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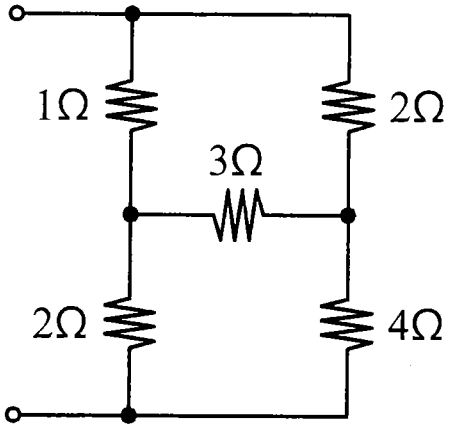
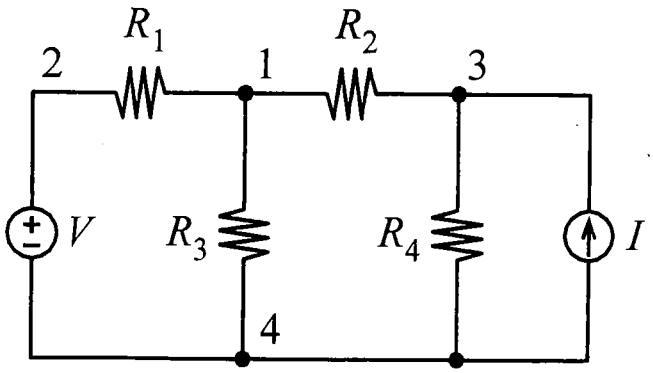
※請在答案卷內作答

計算題，請寫出計算過程。

1. Find the equivalent resistance between the indicated terminals of the following circuit. (5%)



2. Set node 4 as the reference ground. Also, set the node voltage of node 1 as v_1, the node voltage of node 2 as $v2$, and the node voltage of node 3 as $v3$. Use node method and write a complete set of equations that solve the voltages v_1, v_2, and v_3. (5%)



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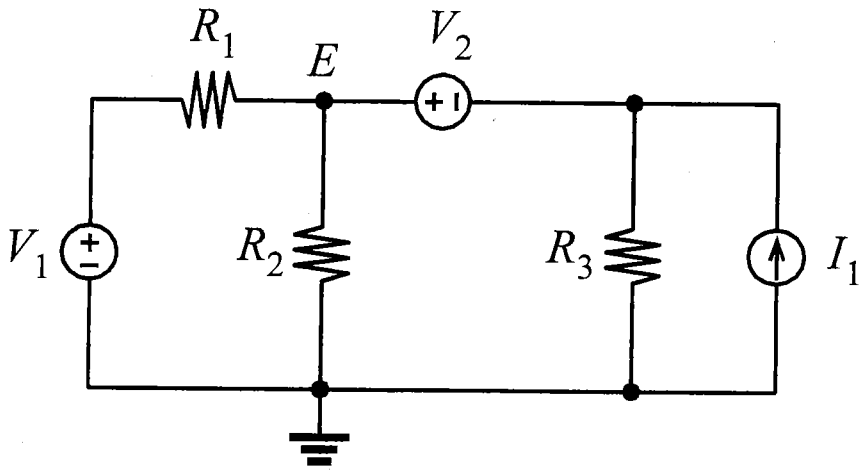
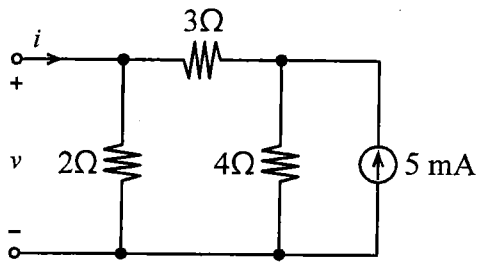
※請在答案卷內作答

3. Use superposition to analyze the following circuit.
   (a) Find out the node voltage E with only the voltage source V_1 active. (5%)
   (b) Find out the node voltage E with only the current source I_1 active. (5%)
   (c) With R_1=4 kOhms, R_2=4 kOhms, R_3=0.2 kOhms, V_1=5 V, V_2=1 V, and I_1=5 mA, what is the node voltage E? (5%)



4. Find the Thevenin and Norton equivalent for the following network. (10%)



5. Consider the circuit in the figure below. The voltage source and the output voltage are given as

$$v_S(t) = 3 + u(t)$$

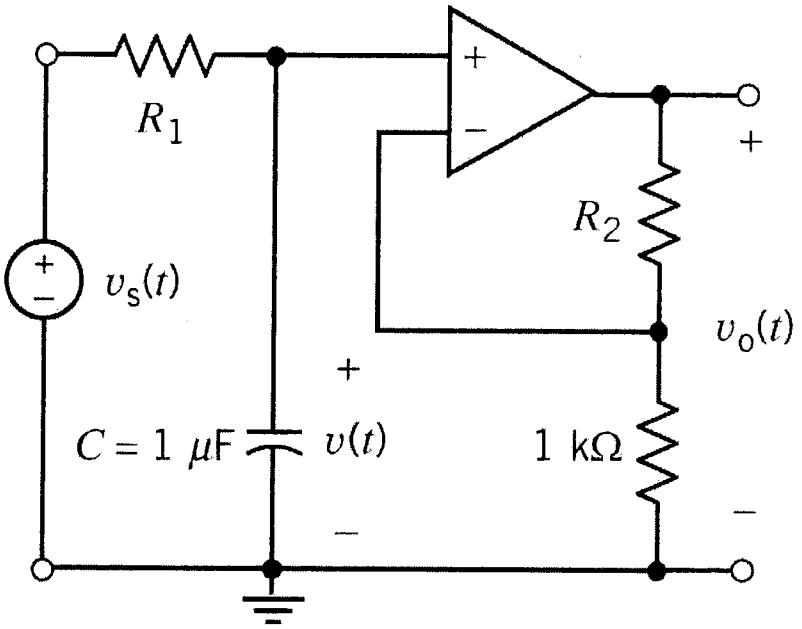
$$v_O(t) = 20 - 5e^{-125t}$$

Please answer the questions below:

(a) Please derive $v(0^+)$ and $v_O(0^+)$ in the circuit. (5%)

(b) Please determine the value of R_1. (5%)

(c) Please determine the value of R_2. (5%)



6. Consider the circuit below. The two voltage sources are given as:

$$v_1(t) = \cos(w_1 t)$$
$$v_2(t) = \cos(w_2 t)$$

Let $v_x(t) = A_1\cos(w_1 t+\phi_1)+A_2\cos(w_2 t+\phi_2)$，please answer the following questions:

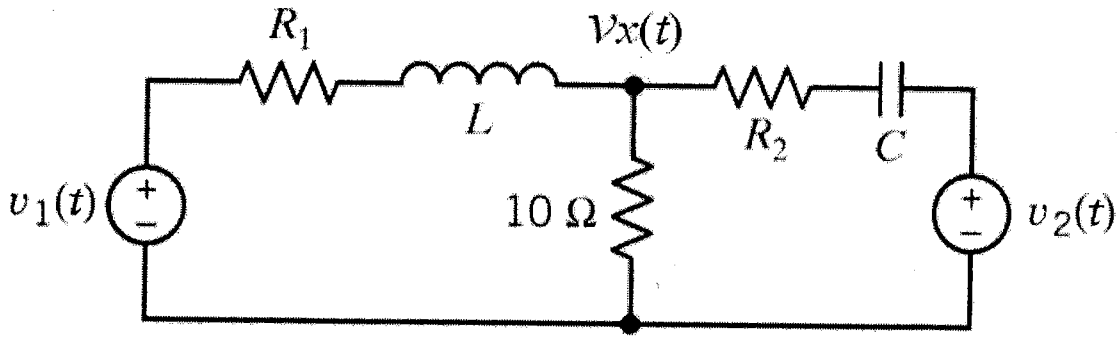
(a) If w_1 is decreased, $\mathbf{A_1}$ will **increase**? **decrease**? or remain **unchanged**? Please **explain** your answers clearly. (5%)

(b) If w_2 is decreased, $\mathbf{A_2}$ will **increase**? **decrease**? or **remain unchanged**? Please **explain** your answers clearly. (5%)

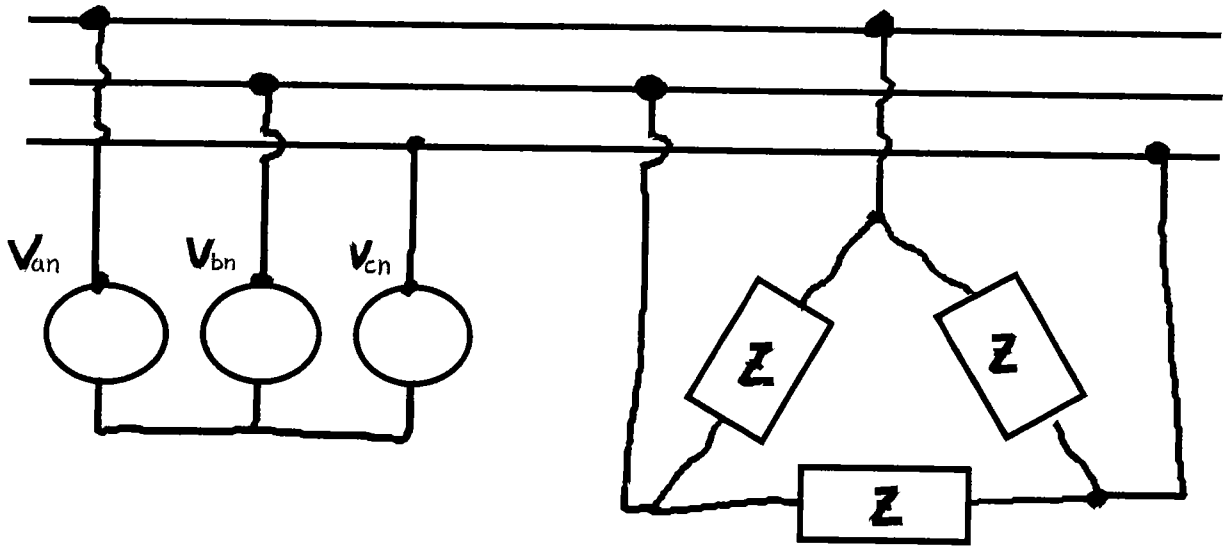
(c) Let $w_1 = w_2 = w$ and the two voltage sources are give as

$$v_1(t) = \cos(wt + 120°)$$
$$v_2(t) = \cos(wt + 45°)$$

If $w \to \infty$, the **phase angle** of $v_X(t)$ will approximates how much? Please **explain** your answers clearly. (5%)



7. A delta-connected load with Z=40 +j30 ohm (per phase) is driven by a balance three phase voltages of 2400V (RMS, line-to-line, 60Hz). For the following calculation, use V_{an} as the phase reference.
   (a) Calculate the load currents and line currents of all three phases. (5%)
   (b) Find the average and reactive power delivered to the load. (5%)
   (c) Design a circuit to compensate the power factor of the load to unity. (5%)



8. Assume the input voltage V_d and the output voltage V_o of the boost converter are constant, and all components are ideal.
   (a) Sketch the steady state waveforms of i_L and i_o under the continuous conduction mode (CCM). (5%)
   (b) Please derive the I_L (average of i_L) and I_o (average of i_o) under the CCM. (5%)

9. In the boost converter, the duty ratio is adjusted to regulate the output voltage V_o at 48 V. The input voltage V_d varies from 12 to 36 V. The maximum power output is 120 W. This converter must operate in the discontinuous-conduction (DCM) mode at all times. The switching frequency is 50 kHz. Assuming all components are ideal, and the output filter capacitor is very large. Calculate the maximum value of the inductor that can be used. (10%)