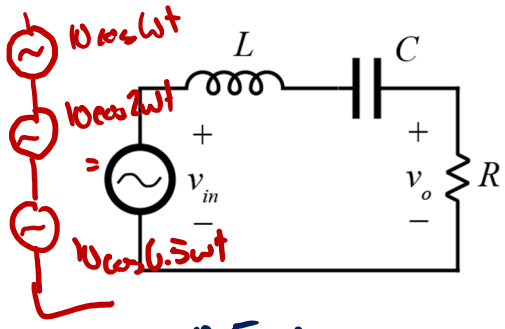
Phasor Superposition

3 frequencies — phasor analysis doesn't apply?

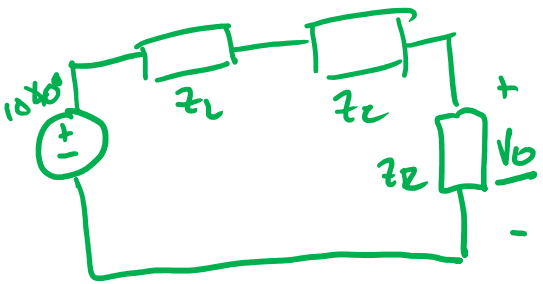


Find $v_o(t)$ for $v_{in}(t) = 10\cos(\omega t) + 18\cos(2\omega t) + 15\cos(0.5\omega t)$
and $\omega = 2\pi 100$ kHz, $R = 10\ \Omega$, $L = 10\ \mu$H, and $C = 253$ nF

Apply superposition in the time domain

$\omega_2 = 2\omega = 2\pi\ 200$ kHz

0.5ω



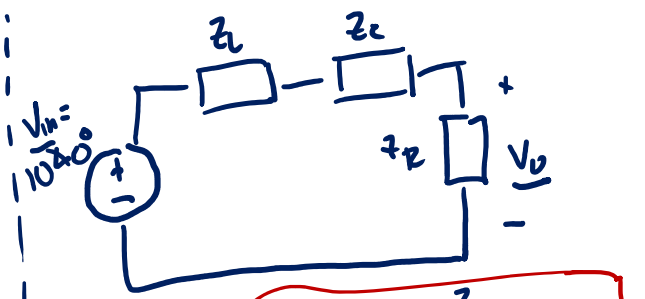
$$V_o = V_{in}\frac{Z_R}{Z_L + Z_C + Z_R}$$

$Z_L = j(0.5\omega)L \qquad Z_C = \frac{-j}{(0.5\omega)C}$

$V_o = 0.73\angle 43°$

$v_o(t) = 0.73\cos(0.5\omega t + 43°)$

ω



$$V_o = V_{in}\frac{Z_R}{Z_L + Z_C + Z_R}$$

$V_o = 10\angle 0°$

$v_o(t) = 10\cos(\omega t)$

$Z_C = \frac{-j}{(2\pi 200\text{kHz})(253\text{nF})} = -j\pi$

$Z_L = j(\omega_2 L) = j(2\pi 200\text{kHz})(10\text{mH})$

$= j4\pi$

$Z_L = j(2\omega)L \qquad Z_C = \frac{-j}{(2\omega)C}$

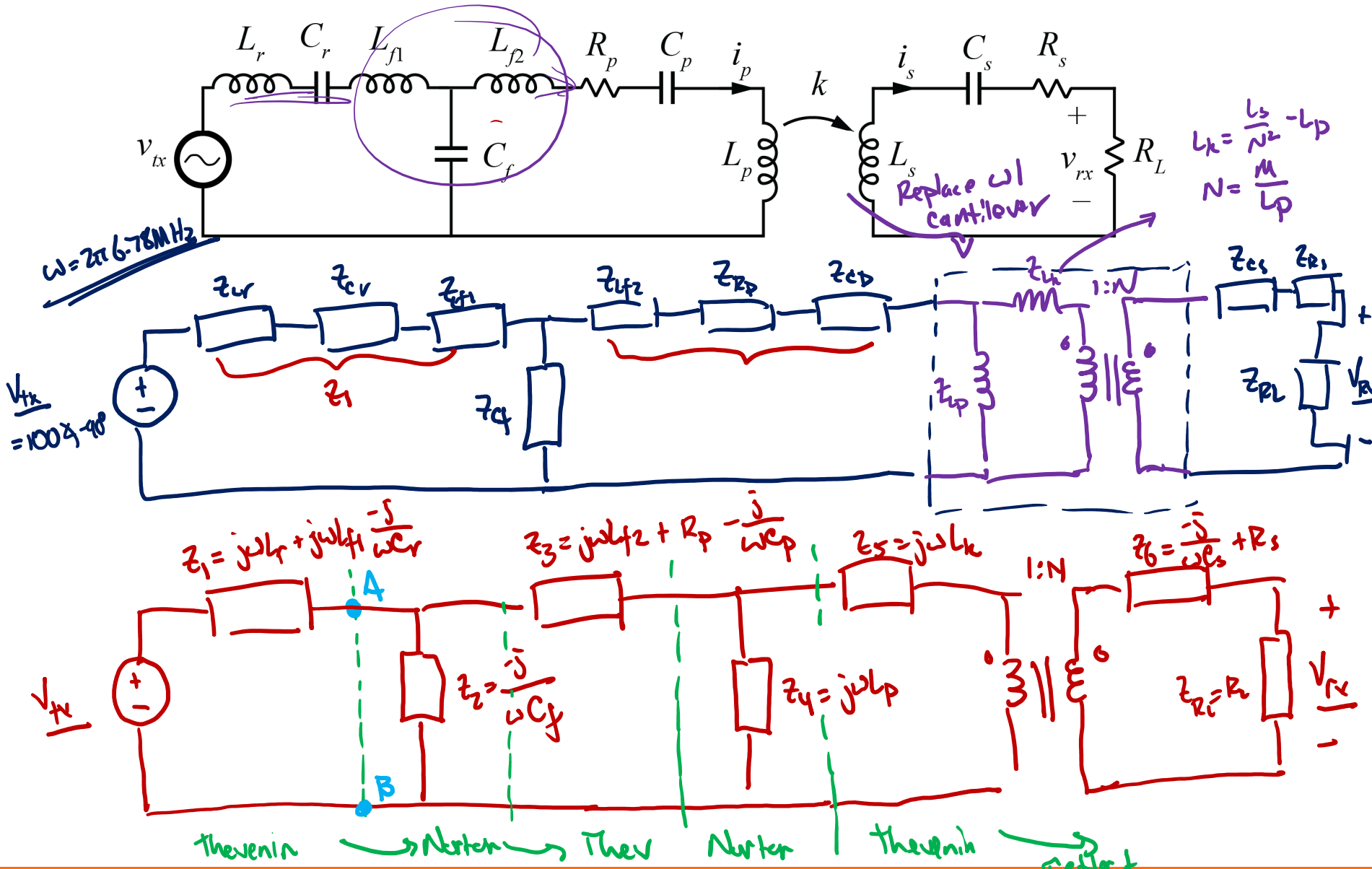
$V_o = 0.73\angle -43°$

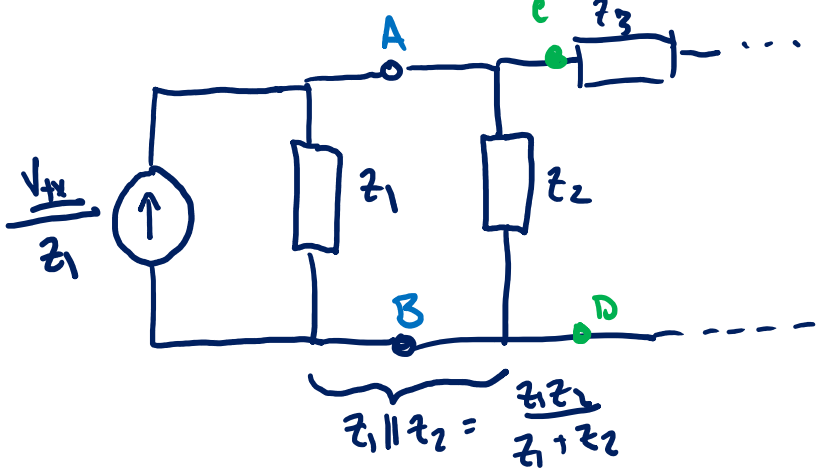
$v_o(t) = 0.73\cos(2\omega t - 43°)$

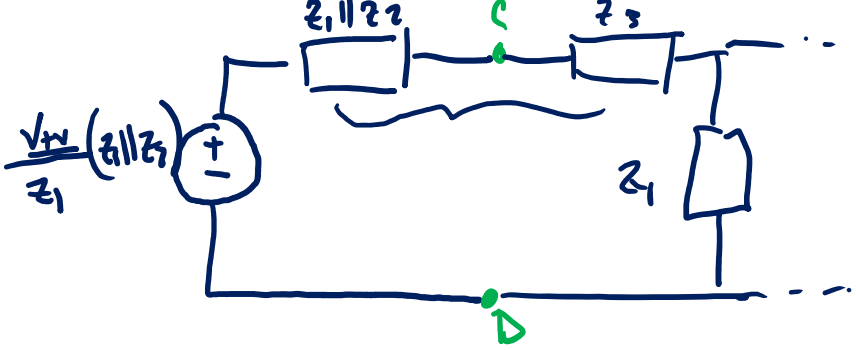
$$v_o(t) = 0.73\cos(0.5\omega t + 43°) + 10\cos(\omega t) + 0.73\cos(2\omega t - 43°)$$

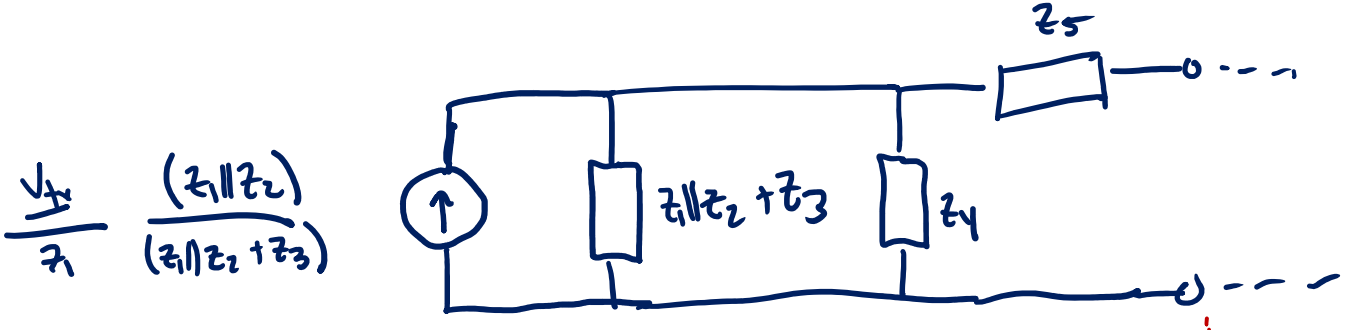
Example: WPT Problem

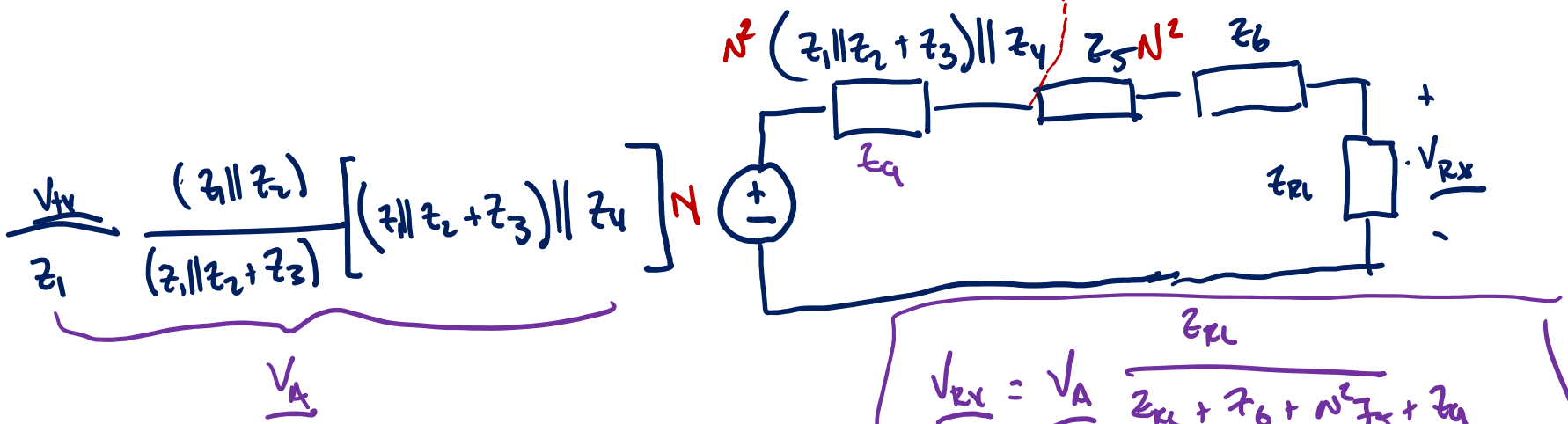
$v_{tx}(t) = 100 \sin(2\pi\, 6.78\text{MHz}\, t)$




A
C
z_3
$\frac{V_{TH}}{z_1}$
z_1
z_2
B
D
$z_1 \| z_2 = \frac{z_1 z_2}{z_1 + z_2}$


$z_1 \| z_2$
C
z_3
$\frac{V_{TH}}{z_1}(z_1 \| z_3)$
z_1
D


z_5
$\frac{V_{TH}}{z_1}$ $\frac{(z_1 \| z_2)}{(z_1 \| z_2 + z_3)}$
$z_1 \| z_2 + z_3$
z_4


$N^2 (z_1 \| z_2 + z_3) \| z_4$
$z_5 N^2$
z_6
z_{eq}
z_{RL}
+
V_{RX}
-
$\frac{V_{TH}}{z_1}$ $\frac{(z_1 \| z_2)}{(z_1 \| z_2 + z_3)}$ $\left[(z_1 \| z_2 + z_3) \| z_4 \right]$ N
V_A
$V_{RX} = V_A \frac{z_{RL}}{z_{RL} + z_6 + N^2 z_5 + z_{eq}}$