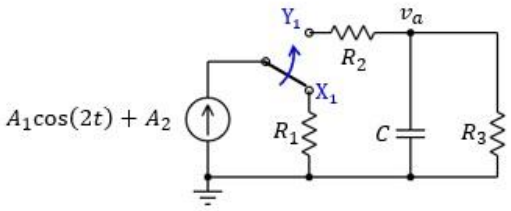
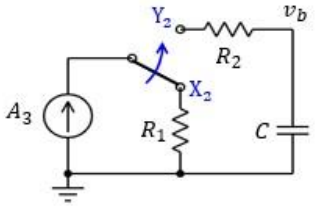
Q1

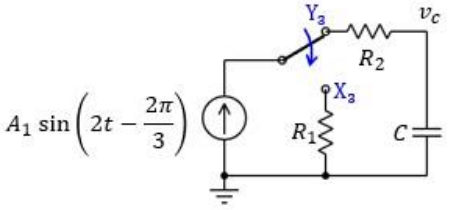
(a) For $t < \frac{\pi}{6}$ s, the switch is in position X_1, and at time $t = 0$ s the capacitor is fully discharged. At time $t = \frac{\pi}{6}$ s, the switch moves from position X_1 to position Y_1. Find the steady state node voltage waveform v_a(t).



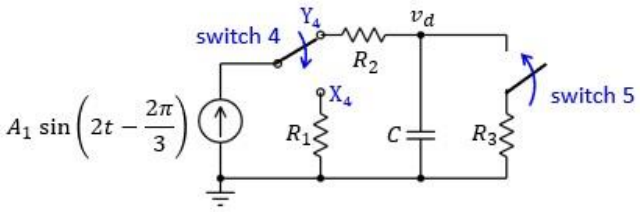
(b) For $t < \frac{\pi}{6}$ s, the switch is in position X_2, and at time $t = 0$ s the capacitor is fully discharged. At time $t = \frac{\pi}{6}$ s, the switch moves from position X_2 to position Y_2. Find the node voltage $v_b(\pi$ s), i.e., at time $t = \pi$ s.



(c) For $t < \frac{\pi}{6}$ s, the switch is in position Y_3, and you may assume the system has reached steady state. At time $t = \frac{\pi}{6}$ s, the switch moves from position Y_3 to position X_3. Find the node voltage $v_c(\pi$ s).



(d) For $t < \frac{\pi}{6}$ s, switch 4 is in position Y_4 and switch 5 is open, and you may assume the system has reached steady state. At time $t = \frac{\pi}{6}$ s, switch 4 moves from position Y_4 to position X_4 and switch 5 closes. Find the node voltage $v_d(\pi$ s).



R1:	1 Ω
R2:	1 Ω
R3:	1 Ω
C:	500 mF
A1:	3 A
A2:	2 A
A3:	3 A

Q2

The AC circuit below has ω = 10 rad/s and is in steady state. The phasor diagram shows the phasors of i_S and v_L. You are given the angles α (between $\mathbf{I_S}$ and the x-axis), β (between $\mathbf{V_L}$ and the x-axis), $|\mathbf{I_S}|$ and $|\mathbf{V_L}|$.
The diagram is not necessarily drawn to scale.
The element represented by the rectangular box is either an inductor or a capacitor but you are not told which.

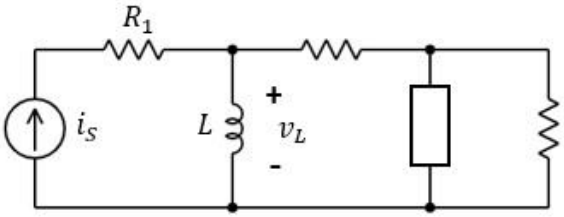
(a) Find the complex power $\mathbf{S_L}$ received by the inductor.

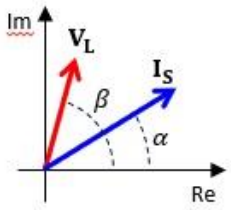
(b) Find the complex power $\mathbf{S_S}$ supplied by the current source.

(c) Find the complex power $\mathbf{S_M}$ received by the mystery element.

(d) What is the mystery element (capacitor or inductor)? (You do not need to find its value, but your answer needs to be motivated)

|Is|:	3 A
alpha:	20 degrees
|VL|:	4 V
Beta:	80 degrees
R1:	2 Ω
L:	200 mH



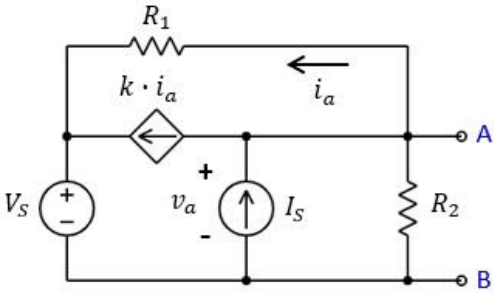


Q3

Consider the circuit below.

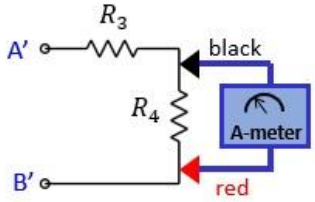
(a) Find the voltage v_a.

(b) Draw the Thevenin model for the circuit between A and B (make sure you label A and B in your drawing).



R1:	18 Ω
R2:	3 Ω
k:	2 A/A
Vs:	3 V
Is:	2 A
R3:	2 Ω
R4:	2 Ω

(c) Connect the circuit on the right to the one on top (A' connected to A and B' connected to B). What is the reading X of the ideal **ammeter**?

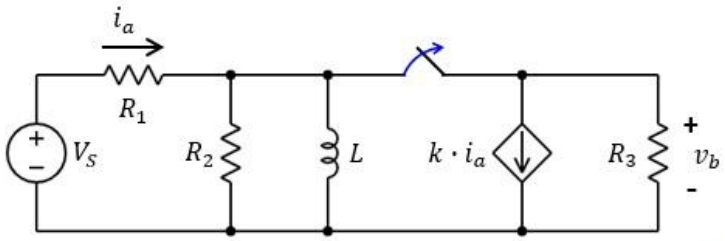


Q4

For $t < 2$ s, the switch is closed, and you may assume the system has reached steady state. The switch opens at time $t = 2$ s.

(a) Find $v_b(t)$ for $t > 2$ s.

(b) What is the instantaneous power received by the inductor at time $t = 2^+$ s.



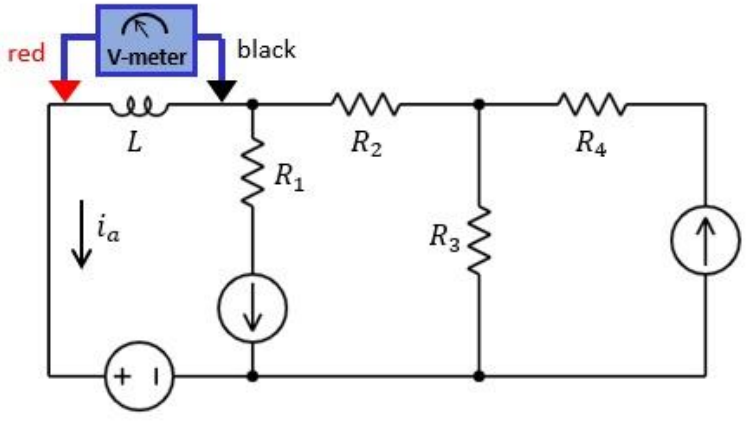
Vs:	4 V
R1:	2 Ω
R2:	2 Ω
R3:	3 Ω
L:	200 mH
k:	3 A/A

Q5

The circuit below is an AC circuit and is in steady state. The three independent sources all have ω = 10 rad/s.

You measure the waveform $i_a(t) = A_1 \cos(10t + B_1)$.

Now the circuit is changed: the inductor **L** is replaced by capacitor **C**. In this changed circuit, what will be the reading of the ideal volt-meter?



R1:	2 Ω
R2:	2 Ω
R3:	3 Ω
R4:	2 Ω
A1:	10 A
B1:	60 degrees
L:	300 mH
C:	40 mF