ECE 411 - Circuit Theory Spring 2024

Homework 4

Due Wednesday February 28, 202 at 1:30 pm via Gradescope

ANSWER SHEET

Only answers marked on this sheet will be graded.

Name Morris Lin

1. $I = 0.045 \cos(1200t - 44.4^\circ)$
2. $I_{ind} = 0.047 \cos(800t - 48.81^\circ)$
3. $I_{cap} = 0.036 \cos(800t + 64.36^\circ)$
4. $I_{total} = 0.0467 \cos(800t - 3.55^\circ)$
5. $I_{total} = 0.006325 \cos(1000t + 71.565^\circ)$
6. $V_{Th} = 53.666 \angle 36.565^\circ$
7. $Z_{Th} = 447.2136 \angle -63.435^\circ$
8. $V_{ind} = 19.2055 \cos(500t + 129.806^\circ)$
9. $I_{total} = 0.032 \cos(500t + 76.68^\circ)$
10. $I = 1.25 + 0.2466 \cos(20t - 80.5377^\circ)$

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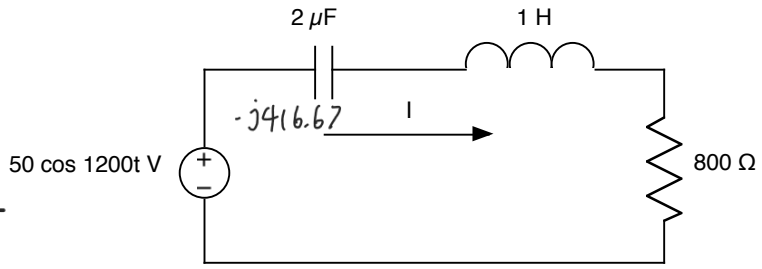
1. For the circuit shown below, find I.



$$I = \frac{50\angle 0^\circ}{-\frac{j}{1200\cdot 2\times 10^{-6}} + j\cdot 1200 + 800}$$

$$I = \frac{50\angle 0^\circ}{-j416.66 + j1200 + 800}$$

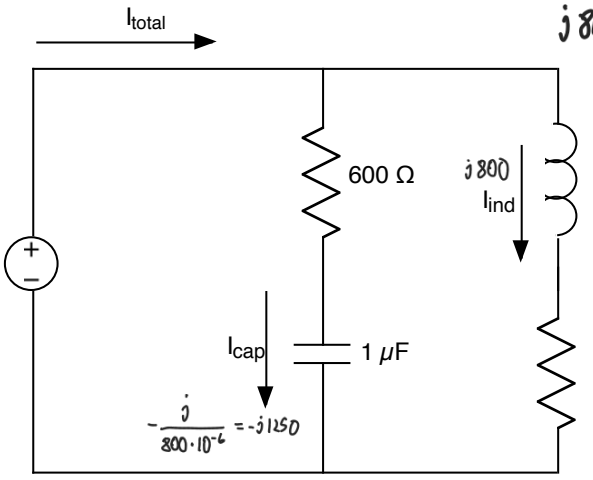
$$I = \frac{50\angle 0^\circ}{800 + j783.33}$$

$$I = \frac{50\angle 0^\circ}{1119.65\angle 44.4^\circ}$$

$$I = 0.04466\angle -44.4^\circ$$

$$I = 0.045\cos(1200t + 44.4^\circ)$$

2. For the circuit shown below, find I_{ind}.



$$\frac{50\angle 0^\circ}{-\frac{j}{800\cdot 10^{-6}} + 600} = \frac{50\angle 0^\circ}{600 - j1250}$$

$$= \frac{50\angle 0^\circ}{1386.54\angle -64.36^\circ}$$

$$= 0.036\angle 64.36^\circ$$

$$= 0.036\cos(800t + 64.36^\circ)$$

$$\frac{50\angle 0^\circ}{j800 + 700}$$

$$= \frac{50\angle 0^\circ}{1063.01\angle 48.81^\circ}$$

$$= 0.047\angle -48.81^\circ$$

$$= 0.047\cos(800t - 48.81^\circ)$$

3. For the circuit of problem 2, find I_{cap}.

I_{cap} $0.036\cos(800t + 64.36^\circ)$

4. For the circuit of problem 2, find I_{total}.

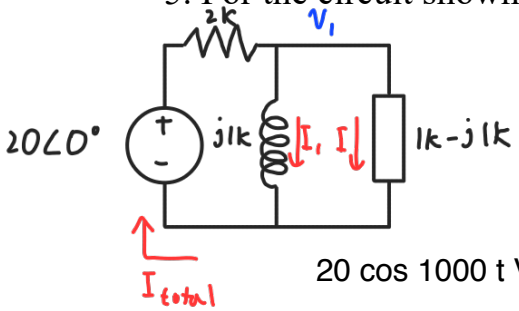
$0.0467\cos(800t - 3.55^\circ)$

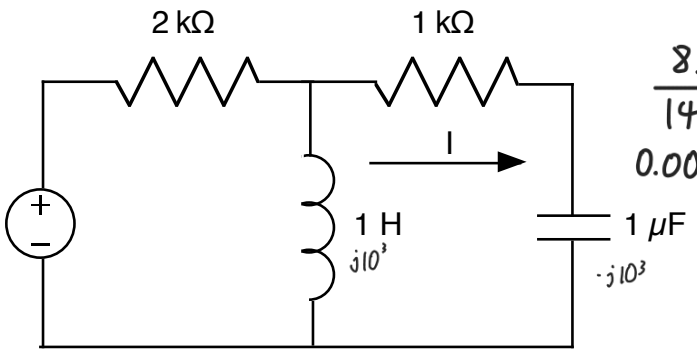
$$\frac{50\angle 0^\circ}{600 - j1250 \;||\; 700 + j800}$$

$$= \frac{50\angle 0^\circ}{\frac{1386.54\angle -64.36^\circ \cdot 1063.01\angle 48.81^\circ}{1375.68\angle -19.09^\circ}}$$

$$= 0.0467\angle -3.55^\circ$$

5. For the circuit shown below, find I.





$$\frac{10^3\angle 90^\circ \cdot 1414.21\angle -45^\circ}{10^3} = 1414.21\angle 45^\circ$$

$$= 10^3 + j10^3$$

$$Z_{total} = 3k + j1k$$

$$= 3162.28\angle 18.43^\circ$$

$$I_{total} = \frac{20\angle 0^\circ}{3162.28\angle 18.43^\circ}$$

$$= 0.00063\angle -18.43^\circ$$

$$= 0.006 - j0.002$$

$$V_1 = 20\angle 0^\circ - 2k\cdot 0.00063\angle -18.43^\circ$$

$$V_1 = 20 - 12 + j4 \quad V_1 = 8.9443\angle 26.565^\circ$$

$$V_1 = 8 + j4$$

$$\frac{8.9443\angle 26.565^\circ}{1414\angle -45^\circ}$$

$$0.006324\angle 71.565^\circ$$

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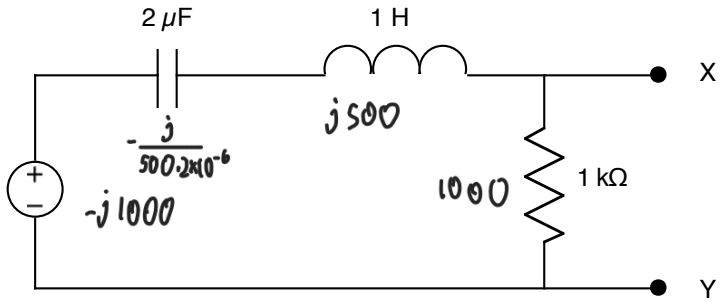
6. For the circuit shown below, find the Thevenin equivalent voltage at terminals X - Y.

$V_x = 60\angle 10° \cdot \dfrac{1000}{-\frac{j}{10^{-3}} + j500 + 1000}$ $\omega = 500$

$V_x = 60\angle 10° \cdot \dfrac{1000}{1000 - j500}$

$V_x = 60\angle 10° \cdot \dfrac{1000\angle 0°}{1118.03\angle -26.56°}$

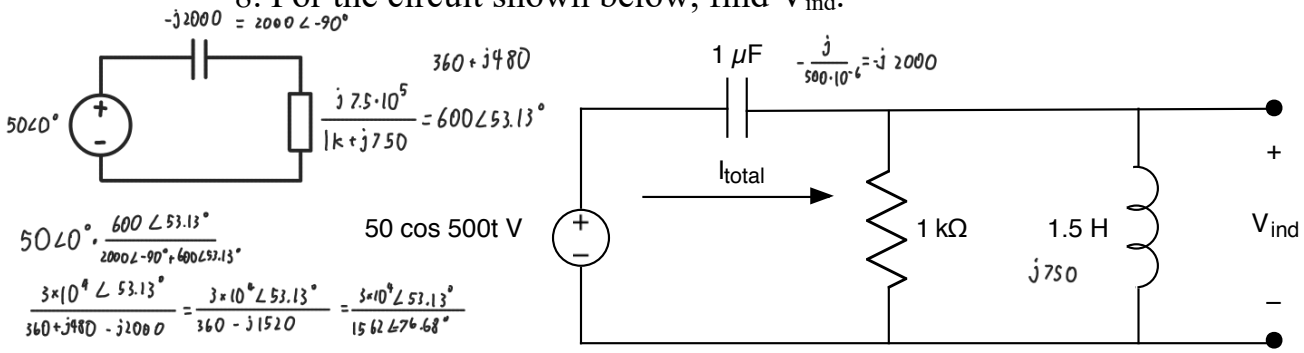


$V_x = 60\angle 10° \cdot 0.8944\angle 26.56° = 53.666\angle 36.565$ $V_{Th} = 53.666\angle 36.565°$

7. For the circuit of problem 6, find the Thevenin equivalent impedance at terminals X - Y.

$Z_{th} = 1000 \,||\, -j500 = 447.2136\angle -63.435°$

8. For the circuit shown below, find V_{ind}.



$5\angle 0° \cdot \dfrac{600\angle 53.13°}{2000\angle -90° + 600\angle 53.13°}$

$\dfrac{3\times10^4\angle 53.13°}{360 + j480 - j2000} = \dfrac{3\times10^4\angle 53.13°}{360 - j1520} = \dfrac{3\times10^4\angle 53.13°}{1562\angle -76.68°}$

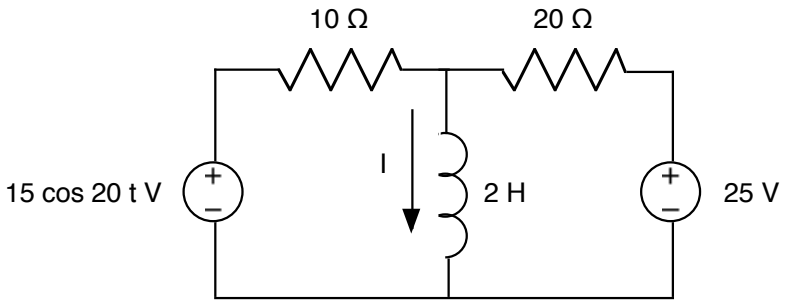
$= 19.2055\angle 129.806°$

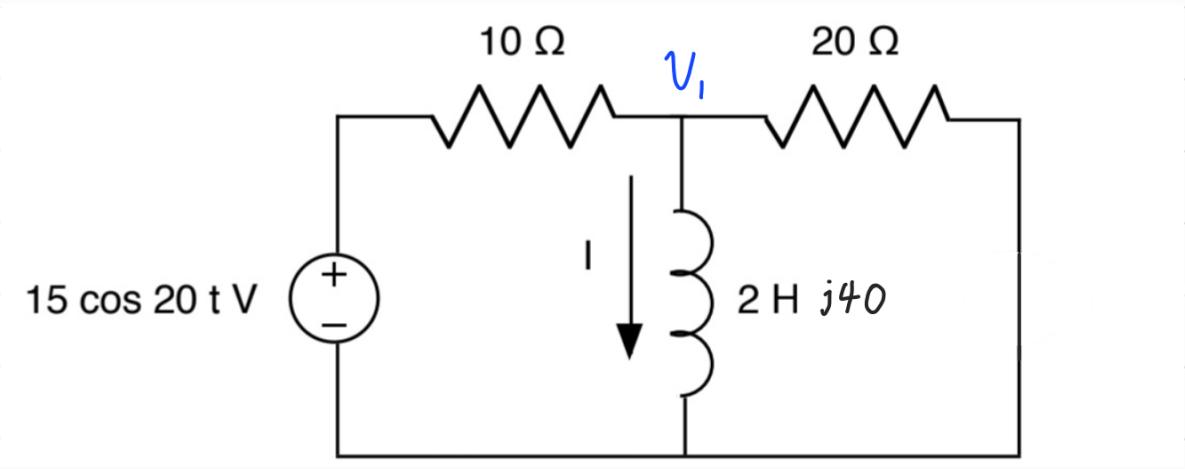
$V_{ind} = 19.2055\cos(500t + 129.806°)$

9. For the circuit of problem 8, find I_{total}.

$\dfrac{5\angle 0°}{360 + j480 - j2000} = \dfrac{5\angle 0°}{1562.05\angle -76.68} = 0.032\angle 76.68°$ $I_{total} = 0.032\cos(500t + 76.68°)$

10. For the circuit shown below, find I using superposition.





$$I_{DC} = \frac{25}{20} = 1.25\,A$$

$$I_{total} = \frac{15\angle 0^\circ}{10 + 16 + j8}$$

$$= \frac{15\angle 0^\circ}{26 + j8}$$

$$= \frac{15\angle 0^\circ}{27.203\angle 17.103^\circ} = 0.5514\angle -17.103^\circ$$

$$j40 \parallel 20 = \frac{j800}{20 + j40} = \frac{800\angle 90^\circ}{44.721\angle 63.43^\circ}$$

$$= 17.889\angle 26.57^\circ$$

$$= 16 + j8$$

$$V_1 = 15\angle 0^\circ - 10(0.5514\angle -17.103^\circ)$$

$$= 9.864\angle 9.462^\circ$$

$$I_{AC} = \frac{V_1}{j40} = 0.2466\angle -80.5377$$

$$I = 1.25 + 0.2466\cos(20t - 80.5377^\circ)$$