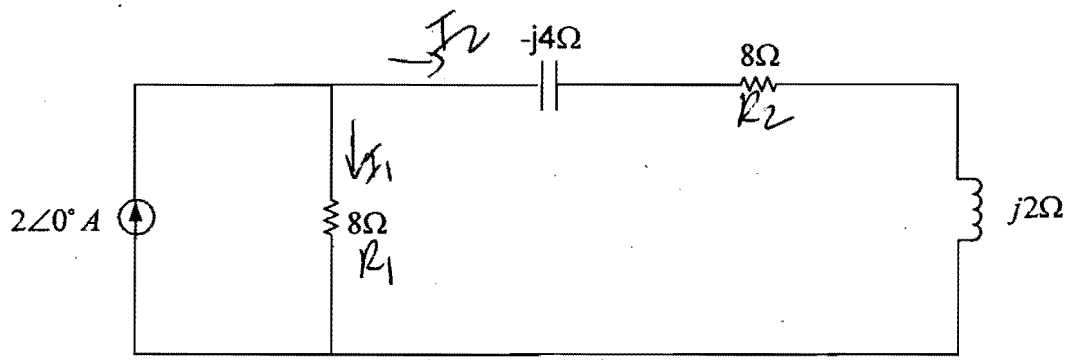
EE 221 Quiz 6
09 November 2011

Name:

For the circuit below find:
(a) The power absorbed by each element.
(b) The power supplied by the current source.



(a) $I_1 = \left(\frac{8-j2}{6-j2}\right)(2\angle 0°) = 1.023\ \angle -6.91°\ A$

From KCL

$I_2 = 2\angle 0° - 1.023\ \angle -6.91° = 992\ \angle 7.13°\ mA$

$P_{R1} = \frac{1}{2} I_m^2 R = \frac{1}{2}(1.023)^2(8) = 4.19\ W$

$P_{R2} = \frac{1}{2} I_m^2 R = \frac{1}{2}(0.992)^2(8) = 3.94\ W$

$P_{cap} = 0\ W,\quad P_{ind} = 0\ W$

(b) From conservation of energy

$P_{supplied} = P_{R1} + P_{R2} = 4.19 + 3.94 = 8.1\ W$

OR

Since R_1 // current source

$V_s = I_1 R_1 = (1.023\ \angle -6.91°)(8) = 8.18\ \angle -6.91°\ V$

$P_{supplied} = \frac{1}{2} V_m I_m \cos(\theta_v - \theta_i)\ W$

$= \frac{1}{2}(8.18)(2)\cos(-6.91° - 0°) = 8.1\ W$

No aid given, received, or observed: _____

Alternate approaches to part (a) (LONG WAY!)

R_1:

$$V_{R_1} = I_1 R_1 = (1.023 \angle -6.91°)(8) = 8.184 \angle -6.91° \text{ V}$$

$$P_{AVG_{R_1}} = \tfrac{1}{2} V_m I_m \cos(\theta_v - \theta_i) \text{ W}$$

$$P_{AVG_{R_1}} = \tfrac{1}{2}(8.184)(1.023)\cos(-6.91° - (-6.91°))$$

$$P_{AVG_{R_1}} = 4.19 \text{ W}$$

R_2:

$$V_{R_2} = I_2 R_2 = (0.992 \angle 7.13°)(8) = 7.94 \angle 7.13° \text{ V}$$

$$P_{AVG_{R_2}} = \tfrac{1}{2} V_m I_m \cos(\theta_v - \theta_i) \text{ W}$$

$$= \tfrac{1}{2}(7.94)(0.992)\cos(7.13° - 7.13°)$$

$$= 3.94 \text{ W}$$

C:

$$V_C = I_2 Z_C = (0.992 \angle 7.13°)(4 \angle -90°)$$

$$= 3.97 \angle -82.87° \text{ V}$$

$$P_{AVG_C} = \tfrac{1}{2} V_m I_m \cos(\theta_v - \theta_i)$$

$$= \tfrac{1}{2}(3.97)(.992)\cos(-82.87° - 7.13°)$$

$$= \tfrac{1}{2}(3.97)(.992)\cos(-90°)$$

$$= 0 \text{ W}$$

L:

$$V_L = I_2 Z_L = (0.992 \angle 7.13°)(2 \angle 90°)$$

$$= 1.984 \angle 97.13° \text{ V}$$

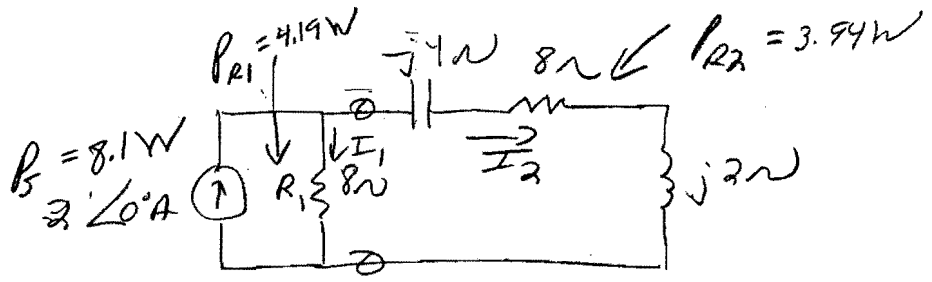
$$P_{AVG_L} = \tfrac{1}{2} V_m I_m \cos(\theta_v - \theta_i)$$

$$= \tfrac{1}{2}(1.984)(0.992)\cos(97.13° - 7.13°)$$

$$= \tfrac{1}{2}(1.984)(0.992)\cos(90°)$$

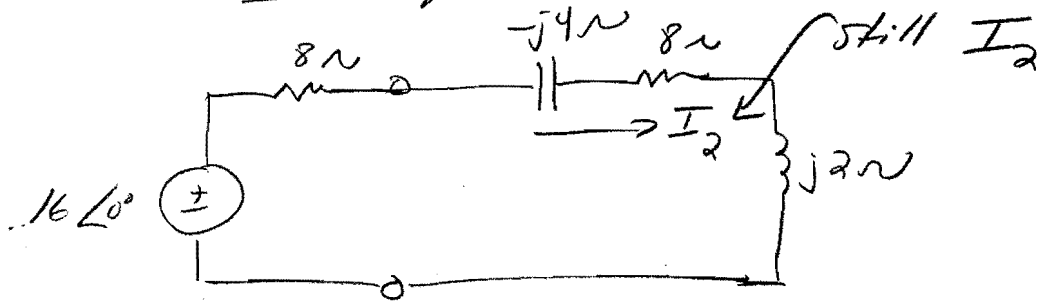
$$= 0 \text{ W}$$

Why source transformation will give incorrect power values for the current source and R1.



I_1 and I_2 are different!

When we do a source transformation, the source looks the same from the loads point of view



The internal details of the source can change, so those values cannot be used to find P_{source} ? P_{R1}

Here $P_{16V\,source} = \frac{1}{2}(16)(0.992)\cos(0 - 7.13°)$

$= 7.87W \neq 8.1W$

Here $P_{8\Omega} = 3.94W$ true for R2 but NOT R1