13.5

University of Jordan Department of Electrical Engineering	EE212 - Electric Circuits II second Semester 2016-2017	Second Exam	Sunday, 16/4/2017 Time: 15:00 - 16:30 pm

[redacted]

Questions 1 (4 points)

If the source line voltage in the figure below is 208 V_{rms}, determine the source currents I_a, I_b, I_c and the current in the neutral line, I_{nN}. What is the total complex power supplied by the source, and what is the total power losses in the transmission lines.

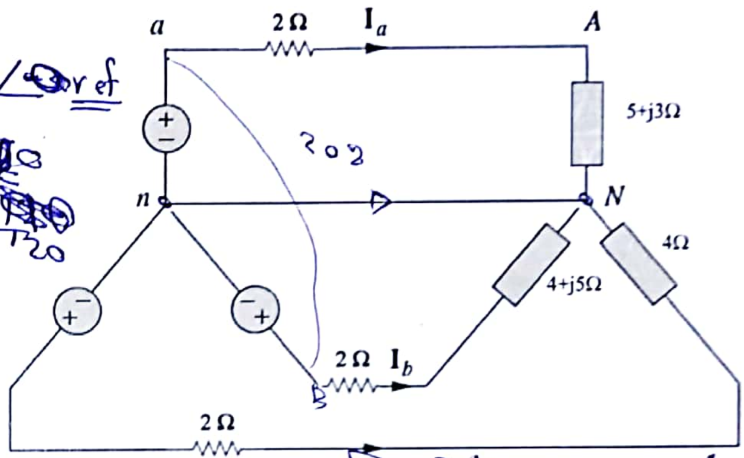
-1

$V_{an} = \cancel{\sqrt{3}}\ \frac{208}{\sqrt{3}} \angle -30$

$\cancel{360.2 \angle 0}$ $120 \angle 0$ ref

$V_{bn} = \cancel{360.2}\ 120 \angle -120$

$V_{cn} = \cancel{360.1}\ 120 \angle +120$



$I_a = \frac{V_{an}}{2+5+j3}$

$= \frac{\cancel{360.2}\ 120 \angle 0}{7+j3} = 43.4 - 12.6j = \cancel{47.8}\ \cancel{\angle 0.4}\ 15 \angle -23.1$

$I_b = \frac{V_{bn} \angle -120}{2+4+5j} = \cancel{46.1 \angle +.31} = 15.36 \angle -159.19$

$I_c = \frac{V_{cn}}{2+4} = \cancel{60.03 \angle +120} = 20 \angle 120$

$I_n = -(I_a + I_b + I_c)$

$I_n = -(12.13 \angle 150)$

$I_{nN} = I_n - I_N = \cancel{8.17\ \angle 152.8}$

$12.13 \angle -29.5$

$S_{source} = \boxed{3 V I^*}$

$S_1 = 3 V_1 I_1^* = 1800 \angle 30$

$S_2 = 1843 \angle$

$S_3 = 2400 \angle$

$S = S_1 + S_2 + S_3$

$= \cancel{9326 - 64.9j}$

$4350.3 + 2525.4j$

I_a	I_b	I_c	I_{nN}	S_{source}	$P_{T.L.losses}$
15 ∠-23.1	15.36 ∠-159.19	20 ∠120	12.13 ∠-29.5		

$P_{loss} = VI$

$4350.3 + 2626.4j$

Questions 2 (4 points)

For the shown figure below, if $Z_\Delta = 15 - j12\ \Omega$, $Z_Y = 5 + j5$, $Z_l = 3\ \Omega$. The source voltages are given in RMS values. Find:

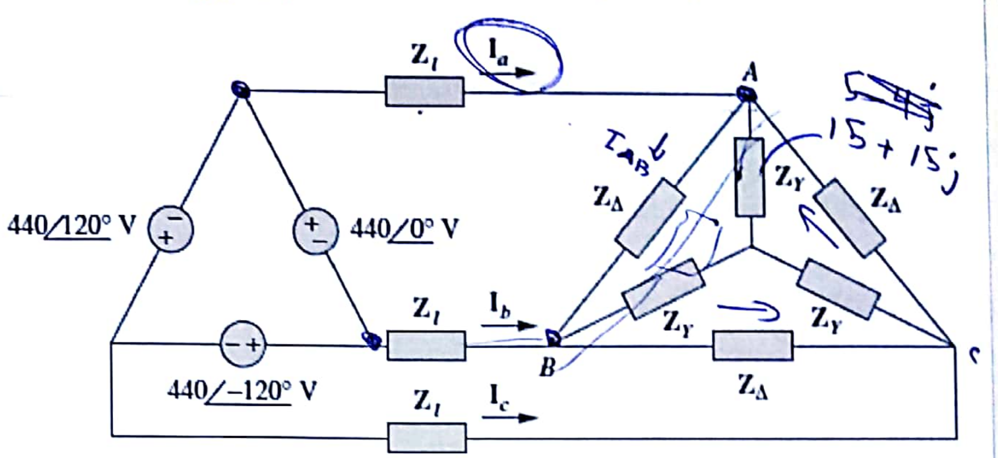
-4

a) The total line current Ia.

b) The phase current I_{AB} in the Δ connected load.

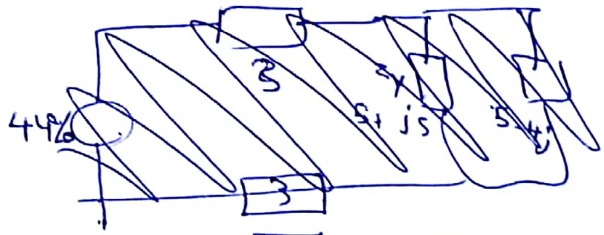
c) The line voltage at the load side V_{AB}.

d) The total complex power consumed by the Y connected load.

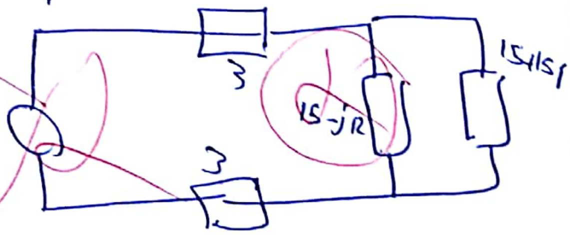


$$I_a = I_\Delta + I_Y \Rightarrow I_\Delta = I_{AB} = \frac{V_{AB}}{\quad}$$

$$I_b = I_{AB} - I_{CA} =$$



$$I_{AB} = 18.45\left(\frac{3+3+15+15j}{3+3+15+15j+15-j12}\right)$$



$$= \cancel{19.4}$$

$$20\angle 16.4$$

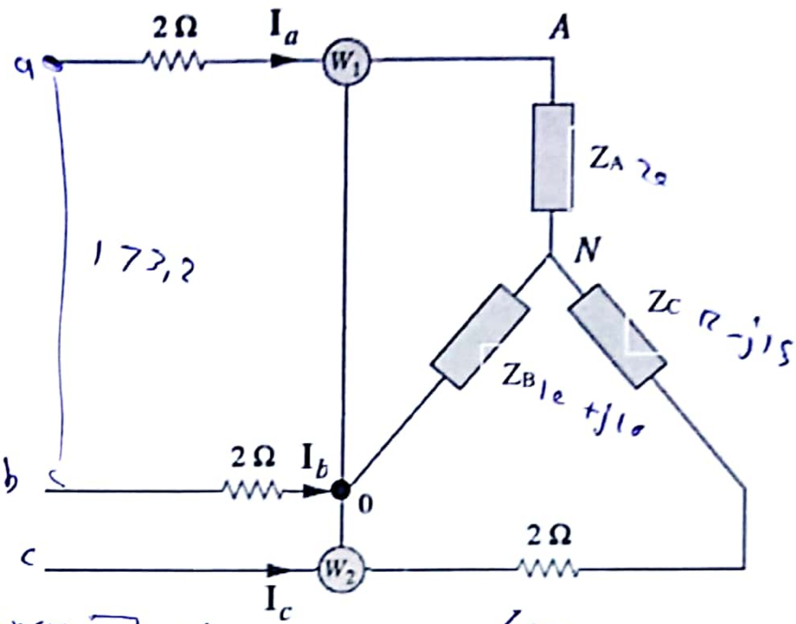
$$I_a = 28.45\angle -239$$

$$V_{AB} = 440\left(\qquad\right)$$

I_a	$I_{AB(\Delta)}$	$V_{AB(load)}$	S_Y
28.45 ∠-239	20 ∠16.4		

Questions 3 (5 points)

For the circuit shown Z_A = 20 Ω, Z_B =10+j10 Ω, and Z_C= 12 – j15 Ω, while the line voltage of the source is 173.2 V_{RMS}. Find the readings of the two wattmeter's, the load power factor, and the apparent power supplied to the load.



3

$W_1 \Rightarrow V_{ab}$, I_{aA}

$W_1 \Rightarrow V_{cb}$, I_{cC}

$V_{ab} = V_{AB} = 173.2\angle 0$ reference

$V_{BC} = 173.2 \angle -120$

$V_{CA} = 173.2 \angle +120$

$V_{an} = 99.9 \angle -30$

~~$V_{an} = 173.2\angle 0 \; \angle -30 = 99.9 \angle -30$~~

$$I_{an} = \frac{V_{an}}{2+20} = 4.5 \angle -30$$

$$I_{bn} = \frac{V_{bn}}{2+10+10j} = 6.3 \angle 170.1$$

$$I_{cn} = \frac{V_{cn}}{2+12-j15} = 4.2 \angle 136.9$$

$$P_1 = |173.2|\,|4.5| \cos(0 - -30) = 674.9$$

$$P_2 = |173.2|\,|4.8| \cos(120 - 136.9) = 795.4$$

+1

P_1	P_2	PF	|S|
674.9	795.4	0.990	1494.7

$$\tan\theta = \frac{\sqrt{3}(P_2 - P_1)}{P_2 + P_1}$$

θ = 8.07

$|S| = \sqrt{P_T^2 + Q^2}$

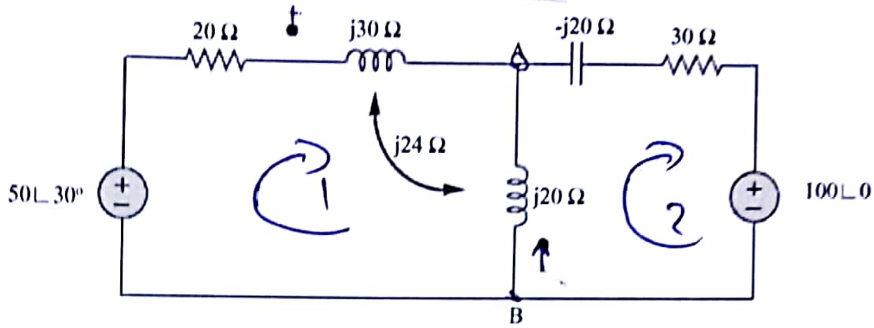
$= \sqrt{(1470.3)^2 + (208)^2}$

$= 1484.7$

3

Questions 4 (5 points)

In the shown network, write down the 2 mesh equations that governs the current relations in the circuit in their simplest form. Then find V_{AB}. The given voltages are in RMS.



$$-50\angle 30 + (20 + j30 + j20)I_1 + j24\, I_2 = 0$$

$$(-\cancel{20}j + 30 + \cancel{20}j)I_2 + 100\angle 0 + j20\, I_1 = 0$$

$$I_1 = \frac{-100 - 30 I_2}{20j}$$

$$(20 + 50j)\left(\frac{-100 - 30I_2}{20j}\right) + 24j\, I_2 = 50\angle 30$$

$$\frac{-2000 - 600 I_2 - 5000j - 1500j\, I_2}{20j} + 24j\, I_2 = 50\angle 30$$

~~-100-30I2=~~

$$\frac{(-2000 - 5000j)}{20j} + \frac{(-600 - 1500j)I_2}{20j} + 24j\, I_2$$

Equations
1) $(20 + 50j)I_1 + 24j\, I_2 = 50\angle 30$
2) $30\, I_2 + 20j\, I_1 = -100$
$V_{AB} =$ $193.4\angle 30$

$$(-250 + 100j) + (-75 + 30j)I_2 + (24j)I_2 = 50\angle 30$$

$$(-75 + 54j)I_2 = 50\angle 30 - (-250 + 100j)$$

$$V_{AB} = V_A - V_B = IR = (I_1 - I_2)j20$$

$$= 193.4\angle 30$$

$$I_2 = 3.27\angle -1585$$

$$I_1 = 0.4761 + 0.1925 = 9.74\angle -79.38$$

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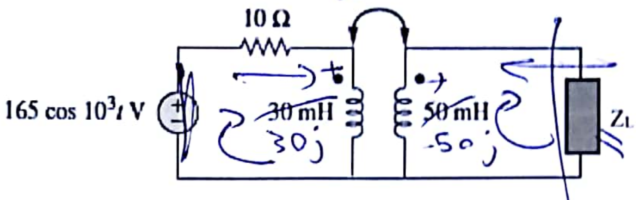
Question 5 (5 points)

For the circuit shown, find the value of Z_L that maximize the power transfered to the load, and what is this maximum power. ~~Find the energy stored in the coupled coils at t= 0.~~

$w = 10^3$



$Z_L = Z_{th}^*$

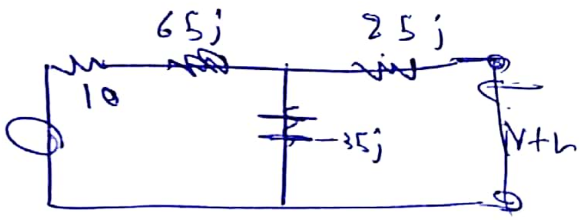
~~10 + 30~~

~~10 + 30j~~

~~30mH = jwL~~

~~30mH = j~~

$30 \rightarrow j\, 10^3\, 30\, 10^{-3}$
$= 30j$



$L_a = L_1 + M$

$L_b = L_2 + M$

$L_c = -M$

$L_a = 30j + 35j$
$= 65j$

$L_b = 50j + 35j$
$= 85j$

$L_c = -35j$

$(10 + 65j) // -35j + 85j$

$Z_{th} = 12.25 + 13.25j$

$Z_L = 12.25 - 13.25j$

$V_{th} = 165 \left(\frac{-35j}{10 + 65 - 35j} \right)$
$= 182.6 \angle -161$

$max\,P = \frac{V_{th}^2}{8R} = 340.23\ W$

Z_L	P_{max}	W_{total}
12.25 - 13.25j	340.23	

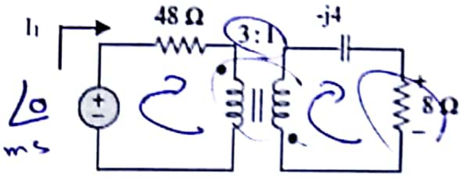
280

Question 6 (3 points):

For the circuit shown below find the input current I_1 and the power absorbed by the $8\ \Omega$ resistor.

$\cancel{P = V_1 I_1^*}$

100 $\angle 0$
rms



$\cancel{-100 + 48}$

$\cancel{+100 + 48}$

$M =$

$\frac{N_2}{N_1} = \frac{1}{3}$

$\cancel{Z_{in} = \frac{Z_L}{n^2}}$

$-\frac{1}{3} = \frac{I_1}{I_2}$

$I_2 = -3I_1$

$\cancel{= \frac{8 - j4}{(\frac{1}{3})^2} = 72 - 36i}$

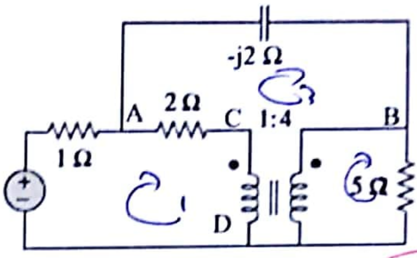
$100\angle 0 + 48 I_1 +$

I_1	P

0 5

Question 7 (4 points)

For the circuit shown, find the power absorbed by the 5 Ω load. Find the voltages V_{AB}, V_{CD}, and the source PF.



$-10 + I_1 + 2(I_1 - I_3) + V_1 = 0$

$5 I_2 + V_2 = 0$

$-2j I_3 + V_1 + V_2 + 2 I_3 = 0$

$5 I_2 + V_2 = 0$

$\frac{V_2}{V_1} = \frac{4}{1}$

$V_2 = 4V_1$

P	V_{AB}	V_{CD}	PF_{source}