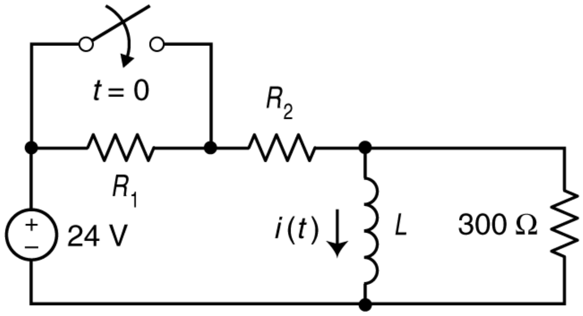
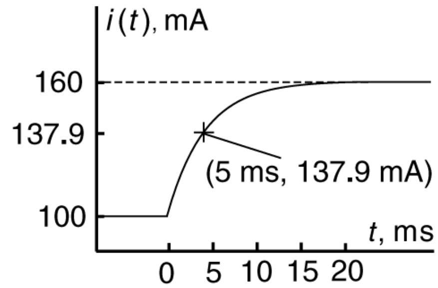
EE221 1st Midterm Exam - Spring 2014

Name ______________________________________ Student #__________

1.



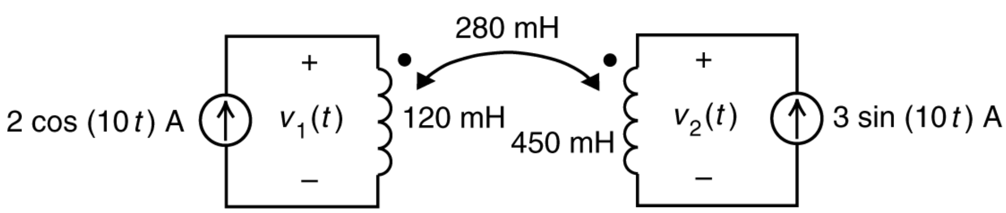


Determine the values of R_1 and R_2.

R_1 = ____90___ Ω and R_2 = ___150_____ Ω.

b. Determine the value of the time constant, τ, of the this circuit after the switch closes: τ = __5__ ms.

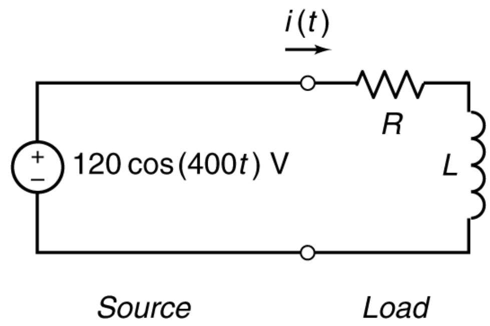
2.



(Recall that $\sin(\omega t) = \cos(\omega t - 90°)$.) The coil voltages in this circuit are $v_1(t) = A\cos(10t + 15.95°)$ V and $v_2(t) = B\cos(10t + 22.53°)$ V. Determine the values of A and B:

A = ____8.736______ V and B = ____14.615______ V

3. An AC source is connected to a load:



a) Suppose that the voltage source supplies

$$\mathbf{S} = 9.1\angle 24.49° = 8.2814 + j\,3.7723 \text{ VA}$$

Determine values of the resistance and inductance.

R = ___720____Ω and L = ___820___mH

b) Suppose **instead** that R =420 Ω and L = 800 mH. Determine the power factor of the load:

pf = ___0.7954__

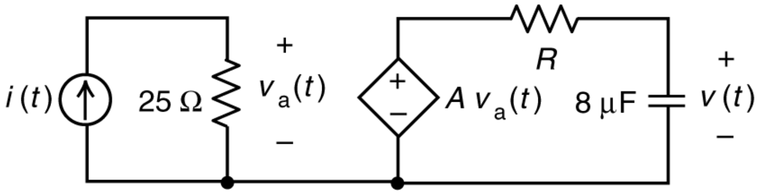
c) Suppose **instead** that the voltage source supplies 9.1278 W at a power factor of 0.7962 lagging. Determine the values of the apparent and reactive powers supplied by the source to the load.

$|\mathbf{S}|$ = ____11.464__ VA and Q = ___6.936___ VAR

d) Suppose **instead** that $i(t) = 176.47\cos\left(400t - 28.1°\right)$ mA . Determine the values of the real and reactive powers supplied by the source to the load.

P = ____9.34__ W and Q = ___4.98___ VAR

4.



The network function of this circuit is:

$$\mathbf{H}(\omega) = \frac{\mathbf{V}(\omega)}{\mathbf{I}(\omega)} = \frac{450}{1 + j\dfrac{\omega}{250}}$$

a) The value of the resistance is R = ___500___ Ω.

b) The value of the gain of the VCVS is A = ____18___ V/V.

c) When ω = ____433__ rad/sec, the value of the gain of the circuit is 225 V/A.

d) When ω = ____144_ rad/sec, the value of the phase shift of the circuit is –30°.

e) When ω = 200 rad/sec, the value of the gain of the circuit is ____351____ V/A.

f) When ω = 200 rad/sec, the value of the phase shift of the circuit is ___–38.7___°.

g) At low frequencies the value of the gain of the circuit is _____450____ V/A.

h) At high frequencies the value of the phase shift of the circuit is ____–90____°.

i) When the input is $i(t) = 180\cos(300\,t + 30°)$ **mA** the phase angle of $v(t)$ is ____–20.2____°.

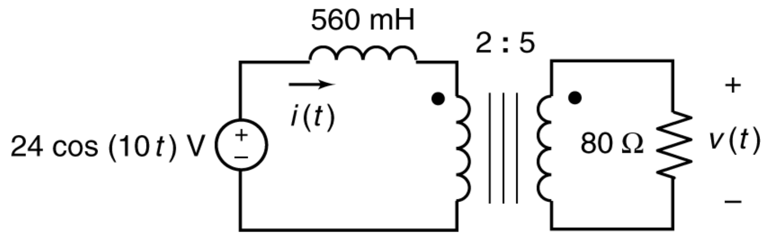
j) When the input is $i(t) = 180\cos(300\,t + 30°)$ **mA** the amplitude of $v(t)$ is _____51.85____V.

5. The current $i(t)$ and voltage $v(t)$ labeled on the circuit drawing are

$$i(t) = A\cos(10t - 23.63°)\text{ Amps}$$

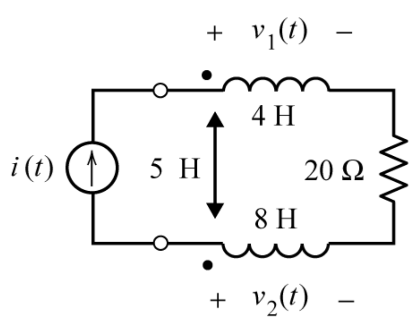
and $$v(t) = B\cos(10t - 23.63°)\text{ V}$$

Determine the values of A and B:



A = ____1.718______ Amps and B = ____54.97______ V

6.



The input current is

$$i(t) = 1.3\cos(5t)\text{ A}$$

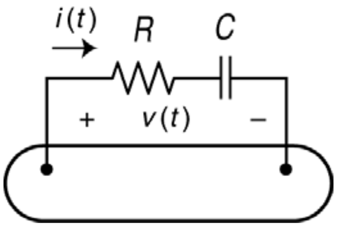
The coil voltages are

$$v_1(t) = E\cos(5t - 90°)\text{ V} \quad \text{and} \quad v_2(t) = F\cos(5t - 90°)\text{ V}$$

Determine the values of E and F.

E = ___6.5___ V and F = ___19.5____ V

7.



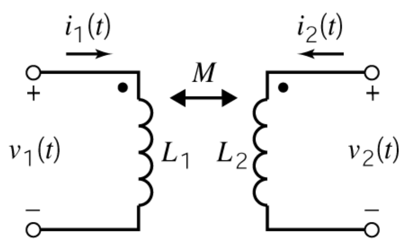
This voltage and current are given by

$$v(t) = 20\cos(25t + 15°)\ \text{V} \quad \text{and} \quad i(t) = 3.05\cos(25t + 39°)\ \text{A}$$

Determine the values of the resistance, R, and capacitance, C.

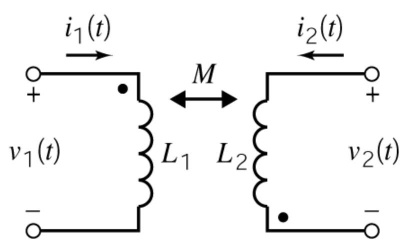
$R =$ _____6_____ Ω and $C =$ ______15________m F

QUANTITY	RELATIONSHIP USING PEAK VALUES	RELATIONSHIP USING rms VALUES	UNITS
Element voltage, $v(t)$	$v(t) = V_\mathrm{m} \cos(\omega t + \theta_\mathrm{v})$	$v(t) = V_\mathrm{rms}\sqrt{2}\cos(\omega t + \theta_\mathrm{V})$	V
Element current, $i(t)$	$i(t) = I_\mathrm{m} \cos(\omega t + \theta_\mathrm{I})$	$i(t) = V_\mathrm{rms}\sqrt{2}\cos(\omega t + \theta_\mathrm{I})$	A
Complex power, **S**	$\mathbf{S} = \dfrac{V_\mathrm{m} I_\mathrm{m}}{2}\cos(\theta_\mathrm{V} - \theta_\mathrm{I}) + j\dfrac{V_\mathrm{m} I_\mathrm{m}}{2}\sin(\theta_\mathrm{V} - \theta_\mathrm{I})$	$\mathbf{S} = V_\mathrm{rms} I_\mathrm{rms} \cos(\theta_\mathrm{V} - \theta_\mathrm{I}) + jV_\mathrm{rms} I_\mathrm{rms} \sin(\theta_\mathrm{V} - \theta_\mathrm{I})$	VA
Apparent power, $\lvert\mathbf{S}\rvert$	$\lvert\mathbf{S}\rvert = \dfrac{V_\mathrm{m} I_\mathrm{m}}{2}$	$\lvert\mathbf{S}\rvert = V_\mathrm{rms} I_\mathrm{rms}$	VA
Average power, P	$P = \dfrac{V_\mathrm{m} I_\mathrm{m}}{2}\cos(\theta_\mathrm{V} - \theta_\mathrm{I})$	$P = V_\mathrm{rms} I_\mathrm{rms} \cos(\theta_\mathrm{V} - \theta_\mathrm{I})$	W
Reactive power, Q	$Q = \dfrac{V_\mathrm{m} I_\mathrm{m}}{2}\sin(\theta_\mathrm{V} - \theta_\mathrm{I})$	$Q = V_\mathrm{rms} I_\mathrm{rms} \sin(\theta_\mathrm{V} - \theta_\mathrm{I})$	VAR



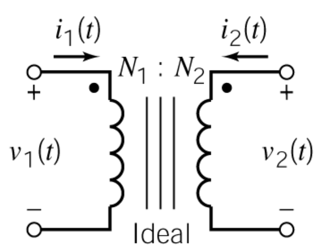
$$v_1 = L_1 \frac{di_1}{dt} + M \frac{di_2}{dt} \qquad \mathbf{V}_1 = j\omega L_1 \mathbf{I}_1 + j\omega M \mathbf{I}_2$$

$$v_2 = L_2 \frac{di_2}{dt} + M \frac{di_1}{dt} \qquad \mathbf{V}_2 = j\omega L_2 \mathbf{I}_2 + j\omega M \mathbf{I}_1$$



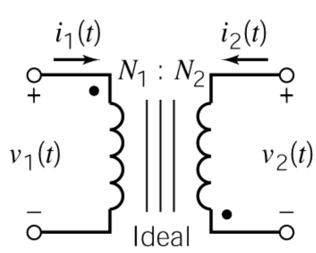
$$v_1 = L_1 \frac{di_1}{dt} - M \frac{di_2}{dt} \qquad \mathbf{V}_1 = j\omega L_1 \mathbf{I}_1 - j\omega M \mathbf{I}_2$$

$$v_2 = L_2 \frac{di_2}{dt} - M \frac{di_1}{dt} \qquad \mathbf{V}_2 = j\omega L_2 \mathbf{I}_2 - j\omega M \mathbf{I}_1$$



$$\mathbf{V}_1 = \frac{N_1}{N_2}\mathbf{V}_2$$

$$\mathbf{I}_1 = -\frac{N_2}{N_1}\mathbf{I}_2$$



$$\mathbf{V}_1 = -\frac{N_1}{N_2}\mathbf{V}_2$$

$$\mathbf{I}_1 = \frac{N_2}{N_1}\mathbf{I}_2$$