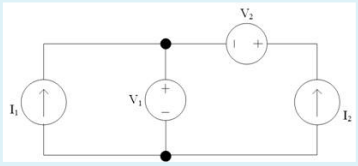
Quiz 02

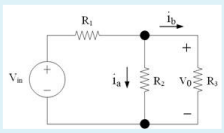


Quiz 2-1

Given: $I_1 = 13$ Amps $V_1 = 227$ Volts $I_2 = 2$ Amps $V_2 = 67$ Volts

What is the current through the voltage source V_1?

Answer: 15 ✔



Quiz 2-2b

Given: $V_{in} = 60$ Volts

$R_1 = 4\ \Omega$ (Ohm) $R_2 = 20\ \Omega$ (Ohm) $R_3 = 80\ \Omega$ (Ohm)

a) Find the value of i_a. i_a = 2.4 ✔ A

b) Find the value of v_0. v_0 = 48 ✔ V

c) Find the power dissipated in each resistor.

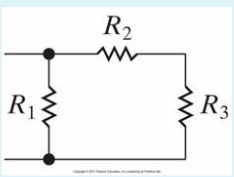
P_{R1} = 36 ✔ W P_{R2} = 115.2 ✔ W P_{R3} = 28.8 ✔ W

d) Find the power delivered by the V_{in} source.

P_{Vin} = -180 ✔ W

Remember: "-" = Delivering "+" = Absorbing

Quiz 03

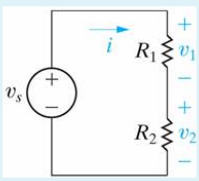


Quiz 3 - Q1f

Given: $R_1 = 1$ kΩ (Ohms) $R_2 = 60\ \Omega$ (Ohms) $R_3 = 190\ \Omega$ (Ohms)

Find the equivalent resistance R_{Eq}.

R_{Eq} = 200 ✔ Ω (Ohms)



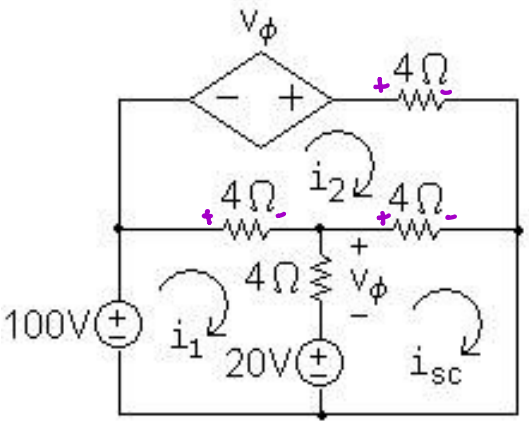
Quiz 3 - Q2e

Given: $v_s = 60$ Volts $R_1 = 450\ \Omega$ (Ohms) $R_2 = 800\ \Omega$ (Ohms)

a) Find the voltage v_1. v_1 = 21.6 ✔ Volts

b) Find the voltage v_2. v_2 = 38.4 ✔ Volts

c) Find the current i. i = 48 ✔ mA (milli Amp)



$100 - 4(i_1 - i_2) - 4(i_1 - i_{sc}) - 20 = 0$

$-8i_1 + 4i_2 + 4i_{sc} + 80 = 0$ (1)

$20 + 4(i_1 - i_{sc}) - 4(i_{sc} - i_2) = 0$

$4i_1 + 4i_2 - 8i_{sc} + 20 = 0$ (2)

$V_\phi = 4(i_1 - i_{sc})$

$V_\phi - 4i_2 + 4(i_{sc} - i_2) + 4(i_1 - i_2) = 0$

$4(i_1 - i_{sc}) - 4i_2 + 4(i_{sc} - i_2) + 4(i_1 - i_2) = 0$

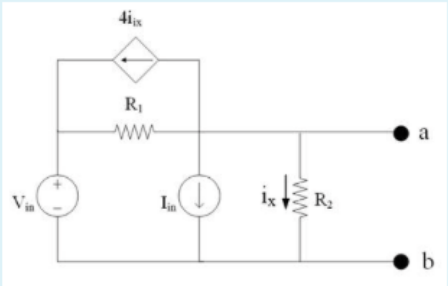
$8i_1 - 12i_2 = 0$ (3)

$-8i_1 + 4i_2 + 4i_{sc} = -80$
$4i_1 + 4i_2 - 8i_{sc} = -20$
$8i_1 - 12i_2 = 0$

$i_1 = 45$ A
$i_2 = 30$ A
$i_{sc} = 40$ A

$P_{V_\phi} = i_2 V_\phi = i_2[4(i_1 - i_{sc})]$
$= (30)[4(45-40)]$
$= 600$ (-)

Quiz 07



Quiz 7a

Given: $V_{in} = 20$ V $I_{in} = 4$ A $R_1 = 2$ Ω (Ohms) $R_2 = 6$ Ω (Ohms)

Find the Thévenin equivalent circuit with respect to the terminals ab.

V_{Th} = 4.5 ✔ V

R_{TH} = 0.75 ✔ Ω (Ohms)

NODE V_A: $\frac{20 - V_A}{2} - 4 - 4i_x - i_n = 0$

NODE V_B: $i_n = \frac{V_B}{6} = i_x$

$20 - V_A - 8 - 8i_x - 2i_n = 0$

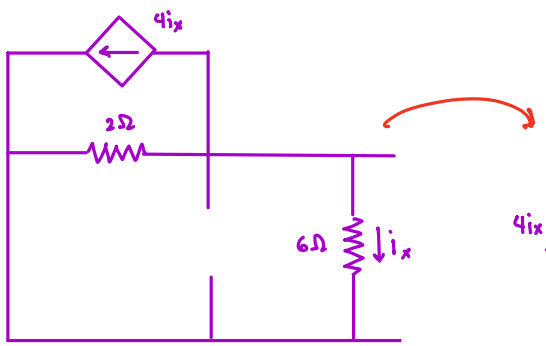
$12 - V_A - 8(V_B/6) - 2(V_B/6) = 0$

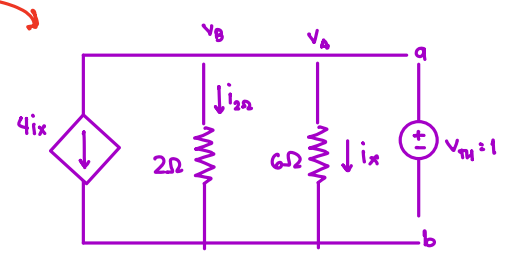
$72 - 6V_A - 8V_B - 2V_B = 0$ $\quad V_A = V_B$

$72 - 6V_A - 10V_A = 0$

$16V_A = 72$

$V_A = 4.5 = V_{TH}$





$\frac{V}{I} = R_{TH}$

$\frac{1}{I} = R_{TH}$

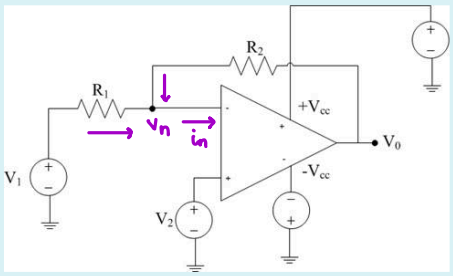
$R_{TH} = \frac{V}{I} = \frac{1}{4/3} = \frac{3}{4}$

$= 0.75\Omega$

$V_{TH} = V_A = V_B$ $\quad i_x = \frac{V_{TH}}{6\Omega} = \frac{1}{6}$ $\quad 4i_x = 4(1/6) = 2/3$

$i_{2\Omega} = \frac{V_{TH}}{2\Omega} = \frac{1}{2}$ $\quad I = \frac{2}{3} + \frac{1}{6} + \frac{1}{2} = \frac{4}{3}$

Quiz 08



Quiz 8f

You may assume the opamp is ideal.

Given: $V_1 = -2.0$ Volts $V_2 = 1.0$ Volts

R1 = 6,000 W (Ohm) R2 = 14,000 W (Ohm)

The power supplies voltages are $+V_{cc} = 15$ Volts $-V_{cc} = -15$ Volts

Using the linear region opamp equations, find the voltage V_0.

$V_0 =$ 8 ✔

Is the opamp operating in the linear region?

Yes ✔

Now use all of the ideal opamp assumptions and state the output voltage.

$V_0 =$ 8 ✔ Volts

NODE V_n: $\frac{V_n - V_1}{R_1} + \frac{V_n - V_0}{R_2} - i_n = 0$ $\quad i_n = 0$

$V_n = V_2 = 1.0\,V$

$\left[\frac{1.0 + 2.0}{6000} + \frac{1.0 - V_0}{14\,000} = 0\right] 42000$

$(3.0)(7) + 3(1.0) - 3V_0 = 0$

$\boxed{V_0 = 8\ V}$

Quiz 09

Quiz 9g

A circuit has the following measured voltage and current at the input terminals.

v(t) = 12 sin (250 t + 15°) V

i(t) = 15 sin (250 t – 15°) A

a) What is the frequency w (Omega) in radians of the time varying input?

$\omega =$ 250 ✔ rad/sec

b) What is the frequency f in Hertz of the time varying input?

$f =$ 39.79 ✔ Hz

c) What is the period T in ms (milli sec) of the time varying input?

$T =$ 25.13 ✔ ms (milli sec)

d) What is the phase angle Φ_V in radians of the terminal voltage in the cosine convention?

$\Phi_V =$ 0.2618 ✖ rad

e) What is the phase angle Φ_I in radians of the terminal current in the cosine convention?

$\Phi_I =$ -1.833 ✔ rad

f) What is the rms voltage value of the terminal voltage?

$V_{rms} =$ 8.485 ✔ V_{rms}

g) What is the rms current value of the terminal current?

$i_{rms} =$ 10.61 ✔ A_{rms}

$v(t) = V_m \cos(\omega t + \phi)$

$i(t) = I_m \sin(\omega t + \phi)$

(a) $\omega = 250\ rad/s$

(b) $f = \omega/2\pi = 250/2\pi = 39.79\ Hz$

(c) $T = 2\pi/\omega = 2\pi/250 = 0.02513 \approx 25.13\ ms$

(d) $\Phi_V = 15° \approx 0.2618\ rad$

(e) $i(t) = 15 \sin(250t - 15°)$

$\cos(90 - \theta) = \sin\theta$

$i(t) = 15 \cos[90° - (250t - 15°)]$

$= 15 \cos(-250t + 105°)$

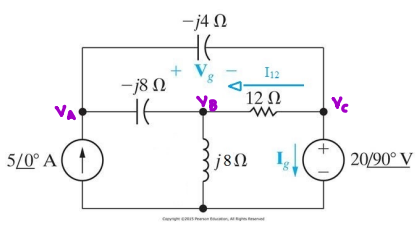
$= 15 \cos[-(250t - 105°)]$ $\quad \cos(-t) = \cos t$

$= 15 \cos(250t - 105°)$

$\Phi_I = -105° \approx -1.833\ rad$

(f) $V_{rms} = \frac{V_m}{\sqrt{2}} = \frac{12}{\sqrt{2}} = 8.485$

(g) $I_{rms} = \frac{I_m}{\sqrt{2}} = \frac{15}{\sqrt{2}} = 10.61$



$5\angle 0° \longrightarrow 5 + j0$

$20\angle 90° \longrightarrow 0 + j20$

NODE V_A: $-5 + \frac{V_A - V_C}{-j4} + \frac{V_A - V_B}{-j8} = 0$

$\left[-5 + \frac{V_A - V_C}{-j4} + \frac{V_A - V_B}{-j8} = 0\right] -j8$

$j40 + 2V_A - 2V_C + V_A - V_B = 0$

$j40 + 3V_A - 2(j20) - V_B = 0$

$3V_A - V_B = 0$

$3V_A = V_B$

$V_A = V_B/3$

NODE V_B: $\frac{V_B - V_A}{-j8} + \frac{V_B}{j8} + \frac{V_B - V_C}{12} = 0$

$\left[\frac{V_B - V_A}{-j8} + \frac{V_B}{j8} + \frac{V_B - (j20)}{12} = 0\right] j24$

$-3V_B + 3V_A + 3V_B + j2V_B - j\cdot j40 = 0$

$3V_A + j2V_B + 40 = 0$

$3(V_B/3) + j2V_B + 40 = 0$

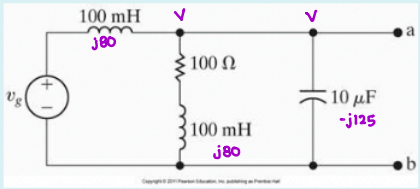
$V_B + j2V_B + 40 = 0$

$V_B(1 + j2) = -40$

$V_B = \frac{-40}{1 + j2} \cdot \frac{1 - j2}{1 - j2} = \frac{-40(1 - j2)}{1 + 4} = -8 + j16$

$I_{12} = \frac{V_C - V_B}{12} = \frac{j20 - (-8 + j16)}{12} = \frac{8 + j4}{12} = \frac{2}{3} + j\frac{1}{3} \approx \boxed{0.667 + j0.333}$

Quiz 11



Quiz 11b

The sinusoidal voltage source in the circuit is developing a voltage equal to 200 cos(800t + 45°) V_{rms}.

a) Find the Thévenin voltage with respect to the terminals a,b.

Express your answer in polar form.

Magnitude $|V_{Th}|$ = 221.139 ✖ V

Angle = 12.03 ✔ ° (Degrees)

b) Find the Thévenin impedance with respect to the terminals a,b.

Express your answer in polar form.

Magnitude $|Z_{ab}|$ = 88.46 ✔ Ω (Ohm)

Angle = 57.03 ✔ ° (Degrees)

$Z_L = j\omega L = j(800)(100\times10^{-3}) = j80$

$Z_C = \frac{-j}{\omega C} = \frac{-j}{(800)(10\times10^{-6})} = -j125$

$V_g = 200\angle 45° \approx 100\sqrt{2} + j100\sqrt{2}$

NODE V: $\left[\frac{V-V_g}{j80} + \frac{V}{100+j80} + \frac{V}{-j125} = 0\right] j80$

$V\left[1 + \frac{j8}{10+j8} - 0.64\right] = V_g$

$V\left[\frac{j8}{10+j8} + 0.36\right] = V_g$

$V\left[\frac{j8+3.6+j2.88}{10+j8}\right] = 100\sqrt{2} + j100\sqrt{2}$

$V = \frac{(100\sqrt{2} + j100\sqrt{2})(10+j8)}{(3.6+j10.88)}$

$= \frac{(200\angle 45°)(2\sqrt{41}\angle 38.66°)}{(11.46\angle 71.69°)}$

$V_{TH} = 223.50\angle 11.97°$

$100+j80 \,//\, -j125 = \frac{(100+j80)(-j125)}{100+j80-j125} = \frac{(20\sqrt{41}\angle 38.66°)(125\angle -90°)}{5\sqrt{481}\angle -24.23°}$

$= 195.98\angle -27.11° \approx 129.94 - j66.52$

$V_{TH} = \frac{(195.98\angle -27.11°)V_g}{129.94 - j66.52 + j80}$

$= \frac{(195.98\angle -27.11°)(200\angle 45°)}{130.64\angle 5.92°}$

$= 223.48\angle 11.97°$

$Z_{TH} = 195.98\angle -27.11° \,//\, j80$

$= \frac{(195.98\angle -27.11°)(80\angle 90°)}{129.94 - j66.52 + j80}$

$= \frac{(195.98\angle -27.11°)(80\angle 90°)}{130.64\angle 5.92°}$

$= 89.40\angle 68.81°$

Quiz 10

$V = 250\angle 0^\circ \approx 250$

$$\frac{V_L - V}{1+j4} + \frac{V_L}{-j100} + \frac{V_L}{26+j39} = 0$$

$$V_L\left[\frac{1}{1+j4} - \frac{1}{j100} + \frac{1}{26+j39}\right] = \frac{V}{1+j4}$$

$$V_L\left[\frac{1-j4}{17} - \frac{-j100}{10K} + \frac{26-j39}{2197}\right] = \frac{V}{1+j4}$$

$$\left[V_L\left(\frac{1-j4}{17} + \frac{j}{100} + \frac{2-j3}{169}\right) = \frac{V}{1+j4}\right](17)(100)(169)$$

$$V_L\left[16900(1-j4) + 2873j + 1700(2-j3)\right] = \frac{V(17)(100)(169)}{1+j4}$$

$$V_L(20300 - j69827) = \frac{V(287300)}{(1+j4)(20300-j69827)} = \frac{(250)(287300)}{20300+j11373+279308}$$

$$= \frac{71825000}{299608+j11373} \cdot \frac{299608-j11373}{299608-j11373}$$

$$= (8\times10^{-4})(299608 - j11373)$$

$$= 239.6864 - j9.0984$$

$$V_L = 239.6864 - j9.0984 \approx 239.867\angle -2.17^\circ$$

$$I_L = \frac{V_L}{26+j39} = \frac{239.6864 - j9.0984}{26+j39} \cdot \frac{26-j39}{26-j39}$$

$$= \frac{6231.8464 - j9584.328 - 354.8376}{2197} = \frac{5877.0088 - j9584.328}{2197}$$

$$= 2.675 - j4.36 \approx 5.117\angle -58.47^\circ$$

$$P_{avg} = \frac{239.86(5.11)}{2}\cos(-2.17^\circ - -58.47^\circ)$$

$=$

$$Q = -\frac{(250)(5.11)}{2}\sin(0 - -58.47)$$

$= -544.45\,W$

$$pf = \cos(\theta_v - \theta_i) = \cos(0 - -58.47) = 0.52$$

$$Z_L = 1228.68\angle -60.64$$
$$\approx 600.95$$

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Given this set of equations:

$$\frac{v_0-10V}{10\Omega}+\frac{v_0}{40\Omega}+\frac{v_0-(-20i_\Delta)}{20\Omega}=0$$

$$v_0\left(-\frac{1}{10\Omega}\right)+i_\Delta\left(-\frac{1}{3}\right)=-1.333$$

Find the voltage and current.

v_0 = 23.992 ✔ V

i_Δ = -3.1986 ✔ A