ECE 35, Fall 2021

Quiz 2

/ 12

Your sequence number

Last name

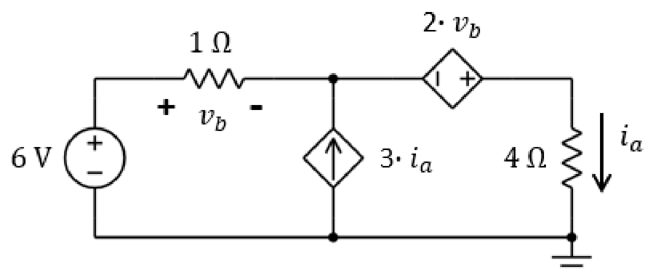
First + middle name(s)

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) (a) *(4 points)* Find the current i_a. You can use any analysis method. (Hint: we recommend mesh analysis.)

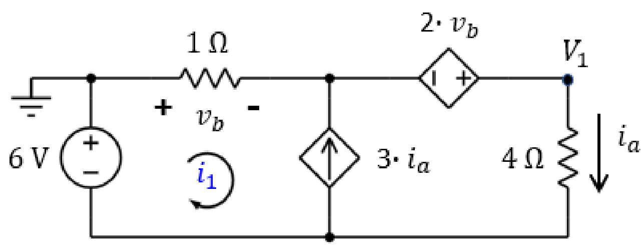
i_a



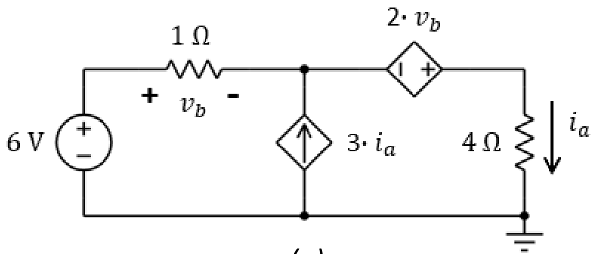
(b) *(2 points)* We keep the circuit the same but move the ground to a new location as shown below. Find the mesh current i_1 and the node voltage V_1.

i_1

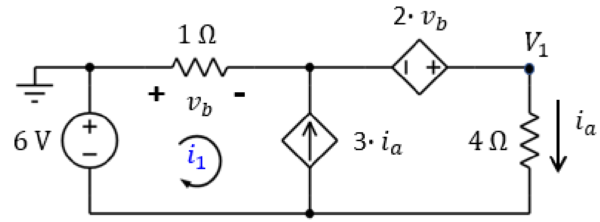
V_1



The circuits are copied on the next page for your convenience.



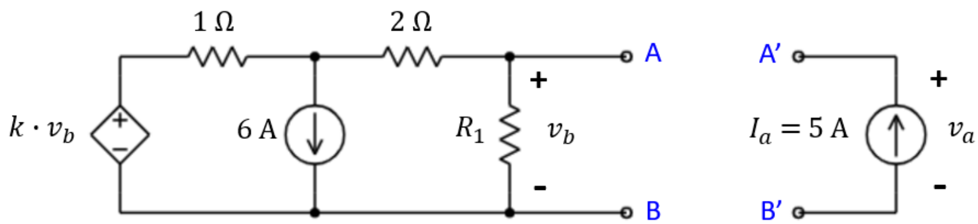
(a)



(b)

(2) (a) *(4 points)* You are asked to find the Norton equivalent model of the circuit below on the left. You are not given the values of R_1 and k in this circuit. However, you are told that if you connect the circuit on the right to it (A' connected to A and B' connected to B), a voltage v_a of **12 V** will appear across current source I_a (as indicated).

<u>Draw the Norton equivalent model</u> between A and B of the circuit on the left (i.e., without the circuit on the right attached to it). Make sure you label A and B in your model. (Hint: find the Norton equivalent current source I_N first.)



(b) *(2 points)* In the scenario above, we double the 6 A independent current source to **12 A** and change I_a to **1 A**. All other circuit elements remain the same. What is the new value of v_a when the two circuits are connected?

v_a $\boxed{}$

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