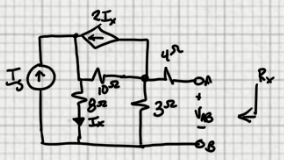
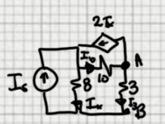
Given the ckt:



Find V_{AB} & R_x

First V_{AB}

We see V_{AB} is open so therefore no current flows through it. if no current then the 4Ω resistor drops no voltage and does nothing to V_{AB}. The new ckt becomes:



Equations

KCL

$$I_s + 2I_x = I_{10} + I_x$$

$$I_{10} = 2I_x + I_3$$

$$\therefore\ I_s + \cancel{2I_x} = \cancel{2I_x} + I_3 + I_x$$

$$I_s - I_x = I_3 \qquad \text{where: } I_3 = \frac{V_A - V_B}{3} = \frac{V_{AB}}{3}$$

$$\therefore\ \frac{V_{AB}}{3} = I_s - I_x \rightarrow V_{AB} = 3(I_s - I_x)$$

The only equation left is KVL. REMEMBER: Current sources yield NO Voltage information. Therefore:

$$V_8 = V_{10} + \cancel{V_3}^{V_{AB}}$$

where

$$V_8 = 8 \cdot I_x \qquad \& \ V_{10} = 10 \cdot \left(2I_x + \frac{V_{AB}}{3}\right)$$

$$8I_x = 20I_x + \frac{10}{3}V_{AB} + V_{AB}$$

$$-12I_x = \left(\frac{10}{3} + 1\right)V_{AB} \rightarrow -36 I_x = 13 V_{AB}$$

$$I_x = \frac{-13}{36} V_{AB}$$

$$\therefore\ V_{AB} = 3\left(I_s - \left(\frac{-13}{36} \cdot V_{AB}\right)\right)$$

$$\hookrightarrow V_{AB} = 3I_s + \frac{13}{12}V_{AB} \rightarrow -\frac{1}{12}V_{AB} = 3I_s$$

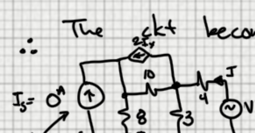
$$\therefore\ \boxed{V_{AB} = -36 I_s}$$

As for R_x you can go about it 2 ways:

① My favorite is to zero out any independent sources and solve

$$R_x = \frac{V}{I}$$

$\therefore$ The ckt becomes



KCL

$$I = 2I_x + I_{10} + I_3$$

$$2I_x + I_{10} = I_x$$

$$I = I_x + I_3$$

KVL

$$V = V_4 + V_3$$

$$V_3 = V_{10} + V_8$$

$$\therefore\ I_{10} = I_x - 2I_x = -I_x \quad \& \ V_8 = 8I_x$$

$$V_3 = 10(-I_x) + 8I_x = -2I_x$$

$$I = I_x + \frac{V_3}{\cancel{3}} - \frac{2}{3}I_x \longrightarrow 3I = 3I_x - 2I_x$$

$$\hookrightarrow I_x = 3I \quad \& \ V_3 = -6I$$

Therefore,

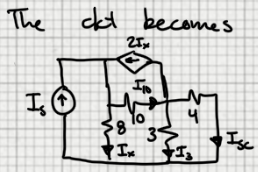
$$V = 4(I) + (-6I) = -2I$$

$$\hookrightarrow \frac{V}{I} = -2 \rightarrow \boxed{R_x = \frac{V}{I} = -2^{\Omega}}$$

or you can find R_x by finding I_{sc}, since we have already found $V_{oc} = V_{AB}$

$$R_{th} = \frac{V_{oc}}{I_{sc}}$$

The ckt becomes



KCL

$$I_s = I_x + I_3 + I_{sc}$$

$$I_s + 2I_x = I_x + I_{10}$$

$$I_{10} = 2I_x + I_3 + I_{sc}$$

KVL

$$V_8 = V_{10} + V_3$$

$$V_3 = V_4 = 4 \cdot I_{sc}$$

$$V_8 = 8I_x = \cancel{V_{10}}^{10(2I_x + I_3 + I_{sc})} + \cancel{V_4}^{4I_{sc}}$$

$$8I_x = 20I_x + 10\frac{\cancel{V_3}^{4I_{sc}}}{3} + 10I_{sc} + 4I_{sc}$$

$$24I_x = 60I_x + 40I_{sc} + 30I_{sc} + 12I_{sc}$$

$$-36I_x = 82I_{sc} \rightarrow I_x = \frac{-82}{36}I_{sc}$$

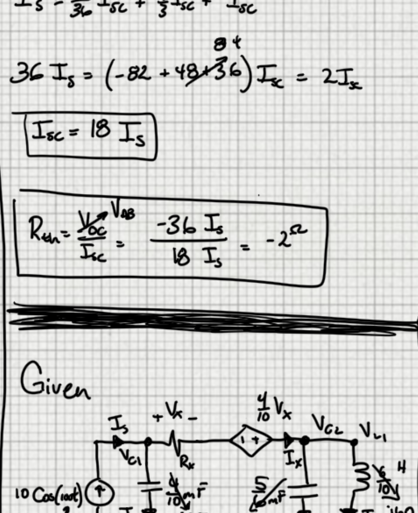
$$I_s = \frac{-82}{36}I_{sc} + \frac{4}{3}I_{sc} + I_{sc}$$

$$36I_s = (-82 + 48 + \cancel{36}^{84})I_{sc} = 2I_{sc}$$

$$\boxed{I_{sc} = 18 I_s}$$

$$\boxed{R_{th} = \frac{\cancel{V_{oc}}^{V_{AB}}}{I_{sc}} = \frac{-36 I_s}{18 I_s} = -2^{\Omega}}$$

Given

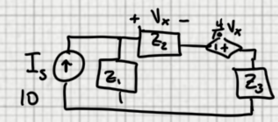


what is $V_x(t)$?

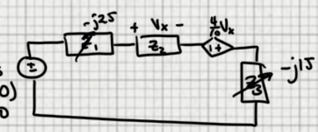
maybe simplify to get better visual?

$$Z_1 = -j25$$

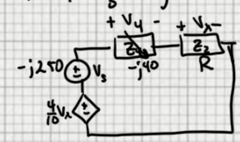
$$Z_2 = R_x \qquad Z_3 = -j12 \| j60 = -j15$$



$\hookrightarrow Z_1 I_s$
$(-j25)(10)$
$-j250$



$$Z_4 = Z_1 + Z_3 = -j40$$



Voltage Divider

$$V_x = \frac{Z_2}{Z_2 + Z_4}(V_{Tot})$$

$$V_x = \left(\frac{R}{R - j40}\right)\left(-j250 + \frac{4}{10}V_x\right)$$

$$(R - j40)V_x = -jR250 + \frac{4R}{10}V_x$$

$$\left(10 - j\frac{400}{R}\right)V_x = -j2500 + 4V_x$$

$$\left(6 - j\frac{400}{R}\right)V_x = -j2500$$

$$V_x = \frac{-j2500}{6 - j\frac{400}{R}} \qquad |V_x| = 250$$

$$\hookrightarrow \frac{2500}{\sqrt{36 + \left(\frac{400}{R}\right)^2}} = 250 \rightarrow \sqrt{36 + \left(\frac{400}{R}\right)^2} = 10$$

$$\hookrightarrow 36 + \left(\frac{400}{R}\right)^2 = 100 \rightarrow \frac{400}{R} = \sqrt{64}$$

$$R = \frac{400}{8} = 50$$

or $|V_x| = 125$

$$\sqrt{36 + \left(\frac{400}{R}\right)^2} = 20 \rightarrow 36 + \left(\frac{400}{R}\right)^2 = 400$$

$$\frac{400}{R} = \sqrt{400 - 36} \longrightarrow R = \frac{400}{\sqrt{400-36}} \approx 20.97$$

Going w/ $R = 50^{\Omega}$

$$V_x = \frac{-j2500}{6 - j\frac{400}{50}} = \frac{-j2500 \cdot j}{6 - j8 \cdot j} = \frac{1250}{4 + j3}$$

$$\therefore\ |V_x| = \frac{1250}{\sqrt{4^2 + 3^2}} = \frac{1250}{\sqrt{25}} = \frac{1250}{5} = 250$$

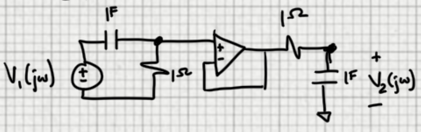
$$\angle V_x = \cancel{\arctan\left(\frac{0}{1250}\right)}^{0} - \arctan\left(\frac{3}{4}\right)$$

$$\angle V_x = -\arctan\left(\frac{3}{4}\right)$$

$\therefore$ Given $R_x = 50^{\Omega}$

$$V_x(t) = 250\cos\left(100t - \arctan\left(\frac{3}{4}\right)\right)$$

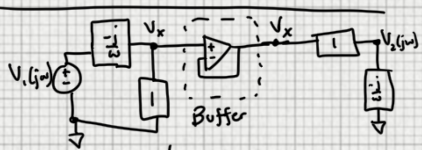
Given



Find the transfer function

$H(j\omega) = \frac{V_2(j\omega)}{V_1(j\omega)}$

Redraw ckt using phasor technique



using voltage divider we see:

$V_x = \frac{1}{1-j(\frac{1}{\omega})} \cdot V_1(j\omega) = \frac{j\omega}{1+j\omega} V_1(j\omega)$

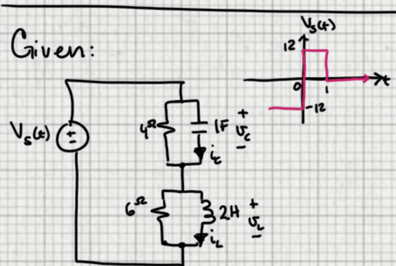
&

$V_2(j\omega) = \left(\frac{\frac{-j}{\omega}}{1-\frac{j}{\omega}}\right) V_x = \left(\frac{1}{1+j\omega}\right) V_x$

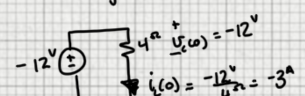
∴ $V_2(j\omega) = \left(\frac{1}{1+j\omega}\right)\left(\frac{j\omega}{1+j\omega}\right) V_1(j\omega)$

∴ $\boxed{H(j\omega) = \frac{V_2(j\omega)}{V_1(j\omega)} = \frac{j\omega}{(1+j\omega)^2} = \frac{j\omega}{(1-\omega^2)+j2\omega}}$

Given:



@ $t = 0^-$ the ckt was @ steady state



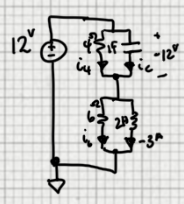
Find $i_c(0^+)$ & $v_L(0^+)$.

DON'T try and solve for equations. Use what you assume about cap & ind.

At $t=0^+$ $v_c(0^+) = v_c(0^-) = -12^V$

$i_L(0^+) = i_L(0^-) = -3^A$

Looking @ ckt for $t=0^+$



KVL

$12 = v_c(0^+) + v_L(0^+)$

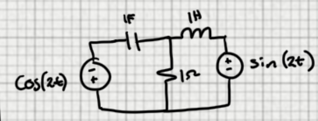
$\boxed{v_L(0^+) = 12-(-12) = 24^V}$

KCL

$i_4 + i_c(0^+) = i_6 + i_L(0^+) \rightarrow \frac{v_c(0^+)}{4} + i_c(0^+) = \frac{v_L(0^+)}{6} - 3^A$

∴ $i_c(0^+) = \frac{24}{6} - 3 - \frac{(-12)}{4} = 4^A \rightarrow \boxed{i_c(0^+) = 4^A}$

Given:



what is the average power consumed by the resistor?

Another way of asking is what is

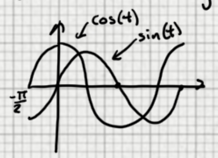
$\frac{1}{T}\int_0^T v_R(t)\cdot i_R(t)\,dt$

where $T = \frac{2\pi}{\omega}$ & $\omega = 2$

∴ $T = \pi$

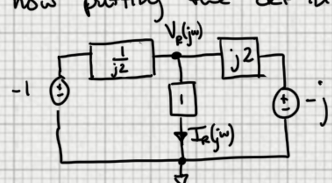
Since there are no initial conditions let's use Phasor techniq

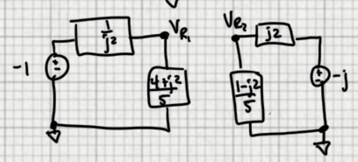
∴ if $\cos(2t)$ is the starting point then $\sin(2t)$ needs to be in terms of $\cos(2t+\theta)$, looking @ the functions will give you the insight:



notice if we take values of $\cos(t-\frac{\pi}{2})$ then it looks like $\sin(t)$

now putting the ckt in Phasor





$V_{R_1} = -\frac{\frac{4+j2}{5}}{\frac{1}{j2}+\frac{4+j2}{5}}$ $\quad V_{R_2} = \frac{2+j}{1+j8}$

$V_{R_1} = -\frac{\frac{4+j2}{5}}{\frac{8-j}{10}} = -\frac{8+j4}{8-j} = -\frac{12+j8}{13}$

$V_{R_2} = \frac{2-j3}{13}$

$V_R = V_{R_1}+V_{R_2} = \frac{-12-j8+2-j3}{13} = \frac{-10-j11}{13}$

$|V_R| = \frac{\sqrt{221}}{13}$ $\quad \angle V_R = \pi + \arctan(\frac{11}{10})$

∴ $v_R(t) = \frac{\sqrt{221}}{13}\cos(2t+\pi+\arctan(\frac{11}{10}))$

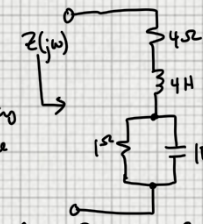
$P_R(t) = \frac{|V_R||I_R|}{2} = \frac{221}{2\cdot 13^2} = \frac{17}{26} = 0.6538$

not sure what is going on w/ multiple choice of

0.8
1.1
2.6
4.8
?

I have even done time domain and got the same answer

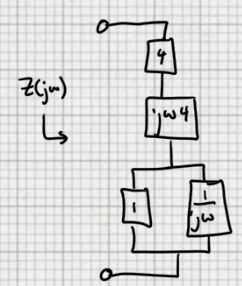
Given:



what frequency will resonate this ckt?

In other words, @ what f will $Im(Z(j\omega)) = 0$ or ∞

Let's transform into Phasor:



where: $1 \| \frac{1}{j\omega} = \frac{\frac{1}{j\omega}}{1+\frac{1}{j\omega}}$

↳ $\frac{1}{j\omega+1}\cdot\frac{(1-j\omega)}{(1-j\omega)}$

↳ $\frac{1-j\omega}{\omega^2+1}$

∴ $Z(j\omega) = 4 + j\omega 4 + \frac{1-j\omega}{\omega^2+1}$

$\underbrace{\left(4+\frac{1}{\omega^2+1}\right)}_{Re} + j\underbrace{\left(4\omega - \frac{\omega}{\omega^2+1}\right)}_{Im}$

∴ $\frac{\omega 4(\omega^2+1)-\omega}{\omega^2+1} = 0$

↳ $(\omega^2+1) - \frac{1}{4} = 0$

↳ $\omega^2 = -\frac{3}{4} \rightarrow \omega = j\pm\sqrt{\frac{3}{4}} = j\frac{\sqrt{3}}{2}$

∴ $\omega = j\frac{\sqrt{3}}{2}$

we see

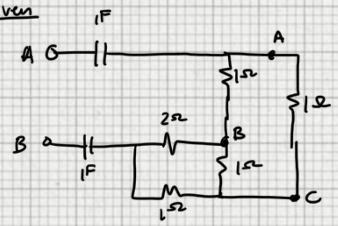
$Z(j\frac{\sqrt{3}}{2}) = 4(j\frac{\sqrt{3}}{2}) - \frac{j\frac{\sqrt{3}}{2}}{-\frac{3}{4}+1}$

$= j2\sqrt{3} - \frac{j\frac{\sqrt{3}}{2}}{\frac{1}{4}}$ $-j2\sqrt{3}$ $=0$

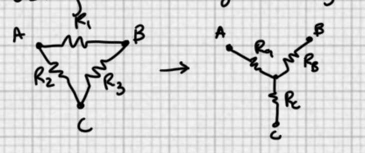
there is no real value of ω that will yield a zero or ∞.

Therefore no resonant frequency

Given



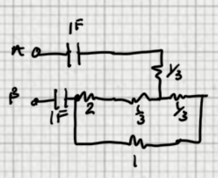
using delta-wye transform

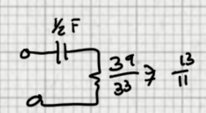


$R_a = \frac{R_1 R_2}{R_1+R_2+R_3} = \frac{1}{3}$

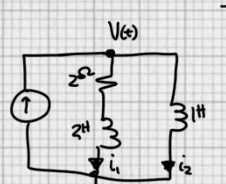
$R_b = \frac{R_1 R_3}{R_1+R_2+R_3} = \frac{1}{3}$

$R_c = \frac{R_2 R_2}{R_1+R_2+R_3} = \frac{1}{3}$



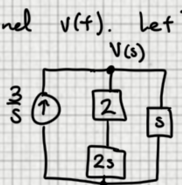


Given: $t \geq 0$



$3^A u(t)$ can't use phasor technique

with no initial conditions find $v(t)$. Let's use laplace.



where, $2(s+1) \| s$

$\hookrightarrow \frac{2s(s+1)}{2s+2+s} = \frac{2s(s+1)}{3s+2}$

$\therefore\ V(s) = \frac{2\cancel{s}(s+1)}{3s+2} \cdot \frac{3}{\cancel{s}} = \frac{6(s+1)}{3(s+\frac{2}{3})}$

$V(s) = \frac{2(s+1)}{s+\frac{2}{3}} = s\left(\frac{2}{s+\frac{2}{3}}\right) + \frac{2}{s+\frac{2}{3}}$

$\mathcal{L}^{-1}\{\}$

$v(t) = \frac{d}{dt}\left(2e^{-\frac{2}{3}t}\right) + 2e^{-\frac{2}{3}t}$

$v(t) = -\frac{4}{3}e^{-\frac{2}{3}t} + \frac{6}{3}e^{-\frac{2}{3}t} = \frac{2}{3}e^{-\frac{2}{3}t}$

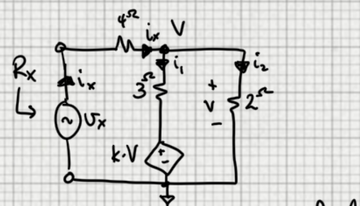
$\therefore$

$v(t) = \frac{2}{3}e^{-\frac{2}{3}t}u(t)$ or

for $t \geq 0$

$v(t) = \frac{2}{3}e^{-\frac{2}{3}t}$

Given:



what value of k is needed to make $R_x = 0$?

KCL

$i_x = \underbrace{\frac{V-kV}{3}}_{i_1} + \underbrace{\frac{V}{2}}_{i_2} = \left(\frac{(1-k)}{3} + \frac{1}{2}\right)V$

also

$v_x - 4i_x = V$

$\therefore\ 6i_x = (2(1-k)+3)V$

$\hookrightarrow \frac{6i_x}{5-2k} = v_x - 4i_x \rightarrow \left(\frac{6}{5-2k} + \frac{4(5-2k)}{5-2k}\right)i_x = v_x$

$\frac{v_x}{i_x} = \frac{6+20-8k}{5-2k} = \frac{26-8k}{5-2k}$

$R_x = 0$ when $26-8k=0$

$\hookrightarrow 13-4k=0 \rightarrow \boxed{k=\frac{13}{4}}$

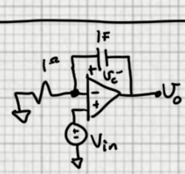
checking

$i_x = \frac{V(1-\frac{13}{4})}{3} + \frac{V}{2} = \left(-\frac{3}{4}+\frac{1}{2}\right)V = -\frac{V}{4}$

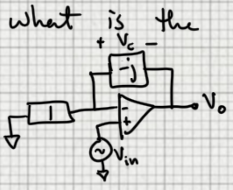
$V = -4i_x$ & $v_x = 4i_x + V = 4i_x - 4i_x$

& $\frac{v_x}{i_x} = 4-4 = 0$ ✓

Give



where the sinusoidal steady state $v_o(t)$ is equal to $\cos(t)$, what is the $v_c(t)$? $w=1$



$\therefore$ using general negative feedback opamp equation

$V_o = \left(\frac{Z_1+Z_2}{Z_1}\right)V_2 - \cancel{\frac{Z_2}{Z_1}V_1}^{\,0}$

$1 = (1-j)V_{in}$

$\therefore\ V_{in} = \frac{1}{1-j} = \frac{1+j}{2}$

$V_c = V_{in} - V_o = \frac{1+j}{2} - 1 = \frac{-1+j}{2}$

$|V_c| = \frac{\sqrt{2}}{2}$ $\quad \angle V_c = \arctan\left(\frac{-1}{1}\right) = -45^\circ$

$\therefore\ \boxed{V_c(t) = \frac{\sqrt{2}}{2}\cos(t-45^\circ)}$