CHAPTER

1.7

SINUSOIDAL STEADY STATE ANALYSIS

1. $i(t) = ?$

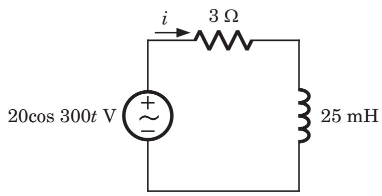

Fig. P1.7.1

(A) $20\cos(300t + 68.2°)$ A

(B) $20\cos(300t - 68.2°)$ A

(C) $2.48\cos(300t + 68.2°)$ A

(D) $2.48\cos(300t - 68.2°)$ A

2. $v_C(t) = ?$

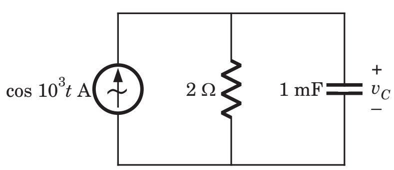

Fig. P1.7.2

(A) $0.89\cos(10^3t - 63.43°)$ V

(B) $0.89\cos(10^3t + 63.43°)$ V

(C) $0.45\cos(10^3t + 26.57°)$ V

(D) $0.45\cos(10^3t - 26.57°)$ V

3. $v_C(t) = ?$

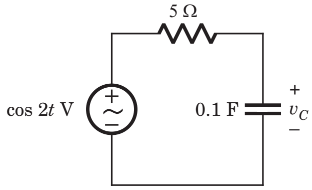

Fig. P1.7.3

(A) $\frac{1}{\sqrt{2}}\cos(2t - 45°)$ V

(B) $\frac{1}{\sqrt{2}}\cos(2t + 45°)$ V

(C) $\frac{1}{\sqrt{2}}\sin(2t - 45°)$ V

(D) $\frac{1}{\sqrt{2}}\sin(2t + 45°)$ V

4. $v_C(t) = ?$

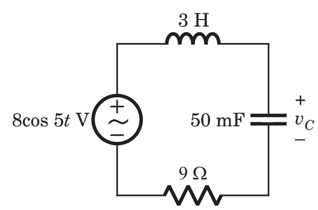

Fig. P1.7.4

(A) $2.25\cos(5t + 150°)$ V

(B) $2.25\cos(5t - 150°)$ V

(C) $2.25\cos(5t + 140.71°)$ V

(D) $2.25\cos(5t - 140.71°)$ V

5. $i(t) = ?$

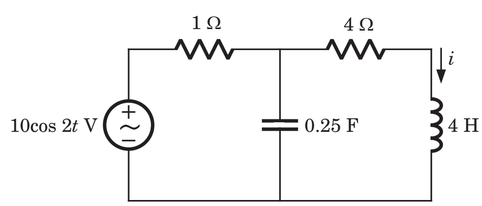

Fig. P1.7.5

(A) $2\sin(2t + 5.77°)$ A

(B) $\cos(2t - 84.23°)$ A

(C) $2\sin(2t - 5.77°)$ A

(D) $\cos(2t + 84.23°)$ A

13. In the bridge shown in fig. P1.7.13, $Z_1 = 300\ \Omega$, $Z_2 = (300 - j\ 600)\ \Omega$, $Z_3 = (200 + j\ 100)\Omega$. The Z_4 at balance is

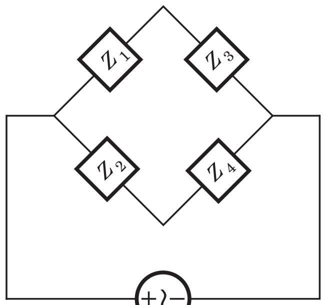

Fig. P1.7.13

(A) $400 + j300\ \Omega$
(B) $400 - j\ 300\ \Omega$
(C) $j100\ \Omega$
(D) $-\ j900\ \Omega$

14. In a two element series circuit, the applied voltage and the resulting current are $v(t) = 60 + 66\sin(10^3 t)$ V, $i(t) = 2.3\sin(10^3 t + 68.3°)$ A. The nature of the elements would be

(A) $R - C$
(B) $L - C$
(C) $R - L$
(D) $R - R$

15. $V_o = ?$

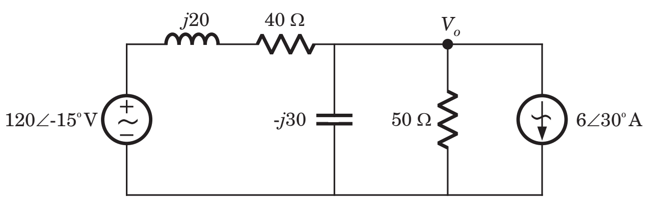

Fig. P1.7.15

(A) $223\angle -56°$ V
(B) $223\angle 56°$ V
(C) $124\angle -154°$ V
(D) $124\angle 154°$ V

16. $v_o(t) = ?$

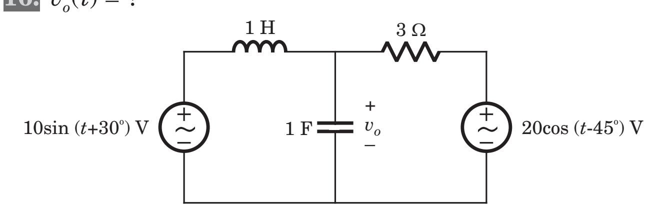

Fig. P1.7.16

(A) $31.5\cos(t + 112°)$ V
(B) $43.2\cos(t + 23°)$ V
(C) $31.5\cos(t - 112°)$ V
(D) $43.2\cos(t - 23°)$ V

Statement for Q.17-18:

The circuit is as shown in fig. P1.7.17-18

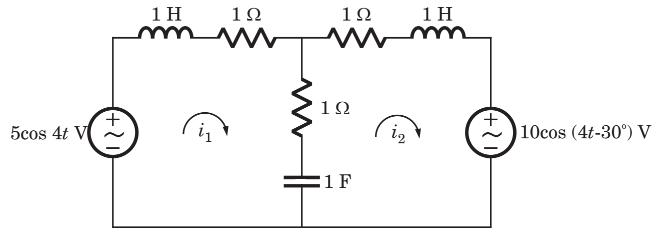

Fig. P1.7.17–18

17. $i_1(t) = ?$

(A) $2.36\cos(4t - 41.07°)$ A
(B) $2.36\cos(4t + 41.07°)$ A
(C) $1.37\cos(4t - 41.07°)$ A
(D) $2.36\cos(4t + 41.07°)$ A

18. $i_2(t) = ?$

(A) $2.04\sin(4t + 92.13°)$ A
(B) $-2.04\sin(4t + 2.13°)$ A
(C) $2.04\cos(4t + 2.13°)$ A
(D) $-2.04\cos(4t + 92.13°)$ A

19. $I_x = ?$

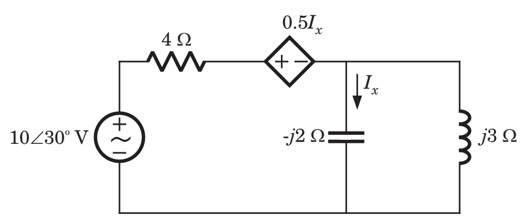

Fig. P1.7.19

(A) $3.94\angle 46.28°$ A
(B) $4.62\angle 97.38°$ A
(C) $7.42\angle 92.49°$ A
(D) $6.78\angle 49.27°$ A

20. $V_x = ?$

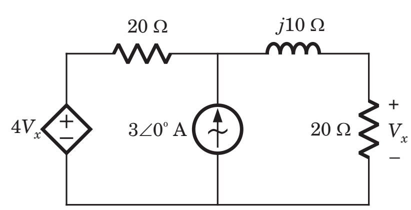

Fig. P1.7.20

(A) $29.11\angle 166°$ V
(B) $29.11\angle -166°$ V
(C) $43.24\angle 124°$ V
(D) $43.24\angle -124°$ V

Statement for Q.27–32:

Determine the complex power for hte given values in question.

27. $P = 269$ W, $Q = 150$ VAR (capacitive)

(A) $150 - j269$ VA (B) $150 + j269$ VA

(C) $269 - j150$ VA (D) $269 + j150$ VA

28. $Q = 2000$ VAR, $pf = 0.9$ (leading)

(A) $4129.8 + j2000$ VA (B) $2000 + j4129.8$ VA

(C) $2000 - j4129.8$ VA (D) $4129.8 - j2000$ VA

29. $S = 60$ VA, $Q = 45$ VAR (inductive)

(A) $39.69 + j45$ VA (B) $39.69 - j45$ VA

(C) $45 + j39.69$ VA (D) $45 - j39.69$ VA

30. $V_{rms} = 220$ V, $P = 1$ kW, $|Z| = 40\ \Omega$ (inductive)

(A) $1000 - j681.25$ VA (B) $1000 + j681.25$ VA

(C) $681.25 + j1000$ VA (D) $681.25 - j1000$ VA

31. $V_{rms} = 21\angle 20^\circ$ V, $V_{rms} = 21\angle 20^\circ$ V, $I_{rms} = 8.5\angle -50^\circ$ A

(A) $154.6 + j89.3$ VA (B) $154.6 - j89.3$ VA

(C) $61 + j167.7$ VA (D) $61 - j167.7$ VA

32. $V_{rms} = 120\angle 30^\circ$ V, $Z = 40 + j80\ \Omega$

(A) $72 + j144$ VA (B) $72 - j144$ VA

(C) $144 + j72$ VA (D) $144 - j72$ VA

33. $V_o = ?$

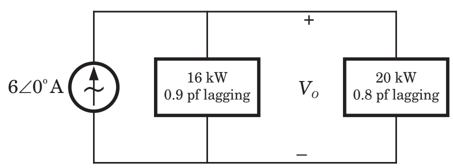

Fig. P1.7.33

(A) $7.1\angle 32.29^\circ$ kV (B) $42.59\angle 32.29^\circ$ kV

(C) $38.49\angle 24.39^\circ$ kV (D) $38.49\angle 32.29^\circ$ kV

34. A relay coil is connected to a 210 V, 50 Hz supply. If it has resistance of 30 Ω and an inductance of 0.5 H, the apparent power is

(A) 30 VA (B) 275.6 VA

(C) 157 VA (D) 187 VA

35. In the circuit shown in fig. P1.7.35 power factor is

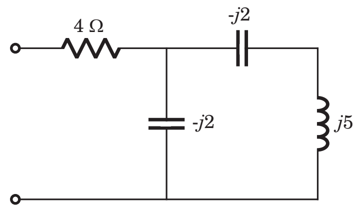

Fig. P1.7.35

(A) 56.31 (leading) (B) 56.31 (lagging)

(C) 0.555 (lagging) (D) 0.555 (leading)

36. The power factor seen by the voltage source is

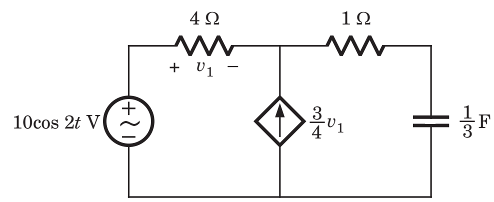

Fig. P1.7.36

(A) 0.8 (leading) (B) 0.8 (lagging)

(C) 36.9 (leading) (D) 39.6 (lagging)

37. The average power supplied by the dependent source is

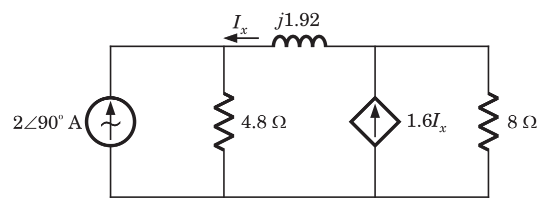

Fig. P1.7.37

(A) 96 W (B) –96 W

(C) 92 W (D) –192 W

38. In the circuit of fig. P1.7.38 the maximum power absorbed by Z_L is

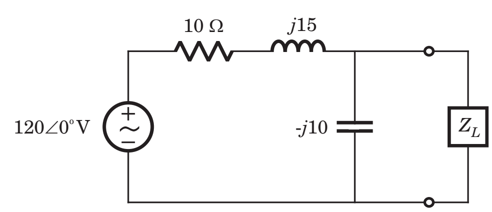

Fig. P1.7.38

(A) 180 W (B) 90 W

(C) 140 W (D) 700 W

39. The value of the load impedance, that would absorbs the maximum average power is

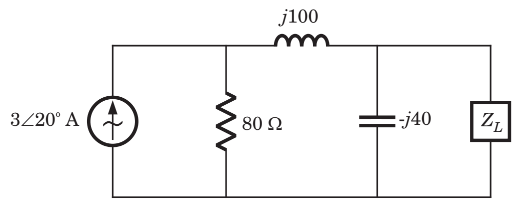

Fig. P1.7.39

(A) $12.8 - j49.6\ \Omega$ (B) $12.8 + j49.6\ \Omega$

(C) $33.9 - j86.3\ \Omega$ (D) $33.9 + j86.3\ \Omega$

Statement for Q.40–41:

In a balanced Y–connected three phase generator $V_{ab} = 400\ V_{rms}$

40. If phase sequence is *abc* then phase voltage V_a, V_b, and V_c are respectively

(A) $231\angle 0°$, $231\angle 120°$, $231\angle 240°$

(B) $231\angle -30°$, $231\angle -150°$, $231\angle 90°$

(C) $231\angle 30°$, $231\angle 150°$, $231\angle -90°$

(D) $231\angle 60°$, $231\angle 180°$, $231\angle -60°$

41. If phase sequence is *acb* then phase voltage are

(A) $231\angle 0°$, $231\angle 120°$, $231\angle 240°$

(B) $231\angle -30°$, $231\angle -150°$, $231\angle 90°$

(C) $231\angle 30°$, $231\angle 150°$, $231\angle -90°$

(D) $231\angle 60°$, $231\angle 180°$, $231\angle -60°$

42. A balanced three-phase Y-connected load has one phase voltage $V_c = 277\angle 45°$ V. The phase sequence is *abc*. The line to line voltage V_{AB} is

(A) $480\angle 45°$ V (B) $480\angle -45°$ V

(C) $339\angle 45°$ V (D) $339\angle -45°$ V

43. A three-phase circuit has two parallel balanced Δ loads, one of the 6 Ω resistor and one of 12 Ω resistors. The magnitude of the total line current, when the line-to-line voltage is 480 V_{rms}, is

(A) 120 A_{rms} (B) 360 A_{rms}

(C) 208 A_{rms} (D) 470 A_{rms}

44. In a balanced three-phase system, the source has an *abc* phase sequence and is connected in delta. There are two parallel Y-connected load. The phase impedance of load 1 and load 2 is $4 + j4\ \Omega$ and $10 + j4\ \Omega$ respectively. The line impedance connecting the source to load is $0.3 + j0.2\ \Omega$. If the current in a phase of load 1 is $I = 10\angle 20°\ A_{rms}$, the current in source in *ab* branch is

(A) $15\angle -122°\ A_{rms}$ (B) $8.67\angle -122°\ A_{rms}$

(C) $15\angle 27.9°\ A_{rms}$ (D) $8.67\angle -57.9°\ A_{rms}$

45. An *abc* phase sequence 3-phase balanced Y-connected source supplies power to a balanced Δ–connected load. The impedance per phase in the load is $10 + j8\ \Omega$. If the line current in a phase is $I_{aA} = 28.10\angle -28.66°\ A_{rms}$ and the line impedance is zero, the load voltage V_{AB} is

(A) $207.8\angle -140°\ V_{rms}$ (B) $148.3\angle 40°\ V_{rms}$

(C) $148.3\angle -40°\ V_{rms}$ (D) $207.8\angle 40°\ V_{rms}$

46. The magnitude of the complex power supplied by a 3-phase balanced Y-Y system is 3600 VA. The line voltage is 208 V_{rms}. If the line impedance is negligible and the power factor angle of the load is 25°, the load impedance is

(A) $5.07 + j10.88\ \Omega$ (B) $10.88 + j5.07\ \Omega$

(C) $43.2 + j14.6\ \Omega$ (D) $14.6 + j43.2\ \Omega$

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SOLUTIONS

1. (D) $Z = 3 + j(25\text{m})(300) = 3 + j7.5\ \Omega = 8.08\angle 68.2°$

$$I = \frac{20\angle 0}{8.08\angle 68.2°} = 2.48\angle -68.2°\ \text{A}$$

$i(t) = 2.48\cos(300t - 68.2°)$ A

2. (A) $Y = \frac{1}{2} + j(1\text{m})(10^3) = 0.5 + j = 1.12\angle 63.43°$

$$V_C = \frac{(1\angle 0)}{1.12\angle 63.43°} = 0.89\angle -63.43°\ \text{V}$$

$v_C(t) = 0.89\cos(10^3 t - 63.43°)$ V

3. (A) $Z = 5 + \frac{-j}{(0.1)(2)} = 5 - j5 = 5\sqrt{5}\angle -45°$

$$V_C = \frac{(1\angle 0)(5\angle -90°)}{5\sqrt{2}\angle -45°} = \frac{1}{\sqrt{2}}\angle -45°\ \text{V}$$

$$v_C(t) = \frac{1}{\sqrt{2}}\cos(2t - 45°)\ \text{V}$$

4. (D) $Z = 9 + j(3)(5) + \frac{-j}{(50\text{m})(5)} = 9 + j11$

$\Rightarrow \quad Z = 14.21\angle 50.71°\ \Omega$

$$V_C = \frac{(8\angle 0)(4\angle -90°)}{14.21\angle 50.71°} = 2.25\angle 140.71°\ \text{V}$$

$v_C(t) = 2.25\cos(5t - 140.71°)$ V

5. (B) $$V_a = \frac{\frac{10\angle 0}{1}}{\frac{1}{1} + \frac{1}{-j2} + \frac{1}{4 + j8}} = \frac{10\angle 0}{1.05 + j0.4}\ \text{V}$$

$$I = \frac{V_a}{4 + j8} = \frac{10\angle 0}{1 + j10} = 1\angle -84.23\ \text{A}$$

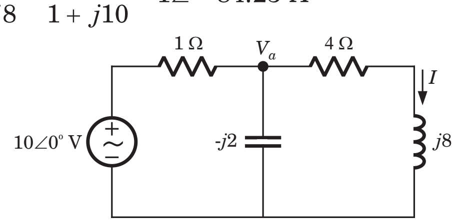

Fig. S1.7.5

$i(t) = \cos(2t - 84.23°)$ A

6. (D) $\omega = 2\pi \times 10 \times 10^3 = 2\pi \times 10^4$

$$Y = j(1\mu)(2\pi \times 10^4) + \frac{-j}{(160\mu)(2\pi \times 10^4)} + \frac{1}{36}$$

$= 0.0278 - j0.0366$ S

$$Z = \frac{1}{Y} = 13.16 + j17.33\ \Omega$$

7. (C) $Z = \left(\frac{-j}{\omega(22\mu)}\right) || (6 + j(27\text{m})\omega)$

$$= \frac{\frac{-j10^6}{22\omega}(6 + j27 \times 10^{-3}\omega)}{6 + j(27\text{m}\omega - \frac{10^6}{22\omega})} = \frac{\frac{27 \times 10^3}{22} - \frac{j6 \times 10^6}{22\omega}}{6 + j\omega\left(27\text{m} - \frac{10^6}{22\omega^2}\right)}$$

$$\frac{-j36 \times 10^6}{\omega 22} - \frac{j27 \times 10^3}{22}\omega\left(27\text{m} - \frac{10^6}{22\omega^2}\right) = 0$$

$\Rightarrow \quad \omega = 1278$

$$f = \frac{\omega}{2\pi}\ \text{Hz} = \frac{1278}{2\pi} = 203\ \text{Hz}$$

8. (C) $V_s = 7.68\angle 47°$ V, $V_2 = 7.51\angle 35°$

$V_1 = V_s - V_2 = 7.68\angle 47° - 7.51\angle 35° = 1.59\angle 125°$

9. (B) $v_{in} = \sqrt{3^2 + (14 - 10)^2} = 5$

10. (C) $I_1 = 744\angle -118°$ mA,

$I_2 = 540\angle 100°$ mA

$I = I_1 + I_2 = 744\angle -118° + 540.5\angle 100°$

$= 460\angle -164°$

$i(t) = 460\cos(3t - 164°)$ mA

11. (A) $$\sqrt{2}\angle 45° = \frac{V_C}{-j4} + \frac{V_C - 20\angle 0}{j5 + 10}$$

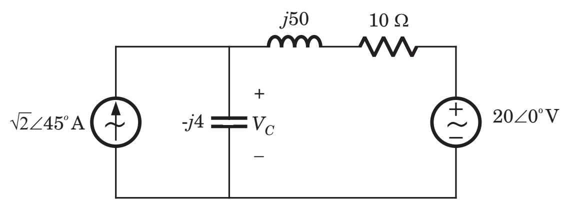

Fig. S1.7.11

$(1 + j)(-j4)(10 + j5) = V_C(10 + j5 - j4) + j8$

$\Rightarrow \quad 60 - j100 = V_C(10 + j)$

$\Rightarrow \quad V_C = 11.6\angle -64.7°$

12. (D) $X = X_L + X_C = 0$

So reactive power drawn from the source is zero.

13. (B) $Z_1 Z_4 = Z_3 Z_2$

$300 Z_4 = (300 - j600)(200 + j100)$

$\Rightarrow \quad Z_4 = 400 - j300$

14. (A) $R - C$ causes a positive phase shift in voltage

$Z = |Z|\angle\theta$, $-90° < \theta < 0$,

$$I = \frac{V}{Z} = \frac{V}{|Z|}\angle -\theta$$

15. (C) $V_o = \dfrac{\dfrac{120\angle 15^\circ}{40 + j20} - 6\angle 30^\circ}{\dfrac{1}{40 + j20} + \dfrac{1}{-j30} + \dfrac{1}{50}} = 124\angle -154^\circ$

16. (C) $10 \sin (t + 30^\circ) = 10 \cos (t - 60^\circ)$

$$V_o = \dfrac{\dfrac{10\angle -60^\circ}{j} + \dfrac{20\angle -45^\circ}{3}}{\dfrac{1}{j} + \dfrac{1}{-j} + \dfrac{1}{3}}$$

$= 30\angle -150^\circ + 20\angle -45^\circ$

$V_o = 31.5\angle -112^\circ$ V

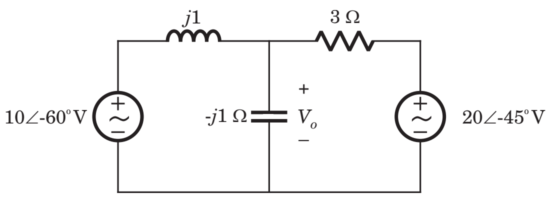

Fig. S.1.7.16

17. (C) $5\angle 0^\circ = I_1\left(j4 + 1 + 1 - \dfrac{j}{4}\right) - I_2\left(1 - \dfrac{j}{4}\right)$

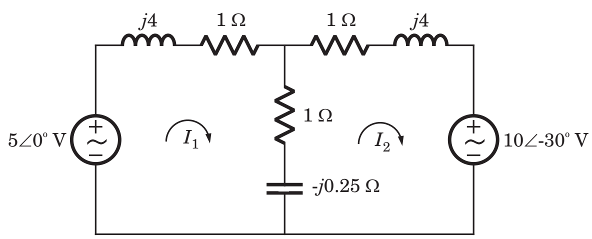

Fig. S.1.7.17

$\Rightarrow \quad (8 + j15)I_1 - (4 - j)I_2 = 20\angle 0$ ...(i)

$-10\angle -30^\circ = I_2\,(1 + j4 + 1 - \dfrac{j}{4}) - I_1\,(1 - \dfrac{j}{4})$

$\Rightarrow \quad (4 - j)I_1 - (8 + j15)I_2 = 40\angle -30^\circ$ ...(ii)

$I_1[(8 + j15)^2 - (4 - j)^2]$

$= (20\angle 0)(8 + j15) - (40\angle -30^\circ)(4 - j)$

$I_1(-176 + j248) = 41.43 + j414.64$

$\Rightarrow \quad I_1 = 1.03 - j0.9 = 1.37\angle -41.07$

18. (B) $I_2 = \dfrac{(8 + j15)(1.03 - j0.9) - 20\angle 0^\circ}{4 - j}$

$= -0.076 + j2.04 \quad \Rightarrow \quad I_2 = 2.04\angle 92.13^\circ$

19. (B) $10\angle 30^\circ = 4I_1 - 0.5I_x + (-j2)I_x$

$(-j2)I_x = (I_1 - I_x)j3,\ I_1 = \dfrac{I_x}{3}$

$10\angle 30^\circ = \left(\dfrac{4}{3} - 0.5 - j2\right)I_x \quad \Rightarrow \quad I_x = \dfrac{10\angle 30^\circ}{2.17\angle -67.38^\circ}$

20. (B) Let V_o be the voltage across current source

$\dfrac{V_o - 4V_x}{20} + \dfrac{V_o - V_x}{j10} = 3$

$V_o(20 + j10) - (20 + j40)V_x = j600$

$V_x = \dfrac{V_o(20)}{20 + j10} \quad \Rightarrow \quad V_o = \dfrac{V_x}{2}(2 + j)$

$V_x = \left(\dfrac{(2 + j)(20 + j10)}{2} - 20(1 + j2)\right) = j600$

$V_x = \dfrac{j600}{-5 - j20} = 29.22\angle -166^\circ$

21. (A) $I_1 = V_3\left(\dfrac{j}{2}\right) + \dfrac{V_3 - V_2}{j10} = j0.1V_2 + j0.4V_3$

$= (0.1\angle 90^\circ)(0.757\angle 66.7^\circ) + (0.4\angle 90^\circ)(0.606\angle -69.8^\circ)$

$\Rightarrow \quad I_1 = 0.196\angle 35.6^\circ$

22. (A) $\dfrac{V_o}{2} + \dfrac{V_o - 3V_o}{j4} = 4\angle -30^\circ$

$V_o(0.5 + j0.5) = 3.46 - j2 \quad \Rightarrow \quad V_o = 5.65\angle -75^\circ$

23. (D) $I_2 = 4\angle 90^\circ$, $I_3 = 2\angle 0^\circ$

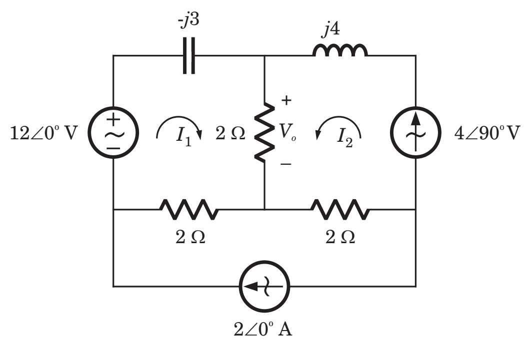

Fig. P1.7.23

$12\angle 0^\circ = I_1(-j3 + 2 + 2) + 8\angle 90^\circ - 4\angle 0^\circ$

$\Rightarrow \quad I_1 = 3.52 + j0.64$

$V_o = 2(3.52 + j0.64 + j4) = 11.65\angle 52.82^\circ$ V

24. (D) $I_2 = 3\angle 0^\circ$ A , $I_4 - I_3 = 6\angle 0^\circ$ A

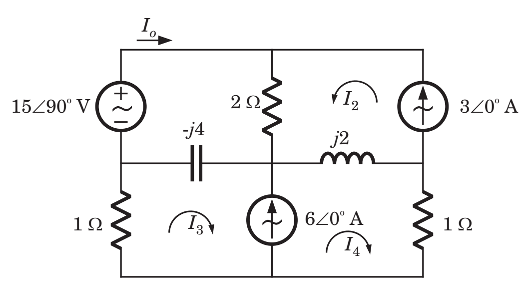

Fig. S.1.7.24

$I_3(1) + (I_3 - I_o)(-j4) + (I_4 + I_2)(j2) + I_4 = 0$

$$I_3 + (I_3 - I_o)(-j4) + (I_3 + 6\angle 0° + 3\angle 0°)(j2) + I_3 + 60° = 0$$

$$I_3(2 - j2) + I_o(j4) = -18j - 6$$

$$I_3 = \frac{-I_o(j2) - 3 - 9j}{(1 - j)}$$

$$\Rightarrow \quad I_3 = I_o + 3 - j6$$

$$15\angle 90° = (I_o + 3\angle 0°)(2) + (I_o - I_3)(-j4)$$

$$\Rightarrow \quad j15 = 2I_o + 6 + (j4)(3 - j6)$$

25. (A) $Z_{TH} = \frac{(j10)(8 - j5)}{8 + j10 - j5} = 9 + j4.4$

$$V_{TH} = \frac{(32\angle 0°)(j10)}{8 + j10 - j5} = 33.9\angle 58° \text{ V}$$

26 (D) $(600 - j300)I_1 + j300I_2 = 9$ ...(i)

$300I_2 = 3V_1$, $V_1 = (-j300)(I_1 - I_2)$

$\Rightarrow \quad I_2 = -j3(I_1 - I_2) \quad \Rightarrow \quad 3I_1 = (3 + j)I_2$ ...(ii)

Solving (i) and (ii) $I_2 = 12.36\angle -16°$ mA

$V_{oc} = 300I_2 = 3.71\angle -16°$

$-2V_1 - V_1 = 0 \quad \Rightarrow \quad V_1 = 0$

$$\Rightarrow \quad I_{sc} = \frac{9\angle 0°}{600} = 15\angle 0° \text{ mA}$$

$$Z_{TH} = \frac{V_{oc}}{I_{sc}} = \frac{3.11\angle -16°}{15\angle 0° \times 10^{-3}} = 247\angle -16°\,\Omega$$

27. (C) $S = P - jQ = 269 - j150$ VA

28. (D) $pf = \cos\theta = 0.9 \quad \Rightarrow \quad \theta = 25.84°$

$$Q = S\sin\theta \quad \Rightarrow \quad S = \frac{Q}{\sin\theta} = \frac{2000}{\sin 25.84°} = 4588.6 \text{ VA}$$

$P = S\cos\theta = 4129.8$,

$S = 4129.8 - j2000$

29. (A) $Q = S\sin\theta \quad \Rightarrow \quad \sin\theta = \frac{Q}{S} = \frac{45}{60}$ or

$\Rightarrow \quad \theta = 48.59°$,

$P = S\cos\theta = 39.69$,

$S = 39.69 + j45$ VA

30. (B) $S = \frac{|V_{rms}|^2}{|Z|} = \frac{(220^2)}{40} = 1210$

$$\cos\theta = \frac{P}{S} = \frac{1000}{1210} = 0.8264 \text{ or } \theta = 34.26°,$$

$Q = S\sin\theta = 681.25$,

$S = 1000 + j681.25$ VA

31. (C) $S = V_{rms}I^*_{rms} = (21\angle 20°)(8.5\angle 50°)$

$= 61 + j167.7$ VA

32. (A) $S = \frac{|V|^2}{Z^*} = \frac{(120)^2}{40 - j80} = 72 + j144$ VA

33. (A) $S_1 = 16 + j\frac{16}{0.9}\sin(\cos^{-1}(0.9)) = 16 + j7.75$

$$S_2 = 20 + j\frac{20}{0.8}\sin(\cos^{-1}(0.8)) = 20 + j15$$

$S = S_1 + S_2 = 36 + j2.75 = 42.59\angle 32.29°$

$S = V_oI^* = 6V_o \quad \Rightarrow \quad V_o = 7.1\angle 32.29°$

34. (B) $Z = 30 + j(0.5)(2\pi)(50) = 30 + j157$,

$$S = \frac{|V|^2}{Z^*} = \frac{(210)^2}{30 - j157}$$

$$\text{Apparent power} = |S| = \frac{(210)^2}{\sqrt{30^2 + 152^2}} = 275.6 \text{ VA}$$

35. (D) $Z = 4 + \frac{(-j2)(j5 - j2)}{-j2 + j5 - j2}$

$= 4 - j6 = 7.21\angle -56.31°$,

$pf = \cos 56.31° = 0.555$ leading

36. (A) $\frac{V_1}{4} + \frac{3}{4}V_1 = \frac{10 - V_1}{1 - j1.5} \quad \Rightarrow \quad V_1 = 4\angle 36.9°$,

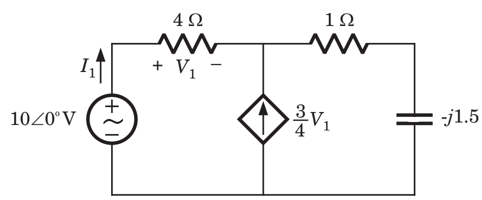

Fig. S.1.7.36

$I_1 = 1\angle 36.9°$

$$S = \frac{(1\angle 36.9°)(10\angle 0°)}{2} = 5\angle -36.9°$$

$pf = \cos 36.9° = 0.8$ leading

37. (A) $(2\angle -90°)4.8 = -I_x(4.8 + j1.92) + 0.6I_x(8)$

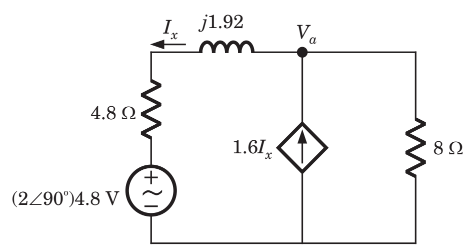

Fig. S.1.7.37

$I_x = 5\angle 0°$, $\quad V_a = 0.6 \times 5 \times 8 = 24\angle 0°$,

$$P_{ave} = \frac{1}{2} \times 24 \times 1.6 \times 5 = 96$$

38. (A) $Z_{TH} = \frac{(-j10)(10+j15)}{10+j15-j10} = 8 - j14\ \Omega$

$V_{TH} = \frac{120(-j10)}{10+j5} = 107.3\angle -116.6°\ \text{V}$

$I_L = \frac{107.3\angle -116.6°}{16} = 6.7\angle -116.6°$

$P_{Lmax} = \frac{1}{2}(6.7)^2 \times 8 = 180\ \text{W}$

39. (B) $Z_{TH} = \frac{(-j40)(80+j100)}{80+j60} = 12.8 - j49.6\ \Omega$

40. (B) $V_a = \frac{400}{\sqrt{3}}\angle -30° = 231\angle -30°\ \text{V}$

$V_b = 231\angle -150°\ \text{V},\ V_c = 231\angle -270°\ \text{V}$

41. (C) For the *acb* sequence

$V_{ab} = V_a - V_b = V_p\angle 0° - V_p\angle 120°$

$400 = V_p\left(1 + \frac{1}{2} - j\frac{\sqrt{3}}{2}\right) = V_p\sqrt{3}\angle -30°$

$\Rightarrow\ V_p = \frac{400}{\sqrt{3}}\angle 30°$

$V_a = V_p\angle 0° = 231\angle 30°\ \text{V},$

$V_b = V_p\angle 120° = 231\angle 150°\ \text{V}$

$V_c = V_p\angle 240° = 231\angle -90°\ \text{V}$

42. (B) $V_A = 277\angle(45° - 120°) = 277\angle -75°\ \text{V}$

$V_B = 277\angle(45° + 120°) = 277\angle 165°\ \text{V}$

$V_{AB} = V_A - V_B = 480\angle -45°\ \text{V}$

43. (C) $Z_A = 6 \,||\, 12 = 4,$

$I_P = \frac{480}{4} = 120\ \text{A}_{\text{rms}}$

$I_L = \sqrt{3}I_P = 208\ \text{A}_{\text{rms}}$

44 (B) $I = \frac{I_{aA}(10+j4)}{(10+j4)+(4+j4)} = 10\angle 20°$

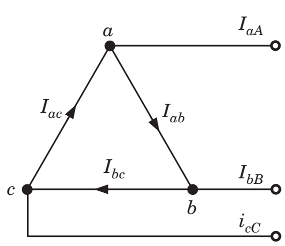

Fig. S.1.7.44

$I_{aA} = 15\angle -27.9°\ \text{A}_{\text{rms}}$

$I_{ab} = -\frac{|I_{aA}|}{\sqrt{3}}\angle(\theta + 30°) = 8.67\angle -122.1°\ \text{A}_{\text{rms}}$

45. (D) $I_{AB} = \frac{I_{aA}}{\sqrt{3}}\angle(\theta + 30°) = 16.22\angle 1.34°\ \text{A}_{\text{rms}}$

$V_{AB} = I_{AB} \cdot Z_{\Delta} = (16.22\angle 1.340°)(10 + j8)$

$= 207.8\angle 40°\ \text{V}_{\text{rms}}$

46. (B) $|S| = \sqrt{3}V_L I_L \quad \Rightarrow \quad I_L = \frac{3600}{208\sqrt{3}} = 10\ \text{A}_{\text{rms}}$

$Z_Y = \frac{208}{10\sqrt{3}}\angle 25° = 12\angle 25° = 10.88 + j5.07\ \Omega$

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