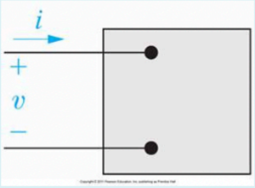
1.



P10.01d_9ed

For the following set of values, calculate P, Q and state whether the circuit inside the box is absorbing or delivering (1) average power and (2) magnetizing vars.

d) v = 200 sin(ωt + 250°) V   i = 5 cos(ωt + 40°) A

P = -250 W Delivering Watts

Q = 433.01 VAR Absorbing VARs

• $v = 200\cos[90° - (\omega t + 250°)]$

$= 200\cos(-\omega t - 160°)$

$= 200\cos(\omega t + 160°)$

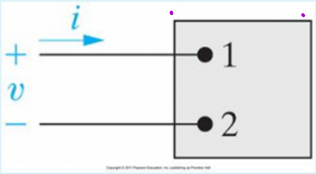
$P_{avg} = \frac{V_m I_m}{2}\cos(\theta_v - \theta_i)$

$= \frac{(200)(5)}{2}\cos(160° - 40°) = -250$ W (DELIVERING)

$Q = \frac{V_m I_m}{2}\sin(\theta_v - \theta_i)$

$= \frac{(200)(5)}{2}\sin(160° - 40°) = 433.01$ VAR (ABSORBING)

2.



P10.01b_6ed

Calculate P and Q of the following voltage and current. State whether the element is absorbing or delivering average power and magnetizing VARs.

v = 75 cos(ωt - 15°) V   i = 16 cos(ωt + 60°) A

P = 155.29 W Absorbing Watts

Q = -579.56 VAR Delivering VARs

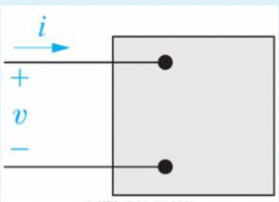
$P_{avg} = \frac{V_m I_m}{2}\cos(\theta_v - \theta_i)$

$= \frac{(75)(16)}{2}\cos(-15° - 60°) = 155.29$ W (ABSORBING)

$Q = \frac{V_m I_m}{2}\sin(\theta_v - \theta_i)$

$= \frac{(75)(16)}{2}\sin(-15° - 60°) = -579.56$ VARs (DELIVERING)

3.



P10.01c_9ed

For the following set of values, calculate P, Q and state whether the circuit inside the box is absorbing or delivering (1) average power and (2) magnetizing vars.

c) v = 400 cos(ωt + 30°) V   i = 10 sin(ωt + 240°) A

P = -1000 W Delivering Watts

Q = -1732.05 VAR Delivering VARs

• $i = 10\sin(\omega t + 240°)$

$= 10\cos[90 - (\omega t + 240°)]$

$= 10\cos(\omega t + 150°)$

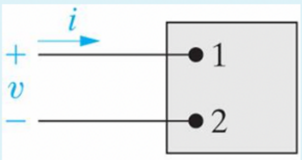
$P_{avg} = \frac{V_m I_m}{2}\cos(\theta_v - \theta_i)$

$= \frac{(400)(10)}{2}\cos(30° - 150°) = -1000$ (DELIVERING)

$Q = \frac{V_m I_m}{2}\sin(\theta_v - \theta_i)$

$= \frac{(400)(10)}{2}\sin(30° - 150°) = -1732.05$ (DELIVERING)

4.



P10.01d_6ed

Calculate P and Q of the following voltage and current. State whether the element is absorbing or delivering average power and magnetizing VARs.

v = 180 sin(ωt + 220°) V   i = 10 cos(ωt + 20°) A

P = -307.82 W Delivering Watts

Q = 845.72 VAR Absorbing VARs

• $v = 180\sin(\omega t + 220°)$ V

$= 180\cos[90 - (\omega t + 220°)]$

$= 180\cos(\omega t + 130°)$

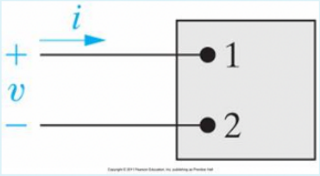
$P_{avg} = \frac{V_m I_m}{2}\cos(\theta_v - \theta_i)$

$= \frac{(180)(10)}{2}\cos(130° - 20°) = -307.82$ W (DELIVERS)

$Q = \frac{V_m I_m}{2}\sin(\theta_v - \theta_i)$

$= \frac{(180)(10)}{2}\sin(130° - 20°) = 845.72$ W (ABSORB)

5



P10.01a_6ed

Calculate P and Q of the following voltage and current. State whether the element is absorbing or delivering average power and magnetizing VARs.

$v = 340\cos(\omega t + 60°)$ V $\quad i = 20\cos(\omega t + 15°)$ A

P = 2404.16 ✔ W Absorbing ✔ Watts

Q = 2404.16 ✔ VAR Absorbing ✔ VARS

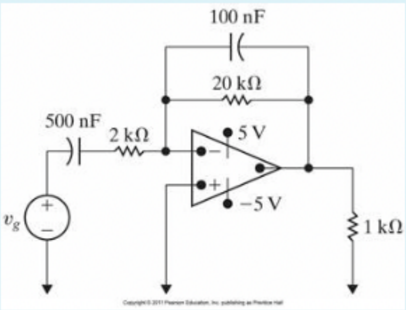
$P_{avg} = \frac{V_m I_m}{2}\cos(\theta_v - \theta_i)$

$= \frac{(340)(20)}{2}\cos(60-15) = 2404.16$ (ABSORB)

$Q = \frac{V_m I_m}{2}\sin(\theta_v - \theta_i)$

$= \frac{(340)(20)}{2}\sin(60-15) = 2404.16$ (ABSORB)

6



P10.07_9ed

The opamp is ideal. $\quad v_g = \cos(1{,}000t)$ V

Calculate the average power dissipated by the 1 kΩ (kilo Ohm) resistor.

$P_{avg,1k\Omega}$ = 5 ✔ mW (milli Watt) ("+" = absorbed, "-" = delivered)

$Z_{500nF} = \frac{-j}{\omega C} = \frac{-j}{(1000)(500\times10^{-9})} = -2000j$

$Z_{100nF} = \frac{-j}{\omega C} = \frac{-j}{(1000)(100\times10^{-9})} = -10\,000j$

$100\,nF \,//\, 20\,k\Omega = \frac{(-10\,000j)(20\,000)}{-10\,000j + 20\,000} = \frac{-200\times10^{6}j}{20\,000 - 10\,000j}\cdot\frac{20\,000+10\,000j}{20\,000+10\,000j}$

$= \frac{-4\times10^{12}j + 2\times10^{12}}{500\times10^{6}} = 4000 - j8000$

$V_g = 1\angle0° = 1$

$\frac{V_n - V_g}{-j2000+2000} + \frac{V_n - V_o}{4000 - j8000} = 0$

$\left[\frac{-1}{2000(1-j)} + \frac{-V_o}{4000(1-j2)} = 0\right](2000)$

$\frac{-1}{1-j} - \frac{V_o}{2(1-j2)} = 0 \longrightarrow \frac{-2(1+j)}{2} = \frac{V_o}{1-j2} \longrightarrow (1+j)(1-j2) = V_o$

$V_o = 1 - j + 2 = 3 - j \approx \sqrt{10}\angle -18.43°$

$V = IR \longrightarrow I = \frac{V}{R} = \frac{3-j}{1000} = 3\times10^{-3} - j1\times10^{-3} \approx 3.16\times10^{-3}\angle -18.43°$

$P_{avg} = \frac{(\sqrt{10})(3.16\times10^{-3})}{2}\cos(0) = 5\times10^{-3}\,W \approx 5\,mW$

7

$$p_{max} = P_{avg} + \sqrt{P^2 + Q^2}$$

$$p_{min} = P_{avg} - \sqrt{P^2 + Q^2}$$

P10.04_9ed

A load consisting of a 480 W resistor in parallel with a (5/9) µF (micro Farad) capacitor is connected across the terminals of a sinusoidal voltage source $v_g = 240\cos(5{,}000t)$ V.

a) What is the average power absorbed/delivered by the load?

P_{avg} = 60 ✔ W

b) What is the reactive power absorbed/delivered by the load?

Q = -80 ✔ VAR

c) What is the peak value of the instantaneous power delivered by the source?

The figure shows the result of a derivation for p_{max}.

p_{max} = -160 ✔ W ("+" = absorbed, "-" = delivered)

d) What is the peak value of the instantaneous power absorbed by the source?

The figure shows the result of a derivation for p_{min}.

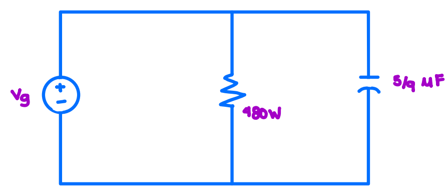
p_{min} = 40 ✔ W ("+" = absorbed, "-" = delivered)

e) What is the power factor of the load?

pf = 0.6 ✔

f) What is the reactive factor of the load?

rf = -0.8 ✔ ("+" = inductive, "-" = capacitive)



$V_g = 240\angle0° \approx 240$

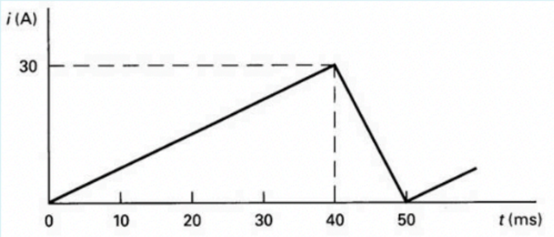
$X_C = \frac{1}{\omega C} = \frac{1}{(5000)(5/9\times10^{-6})}$

$= 360$

$P_{avg} = \frac{V_{rms}^2}{R} = \frac{(240/\sqrt{2})^2}{480} = 60\,W$

$Q = \frac{V_{rms}^2}{X_C} = \frac{(240/\sqrt{2})^2}{360} = 80\,VAR$

8.



P10.5_6ed

Given: The period of the waveform is 50 ms (milli sec).

a) Find the rms value of the periodic current shown in the figure.

i_{rms} = 17.32 ✔ A_{rms}

b) Given that the periodic waveform dissipates an average power of 24 kW in a resistor. What is the value of the resistor?

R = 80 ✔ Ω (Ohm)

$y = mx + b$

$\overline{AB}$: $i = \frac{30-0}{(40\times10^{-3})-0} t + b$

$i = 750t$ $\quad 0 < t < 40$ ms

$\overline{BC}$: $i = \frac{0-30}{50\times10^{-3} - 40\times10^{-3}} t + b$

$i = -3000t + b$

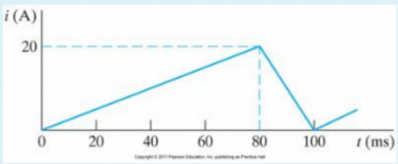
$30 = -3000(40\times10^{-3}) + b$

$b = 150$

$i = -3000t + 150$ $\quad 40 < t < 50$ ms

$i_{rms} = \frac{1}{T}\int_0^T i^2(t)\,dt$

9



P10.13_9ed

Given: The period of the waveform is 100 ms (milli sec).

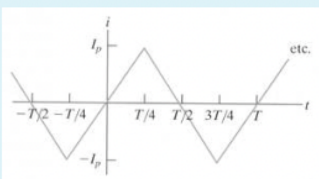
a) Find the rms value of the periodic waveform shown in the figure.

I_{rms} = 11.55 ✔ A_{rms}

b) Given that the periodic waveform dissipates an average power of 1,280 W in a resistor. What is the value of the resistor?

R = 9.6 ✔ Ω (Ohm)

10



AP10.3_9ed

The periodic triangular current has a peak value of 180 mA (milli Amp).

Find the average power that this current delivers to a 5 kΩ (kilo Ohm) resistor.

P_{avg} = 54 ✔ W