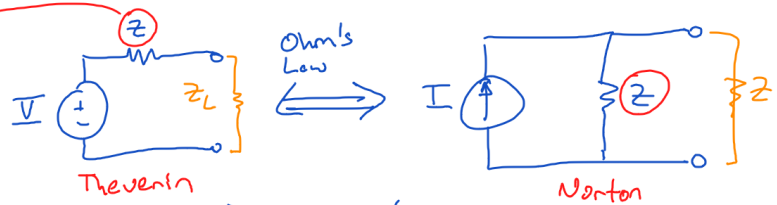
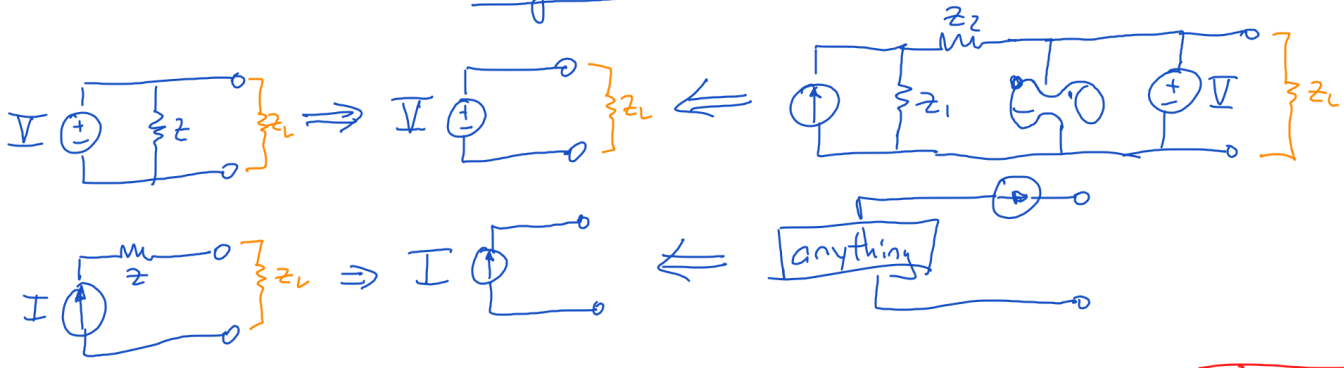
Phasors

- source transforms
- superposition

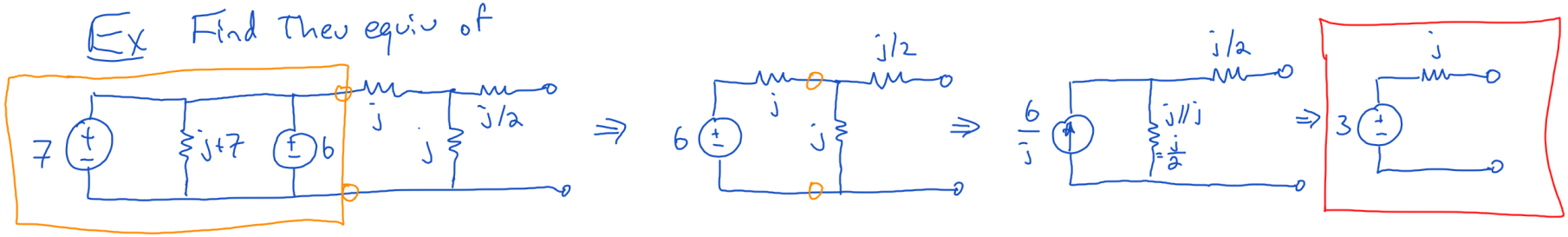
Source Transforms



Degenerate



Ex Find Thev equiv of



Superposition

- Zero all indep sources but 1 (keep all dep sources on)
- If all sources same ω $\Rightarrow$ add partials in freq domain } one ω
  Then convert to time domain
- If sources have different ω's $\Rightarrow$ convert each phasor to time } lots ω
  Then add

Ex

Indep sources: 16V $\quad 5\cos(10t-53^\circ)\text{V} \quad 14\cos(10t+6^\circ)\text{A} \quad 5\sin(20t)\text{A}$

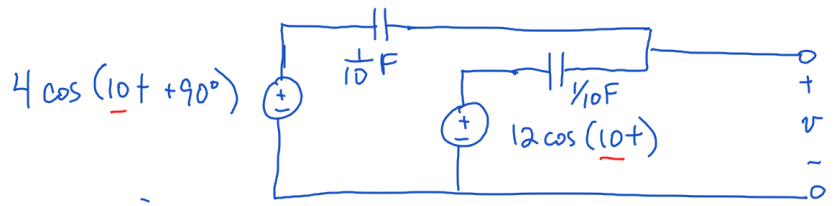
$5\sin(20t)\text{A} \rightarrow 5\angle 60^\circ$

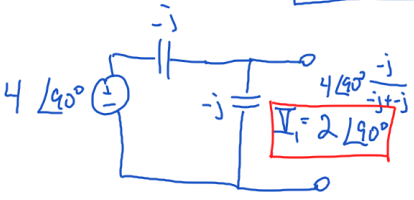
Partial output: 2V $\quad 2\angle 30^\circ\text{V} \quad 1\angle -10^\circ\text{V}$

$2\angle 30^\circ + 1\angle -10^\circ = 2.84\angle 17^\circ$

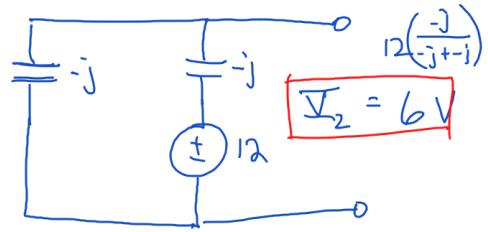
Time $v(t) = 2 + 2.84\cos(10t+17^\circ) + 5\cos(20t+60)$

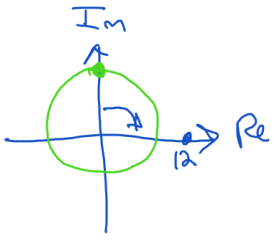
Ex: Superposition in Freq domain – Same frequencies

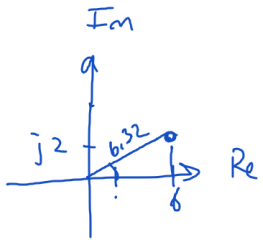




$Z_C = \frac{1}{j\omega C} = \frac{1}{j10(\frac{1}{10})} = \frac{1}{j} = -j$







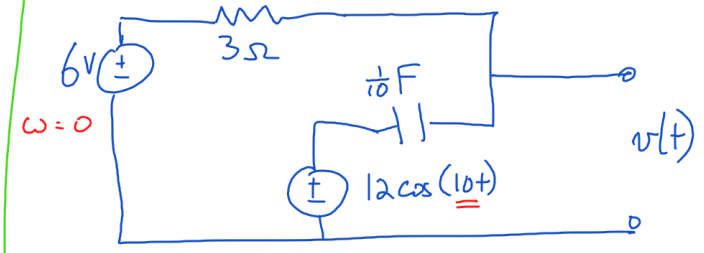
$V = 2\angle 90° + 6$

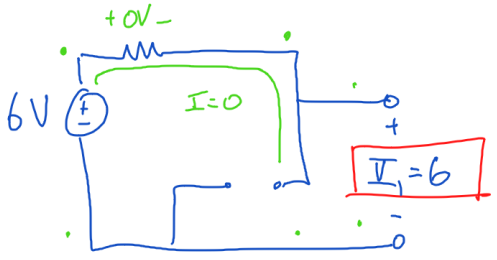
$= j2 + 6$

$= 6.32\angle 18°$

$v(t) = 6.32\cos(10t + 18°)\ V$

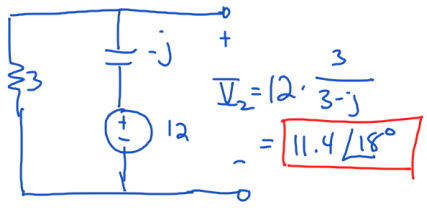
Ex: Superposition in Freq Domain – Different freqs





$Z_L = \frac{1}{j\omega C} = \frac{1}{j10\cdot\frac{1}{10}} = \infty$

$v_1(t) = 6\ V$

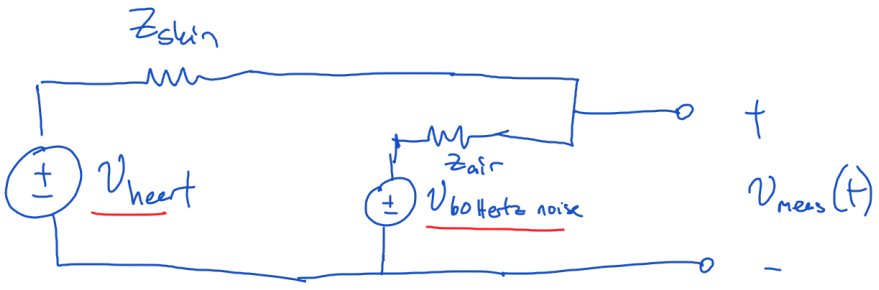


$v_2(t) = 11.4\cos(10t + 18°)$

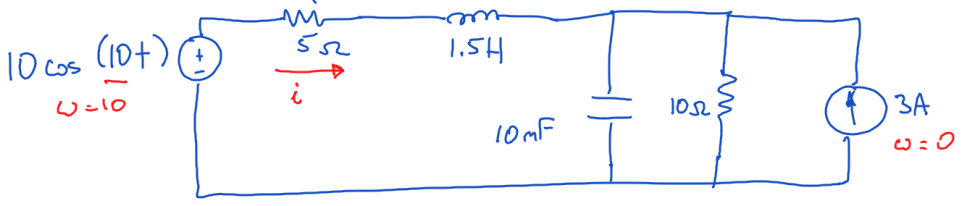
$v(t) = 6 + 11.4\cos(10t + 18°)\ V$

Real World

EKG = ECG



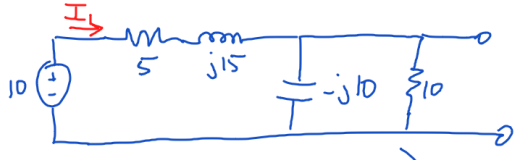
1. Using superposition, find $i(t)$



Left On $\omega = 10$

$Z_L = j\omega L = j15\ \Omega$

$Z_C = \frac{1}{j\omega C} = \frac{1}{j100m} = -j10\ \Omega$



$Z_{eq} = (5+j15) + (-j10 \,//\, 10)$

$= 5 + j15 + \frac{-j100}{10 - j10}$

$= 14.1 \angle 45^\circ\ \Omega$

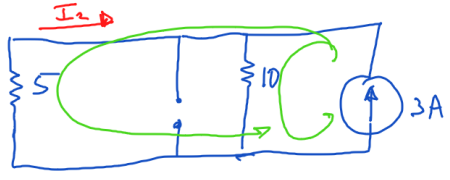
$I = \frac{V}{Z_{eq}} = \frac{10}{14.1 \angle 45^\circ} = 0.707 \angle -45^\circ$

$i_1(t) = 0.707 \cos(10t - 45^\circ)\ A$

Right On $\omega = 0$

$Z_L = j\omega L = 0$.

$Z_C = \frac{1}{j\omega C} = \infty$.



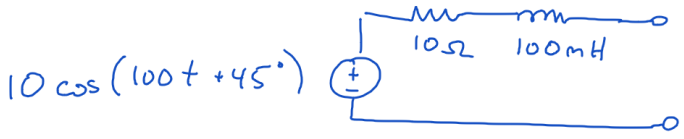
$I_2 = -(3)\frac{10}{5+10}$

$= -2A$

$i_2(t) = -2A$

$i(t) = 0.707 \cos(10t - 45^\circ) - 2\ \ A$

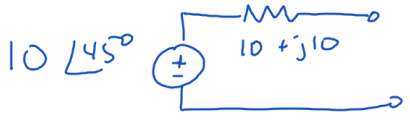
2. Find the Norton equivalent of the circuit below in the frequency domain



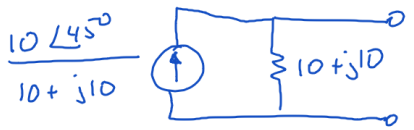
$Z_L = j\omega L$

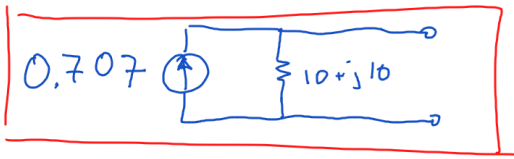
$= j100(0.1)$

$= j10$



Thev. equiv.





Norton equiv.

$Z_L = j\omega L$

$j10 = j100 \cdot L$

$L = \frac{1}{10} H = 100mH$

$Z_C = \frac{1}{j\omega C} = \frac{-j}{\omega C}$