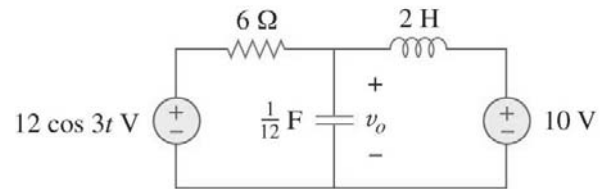


- 1) Given that the voltage across a certain element X is $V = 3 \cos(1000t + 20^\circ)$ and the associated current in the element is $I = 12 \cos(1000t - 45^\circ)$,
- Find the impedance of element X. $Z = 0.25 \angle 65^\circ \Omega$
 - Which of the following combinations could possibly describe element X:
 - A resistor in series with a capacitor
 - A resistor in series with an inductor
 - A capacitor in series with an inductor

- 2) Referring to the circuit in Fig 2,

- Determine v_o due to the DC source.
- Determine v_o due to the AC source.
- What is the average value of v_o ?
- Find the current through capacitor.



Fig

- Short circuit sinusoidal source + replace L with short + replace C with open
 $\Rightarrow V_o = 10 \text{ V}$

- Option 1: Voltage divider rule

$$Y(C||L) = j(3)(1/12) + 1/j(3*2) = j/12$$

$$\Rightarrow Z = -j12$$

- Option 2: Nodal voltage analysis

$$X_c = -j4, X_L = j6$$

$$(12 - V_o)/6 = V_o/(-j4) + V_o/(j6)$$

$$V_o = -j12/(6 - j12) * 12 = 10.73 \angle -26.56^\circ \text{ V}$$

$$V_o(t) = 10.73 \cos(3t - 26.56^\circ) \text{ V}$$

- Average value is given by the DC offset: i.e. 10V
- No current at DC, only component is at 3 rad/s
 $I_o = V_o/X_c = (10.73/4) \angle (-26.56^\circ + 90^\circ)$
 $i_o(t) = 2.68 \cos(3t + 63.44^\circ) \text{ A}$

- 3) Referring to the circuit in Fig 2,

- Find V_1 and V_2 .
- Find I_1 and I_2 .
- Find V_3 and V_4 .
- Find v_o .

- $V_1 = [10/(10+20)] * 5 = 5/3 \text{ V}$
 $\Rightarrow V_2 = V_1 = 5/3 \text{ V}$
- $I_1 = 0 \text{ A}$
 $I_2 = (5/3 - 1)/20k = 1/30 \text{ mA}$
- $5/3 + (1/30 \text{ mA} * 10 \text{ k}) = 2 \text{ V}$
 $V_4 = 0 \text{ V}$
- $V_3/V_o = -40/100 = -2/5$
 $\Rightarrow V_o = -(5/2)*2V = -5V$

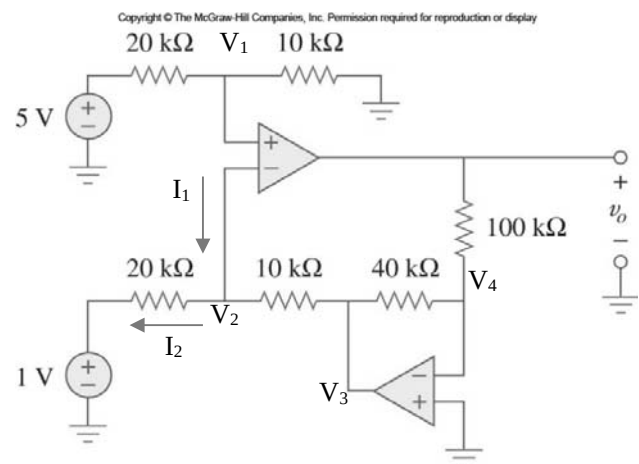


Fig 2