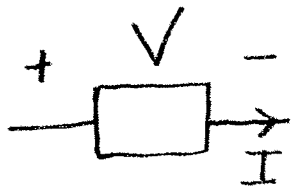
17. Determine the real power absorbed by the given "box" element. Provide the units.

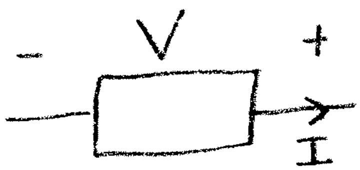


$V = 5\angle 120^\circ$ Vrms

$I = 3\angle 60^\circ$ Arms

$$S = VI^* = (5\angle 120^\circ)(3\angle -60^\circ) = 15\angle 60^\circ$$

18. Determine the reactive power absorbed by the given "box" element. Provide the units.

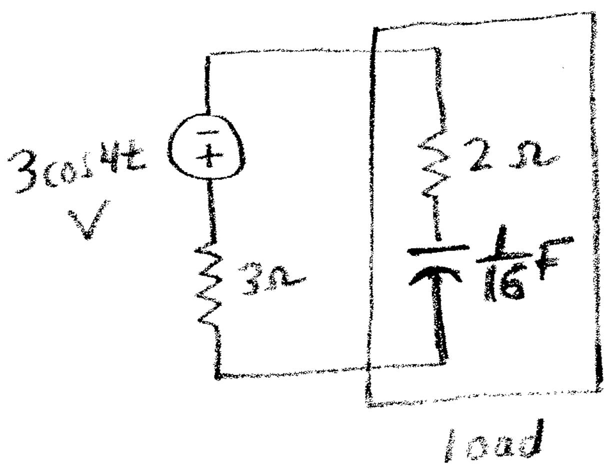


$V = 2+j3$ Vrms

$I = -3+j5$ Arms

$$S = -VI^* = -(2+j3)(-3-j5) = -[-6-j10-j9+15$$

19. For the given circuit, determine the complex power absorbed by the load and place it in the rectangular form $P + jQ$. Provide the units.



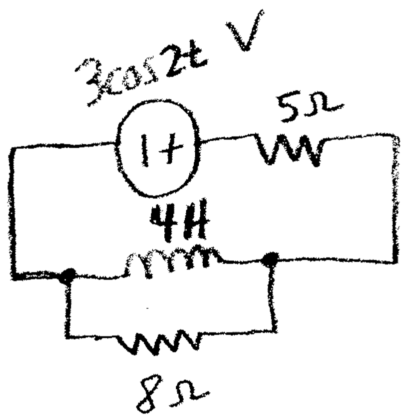
$$\frac{1}{j4\frac{1}{16}} = \frac{1}{j1/4} = -j4$$

when rms not used

$$S = \frac{1}{2}VI^* = \frac{1}{2}3\frac{2-j4}{3+2-j4}\left(\frac{3}{3+2-j4}\right)^*$$

$$= \frac{3}{2}\,\frac{2-j4}{5-j4}\,\frac{3}{5+j4} = \frac{9}{2}\,\frac{2-j4}{25+16}$$

20. For the given circuit, determine the power factor seen by the source. It is not necessary to evaluate the trigonometric functions, but no j's should be present in the final answer.



$$j2(4) = j8$$

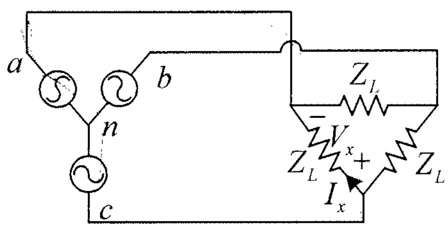
$$Z = 5 + (j8 \| 8)$$

$$= 5 + \frac{j64}{8+j8}$$

$$= \frac{40 + j40 + j64}{8+j8}$$

$$= \frac{40 + j104}{8+j8}$$

$$= \frac{40 + j104}{8+j8} \cdot \frac{8-j8}{8-j8} \ \ldots$$



21. For the balanced Y-Δ configuration shown above $\omega = 4$ rad/s, $V_{an} = 5\angle -240^\circ$ V rms, $V_{bn} = 5\angle -120^\circ$ V rms, $V_{cn} = 5\angle 0^\circ$ V rms, and each load, Z_L, consists of a 5 Ω resistor in series with a 1/4 F capacitor, determine (using the concepts discussed in class, i.e., phasor diagrams, and simplify the expressions in the same manner as presented in class) the current I_x in the frequency domain

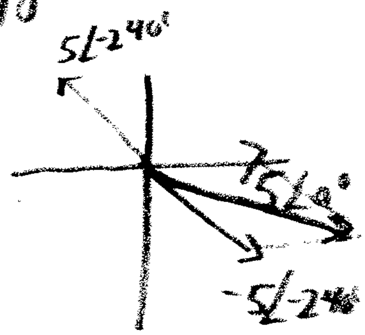
$$Z_L = 5 - \frac{j}{4(\frac{1}{4})} = 5 - j$$

$$V_x + 5\angle -240^\circ - 5\angle 0^\circ = 0$$

$$V_x = 5\angle 0^\circ - 5\angle -240^\circ$$

$$= 5\sqrt{3}\angle -30^\circ$$

$$I_x = \frac{5\sqrt{3}\angle -30^\circ}{5-j}$$



1 17. $15\cos 60^\circ$ W

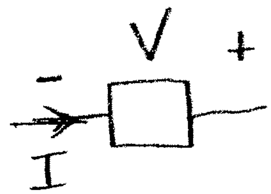
1 18. 19 VAR

4 19. $\frac{9}{25+16} - j\frac{18}{25+16}$ VA

2 20. $\cos\left[\tan^{-1}\frac{104}{40} - \tan^{-1}\frac{8}{8}\right]$

6 21. $\frac{5\sqrt{3}}{\sqrt{5^2+1^2}} \angle -30^\circ - \tan^{-1}\frac{1}{5}$

17. Determine the real power absorbed by the given "box" element. Provide the units.

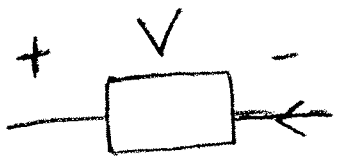


$V = 3\angle 15^\circ$ Vrms

$\overset{I^*}{}I = 2\angle 60^\circ$ Arms

$S = \overset{V}{(3\angle 15^\circ)}\overset{I^*}{(2\angle -60^\circ)} = 6\angle -45^\circ$

18. Determine the reactive power absorbed by the given "box" element. Provide the units.

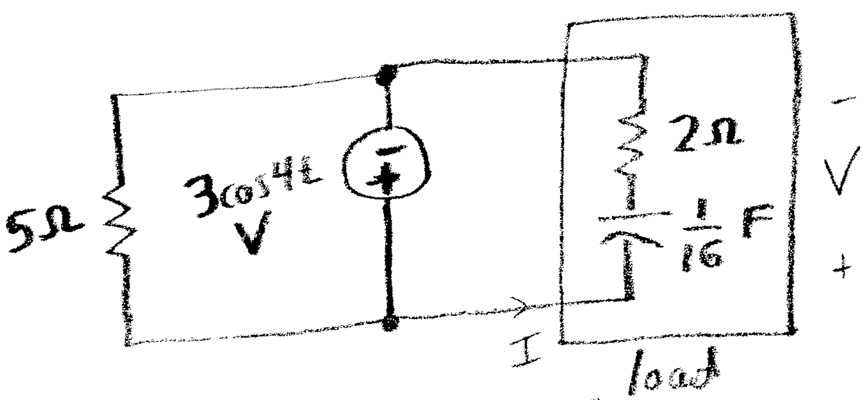


$V = -3 + j2$ Vrms

$I = -5 - j4$ Arms

$-\overset{V}{(-3+j2)}\overset{I^*}{(-5+j4)} = 15 + j12 + j10 + 8$

19. For the given circuit, determine the complex power absorbed by the load and place it in the rectangular form $P + jQ$. Provide the units.



$\frac{1}{j4\frac{1}{16}} = \frac{1}{j\frac{1}{4}} = -j4$

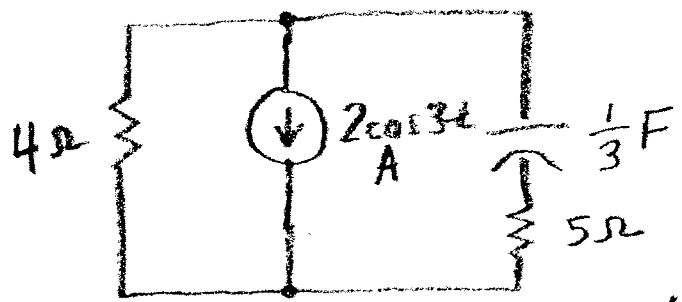
$S = \frac{1}{2}VI^*$ when rms not used

$S = \frac{1}{2}\overset{V}{3\angle 0^\circ}\overset{I^*}{\left(\frac{3\angle 0^\circ}{2-j4}\right)^*} = \frac{3\angle 0^\circ}{2}\,\frac{3\angle 0^\circ}{2+j4}$

$= \frac{1}{2}\,\frac{9}{2+j4}\,\frac{2-j4}{2-j4} = \frac{1}{2}\,\frac{18-j36}{2^2+4^2}$

20. For the given circuit, determine the power factor seen by the source. It is not necessary to evaluate the trigonometric functions, but no j's should be present in the final answer.

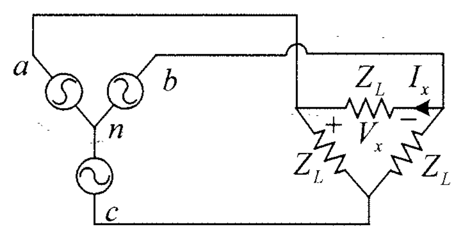
$\frac{1}{j3\frac{1}{3}} = \frac{1}{j} = -j$



$Z = 4 \parallel (5 - j)$

$= \frac{20 - 4j}{9 - j}$

$\angle Z = \tan^{-1}\frac{-4}{20} - \tan^{-1}\frac{-1}{9}$



21. For the balanced Y-Δ configuration shown above $\omega = 4$ rad/s, $V_{an} = 5\angle 120^\circ$ V rms, $V_{bn} = 5\angle -120^\circ$ V rms, $V_{cn} = 5\angle 0^\circ$ V rms, and each load, Z_L, consists of a 3 Ω resistor in series with a 1/2 F capacitor, determine (using the concepts discussed in class, i.e., phasor diagrams, and simplify the expressions in the same manner as presented in class) the current I_x in the frequency domain

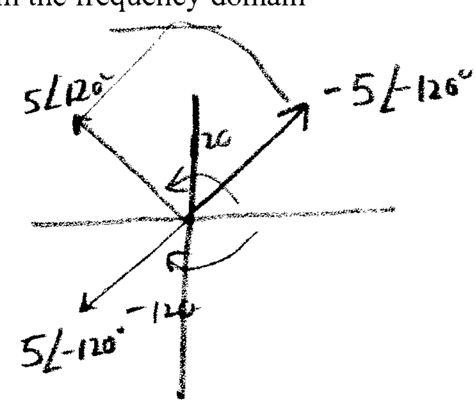
$Z_L = 3 + \frac{1}{j4(\frac{1}{2})} = 3 - \frac{j}{2}$

$+V_x + 5\angle -120^\circ - 5\angle 120^\circ = 0$

$V_x = 5\angle 120^\circ - 5\angle -120^\circ$

$= 5\sqrt{3}\angle 90^\circ$

$I_x = \frac{-5\sqrt{3}\angle 90^\circ}{3 - \frac{j}{2}}$



1 17. $-6\cos(45^\circ)$ W

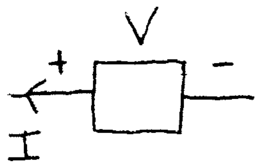
1 18. $+22$ VAR

4 19. $\frac{9}{2^2+4^2} - j\frac{18}{2^2+4^2}$ VA

2 20. $\cos\left[\tan^{-1}\frac{-4}{23} - \tan^{-1}\frac{-1}{9}\right]$

6 21. $\frac{-5\sqrt{3}}{3^2+\left(\frac{1}{2}\right)^2} \angle 90^\circ - \tan^{-1}\frac{-\frac{1}{2}}{3}$ A rms

17. Determine the real power absorbed by the given "box" element. Provide the units.

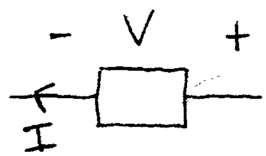


$V = 4\angle 20^\circ \ V_{rms}$

$I = 3\angle 15^\circ \ A_{rms}$

$$S = -(4\angle 20^\circ)(3\angle -15^\circ) = -12\angle 5^\circ = -12\cos 5^\circ + -j12\sin 5^\circ$$

18. Determine the reactive power absorbed by the given "box" element. Provide the units.

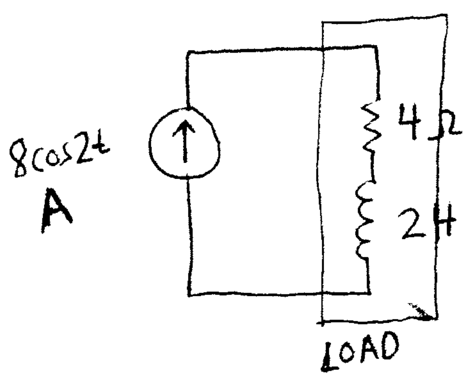


$V = 3 - j8 \ V_{rms}$

$I = 2 + j9 \ A_{rms}$

$$S = (3-j8)(2-j9) = 6 - 72 - j(16+27)$$

19. For the given circuit, determine the complex power absorbed by the load. Provide the units.



$+$

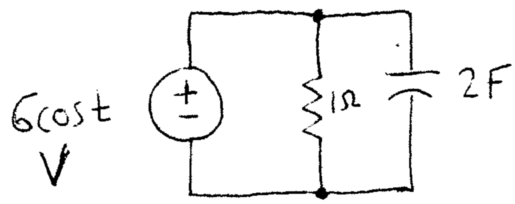
$V_L = (8\angle 0^\circ)(4+j4)$

$-$

$$S = \frac{1}{2}(8\angle 0^\circ)(4+j4)(8\angle 0)^*$$

$$= 32(4+j4)$$

20. For the given circuit, determine the power factor seen by the source. It is not necessary to evaluate the trigonometric functions, but no j's should be present in the final answer.

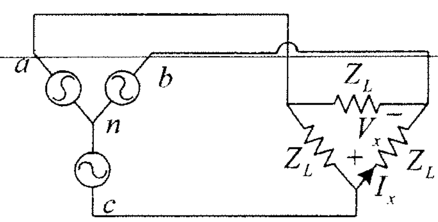


$$Z_L = 1 \,\|\, \frac{1}{j2}$$

$$= \frac{1 \cdot \frac{1}{j2}}{1 + \frac{1}{j2}} = \frac{1}{1+j2}$$

$$= \frac{1\angle 0^\circ}{\sqrt{1+2^2}\angle \tan^{-1}\frac{2}{1}}$$

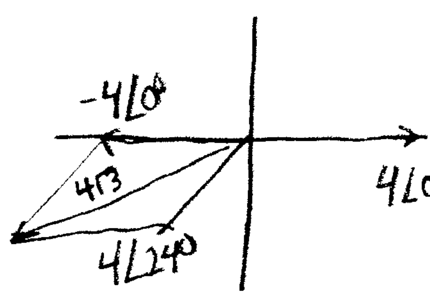
$$= \frac{1}{\sqrt{1+2^2}}\angle -\tan^{-1}\frac{2}{1}$$



21. For the balanced Y-Δ configuration shown above $\omega = 3$ rad/s, $V_{an} = 4\angle 120^\circ$ V rms, $V_{bn} = 4\angle 0^\circ$ V rms, $V_{cn} = 4\angle 240^\circ$ V rms, and each load, Z_L, consists of a 5 Ω resistor in series with a 1/6 F capacitor, determine (using the concepts discussed in class, i.e., phasor diagrams, and simplify the expressions in the same manner as presented in class) the voltage V_x in the frequency domain

$$-V_x + 4\angle 240^\circ - 4\angle 0^\circ = 0$$

$$V_x = 4\angle 240^\circ - 4\angle 0^\circ$$



1 17. $-12\cos 5^\circ$ W

1 18. $-(16+27)$ VAR

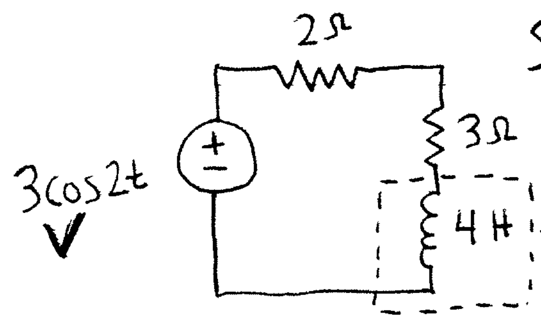
1 19. $32(4+j4)$ VA

2 20. $\cos\left[-\tan^{-1}\frac{2}{1}\right]$

2 21. $4\sqrt{3}\angle 180+30^\circ = 4\sqrt{3}\angle 240-30^\circ$ V_{rms}

$S = \frac{1}{2}\frac{j24}{5+j8} \times \frac{3}{5-j8} = \frac{j36}{5^2+8^2}$

10. For the given circuit, determine the complex power absorbed by the load. Provide the units.



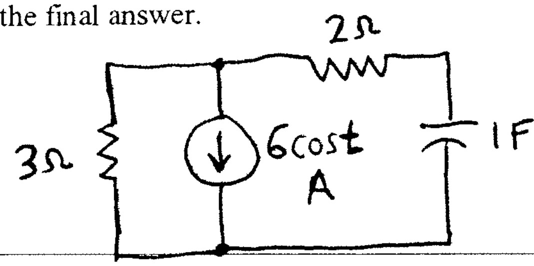
the load is only the 4H inductor

$S = \frac{1}{2}VI^*$

$I = \frac{3}{2+3+j8} = \frac{3}{5+j8}$

$V = \frac{3}{5+j8} \times j8$

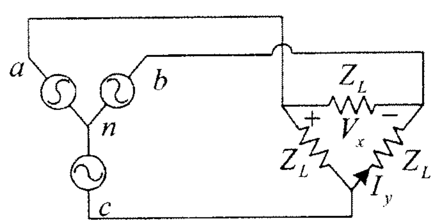
11. For the given circuit, determine the power factor seen by the source. It is not necessary to evaluate the trigonometric functions, but no j's should be present in the final answer.



$3 \parallel (2 + \frac{1}{j}) = 3 \parallel (2-j)$

$\frac{3(2-j)}{3+2-j} = \frac{3(2-j)}{5-j}$

$= \frac{3\sqrt{2^2+1^2}\angle \tan^{-1}\frac{-1}{2}}{\sqrt{5^2+1^2}\angle \tan^{-1}\frac{-1}{5}}$

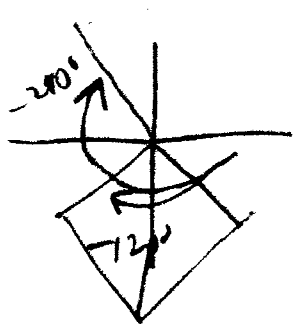


12. For the balanced Y-Δ configuration shown above $\omega = 2$ rad/s, $V_{an} = 4\angle -120^\circ$ V rms, $V_{bn} = 4\angle -240^\circ$ V rms, $V_{cn} = 4\angle 0^\circ$ V rms, and each load, Z_L, consists of a 6 Ω resistor in series with a 1/2 F capacitor, determine (using the concepts discussed in class, i.e., phasor diagrams, and simplify the expressions in the same manner as presented in class) the voltage V_x in the frequency domain

$+V_x + V_{bN} - V_{aN} = 0$

$V_x = V_{aN} - V_{bN}$

$= 4\angle -120^\circ - 4\angle -240^\circ$



 $= 4\sqrt{3}\angle -90^\circ$

2 7. $\dfrac{A}{R+j\omega L} + B \times \dfrac{R}{R+j\omega L}$

$V_3 - 0 = -A \quad , \quad \dfrac{V_4 - 0}{j\omega L} + \dfrac{V_4 - V_3}{R_b} = 0$

$\dfrac{V_2 - V_3}{1/j\omega C} - B = 0 \quad , \quad \dfrac{V_1 - 0}{R_a} + B = 0$

2 8.

$I_1 = -B$

1 9. $R_b I_2 + j\omega L\,(I_2 + I_1) + \dfrac{1}{j\omega C} I_2 - A = 0$

2 10. $S = \dfrac{j36}{5^2+8^2}$ VA (since purely reactive, VAR)

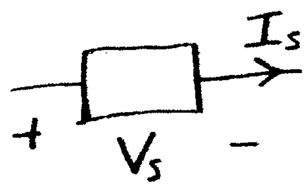
2 11. $\cos\left[\tan^{-1}\left(\frac{-1}{2}\right) - \tan^{-1}\left(\frac{-1}{5}\right)\right]$

1 12. $4\sqrt{3}\angle -90^\circ$ V_{rms}

1 13. BPF

1 14. $\dfrac{R_b \,//\, \frac{1}{j\omega C}}{\left(R_b \,//\, \frac{1}{j\omega C}\right) + R_a + j\omega L}$

17. Determine the real power absorbed by the given "box" element. Provide the units.



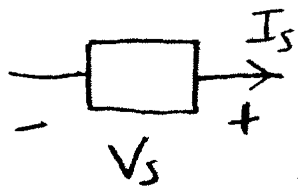
$V_s = 3 + j8 \ V_{rms}$

$I_s = 4\angle 18^\circ \ A_{rms}$

$(3+j8)(4\angle -18^\circ)$

$(3+j8)(4\cos 18^\circ - j4\sin 18^\circ)$

18. Determine the reactive power absorbed by the given "box" element. Provide the units.



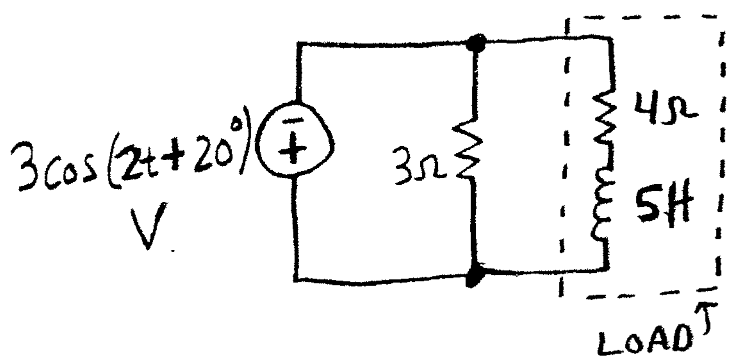
$V_s = 2\angle 120^\circ \ V$

$I_s = 3\angle 15^\circ \ A$

$-\frac{1}{2}(2\angle 120^\circ)(3\angle -15^\circ)$

$= -\frac{6}{2}\angle 120 - 15^\circ$

19. For the given circuit, determine the complex power absorbed by the load and place it in the rectangular form $P + jQ$. Provide the units.

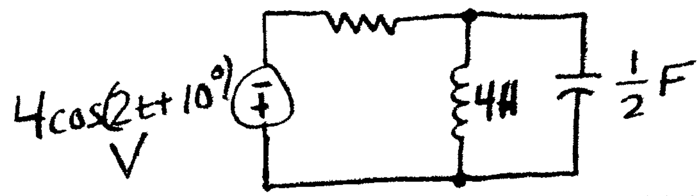


$S = \frac{1}{2}VI^* = (3\angle 20^\circ)\left(\frac{3\angle 20^\circ}{4+j10}\right)^*$

$= \frac{1}{2}(3\angle 20^\circ)\left(\frac{3\angle -20^\circ}{4-j10}\right) = \frac{1}{2}\frac{9}{4-j10}\frac{4+j10}{4+j10}$

$= \frac{1}{2}\frac{9}{4^2+10^2}(4+j10)$

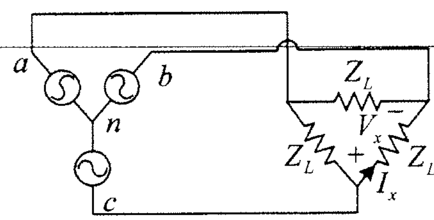
20. For the given circuit, determine the power factor seen by the source. It is not necessary to evaluate the trigonometric functions, but no j's should be present in the final answer.



$$Z_{IN} = 3 + \left(j8 \,//\, \tfrac{1}{j}\right)$$
$$= 3 + \frac{j8\frac{1}{j}}{j8+\frac{1}{j}}$$
$$= 3 + \frac{8}{j7}$$
$$= 3 - \frac{8}{7}j$$
$$= \sqrt{} \angle \tan^{-1}\frac{-\frac{8}{7}}{3}$$

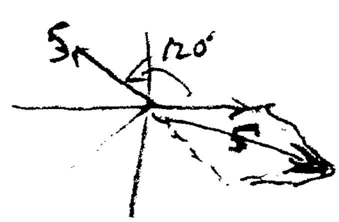
$j\omega L = j8$

$\frac{1}{j\omega C} = \frac{1}{j2\frac{1}{2}} = \frac{1}{j}$



21. For the balanced Y-Δ configuration shown above $\omega = 4$ rad/s, $V_{an} = 5\angle -120^\circ$ V rms, $V_{bn} = 5\angle 120^\circ$ V rms, $V_{cn} = 5\angle 0^\circ$ V rms, and each load, Z_L, consists of a 5 Ω resistor in series with a 2 H inductor, determine (using the concepts discussed in class, i.e., phasor diagrams, and simplify the expressions in the same manner as presented in class) the current I_x in the frequency domain

$$+V_x + 5\angle 120^\circ - 5\angle 0^\circ = 0$$
$$V_x = 5\angle 0^\circ - 5\angle 120^\circ$$
$$= 5\sqrt{3}\angle -30^\circ$$



$$I_x = \frac{5\sqrt{3}\angle -30^\circ}{5 + j8}$$

2 17. $12\cos 18^0 + 32\sin 18^0$ W

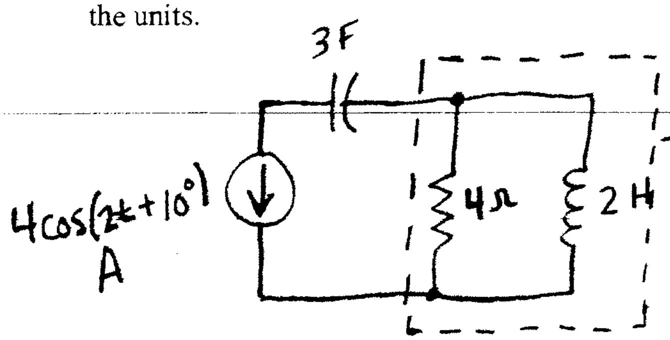
2 18. $-\frac{1}{2} 6 \sin(120 - 15^0)$ VAR

2 19. $\frac{1}{2} \times \frac{9}{4^2+10^2}(4+j10)$ VA

2 20. $\cos\left(\tan^{-1}\frac{-8/7}{3}\right)$

3 21. $\frac{5\sqrt{3}}{\sqrt{5^2+8^2}} \angle -30^0 - \tan^{-1}\frac{8}{5}$ A rms

10. For the given circuit, determine the complex power absorbed by the load. Provide the units.

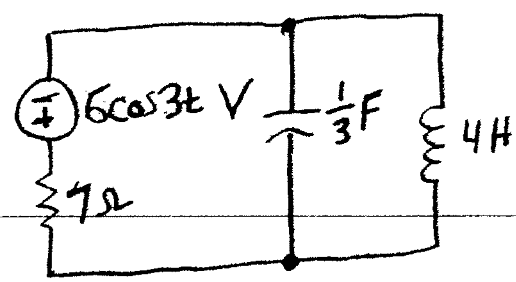


$4 \| j4 = \frac{16j}{4+4j}$

$S = \frac{1}{2}\left(\frac{16j}{4+4j}\, 4\angle 10^\circ\right)\left(4\angle -10^\circ\right) = \frac{(16)^2 j}{4+4j}$ VA

$= \frac{256\angle 90^\circ}{2\sqrt{32}\angle \tan^{-1} 1}$

11. For the given circuit, determine the power factor seen by the source. It is not necessary to evaluate the trigonometric functions, but no j's should be present in the final answer.



$\frac{1}{j\frac{1}{3}3} = \frac{1}{j}$

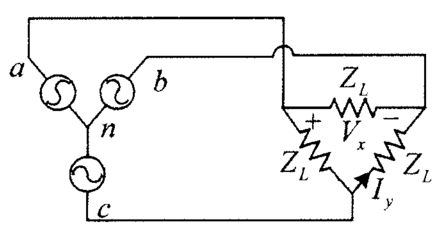
$-j \| j12 + 7$

$\frac{-j \cdot j12}{j11} + 7$

$\frac{12}{j11} + 7$

$-\frac{12}{11}j + 7$

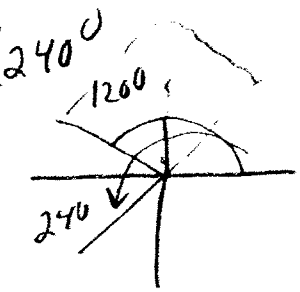
$= \frac{-12j + 77}{11}$



12. For the balanced Y-Δ configuration shown above $\omega = 3$ rad/s, $V_{an} = 2\angle 120^\circ$ V rms, $V_{bn} = 2\angle 240^\circ$ V rms, $V_{cn} = 2\angle 0^\circ$ V rms, and each load, Z_L, consists of a 2 Ω resistor in parallel with a 1/6 F capacitor, determine (using the concepts discussed in class, i.e., phasor diagrams, and simplify the expressions in the same manner as presented in class) the voltage V_x in the frequency domain

$+V_x + 2\angle 240^\circ - 2\angle 120^\circ = 0$

$V_x = 2\angle 120^\circ - 2\angle 240^\circ$



4 7. $-B\angle 0^\circ \times \dfrac{1/j\omega C}{R + \frac{1}{j\omega C}} + \dfrac{A\angle 0^\circ}{R + \frac{1}{j\omega C}}$

(1) $V_1 - V_2 = A\angle 0^\circ$

(3) $\dfrac{V_2 - V_3}{R_a} + \dfrac{V_1 - 0}{1/j\omega C} = 0$

(2) $\dfrac{V_3 - 0}{j\omega L} + \dfrac{V_3 - 0}{R_b} - B\angle 0^\circ + \dfrac{V_3 - V_2}{R_a} = 0$

3 8.

(1) $R_a I_1 - A\angle 0^\circ + I_1 \dfrac{1}{j\omega C} + \underset{\substack{\text{OR} \\ -I_3 j\omega L}}{(I_2 + I_3) R_b} = 0$

(2) $I_1 - I_2 = B\angle 0^\circ$

(3) $I_3 j\omega L + (I_2 + I_3) R_b = 0$

3 9.

4 10. $\dfrac{256}{2\sqrt{32}} \angle 45^\circ = \dfrac{256}{2\sqrt{32}}\left(\dfrac{1}{\sqrt{2}} + \dfrac{j}{\sqrt{2}}\right)$ VA , $\underset{1/\sqrt{2}}{\cos 45^\circ}$, $\underset{1/\sqrt{2}}{\sin 45^\circ}$

$\sqrt{32}\sqrt{2}$
$= \sqrt{16 \cdot 2}\sqrt{2}$
$= 4 \cdot 2 = 8$

3 11. $\cos\left(\tan^{-1} \dfrac{-12/11}{7}\right)$

2 12. $2\sqrt{3} \angle 90^\circ$ V rms

1 13. LPF

2 14. $\dfrac{j\omega L_2}{j\omega L_2 + \left(R \,//\, \frac{1}{j\omega C}\right)}$