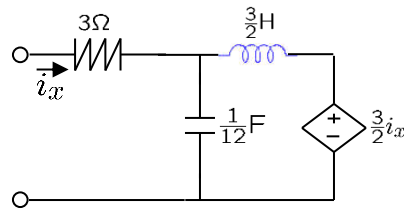


HOMEWORK IV

Question 1 Consider the one-port circuit below.

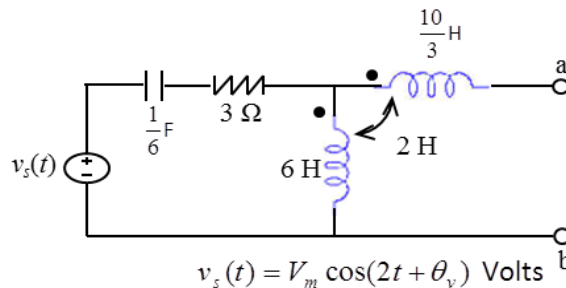


- Find the input impedance of the one-port at the frequency $\omega = 2$ rad/s.
- Find the frequency ω at which the input impedance is $K - jK \Omega$. Also find K .

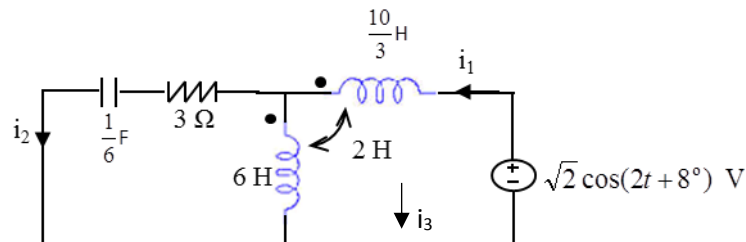
Answer a) $6 + j6 \Omega$. b) $\omega = 6$ rad/s, $K = 18/7 \Omega$.

Question 2

- Find and sketch the Thevenin equivalent of the following circuit in the phasor domain.



- The circuit below is in the steady-state. Find $i_1(t)$, $i_2(t)$, and $i_3(t)$.



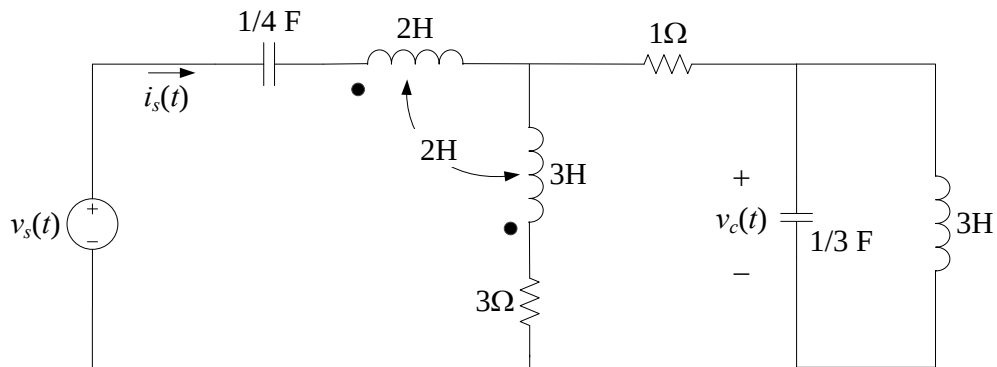
Hint: You may use the result of Part (a).

Answer a) $V_{TH} = \left[\frac{12 + j4}{15} \right] V_s$ V, $Z_{TH} = \frac{32 + j64}{15} \Omega$.

b) $i_1(t) = \frac{3\sqrt{10}}{32} \cos[2t + 8^\circ - \tan^{-1}(2)]$ A,

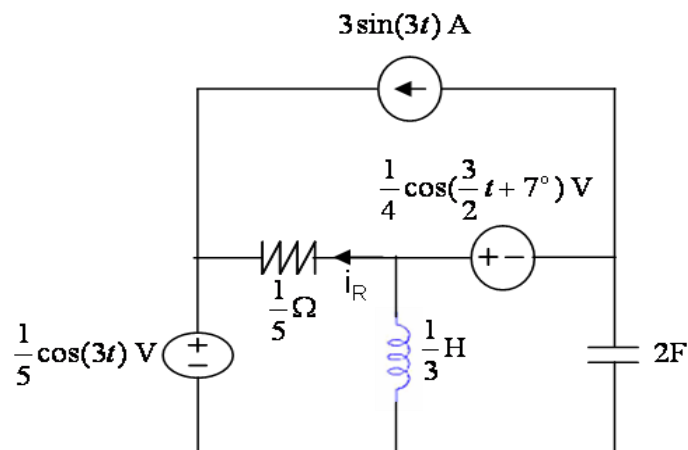
$i_2(t) = 0.25 \cos(2t - 37^\circ)$ A, $i_3(t) = \left[-\frac{\sqrt{10}}{32} \cos[2t + 8^\circ + \tan^{-1}(2)] \right]$ A.

Question 3 The circuit below is in the sinusoidal steady-state. Find $v_C(t)$ and $i_s(t)$.



$$v_s(t) = 14\cos(2t+10^\circ) \text{ V}$$

Question 4 The circuit below is in the steady-state.

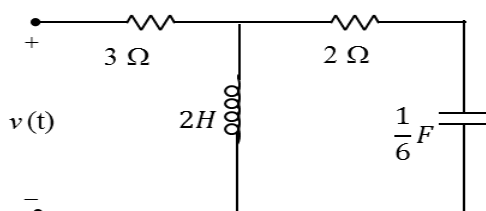


- Find $i_R(t)$.
- Compute the average power delivered to the resistor.

Question 5 The one-port below is in the sinusoidal steady-state.

The average stored energy in the capacitor is 12 J.

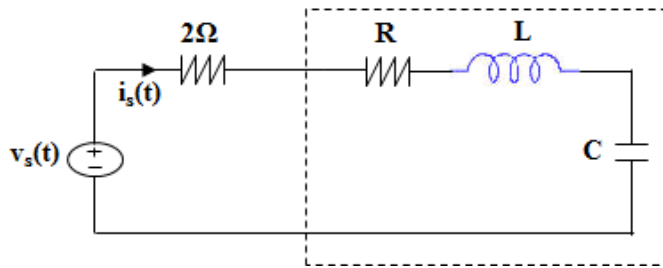
Find V_m and the complex power given to the one-port.



$$v(t) = V_m \cos(3t - 22^\circ) \text{ V}$$

Answer $30\sqrt{2} \text{ V}$, $132 - j24 \text{ VA}$.

Question 6 The circuit below is in the sinusoidal steady-state.



$$v_s(t) = 12\sqrt{2} \cos(\omega t) \text{ V.}$$

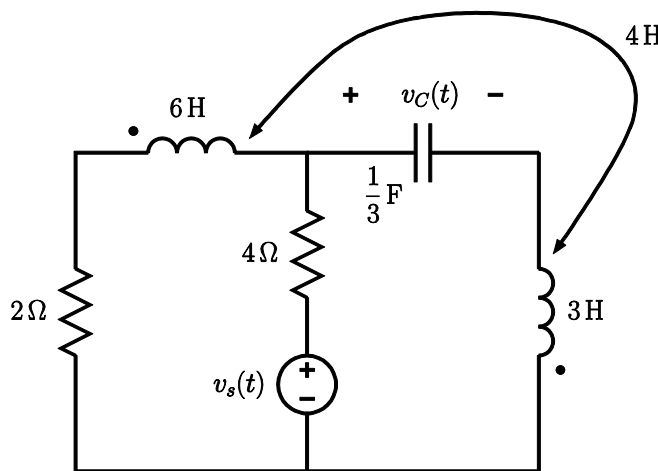
For $\omega = 2 \text{ rad/s}$ $v_s(t)$ and $i_s(t)$ are in phase, the effective value of $i_s(t)$ is less than 3 A, and the average power delivered to the one-port is 16 W.

For $\omega = 4 \text{ rad/s}$ The apparent power supplied by the source is 14.4 VA.

Find the R , L , and C values.

Answer 4Ω , $8/3 \text{ H}$, $3/32 \text{ F}$.

Question 7 The circuit below is in the sinusoidal steady-state.



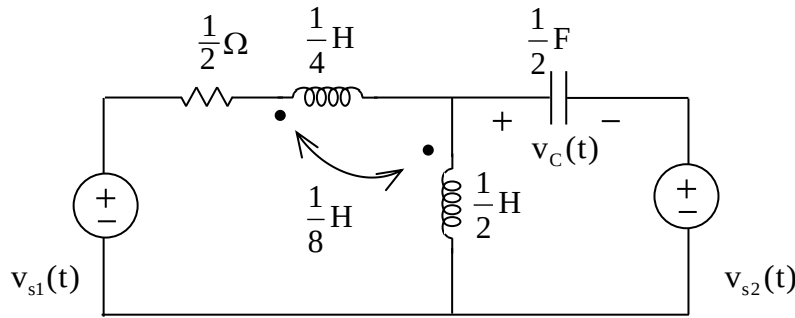
$$v_s(t) = 20\sqrt{2} \cos(3t + 14^\circ) \text{ V}$$

- Find $v_C(t)$.
- Find the average powers delivered to the resistors and the average stored energies in the dynamic elements.

Answer a) $5\sqrt{2} \cos(3t - 76^\circ) \text{ V}$.

b) $P_{2\Omega, \text{avg}} = 20 \text{ W}$, $P_{4\Omega, \text{avg}} = 20 \text{ W}$, $E_{C, \text{avg}} = \frac{25}{6} \text{ J}$, $E_{L, \text{avg}} = 7.5 \text{ J}$.

Question 8 The circuit below is in the steady-state.



$$v_{s1}(t) = 5 \cos(4t) \text{ V}$$

$$v_{s2}(t) = \frac{15}{4} \cos(2t + 30^\circ) \text{ V}$$

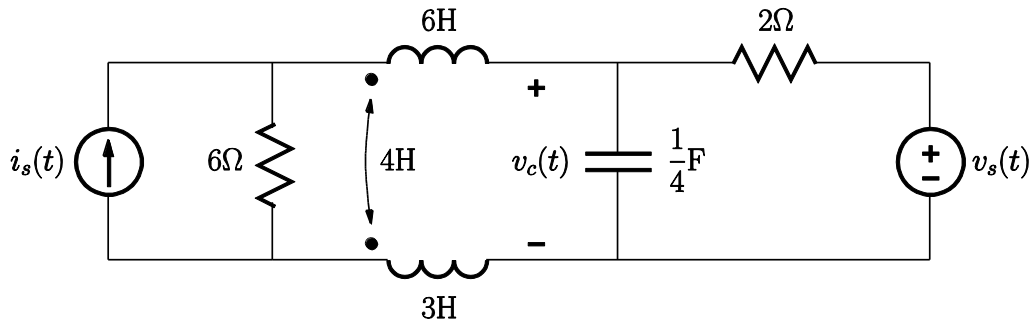
Find,

- $v_c(t)$,
- The average stored energy in the capacitor,
- The average power delivered to the resistor.

Answer a) $2.5\sqrt{10} \cos[4t - \tan^{-1}(3)] - 1.2\sqrt{17} \cos[2t + 30^\circ - \tan^{-1}(0.25)] \text{ V}$.

b) $(125/16) + 3.06 \text{ J}$. c) $22.5 + 2.25 \text{ W}$.

Question 9 The circuit below is in the steady-state.



$$i_s(t) = 10 \cos(2t + 30^\circ) \text{ A}$$

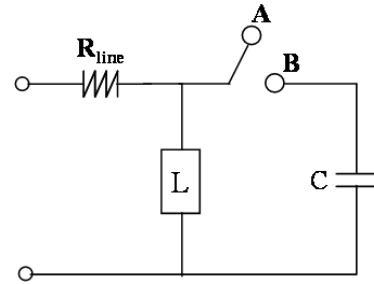
- $v_s(t) = 0$. Find,
 - $v_c(t)$,
 - The average power delivered to the 2Ω resistor,
 - The average stored energy in the capacitor,
 - The complex power supplied by the independent current source.
- $v_s(t) = V_m \cos(4t + \theta_s) \text{ V}$. The average power delivered to the 6Ω resistor is 18 W . Find the average stored energy in the capacitor, the real power supplied by the independent voltage source, and V_m .

Answer a) $12 \cos[2t + 30^\circ - \tan^{-1}(4/3)] \text{ V}$, 36 W , 9 J , $48 + j36 \text{ VA}$.

b) 15.5 J , 96 W , $16\sqrt{2} \text{ V}$.

Question 10 For the one-port circuit shown below,

- The inductive load L operates at the same RMS voltage for both switch positions,
- The real power given to R_{line} is denoted by P_A and P_B when the switch is at positions A and B , respectively,
- $P_L = 12 \text{ kW}$,
- $P_B/P_A = 9/16$,
- The power factor of the compensated load (when the switch is at position B) is 0.8 lagging.



Find the reactive power of the load.

Answer 16 kVAR.