave 4)

$$V_s = 5$$

$$Z_1 = R = 100\Omega$$

$$Z_2 = \frac{1}{j\omega C} = \frac{1}{j2\pi 10^{-4}}\Omega$$

$$Z_3 = j\omega L = j2\pi 10\Omega$$

a)

$$V_1 = \frac{V_s}{Z_1 + Z_2||Z_3} \cdot Z_2||Z_3 \qquad | \; Z_2||Z_3 = \frac{Z_2 \cdot Z_3}{Z_2 + Z_3}$$

b)

Putter vi inn tallverdier for utrykket i a) får vi at:

```
Z_1:=100
```

$$\rightarrow \quad Z_1 := 100$$

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Z_2:=1/( i *2*pi*10**(-4))
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$$\rightarrow \quad Z_2 := \frac{-5000\ i}{\pi}$$

```
Z_3:= i*2*pi*10
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$$\rightarrow \quad Z_3 := 20\ i\ \pi$$

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Z_{2|3}:=(Z_2*Z_3)/(Z_2+Z_3)
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$$\rightarrow \quad Z_{2|3} := -5000\ i\ \frac{\pi}{\pi^2 - 250}$$

```
V_s:=5
```

$$\rightarrow \quad V_s := 5$$

```
V_s/(Z_1+Z_{2|3}) * Z_{2|3}
```

$$\approx \quad 1.5 + 2.29\ i$$

$$V_1 \approx 1.5 + 2.29j \implies v_1(t) = 2.74 \cdot \cos(2\pi 10^4 t + 0.99)$$

c)

Bruker da at:

$$I = \frac{V}{Z}$$

For spole og kondensator og får at:

$$I_2 = \frac{V_1}{Z_2} = \frac{1.5 + 2.29j}{\frac{1}{j2\pi 10^{-4}}} = -1.4 \cdot 10^{-3} + j0.9 \cdot 10^{-3}$$

$$I_3 = \frac{V_1}{Z_3} = \frac{1.5 + 2.29j}{j2\pi 10} = 36.5 \cdot 10^{-3} + j23.8 \cdot 10^{-3}$$