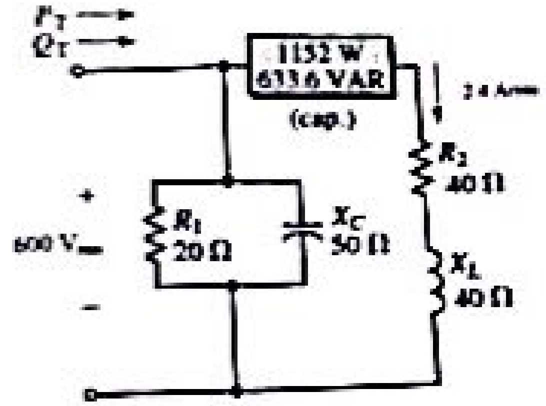
Question 4 (4 points)
For the circuit shown below, Find:

a) the total real power supplied by the source P_T.
b) the total reactive power supplied by the source Q_T.
c) the apparent power supplied by the source $|S_T|$.
d) the complex power supplied by the source S_T.
e) the source power factor.
f) the total current supplied by the source.



a)

$P_T = 1152 + (2.4)^2 * 40 + \frac{(600)^2}{20}$

$= 19.38$ KW

b) $Q_T = -633.6 + (2.4)^2 * 40 - \frac{(600)^2}{50}$

$= -7.6$ KVAR

c) $|S_T| = \sqrt{(19.38)^2 + (-7.6)^2}$

$= 20.81$ KVA

d) $S_T = 19.38 - j7.6$

$= 20.81 \angle -21$

e) $PF_{source} = \cos(-21)$

$= 0.933$

f) $I^* = \frac{S}{V}$

$= \frac{19.81 \times 10^3 - j7.6 \times 10^3}{600\angle 0}$

$= 35.36 \angle -21$

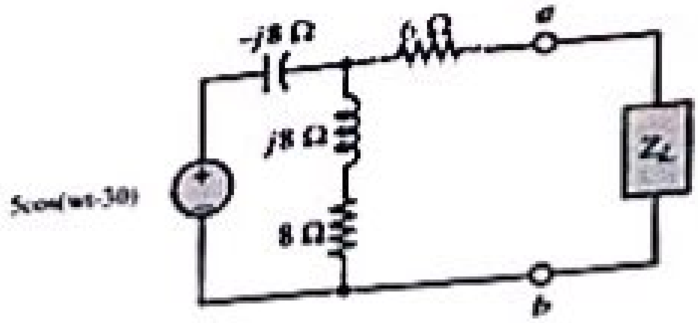
$I = 35.36 \angle +21$

P_T	Q_T	$\|S_T\|$	S_T	PF_{source}	I_{total}
19.38 KW	−7.6 KVAR	20.81 KVA	20.81∠−21 KVA	0.933	35.36∠21

½ ½ ½ ½ ½ ½

Question 3 (7 points)

For the circuit shown below:

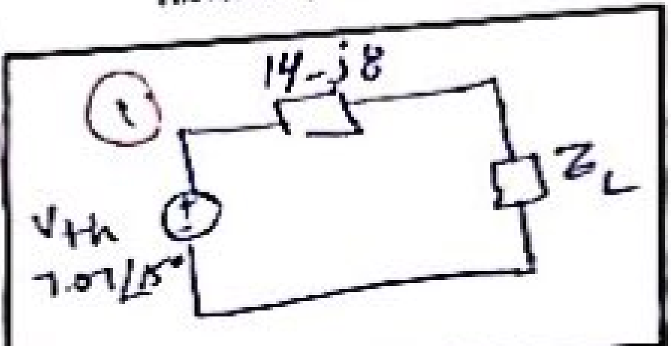


a) Find, draw and label the Thevenin equivalent circuit as seen by the load Z_L.
b) What is the value of Z_L that maximizes the power transferred to the load.
c) What is the value of this maximum power. ()
d) What is value of the reactive power supplied by the source.
e) If Z_L is replaced by a purely resistive load, what is the value of R_L that maximize the power transfer.
f) and what is the value of this power in case (e).

$$Z_{th} = 6 + \frac{(-j8)(8+j8)}{8} = 16.12\angle -29.7 = \boxed{14 - j8}\ \Omega \quad (1)$$

$$V_{th} = 5\angle -30 \cdot \frac{8+j8}{8} = \boxed{7.07\angle 15^\circ}\ V$$

Thevenin equivalent circuit



$$P_{max} = \frac{|V_{th}|^2}{8R} = \frac{(7.07)^2}{8 \times 14} = 0.446\ W$$

source: I & V are in phase [sin θ = 0]

Q = 0

(e) (½) $R_L = \sqrt{(R_{th})^2 + (X_{th})^2} = \sqrt{14^2 + (8)^2} = 16.12\ \Omega$

(f) (1) $I_m = \frac{7.07\angle 15^\circ}{14 - j8 + 16.12} = 0.227\angle 29.87$

$$P_{max} = \frac{1}{2}(0.227)^2 \times 16.12 = 0.415$$

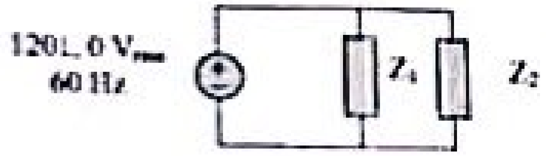
Z_L	P_{max}	Q_{source}	R_L	P_{max}
14+j8 Ω	0.446 W	0	16.12 Ω	0.415 W

(½) (½) (1) (½) (½)

Question 2 (4 points)

For the circuit shown, $Z_1 = 10+j12$ and $Z_2 = 5+j8$. Find the following:

a) the source PF.
b) the total current supplied by the source (magnitude and phase)
c) the value of a capacitor to be added in parallel with the loads to make the source PF = 0.95.
d) the total source current after the capacitor is connected to the circuit(magnitude and phase).



a&b

$$Z_{eq} = \frac{(10+j12)(5+j8)}{15+j20}$$

$$= 5.89\angle 55°$$

$$I_{rms} = \frac{V_{rms}}{Z} = \frac{120\angle 0}{5.89\angle 55}$$

$$= 20.3\angle -55$$

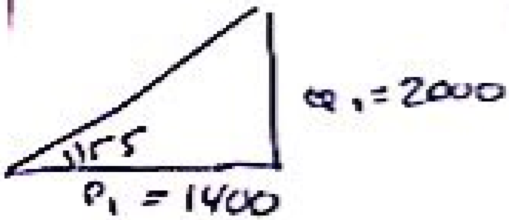
$$PF = \cos(0 - -55)$$

$$= 0.573$$

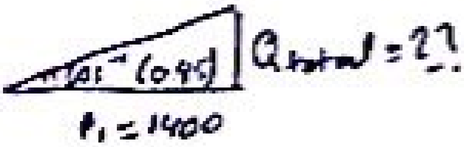
c $S = P + jQ = 120\angle 0 \times 20.3\angle 55$

$$= 1400 + j2000$$

Before



After



$$Q_{total} = Q_c + Q_1$$

$$Q_{total} = P_1 \times \tan(\cos^{-1} 0.95)$$

$$= 460 \text{ VAR}$$

$$Q_c = 460 - 2000$$

$$= -1540 \text{ VAR}$$

$$C = \frac{Q_c}{\omega V_{rms}^2} = \frac{1540}{2\pi(60)(120)^2}$$

$$= 2.837 \times 10^{-4} \text{ F}$$

d $S = V I^*$

$\Rightarrow 1400 + j460 = 120\angle 0 \times I^*$

$$I^* = 12.23\angle 18.18$$

$$I = 12.23\angle -18.18 \text{ A}$$

PF_{source}	$I_{source,old}$	C	$I_{source,new}$
0.573	20.35∠-55	2.837×10^{-4}	12.23∠-18.18

University of Jordan
Department of Electrical Engineering

EE212 - Electric Circuits II
First Semester 2016-2017

First Exam
Time: 1 Hour

Wed., 19/10/2016
15:00 - 16:00 pm

Name: KEY   sec#:   ID#   Serial #:

Question 1 (5 points)

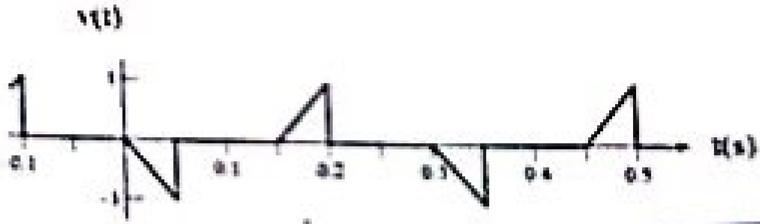
$\rightarrow 0.052 \angle -51.34^\circ$

The voltage across a $4+j5\Omega$ impedance is shown below. Find:

a. the frequency of the signal, f.

b. the voltage effective value (rms) V_{rms}

c. the average real power delivered to the load, P_{avg}



ⓐ $T = 0.3$ sec

$f = \frac{1}{T} = \frac{1}{0.3} = 3.33$ Hz

ⓑ $V_{rms} = \sqrt{\frac{1}{T}\int_0^T v^2(t)\,dt}$

where $v(t) = \begin{cases} -20t & 0<t<0.05 \\ 20t-3 & 0.15<t<0.2 \\ 0 & \text{elsewhere} \end{cases}$

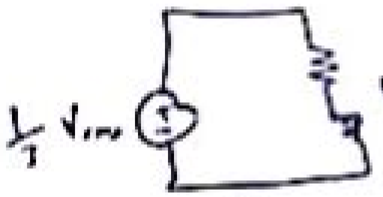
$\Rightarrow V_{rms} = \sqrt{\frac{1}{0.3}\left[\int_0^{0.05}(400t^2)\,dt + \int_{0.15}^{0.2}(400t^2-120t+9)\,dt\right]}$

$= \sqrt{\frac{2}{0.3}\int_0^{0.05} 400t^2\,dt}$

$= \sqrt{\frac{2}{0.3} \cdot 400\frac{t^3}{3}\Big]_0^{0.05}}$

$= \frac{1}{3} V_{rms}$

ⓒ



$I_{rms} = \frac{\frac{1}{3}\angle 0}{4+j5}$

$= 0.052 \angle -51.34$

$\Rightarrow P_{avg} = |I_{rms}|^2 R$

$= (0.052)^2 \times 4$

$= 0.011$ W

f	V_{rms}	P_{avg}
3.33 Hz	$\frac{1}{3} V_{rms}$	0.011 W

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