ECE 35, Fall 2019
Final – Section A

Sequence number

Last name	
First + middle name(s)	
PID	

Grade

/ 50

Instructions:

- Do not look at the questions or start writing until it is announced you can do so.
- Read each problem completely and thoroughly before beginning.
- <u>All calculations must be done in your blue book</u>. It should be clear which question they belong to. Answers without supporting calculations will receive zero credit. If you are using intuition, write a short explanation.
- Write clearly and make sure your answer is structured properly. We will not hunt for your work or answers.
- <u>Write your final answers in the answer boxes on these question pages</u>. Make sure you list units!
- You must follow the Final Exam Procedures that were posted on TritonEd. If you are unsure of anything, ask. As a reminder:
    - Your phone should be turned off and put inside your bag in the front of the room (or on the table in the front). If you are found to have a phone (or other communication device) on you during the exam, your exam will not be graded.
    - Calculators are not allowed.
    - This is a closed book exam.

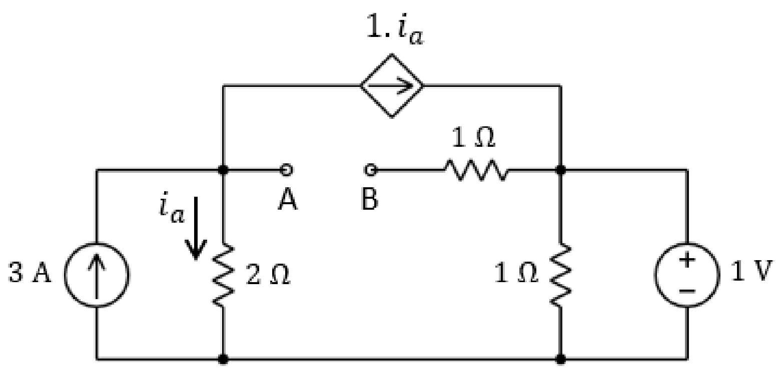
▲

(1) Consider the circuit below.

(a) Find the Thevenin equivalent model between A and B. *(8 points)*

(b) If we were to place a 2/3 Ω resistor between A and B in the circuit below, what is the current i_R through that resistor (measured from A to B)? *(1 point)*

i_R

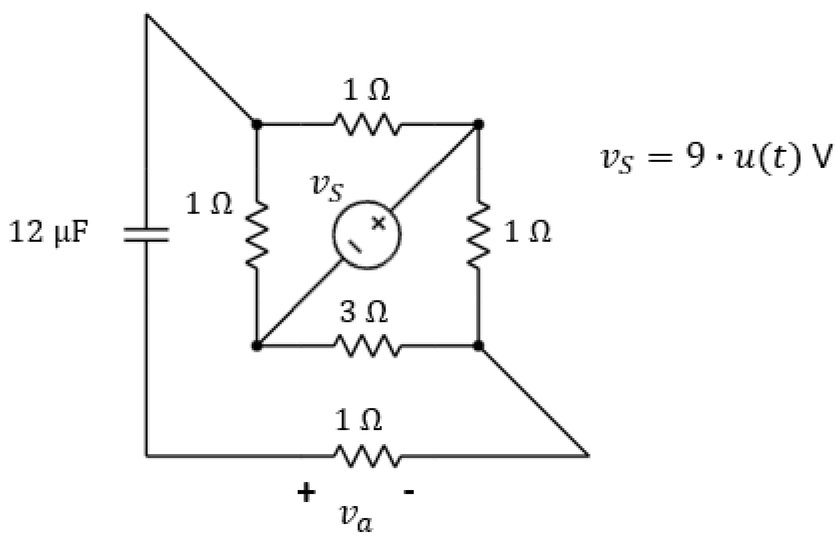


(2) Consider the circuit below. For $t < 0$ s, you may assume the system has reached steady state.

(a) Find $v_a(t)$ for $t > 0$ s.
(8 points)

$v_a(t)$

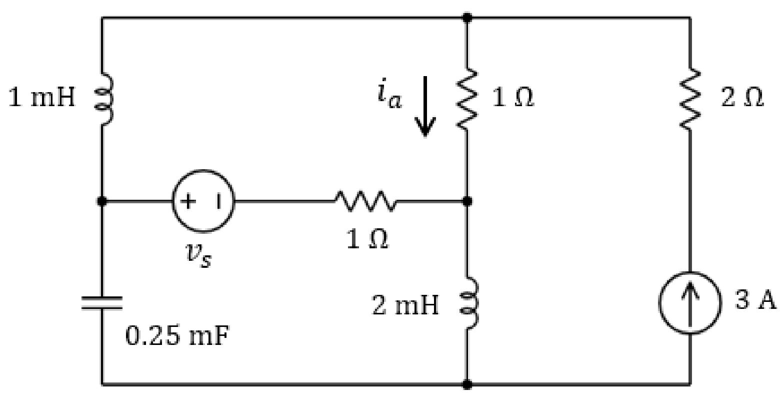
(b) Sketch the waveform $v_a(t)$ for $t > 0$ s. Include where you can observe the time constant.
(2 points)



(3) Consider the circuit below. The system is in steady state. Find $i_a(t)$. *(9 points)*

$i_a(t)$	

$$v_s = 18\cos\left(1000t - \frac{\pi}{2}\right)\ \text{V}$$



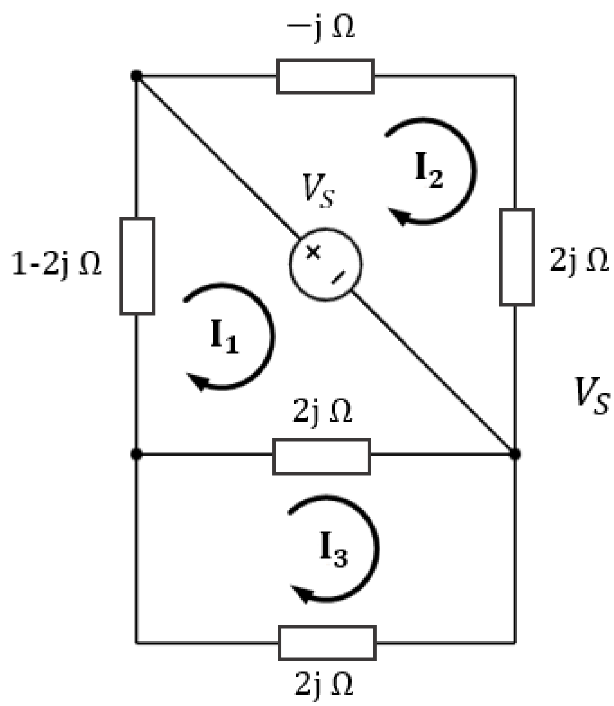
(4) Consider the circuit below. The system is in steady state and represented in phasor form.

(a) Find the mesh currents $\mathbf{I_1}$, $\mathbf{I_2}$ and $\mathbf{I_3}$ (expressed in polar form). *(8 points)*

$\mathbf{I_1}$ $\qquad$ $\mathbf{I_2}$ $\qquad$ $\mathbf{I_3}$

(b) Find the complex power <u>supplied</u> by $\mathbf{V_S}$. *(2 points)*

$\mathbf{S}$



$$V_S = 10\sqrt{2}e^{j\frac{\pi}{5}} \text{ V}$$

(5) Consider the circuit below. The system is in steady state and represented in phasor form. The ammeter and volt-meter are both ideal.

(a) Assume the load $\mathbf{Z_L} = 2j\ \Omega$. What is the reading X of the ammeter and the reading Y of the volt-meter? *(8 points)*

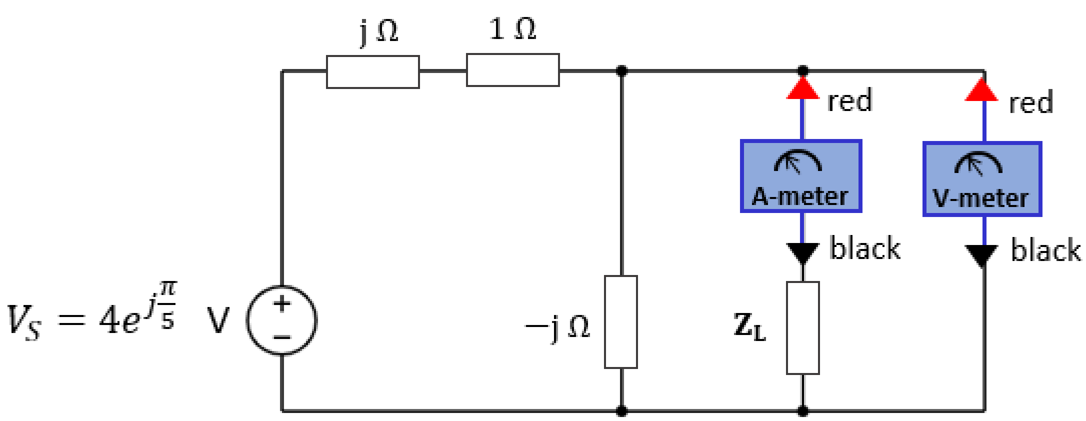
X (ammeter reading) $\boxed{}$ Y (voltmeter reading) $\boxed{}$

(b) We now replace the load $\mathbf{Z_L}$ with a new value such that the average power received by this load is maximized. What is this new value of $\mathbf{Z_L}$? *(2 points)*

$\mathbf{Z_L}$ $\boxed{}$

(c) Find the average power received by the load calculated in part (b). *(2 points)*

P $\boxed{}$



ECE35 Equation Sheet

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

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

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

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

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

Trigonometry:

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

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

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

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

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

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

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

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

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

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

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