

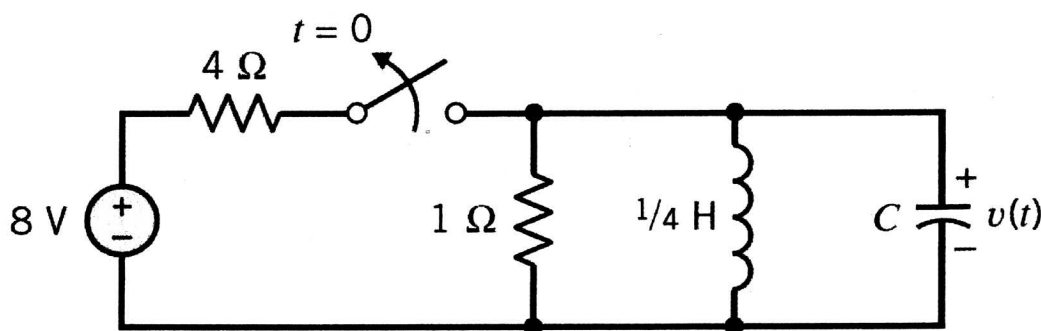
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1. Consider the circuit in the figure below. The switch is opened at $t = 0$. Please answer the questions below (15%):

(a) Assume all nodal voltages and currents in the circuit has reached their steady states before $t < 0$. Please **calculate** the voltage across the capacitor, $v(0)$, and the current flowing through the inductor, $i(0)$, at $t = 0$? Please remember to specify the units for your answers. (5%)

(b) Let $C = 1/4 \text{ F}$ and $v(t)$ represent the voltage across the capacitor after $t > 0$. Is the voltage $v(t)$ an **over-damped** response or an **under-damped** response? Please **explain** your answer clearly. (5%)

(c) If we want to ensure the voltage $v(t)$ across the capacitor has an **over-damped** response after $t > 0$, what is the **maximum value** for the capacitance C ? Please remember to specify the unit for your answer. (5%)



參考用

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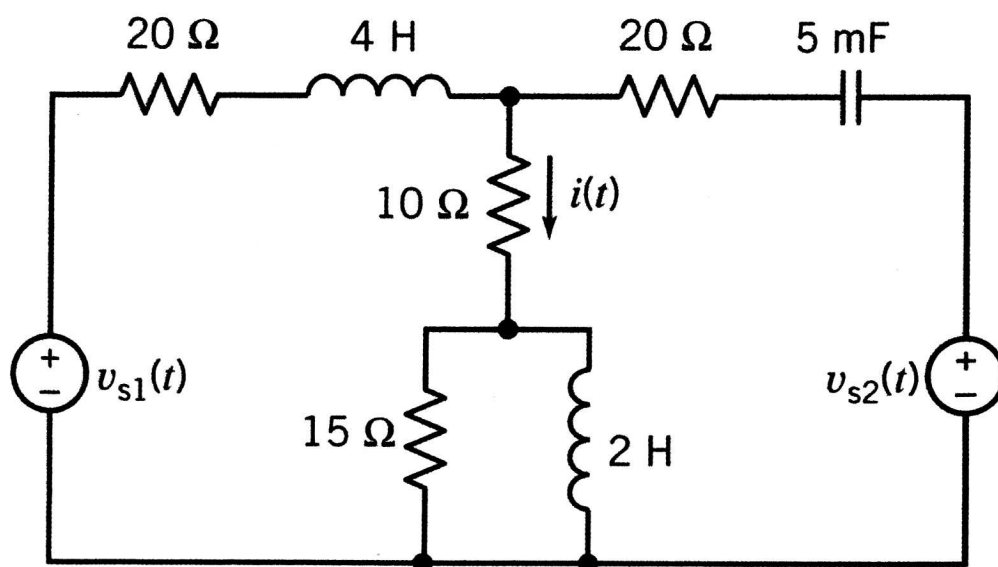
2. Consider the circuit in the figure below. $v_{s1}(t)$ and $v_{s2}(t)$ are both sinusoidal signals given by the equations below:

$$v_{s1}(t) = A_1 \cdot \sin(\omega t + 10^\circ)$$

$$v_{s2}(t) = A_2 \cdot \sin(\omega t + 80^\circ)$$

Let the steady-state response of $i(t)$ be given as $i(t) = i_{s1}(t) + i_{s2}(t)$. According to the superposition rule, $i_{s1}(t)$ represents the steady-state response induced by $v_{s1}(t)$, and $i_{s2}(t)$ the steady-state response by $v_{s2}(t)$. Please answer the following questions (15%):

- As the frequency ω increases, $|i_{s1}(t)|$ will **Increase**? Remain **unchanged**? Or **Decrease**? Please **explain** your answer clearly. (5%)
- As the frequency ω increases, $|i_{s2}(t)|$ will **Increase**? Remain **unchanged**? Or **Decrease**? Please **explain** your answer clearly. (5%)
- As the frequency ω approaches infinite, the **phase angle** of $i(t)$ (the overall response) would approach what value? Please **explain** your answer clearly. (5%)



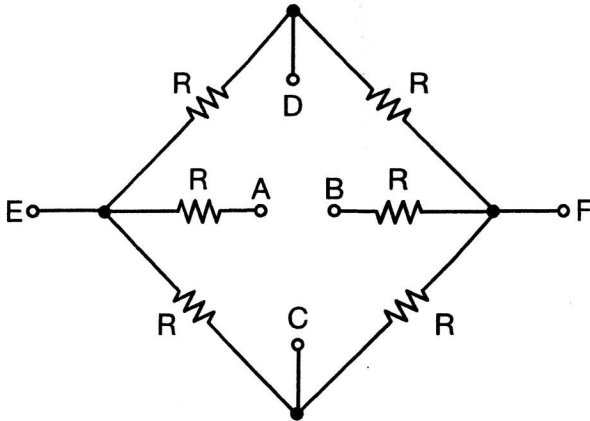
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類組：電機類 科目：電路學(3009)

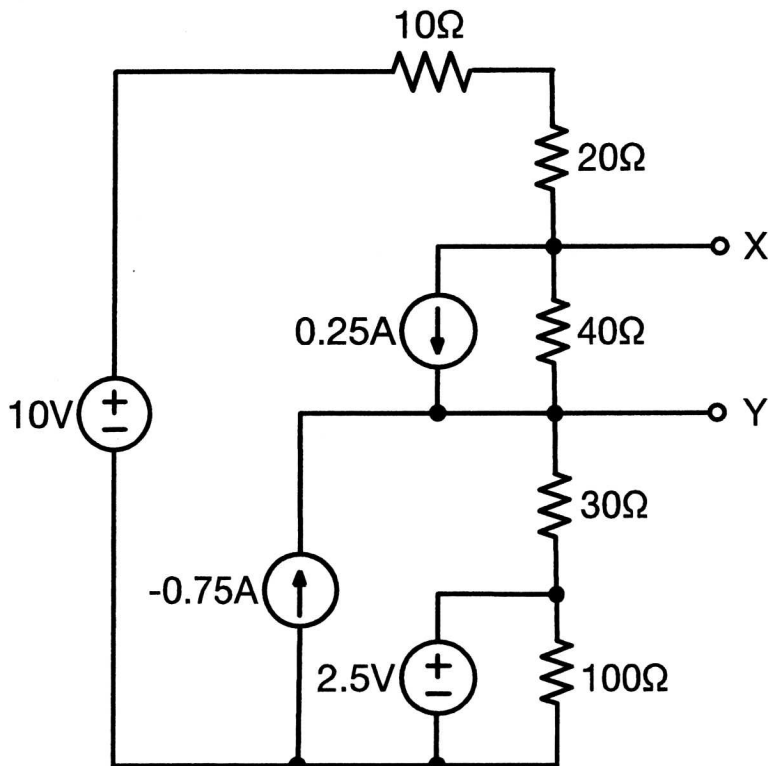
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3. In the following circuit, assume all of the resistors are equal with the same resistance R . Find the equivalent resistance at terminals A and B if
- Terminals C and D are shorted, (5%)
 - Terminals E and F are shorted. (5%)



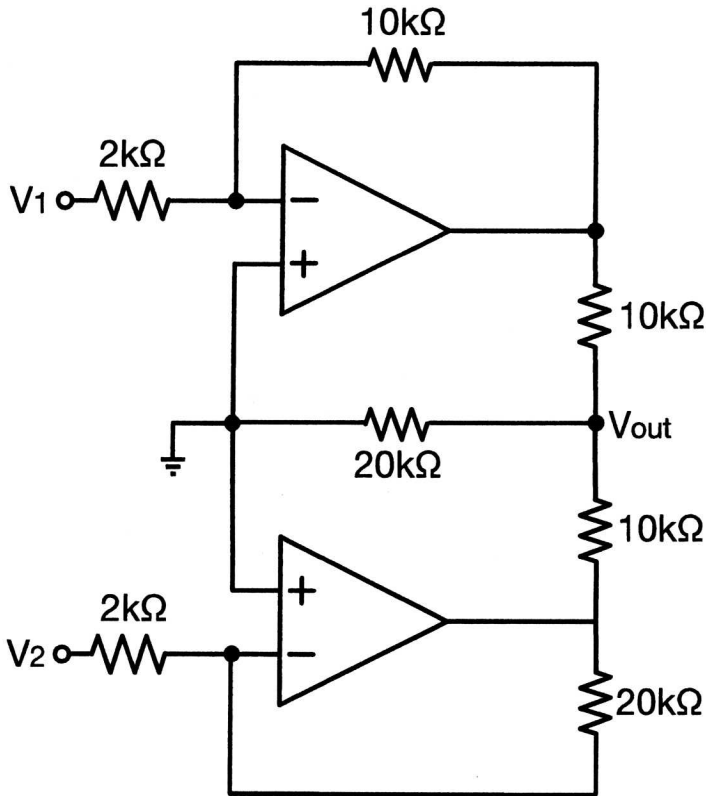
4. Use superposition to find the Thevenin and Norton equivalents with respect to terminals X and Y for the circuit in the following figure. (10%)



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5. In the following figure, assume the operation amplifiers are ideal with infinite input impedance, zero output impedance, and infinite voltage gain. Express v_{out} in terms of v_1 and v_2 . (10%)

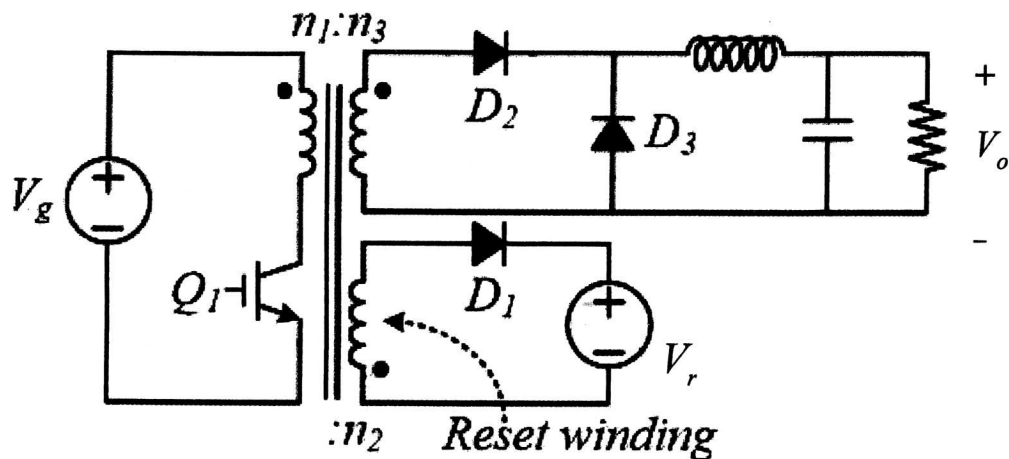


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6. A forward converter with a reset winding and an auxiliary voltage source V_r is as shown. Assume the input voltage V_g is constant, and the transistor operates with a duty ratio of D , and the transformer turns ratios are as illustrated.

- Calculate the average value of output voltage V_o . (5%)
- What is the minimum voltage of V_r that causes the transformer magnetizing current to be reset to zero by the end of the switching period? (10%)
- Please explain why the forward converter needs this reset winding. (5%)



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7. The three-phase and single-phase power system in the figure operate under these conditions:

- The two systems deliver the same total complex power to the load.
- The two systems have the same line-to-line voltages.
- The two systems have the same transmission efficiency.
- The distance from source to load is the same.
- The resistance of the power line is proportional to its length divided by the cross-section area of the wire.

Show that the transmission line in a three-phase system requires 25% less copper than the single-phase system.

(20%)

