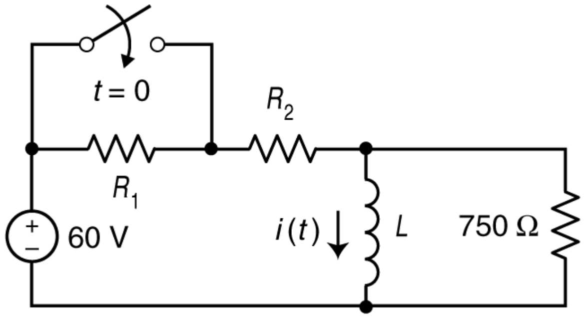
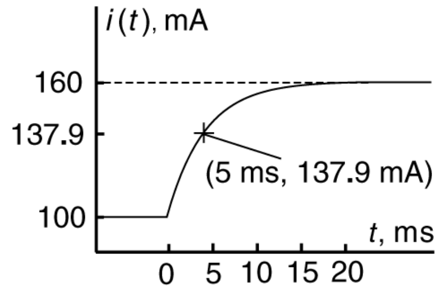
EE221 1st Midterm Exam - Spring 2014

Name ____ Student #__________

1.



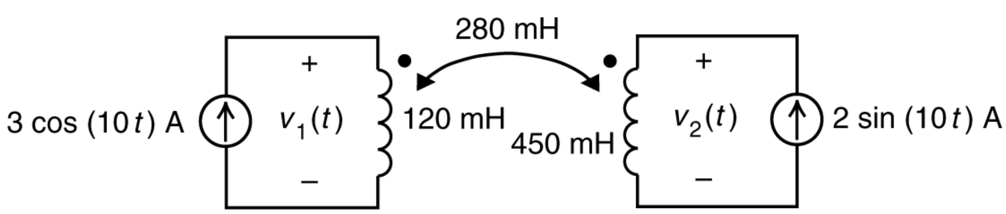


Determine the values of R_1 and R_2.

R_1 = ____225___ Ω and R_2 = ___375_____ Ω.

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

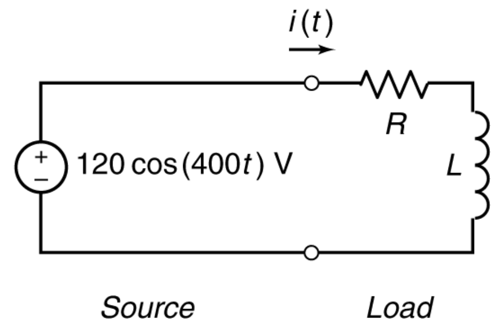
2.



(Recall that $\sin(\omega t) = \cos(\omega t - 90°)$.) The coil voltages in this circuit are $v_1(t) = A\cos(10t + 32.74°)$ V and $v_2(t) = B\cos(10t + 43.03°)$ V. Determine the values of A and B:

A = ____6.657______ V and B = ____12.311______ V

3. An AC source is connected to a load:



a) Suppose that the voltage source supplies

$$\mathbf{S} = 10.186\angle 25.11° = 9.2234 + j\,4.3225 \text{ VA}$$

Determine values of the resistance and inductance.

R = ___640____Ω and L = ___750___mH

b) Suppose **instead** that $i(t) = 191\cos\left(400t - 37.2°\right)$ mA . Determine the values of the real and reactive powers supplied by the source to the load.

P = ____9.13__ W and Q = ___6.93___ VAR

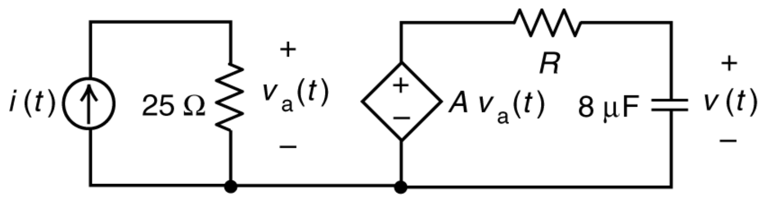
c) Suppose **instead** that R = 500 Ω and L = 600 mH. Determine the power factor of the load:

pf = ___0.9015__

d) Suppose **instead** that the voltage source supplies 7.067 W at a power factor of 0.817 lagging. Determine the values of the apparent and reactive powers supplied by the source to the load.

$|\mathbf{S}|$ = ____8.65__ VA and Q = ____4.99___ VAR

4.



The network function of this circuit is:

$$\mathbf{H}(\omega) = \frac{\mathbf{V}(\omega)}{\mathbf{I}(\omega)} = \frac{800}{1 + j\dfrac{\omega}{500}}$$

a) The value of the resistance is R = ___250____ Ω.

b) The value of the gain of the VCVS is A = _____32_____ V/A.

c) When ω = 400 rad/sec, the value of the gain of the circuit is ____624.7____ V/A.

d) When ω = 400 rad/sec, the value of the phase shift of the circuit is __–38.7___°.

e) When ω = ___866___ rad/sec, the value of the gain of the circuit is 400 V/V.

f) When ω = ___287___ rad/sec, the value of the phase shift of the circuit is –30°.

g) At low frequencies the value of the gain of the circuit is ______800_____ V/A.

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

i) When the input is $i(t) = 180\cos(300t + 15°)$ **mA** the amplitude of $v(t)$ is ____123.5___V.

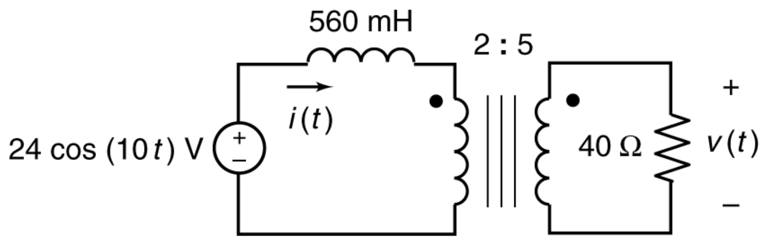
j) When the input is $i(t) = 180\cos(300t + 15°)$ **mA** the phase angle of $v(t)$ is ____–16____°.

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

$$i(t) = A\cos(10t - 41.19°)\text{ Amps}$$

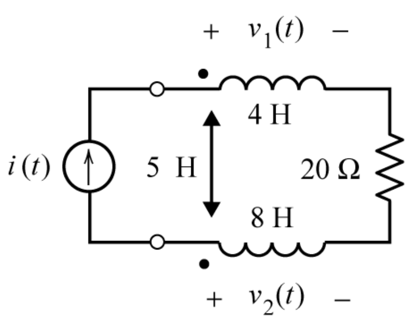
and $$v(t) = B\cos(10t - 41.19°)\text{ V}$$

Determine the values of A and B:



A = ____2.822______ Amps and B = ____45.15______ V

6.



The input current is

$$i(t) = 1.3\cos(6t)\text{ A}$$

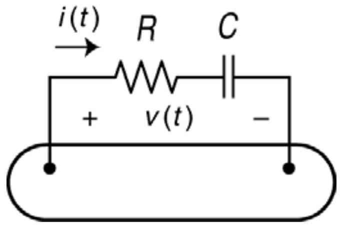
The coil voltages are

$v_1(t) = E\cos(6t - 90°)$ V and $v_2(t) = F\cos(6t - 90°)$ V

Determine the values of E and F.

E = ____7.8____ V and F = ___23.4____ V

7.



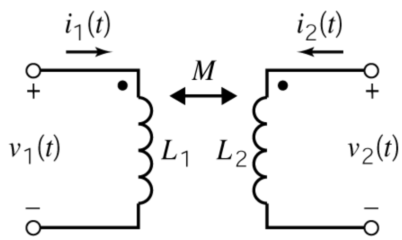
This voltage and current are given by

$$v(t) = 15\cos(20t + 40°)\ \text{V} \quad \text{and} \quad i(t) = 1.59\cos(20t + 72°)\ \text{A}$$

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

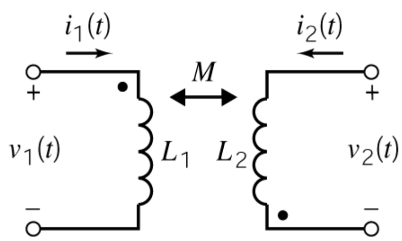
R = _______8_____ Ω and *C* = _________10_______ mF

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



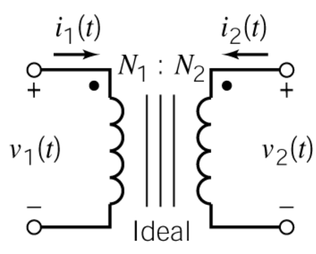
$$v_1 = L_1 \frac{di_1}{dt} + M \frac{di_2}{dt} \qquad \mathbf{V}_1 = j\omega L_1 \mathbf{I}_1 + j\omega M \mathbf{I}_2$$

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



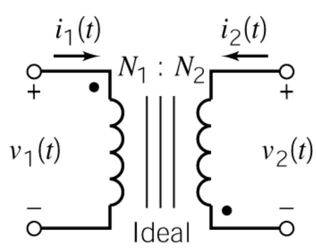
$$v_1 = L_1 \frac{di_1}{dt} - M \frac{di_2}{dt} \qquad \mathbf{V}_1 = j\omega L_1 \mathbf{I}_1 - j\omega M \mathbf{I}_2$$

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



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

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



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

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