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[ STUDENT > # Attempt to verify conclusion for light-bulb test of
[ phase rotation
[ STUDENT > # see
[ http://www.eng-tips.com/viewthread.cfm?qid=240139&page=1
[ STUDENT > restart;
[ STUDENT > # ===SYMBOLS =====
[ STUDENT > # Va, Vb, Vc are voltages referenced to the POWER SUPPLY
[ neutral (assumed balanced)
[ STUDENT > # Vn is the "FLOATING neutral" created at the wye point of
[ the 2 R's and C(different than power supply neutral)
[ STUDENT > # (power supply neutral and this floating neutral are two
[ different things)
[ STUDENT > # Equation1 - expresses KVL at the floating neutral
[ STUDENT > # VnSolution is the solution for Vn based on KVL
[ STUDENT > # Phasors are assumed rotating CCW in the complex plane
[ STUDENT > # a terminal which leads another terminal has a more
[ positive phase angle
[ STUDENT > # a terminal which lags another terminal has a more
[ negative phase angle
[ STUDENT > # A:=exp(I*2*Pi/3) is the 120 deg phase shift between
[ original vectors Va,Vb, Vc
[ STUDENT > # All voltage magnitudes Va Vb Vc assumed to have
[ magnitude 1
[ STUDENT > # Assume an ABC rotation, Va leads Vb, Vb leads Vc, Vc
[ leads Va etc
[ STUDENT > # Arbitrarily start with phase B as our 0 phase angle
[ STUDENT > # As we go from A to B to C we are going in the lagging
[ direction -> divide by A
[ STUDENT > # ABCsubs = substitution of values for voltage vectors Va,
[ Vb, Vc
[ STUDENT >
[ STUDENT > ABCsubs:={Vb=1,Vc=1/A,Va=1/A^2};
[
[ 
$$ABCsubs := \{ Vb = 1, Va = \frac{1}{A^2}, Vc = \frac{1}{A} \}$$

[ STUDENT > Vna:=Va*Zp/(R+Zp);
[
[ 
$$Vna := \frac{Va Zp}{R + Zp}$$

[ STUDENT > Vnc:=Vc*Zp/(R+Zp);
[
[ 
$$Vnc := \frac{Vc Zp}{R + Zp}$$

[ STUDENT > Vnb:=Vb*(R/2)/(R/2 + Zc);

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$$V_{nb} := \frac{1}{2} \frac{V_b R}{\frac{1}{2} R + Z_c}$$

STUDENT > **Vn:=Vna+Vnb+Vnc;**

$$V_n := \frac{V_a Z_p}{R + Z_p} + \frac{1}{2} \frac{V_b R}{\frac{1}{2} R + Z_c} + \frac{V_c Z_p}{R + Z_p}$$

STUDENT > **Zc:=1/(I*w*C);**

$$Z_c := -\frac{I}{w C}$$

STUDENT > **Zp:=Zc*R/(Zc+R);**

$$Z_p := -\frac{I R}{w C \left(-\frac{I}{w C} + R \right)}$$

STUDENT > **Vn;**

$$\begin{aligned} & -\frac{\frac{I V_a R}{w C \left(-\frac{I}{w C} + R \right) \left(R - \frac{I R}{w C \left(-\frac{I}{w C} + R \right)} \right)}}{\frac{1}{2} \frac{V_b R}{\frac{1}{2} R - \frac{I}{w C}}} \\ & -\frac{\frac{I V_c R}{w C \left(-\frac{I}{w C} + R \right) \left(R - \frac{I R}{w C \left(-\frac{I}{w C} + R \right)} \right)}}{\frac{1}{2} \frac{V_b R}{\frac{1}{2} R - \frac{I}{w C}}} \end{aligned}$$

STUDENT > **simplify(Vn);**

$$\frac{-I V_a + V_b R w C - I V_c}{-2 I + R w C}$$

STUDENT > **# The above expression may have enough to answer the question**

STUDENT > **# Assume R*w*C <<1. Denominator -2 *I**

STUDENT > **# Numerator is -I*(Va + Vc) + Vb * R * w * C**

STUDENT > **# When we divide by -2*I we get**

STUDENT > **# Vn ~ 0.5*[(Va + Vc) - I*Vb * R * w * C]**

STUDENT > **# Consider the ABC orientation to be as previously stated**

STUDENT > **ABCsubs:={Vb=1,Vc=1/A,Va=1/A^2};**

$$ABCsubs := \{ V_b = 1, V_a = \frac{1}{A^2}, V_c = \frac{1}{A} \}$$

STUDENT > **# This means again we are interested in the imaginary part.**

STUDENT > **# We see imaginary part is - I*Vb * R * w * C**

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[ STUDENT > # This is the opposite conclusion of the previous file.  
[ STUDENT > # need to double check  
[ STUDENT >
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