ex:

\[ V_d = 440 \angle 0^\circ V \]
\[ V_e = 22 \angle 22.2^\circ V \]
\[ V = j \]

a) Compute \( V_d \) and \( V_e \)

b) Construct phasor diagram showing \( V_d \), \( V_e \), and \( 440 \angle 0^\circ V \).

c) Repeat (a) and (b) with added capacitive load (and with \( 440 \angle 0^\circ V \) still).

\[ a) \text{ soln: Use } V \text{-divider formula } \frac{440 \angle 0^\circ V}{22 \angle 22.2^\circ V} = \frac{23.2 \angle 22.2^\circ V}{1+1} \]
\[ = 11.6 \angle (1+1) \]

\[ \therefore 440 \angle 0^\circ V = V_e \]
\[ 11.6 \angle (1+1) \]

or \( V_e = 440 \angle 0^\circ V \)

\[ 11.6 \angle (1+1) \]

\[ = 476 + j 28 V \]

\[ V_e = V_e - 440 \angle 0^\circ V = 476 + j 28 - 440 \angle 3.87^\circ V = 36 + j 28 V \]

b) soln:

The phasor diagram shows \( 440 \angle 0^\circ V \), \( V_e \), and \( V_d \) as vectors, and it shows that \( 440 \angle 0^\circ V + V_e = V_d \).
c) sol'n: With added load we have $22.2 \| j22.2 \| (-j22.2) \omega$.

In situations like this, we avoid a divide by zero if we use $\frac{1}{R_1} + \frac{1}{R_2} = \frac{L}{R_1 + R_2}$ instead of $\frac{1}{R_1} \| R_2 = \frac{R_1 R_2}{R_1 + R_2}$.

$22.2 \| j22.2 \| -j22.2 = 22.2 \cdot \frac{1}{1 + \frac{1}{\beta}} = 22.0$

The $L$ and the $C$ cancel each other...

For sake of illustration, we take a different approach than previous sol'n. (Previous approach would still work.)

Define $I = \frac{440 \angle 0^\circ \omega}{22}$.

$V_s = 440 \angle 0^\circ \omega + I (0.2 + j1.6) \omega$

$\therefore V_s = 440 \left(1 + \frac{1}{22} (0.2 + j1.6)\right) \omega = 440 \cdot \frac{22.2 + j1.6}{22} \omega$

$V_s = 20 \cdot (22.2 + j1.6) \omega = 444 + j32 \omega = 445.15 \angle 4.12^\circ \omega$

$V_s = 440 \angle 0^\circ \omega + V_e \Rightarrow V_e = 4 + j32 \omega = 32.25 \angle 82.87^\circ \omega$