ECE 35, Fall 2019

Quiz 4 – Section A

Sequence number

Grade

/ 10

Last name

First + middle name(s)

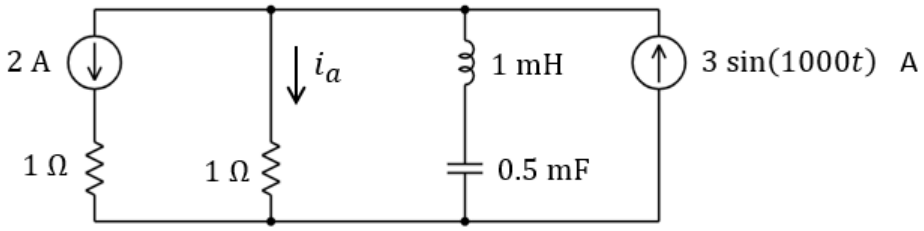
PID

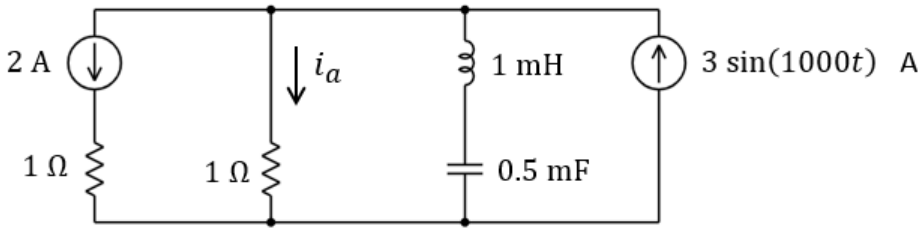
Instructions:

- Read each problem completely and thoroughly before beginning.
- All calculations need to be done on these sheets.
- Write your answers in the answer boxes for each question. Make sure you list units!
- Answers without supporting calculations will receive zero credit.

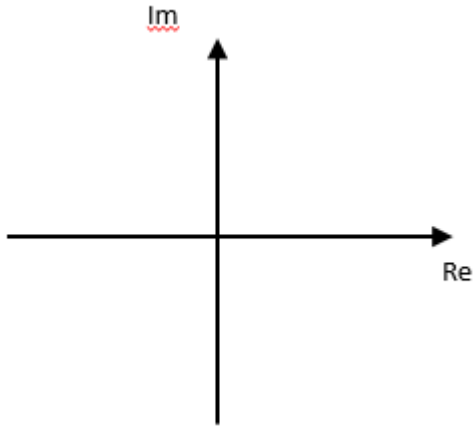
(1) *(5 points)* The system is in steady state. Find $i_a(t)$.

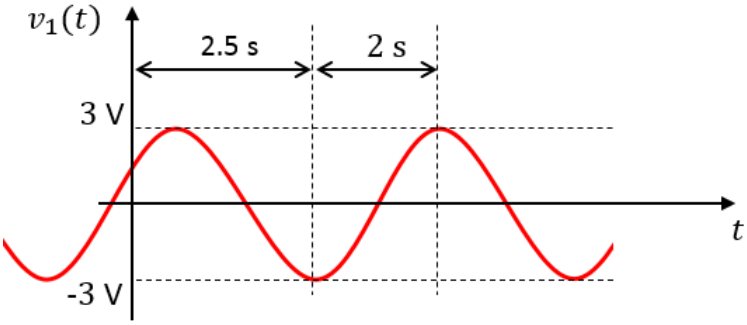
$i_a(t)$




2 A
i_a
1 mH
3 sin(1000t) A
1 Ω
1 Ω
0.5 mF

(2) *(2 points)* Draw the phasor of $v_1(t)$ in the phasor diagram. Make sure it is fully defined (also list the frequency).

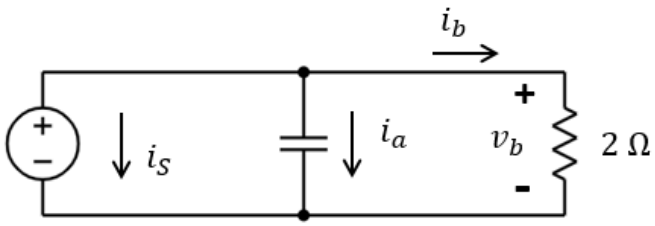


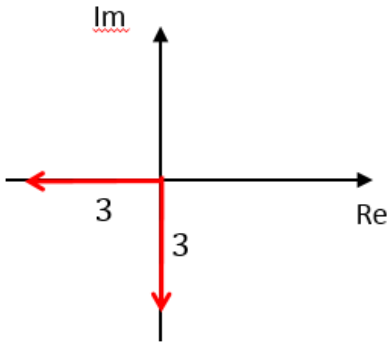


(3) *(3 points)* Consider the AC circuit below. The ω of the source is π rad/s and the system is in steady state. The phasor diagram shows the phasors of i_a and i_b, but you are not told which one is which.

(a) In the phasor diagram below, sketch the phasor of i_S.

(b) What is the value of v_b at t = 0.25 s? $v_b(0.25\text{ s})$





ECE35 Equation Sheet

Basics: $i \triangleq \frac{dq}{dt}$ $v_{ab} \triangleq \frac{dw}{dq}$ $R = \rho\frac{l}{A}$

Capacitors: $C = \epsilon \cdot \frac{A}{d}$ $Q = C \cdot v$ $w_C = \frac{1}{2}Cv^2$

Inductors: $L = \mu \cdot \frac{N^2 A}{l}$ $B \sim i$ $w_L = \frac{1}{2}Li^2$

AC power: $p(t) = \frac{1}{2}V_m I_m \cdot \cos(\theta_v - \theta_i) + \frac{1}{2}V_m I_m \cdot \cos(2\omega t + \theta_v + \theta_i)$

$P = \frac{1}{2}V_m I_m \cos(\theta_v - \theta_i)$ $Q = \frac{1}{2}V_m I_m \sin(\theta_v - \theta_i)$ $X_{rms} = \sqrt{\frac{1}{T}\int_0^T x(t)^2 dt}$

Trigonometry:

$\sin(-\alpha) = -\sin(\alpha)$ $\cos(-\alpha) = \cos(\alpha)$

$\sin(\pi - \alpha) = \sin(\alpha)$ $\cos(\pi - \alpha) = -\cos(\alpha)$

$\sin\left(\frac{\pi}{2} - \alpha\right) = \cos(\alpha)$ $\cos\left(\frac{\pi}{2} - \alpha\right) = \sin(\alpha)$

$\sin\left(\alpha - \frac{\pi}{2}\right) = -\cos(\alpha)$ $\cos\left(\alpha - \frac{\pi}{2}\right) = \sin(\alpha)$

$\sin(2\alpha) = 2\sin(\alpha)\cos(\alpha)$ $\cos(2\alpha) = \cos^2(\alpha) - \sin^2(\alpha)$

$\sin(\alpha \pm \beta) = \sin(\alpha)\cos(\beta) \pm \cos(\alpha)\sin(\beta)$

$\cos(\alpha \pm \beta) = \cos(\alpha)\cos(\beta) \mp \sin(\alpha)\sin(\beta)$

$\sin(\alpha)\sin(\beta) = 0.5 \cdot (\cos(\alpha - \beta) - \cos(\alpha + \beta))$

$\cos(\alpha)\cos(\beta) = 0.5 \cdot (\cos(\alpha - \beta) + \cos(\alpha + \beta))$

$\sin(\alpha)\cos(\beta) = 0.5 \cdot (\sin(\alpha - \beta) + \sin(\alpha + \beta))$

α:	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$
sin(α):	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
tan(α):	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	∞