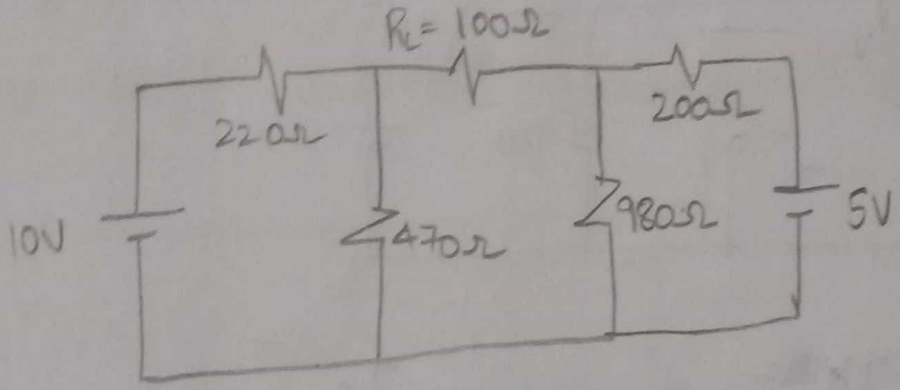
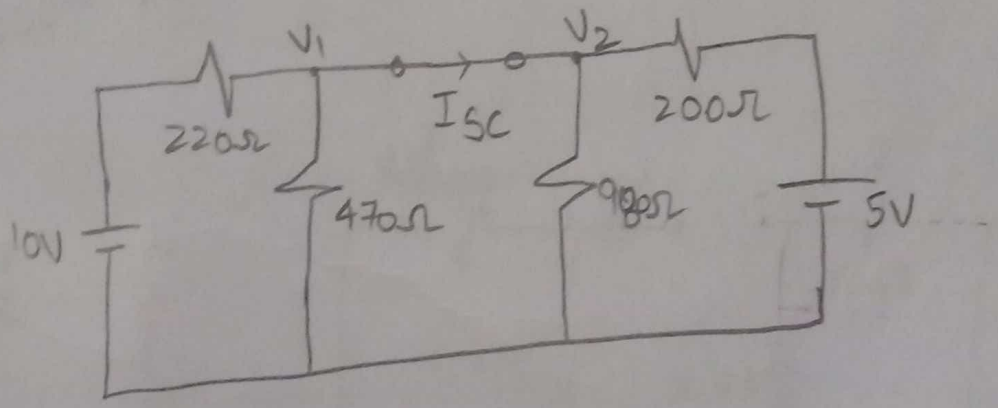
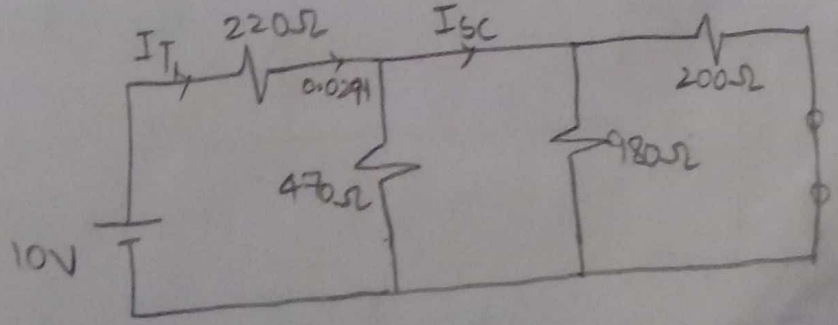
7. Obtain the Norton's model for the given circuit.



Sol



Case i) While 10V source is acting alone



$$R_T = \frac{200 \times 980}{1480} = 166.1\Omega$$

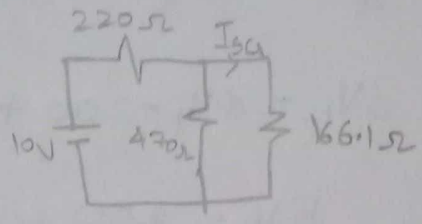
$$= \frac{470 \times 166.1}{166.1} = 122.7\,\Omega$$

$$R_T = 122.7 + 220 = 342.7\,\Omega$$

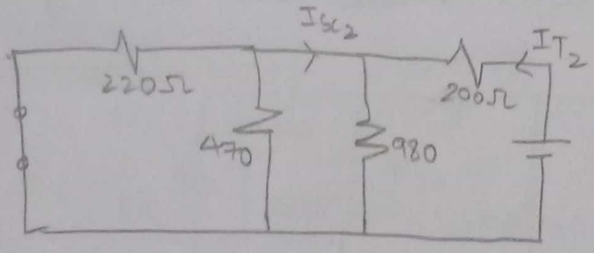
$$I_{T_1} = \frac{V}{R_T} = \frac{10}{342.7} = 0.0291\,A$$

$$I_{SC_1} = \frac{0.0291 \cdot 470}{470 + 166.1}$$

$$I_{SC_1} = 0.021\,A$$

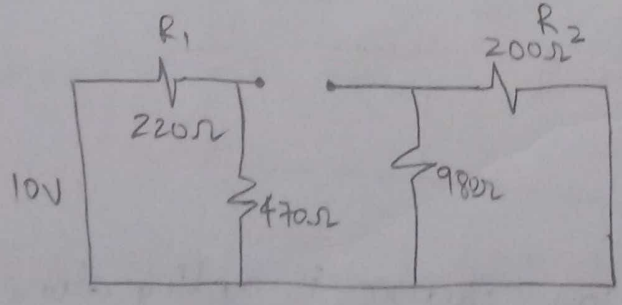


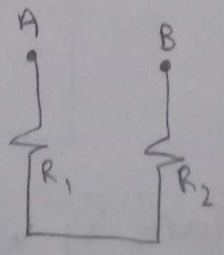
Case 2) While 5V sources acting alone



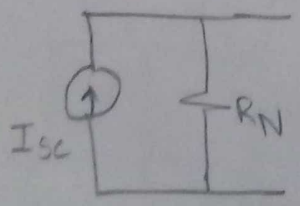
$$I_{SC_2} = I_{T_2}$$

$$I_{SC} = I_{SC_1} - I_{SC_2}$$





$$R_{12} = R_1 + R_2$$



Determine the average, RMS, form factor and peak factor of sign voltage waveform

Sol Form Factor $= \frac{V_{rms}}{V_{avg}} = \frac{V_m/\sqrt{2}}{\frac{2V_m}{\pi}} = \frac{V_m}{\sqrt{2}} \times \frac{\pi}{2V_m}$

$\Rightarrow \frac{1}{\sqrt{2}} \times \frac{\pi}{2} = \frac{\pi}{2\sqrt{2}} = 1.11$

Form Factor = 1.11

Peak Factor $= \frac{V_m}{V_{rms}} = \frac{V_m}{V_m/\sqrt{2}} = \frac{V_m}{1} \times \frac{\sqrt{2}}{V_m}$

Peak factor = 1.414

$\sin^2 t =$

$\therefore \cos 2t$

$\therefore \sin 2t$

$V_{Average}$ of Sine wave form

$$* \frac{1}{\pi}\int_0^{\pi} V_m \sin t \, dt$$

$$= \frac{V_m}{\pi}\left[-\cos t\right]_0^{\pi}$$

$$= -\frac{V_m}{\pi}\left[-1-1\right]$$

$$= \frac{2V_m}{\pi} = \boxed{\frac{2V_M}{\pi} = V_{avg}}$$

$$* \sqrt{\frac{1}{2\pi}\int_0^{2\pi}(V_m \sin t)^2 dt}$$

$$= \sqrt{\frac{V_m^2}{2\pi}\int_0^{2\pi}\left[\frac{1-\cos 2t}{2}\right]dt}$$

$$= \sqrt{\frac{V_m^2}{4\pi}\left[t - \frac{\sin 2t}{2}\right]_0^{2\pi}}$$

$$= \sqrt{\frac{V_m^2}{4\pi}\left[\left(2\pi - \frac{\sin 4\pi}{2}\right) - \left(0 - \frac{\sin 0}{2}\right)\right.}$$

$$= \sqrt{\frac{V_m^2}{4\pi} \left[2\pi - \frac{\sin 4\pi}{2} \right]}$$

$$= \sqrt{\frac{V_m^2}{2} \left[1 - \frac{0}{2} \right]}$$

$$= \sqrt{\frac{V_m^2}{2}} = \frac{V_m}{\sqrt{2}}$$

$$\boxed{V_{rms} = \frac{V_m}{\sqrt{2}}} \text{ ★★★}$$

2) ★ Voltage and current for a circuit with two elements in series are expressed as follows.

$$v(t) = 170 \sin(6280t + \pi/3) \text{ volts.}$$

$$i(t) = 8.5 \sin(6280t + \pi/2) \text{ Amperes.}$$

Determine the frequency in Hz, power factor, nature and values of the elements.

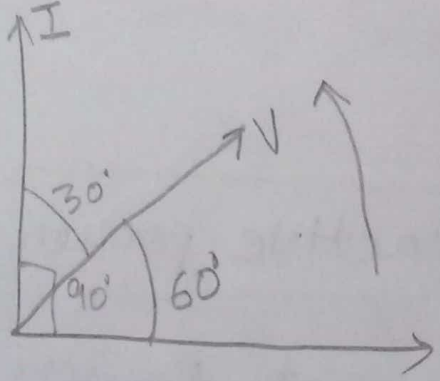
A)

Power factor = $\cos 30^\circ$

$= \sqrt{3}/2$

$= 0.82$ leading

Power factor



$\omega = 2\pi f = 6280$

$= 2\pi f = 6280$

$f = 999 \text{ Hz}$

As current is leading the voltage by 30°, circuit elements are having resistive & capacitive nature.

$$Z = \frac{V_m \angle 60^\circ}{I_m \angle 90^\circ} = \frac{170^\circ}{18.5} \angle -30$$

$Z = 20 \angle -30 \rightarrow$ Polar form

$Z = 20\cos 30^\circ - j\,20\sin 30^\circ$

$$\boxed{Z = 17.7 - j10}\ \Omega$$

R $\quad$ $-jX_C$

$R = 17.7\ \Omega$

$$X_C = \frac{1}{\omega C} \quad 10 = \frac{1}{\omega C}$$

$$C = \frac{1}{10\omega} = \frac{1}{10(6280)}$$

$C = 15.9 \times 10^{-6}$

$$\boxed{C = 15.9\ \mu F}$$

$$\text{Power} = \frac{V_M}{\sqrt{2}} \cdot \frac{I_m}{\sqrt{2}} \cdot \cos\theta$$

$Q = VI\sin\theta$

$V(t) = 27\sin 340t$

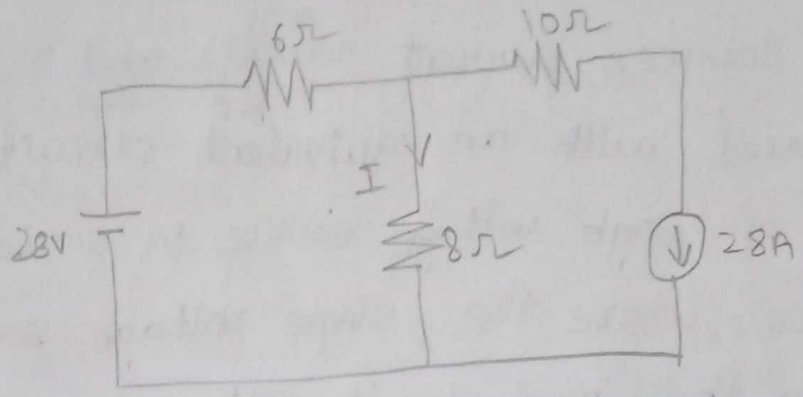
$i(t) = 5\sin(340t + \pi/6)$

$+\pi/2$ Pure capacitor

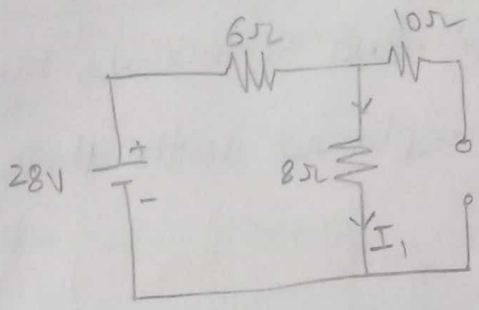
$-\pi/2$ Pure Inductor

$-\pi/6$ R_L.

3. Determine the current in 8Ω resistor using superposition theorem.

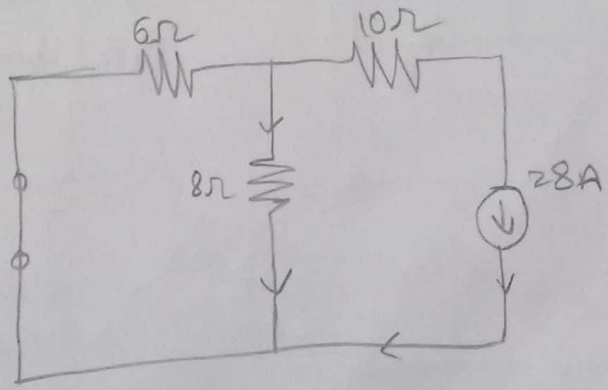


Sol: Case 1) while 28V source acting alone



$$I_1 = \frac{28}{6+8} = 2A$$

Case 2) While 28A source acting alone



$$I_2 = -28 \cdot \frac{6}{6+8}$$

$$I_2 = -12A$$

$$I_{8\Omega} = 2 - 12 = -10A$$