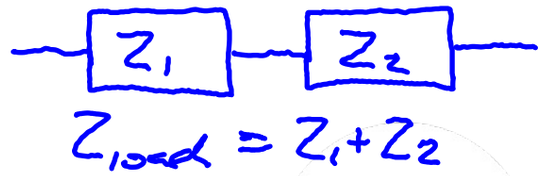
Last Class…

The current flowing into a load is given by



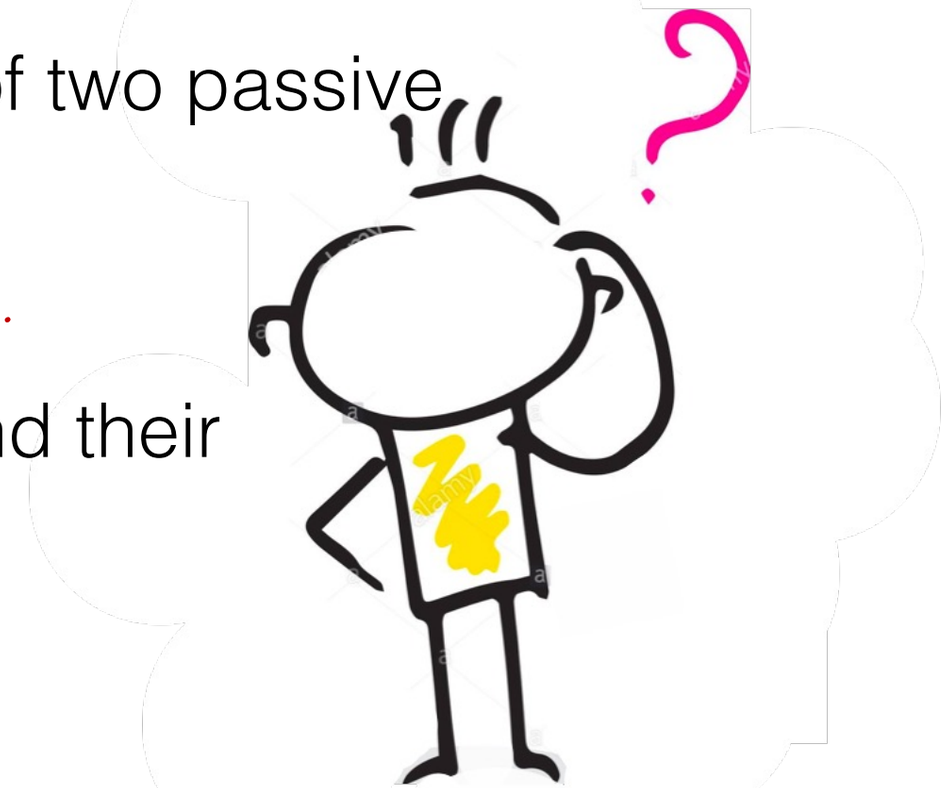
$$i(t) = 2\cos(2500t)A$$

$I(2500j) = 2e^{0^\circ} = 2\angle 0^\circ$

If the load is known to consist of a series of two passive elements, and

complex power

$$S = (10 - j\,8)VA$$



determine the identities of the elements and their values.

Z_1 or Z_2 is a resistor

$$S = \frac{Z_{load} \cdot I_m^2}{2}$$

$$Z_{load} = Z_R + Z_C$$

$$10 - 8j = \frac{Z_{load}(2)^2}{2}$$

$Z_R = 5\Omega$

$$Z_C = \frac{-j}{\omega C} = -4j = \frac{-j}{2500C}$$

$$Z_{load} = \frac{10-8j}{2} = 5 - 4j$$

$$4 = \frac{1}{2500C} \qquad C = \frac{1}{2500(4)} = 10\mu F = Z_C$$

Z_1 or Z_2 is a capacitor (because $-j$)

THE OHIO STATE UNIVERSITY

COLLEGE OF ENGINEERING

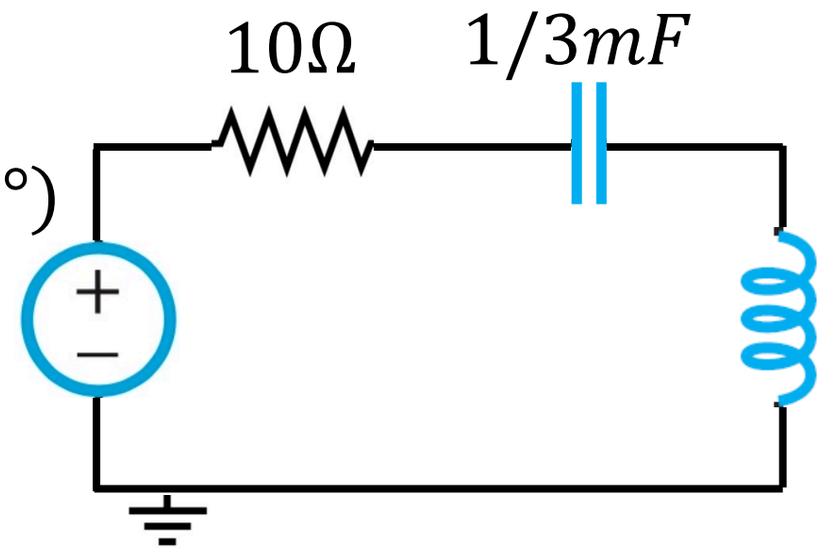
AC Power (Examples)

This Lecture…

- Learning Objectives:
  - Determine the complex power, average real power, and reactive power for any complex load with known input voltage or current.

Example 1

Find the complex power generated by the source $\boldsymbol{V}_s$.



$141\sin(100t + 120°)$

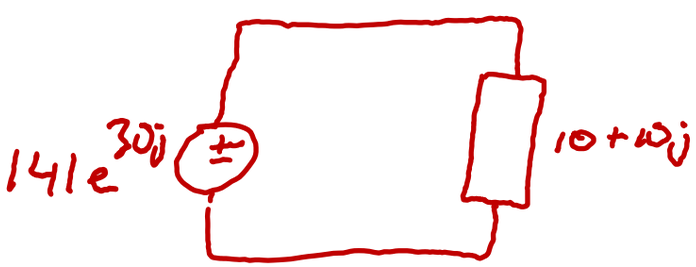
$141\cos(100t + 30°)$

$V_s(100j) = 141e^{30j}$

$Z_R = 10$

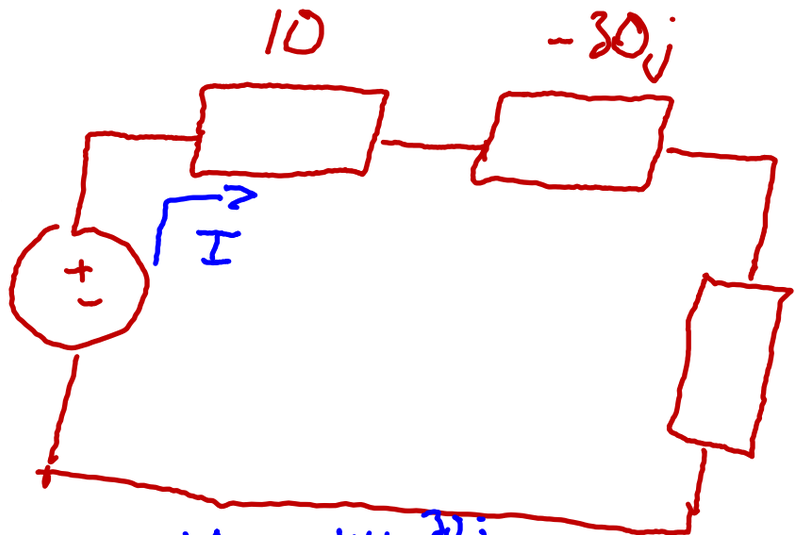
$Z_L = j\omega L = 100(.4)j = 40j$

$Z_c = \frac{1}{j\omega C} = \frac{-j}{100(\frac{1}{3}\times 10^{-3})} = -30j$



A) Complex Power

$S = \frac{VI^*}{2}$



$Z_{eq} = Z_R + Z_c + Z_L$

$= 10 + 40j - 30j$

$= 10 + 10j$

$I = \frac{V_s}{Z_{eq}} = \frac{141e^{30j}}{10+10j} = 9.97e^{-15j} = 9.63 - 2.58i$

conjugate →

$$S = \frac{VI^*}{2} = \frac{(141e^{30j})(9.63+2.58i)}{2} = 497 + 497j \text{ VA} = 702.85e^{45j}$$

$P + Qj$

B) Average Power

$P = 497$ W

D) Apparent Power

$|S| = 702.85$

C) Reactive Power

$Q = 497$ VAR

E. Power Factor

$PF = \frac{P}{|S|} = \frac{497}{702.85} = 0.707$

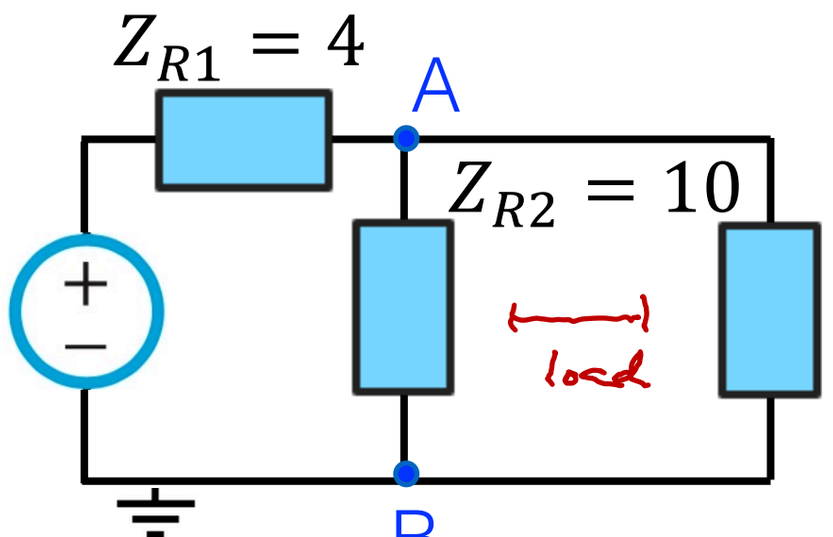
$PF = \cos(\theta_S) = \cos(45) = 0.707$

Example 2

- Find the complex power between A and B.

$$\boldsymbol{V}_s(j\omega) = 110\angle 0°$$

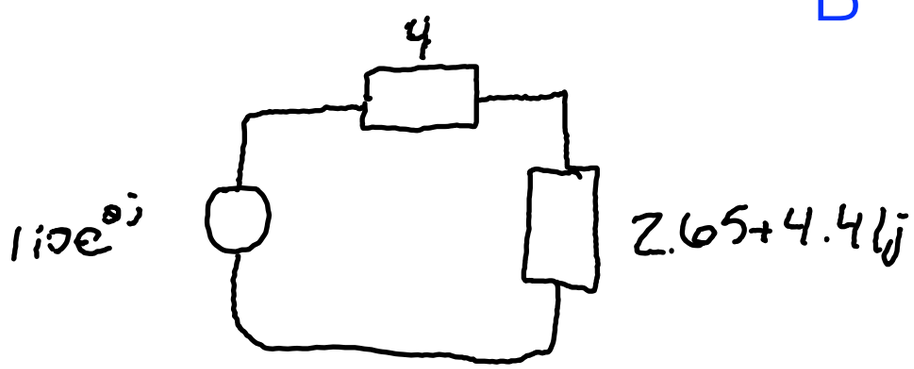
$110e^{0j}$



$$\frac{(10)(6j)}{10+6j} = \frac{60j}{10+6j}$$

$$= 2.65 + 4.41j$$

$S = \frac{VI}{2}$



$$S = \frac{(110e^{0j})(2.65 - 4.41j)}{2} =$$

$145.75 - 242.55j$ VA