ECE 35, Fall 2022

Your sequence number

Last name

Quiz 2

First + middle name(s)

/ 12

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) *(3 points)* Draw the Thevenin model for the circuit in figure 1 below, between A and B (make sure you label A and B in your drawing).

You are not given the values of V_1, I_1 or R_1. However, you are told that if you attach an ammeter as shown in figure 2, the ammeter reading is **2A**. Also, if you attach a voltage source as shown in figure 3, the current i_a is **2A**.

Drawing of the Thevenin model

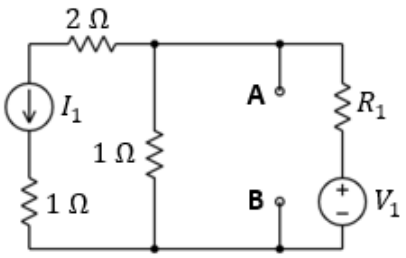


Figure 1

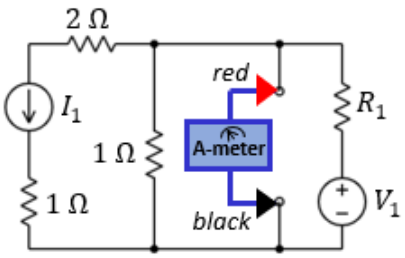


Figure 2

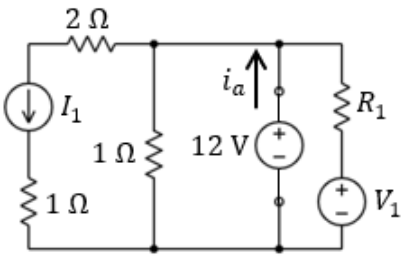


Figure 3

(b) *(3 points)* We attach the circuit from figure 4 to the one from figure 1 above (with A' connected to A and B' connected to B).
Find the value of k such that the power received by the two elements in figure 4 combined is maximized (i.e, the power received by the dependent source and the resistor combined).

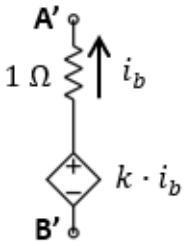


Figure 4

k

Copies of the circuits from the previous page …

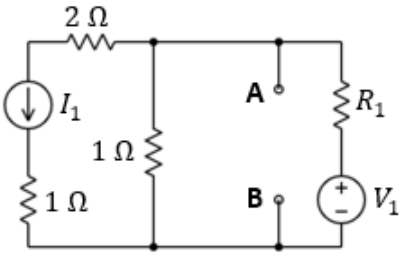


Figure 1

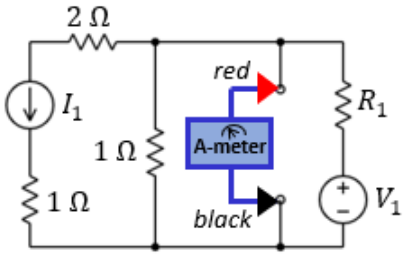


Figure 2

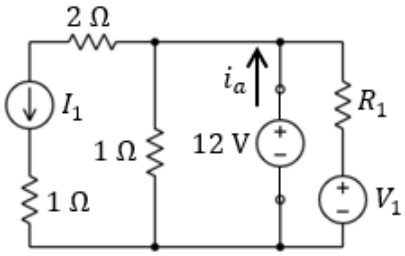


Figure 3

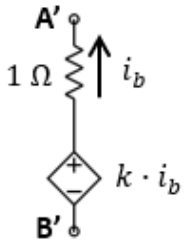


Figure 4

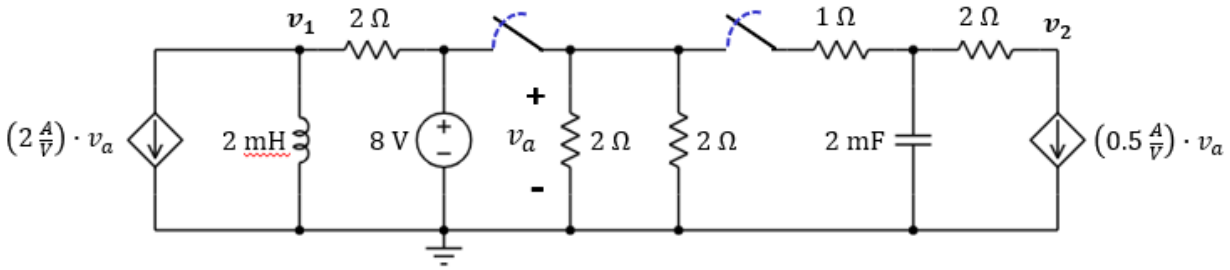
(2) *(6 points)* For $t < 2$ s, both switches are closed, and you may assume that the system has reached steady state. Both switches open at time $t = 2$ s.

(a) Find $v_1(2^- \text{ s})$. (i.e., the left node voltage just before the event) $v_1(2^- \text{ s})$

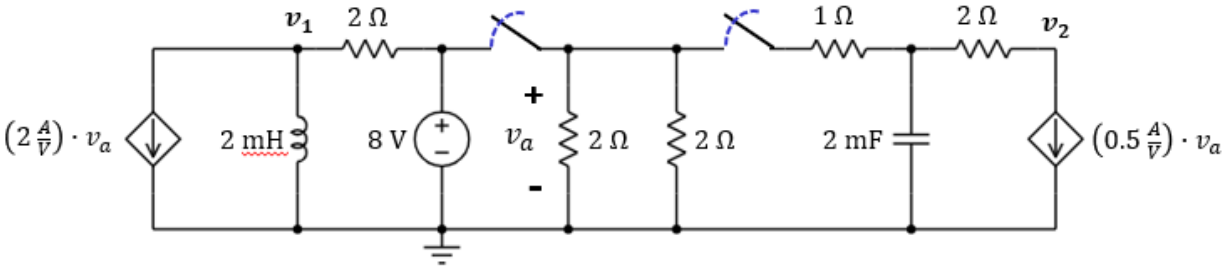
(b) Find $v_2(2^- \text{ s})$. (i.e., the right node voltage just before the event) $v_2(2^- \text{ s})$

(c) Find $v_1(2^+ \text{ s})$. (i.e., the left node voltage just after the event) $v_1(2^+ \text{ s})$

(d) Find $v_2(t)$ for $t > 2$ s.
Write the equation.
(i.e., for the right node voltage) $v_2(t)$



Copy of the circuit from the previous page …



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	$\sqrt{3}$	∞