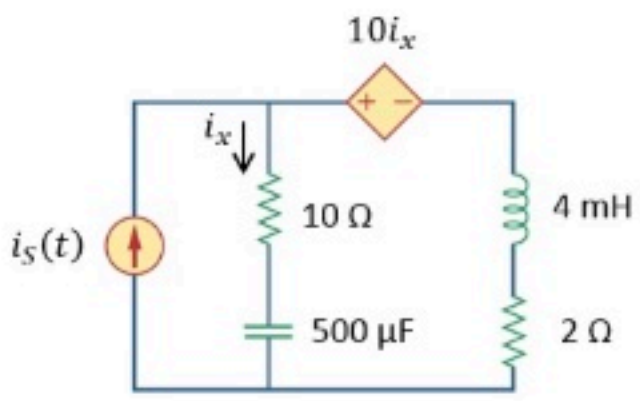
PP AC power 007

Unlimited Attempts.

$$i_S(t) = 2 \cdot \cos\left(10^3 t + \frac{\pi}{4}\right) \text{A}$$

Find the complex power $\mathbf{S_1} = a_1 + b_1 j$ supplied by the source i_S.
Find the complex power $\mathbf{S_2} = a_2 + b_2 j$ received by the 10 Ω resistor.
Find the complex power $\mathbf{S_3} = a_3 + b_3 j$ received by the 2 Ω resistor.
Find the complex power $\mathbf{S_4} = a_4 + b_4 j$ received by the CCVS.
Find the complex power $\mathbf{S_5} = a_5 + b_5 j$ received by the inductor.
Find the complex power $\mathbf{S_6} = a_6 + b_6 j$ received by the capacitor.



Given Variables:

. : . .

Calculate the following:

a1 (W) :

32 ✓

b1 (VAR) :

4 ✓

a2 (W) :

50 ✓

b2 (VAR) :

0 ✓

a3 (W) :

2 ✓

b3 (VAR) :

0 ✓

a4 (W) :

-20 ✓

b4 (VAR) :

10 ✓

a5 (W) :

0 ✓

b5 (VAR) :

4 ✓

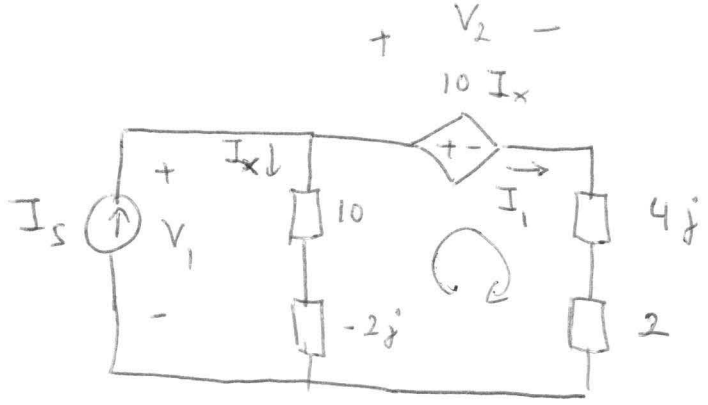
a6 (W) :

0 ✓

b6 (VAR) :

-10 ✓

Hint: Keep Is algebraic.



$I_1 = I_s - I_x$

$|I_s|^2 = 4$

KVL: $I_x(10-2j) = 10I_x + (2+4j)I_1$

$= 10I_x + (2+4j)(I_s - I_x)$

$I_x(\cancel{10} - 2j \cancel{-10} + 2 + 4j) = (2+4j)I_s$

$I_x(2+2j) = I_s(2+4j) \Rightarrow I_x = I_s\frac{(1+2j)}{(1+j)} = I_s\frac{(3+j)}{2}$

① $V_1 = I_x(10-2j) = I_s\frac{(3+j)(10-2j)}{2} = I_s(16+2j)$

NOTE DIRECTION OPPOSITE PASSIVE SIGN CONVENTION

$S_1 = \frac{1}{2}V_1 \cdot I_s^* = \frac{1}{2}I_s(16+2j)I_s^* = |I_s|^2(8+j) \Rightarrow \boxed{S_1 = 32 + 4j}$

② $S_2 = \frac{1}{2}\cdot Z_{10\Omega}\cdot|I_x|^2 = \frac{1}{2}\cdot 10\cdot|I_s|^2\cdot\frac{(10)}{4} \Rightarrow \boxed{S_2 = 50 + 0j}$ → AS EXPECTED

③ $I_1 = I_s - I_x = I_s\left(1 - \frac{(3+j)}{2}\right) = I_s\frac{(-1-j)}{2}$

$S_3 = \frac{1}{2}Z_{2\Omega}|I_1|^2 = \frac{1}{2}\cdot 2\,|I_s|^2\cdot\frac{|-1-j|^2}{4} = \frac{|I_s|^2}{4}\cdot 2 \Rightarrow \boxed{S_3 = 2 + 0j}$ EXPECTED

④ $S_4 = \frac{1}{2}V_2 I_1^* = \frac{1}{2}\cdot 10I_x\cdot I_1^* = 5\cdot I_s\frac{(3+j)}{2}\cdot I_s^*\frac{(-1+j)}{2} = |I_s|^2\cdot\frac{5}{4}(-4+2j)$

$\Rightarrow \boxed{S_4 = -20 + 10j}$ RECEIVED SINCE WE USED PASSIVE SIGN CONVENTION

⑤ $S_5 = \frac{1}{2}Z_L\cdot|I_1|^2 = \frac{1}{2}\cdot 4j\,|I_s|^2\cdot\frac{|-1-j|^2}{4} = 2j\cdot 4\cdot\frac{2}{4} \Rightarrow \boxed{S_5 = 0 + 4j}$ → AS EXPECTED

⑥ $S_6 = \frac{1}{2}Z_C|I_x|^2 = \frac{1}{2}(-2j)|I_s|^2\frac{|3+j|^2}{4} = -j\cdot 4\cdot\frac{10}{4} \Rightarrow \boxed{S_6 = 0 - 10j}$

CHECK: $\Sigma P_{REC} = \Sigma P_{SUPPL} \Rightarrow 50 + 2 - 20 = 32$ OK

$\Sigma Q_{REC} = \Sigma Q_{SUPPL} \Rightarrow 10 + 4 - 10 = 4$ OK