CHAPTER

1.10

TWO PORT NETWORK

Statement for Q.1-4:

The circuit is given in fig. P.1.10.1–4

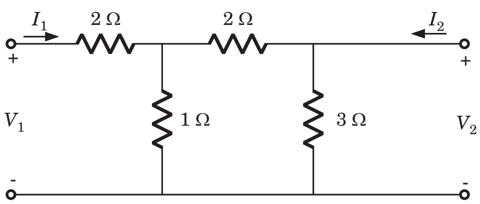

Fig. P.1.10.1–4

1. $[z] = ?$

(A) $\begin{bmatrix} -\frac{1}{2} & -\frac{3}{2} \\ -\frac{17}{6} & \frac{1}{2} \end{bmatrix}$

(B) $\begin{bmatrix} \frac{1}{2} & \frac{3}{2} \\ \frac{17}{6} & \frac{1}{2} \end{bmatrix}$

(C) $\begin{bmatrix} -\frac{17}{6} & -\frac{1}{2} \\ -\frac{1}{6} & \frac{3}{2} \end{bmatrix}$

(D) $\begin{bmatrix} \frac{17}{6} & \frac{1}{2} \\ \frac{1}{6} & \frac{3}{2} \end{bmatrix}$

2. $[y] = ?$

(A) $\begin{bmatrix} \frac{3}{8} & \frac{1}{8} \\ \frac{1}{8} & \frac{17}{24} \end{bmatrix}$

(B) $\begin{bmatrix} \frac{3}{8} & -\frac{1}{8} \\ -\frac{1}{8} & \frac{17}{24} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{17}{6} & \frac{1}{2} \\ \frac{1}{2} & \frac{3}{2} \end{bmatrix}$

(D) $\begin{bmatrix} \frac{17}{6} & -\frac{1}{2} \\ -\frac{1}{8} & \frac{3}{2} \end{bmatrix}$

3. $[h] = ?$

(A) $\begin{bmatrix} \frac{6}{17} & -\frac{3}{17} \\ \frac{3}{17} & \frac{24}{17} \end{bmatrix}$

(B) $\begin{bmatrix} \frac{8}{3} & \frac{1}{3} \\ -\frac{1}{3} & \frac{2}{3} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{6}{17} & \frac{3}{17} \\ -\frac{3}{17} & \frac{24}{17} \end{bmatrix}$

(D) $\begin{bmatrix} \frac{8}{3} & -\frac{1}{3} \\ \frac{1}{3} & \frac{2}{3} \end{bmatrix}$

4. $[T] = ?$

(A) $\begin{bmatrix} \frac{17}{3} & 8 \\ 2 & 3 \end{bmatrix}$

(B) $\begin{bmatrix} \frac{17}{3} & -8 \\ -2 & 3 \end{bmatrix}$

(C) $\begin{bmatrix} -\frac{17}{3} & -8 \\ 2 & -3 \end{bmatrix}$

(D) $\begin{bmatrix} \frac{17}{3} & -8 \\ 2 & -3 \end{bmatrix}$

5. $[z] = ?$

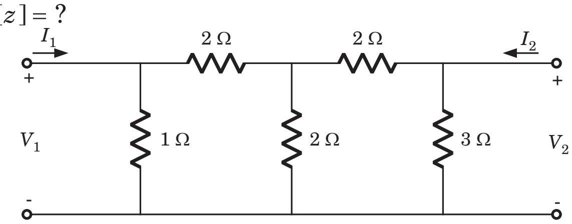

Fig. P.1.10.5

(A) $\begin{bmatrix} \frac{21}{16} & \frac{1}{8} \\ \frac{1}{8} & \frac{7}{12} \end{bmatrix}$

(B) $\begin{bmatrix} \frac{7}{9} & \frac{1}{6} \\ \frac{1}{6} & \frac{7}{4} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{21}{16} & -\frac{1}{8} \\ -\frac{1}{8} & \frac{7}{12} \end{bmatrix}$

(D) $\begin{bmatrix} \frac{7}{9} & \frac{1}{3} \\ \frac{1}{3} & \frac{7}{4} \end{bmatrix}$

6. $[y] = ?$

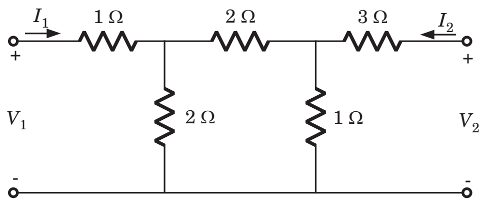

Fig. P.1.10.6

(A) $\begin{bmatrix} \frac{11}{41} & \frac{2}{41} \\ \frac{2}{41} & \frac{19}{41} \end{bmatrix}$ (B) $\begin{bmatrix} \frac{11}{41} & -\frac{2}{41} \\ -\frac{2}{41} & \frac{19}{41} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{19}{41} & \frac{2}{41} \\ \frac{2}{41} & \frac{11}{41} \end{bmatrix}$ (D) $\begin{bmatrix} \frac{19}{41} & -\frac{2}{41} \\ -\frac{2}{41} & \frac{11}{41} \end{bmatrix}$

Statement for Q.7-10:

A two port is described by $V_1 = I_1 + 2V_2$, $I_2 = -2I_1 + 0.4V_2$

7. $[z] = ?$

(A) $\begin{bmatrix} 11 & -5 \\ -5 & 2.5 \end{bmatrix}$ (B) $\begin{bmatrix} 11 & 5 \\ 5 & 2.5 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & -2 \\ 5 & 0.4 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 2 \\ -2 & 0.4 \end{bmatrix}$

8. $[y] = ?$

(A) $\begin{bmatrix} 11 & 5 \\ 5 & 2.5 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & -2 \\ -2 & 4.4 \end{bmatrix}$

(C) $\begin{bmatrix} -2 & 4.4 \\ 4 & -2 \end{bmatrix}$ (D) $\begin{bmatrix} 11 & -5 \\ -5 & 2.5 \end{bmatrix}$

9. $[h] = ?$

(A) $\begin{bmatrix} 3 & -6 \\ 4 & -4 \end{bmatrix}$ (B) $\begin{bmatrix} 4 & -2 \\ -2 & 4.4 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 2 \\ -2 & 0.4 \end{bmatrix}$ (D) $\begin{bmatrix} 11 & 5 \\ 5 & 2.5 \end{bmatrix}$

10. $[T] = ?$

(A) $\begin{bmatrix} 2.2 & 0.5 \\ 0.2 & 0.5 \end{bmatrix}$ (B) $\begin{bmatrix} 2.2 & -0.5 \\ 0.2 & -0.5 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 2 \\ -2 & 0.4 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & -2 \\ -2 & -0.4 \end{bmatrix}$

11. $[y] = ?$

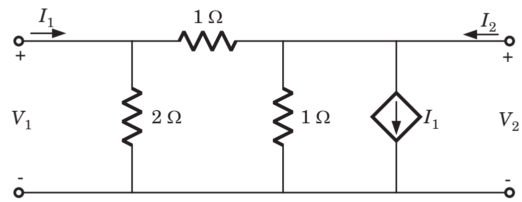

Fig. P.1.10.11

(A) $\begin{bmatrix} \frac{1}{2} & 1 \\ \frac{3}{2} & -1 \end{bmatrix}$ (B) $\begin{bmatrix} \frac{3}{2} & -1 \\ \frac{1}{2} & 1 \end{bmatrix}$

(C) $\begin{bmatrix} \frac{1}{2} & \frac{1}{2} \\ -\frac{1}{4} & \frac{3}{4} \end{bmatrix}$ (D) $\begin{bmatrix} -\frac{1}{4} & \frac{3}{4} \\ \frac{1}{2} & \frac{1}{2} \end{bmatrix}$

12. $[z] = ?$

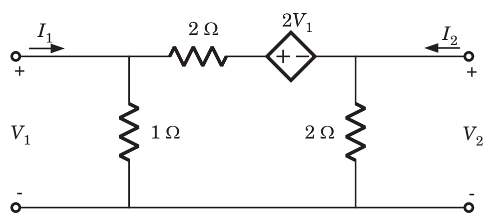

Fig. P.1.10.12

(A) $\begin{bmatrix} \frac{4}{3} & \frac{2}{3} \\ -\frac{2}{3} & \frac{2}{3} \end{bmatrix}$ (B) $\begin{bmatrix} \frac{1}{2} & -\frac{1}{2} \\ \frac{1}{2} & 1 \end{bmatrix}$

(C) $\begin{bmatrix} -\frac{2}{3} & \frac{2}{3} \\ \frac{4}{3} & \frac{2}{3} \end{bmatrix}$ (D) $\begin{bmatrix} \frac{1}{2} & 1 \\ \frac{1}{2} & -\frac{1}{2} \end{bmatrix}$

13. $[y] = ?$

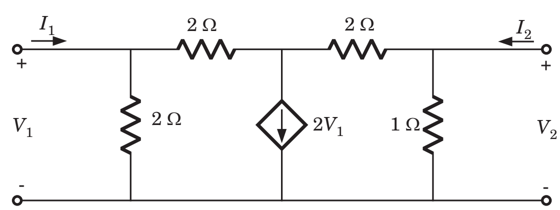

Fig. P.1.10.13

(A) $\begin{bmatrix} \frac{7}{4} & -\frac{1}{4} \\ \frac{1}{2} & \frac{5}{4} \end{bmatrix}$ (B) $\begin{bmatrix} \frac{7}{4} & -\frac{1}{4} \\ \frac{3}{4} & \frac{5}{4} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{10}{19} & \frac{2}{19} \\ \frac{6}{19} & \frac{14}{19} \end{bmatrix}$ (D) $\begin{bmatrix} \frac{6}{19} & \frac{14}{19} \\ \frac{10}{19} & \frac{2}{19} \end{bmatrix}$

14. $[z] = ?$

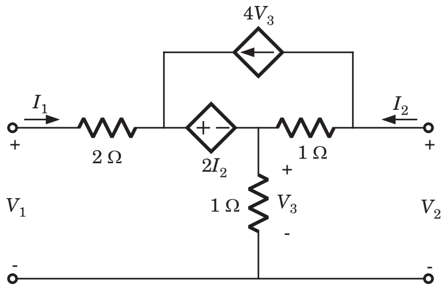

Fig. P.1.10.14

(A) $\begin{bmatrix} 2 & 3 \\ 3 & 3 \end{bmatrix}$ (B) $\begin{bmatrix} -3 & -2 \\ 3 & 3 \end{bmatrix}$

(C) $\begin{bmatrix} 3 & 3 \\ 3 & 2 \end{bmatrix}$ (D) $\begin{bmatrix} 3 & 3 \\ -3 & -2 \end{bmatrix}$

15. $[z] = ?$

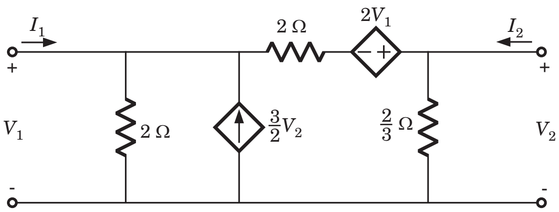

Fig. P.1.1.15

(A) $\begin{bmatrix} 2 & 2 \\ \frac{3}{2} & 2 \end{bmatrix}$ (B) $\begin{bmatrix} -2 & \frac{3}{2} \\ 2 & -2 \end{bmatrix}$

(C) $\begin{bmatrix} 2 & \frac{3}{2} \\ 2 & 2 \end{bmatrix}$ (D) $\begin{bmatrix} 2 & -2 \\ -\frac{3}{2} & 2 \end{bmatrix}$

16. $[y] = ?$

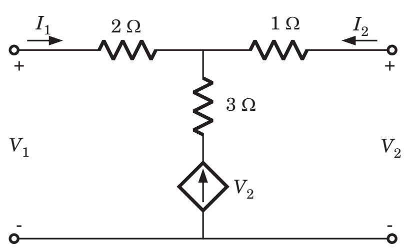

Fig. P.1.10.16

(A) $\begin{bmatrix} -1 & 1 \\ -1 & -2 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & -1 \\ 1 & -2 \end{bmatrix}$

(C) $\begin{bmatrix} -\frac{2}{3} & \frac{1}{3} \\ -\frac{1}{3} & -\frac{1}{3} \end{bmatrix}$ (D) $\begin{bmatrix} -\frac{2}{3} & -\frac{1}{3} \\ \frac{1}{3} & -\frac{1}{3} \end{bmatrix}$

17. $[z] = ?$

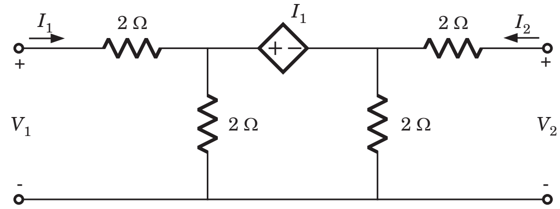

Fig. P.1.10.17

(A) $\begin{bmatrix} 3 & 2 \\ 6 & \frac{1}{7} \end{bmatrix}$ (B) $\begin{bmatrix} 6 & \frac{1}{7} \\ 3 & 2 \end{bmatrix}$

(C) $\begin{bmatrix} \frac{7}{4} & 1 \\ \frac{1}{2} & 3 \end{bmatrix}$ (D) $\begin{bmatrix} \frac{1}{2} & 3 \\ \frac{7}{4} & 1 \end{bmatrix}$

18. $[T] = ?$

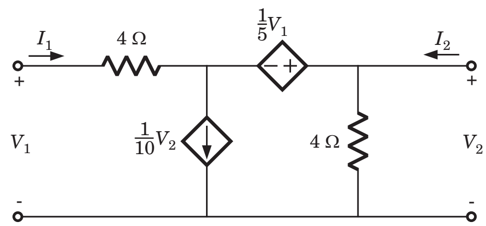

Fig. P.1.10.18

(A) $\begin{bmatrix} 0.35 & -1 \\ 2 & -3.33 \end{bmatrix}$ (B) $\begin{bmatrix} 2 & -3.33 \\ 0.35 & -1 \end{bmatrix}$

(C) $\begin{bmatrix} 2 & 3.33 \\ 0.35 & 1 \end{bmatrix}$ (D) $\begin{bmatrix} 0.35 & 1 \\ 2 & 3.33 \end{bmatrix}$

19. $[h] = ?$

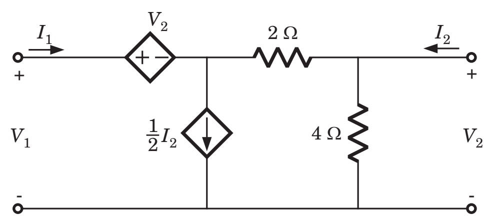

Fig. P.1.10.19

(A) $\begin{bmatrix} 4 & \frac{3}{2} \\ -2 & \frac{1}{2} \end{bmatrix}$ (B) $\begin{bmatrix} -2 & \frac{1}{2} \\ 4 & \frac{3}{2} \end{bmatrix}$

(C) $\begin{bmatrix} 4 & -\frac{3}{2} \\ 2 & \frac{1}{2} \end{bmatrix}$ (D) $\begin{bmatrix} 2 & \frac{1}{2} \\ 4 & -\frac{3}{2} \end{bmatrix}$

(A) $\begin{bmatrix} Z_a + Z_{ab} & Z_{ab} \\ Z_{ab} & Z_b + Z_{ab} \end{bmatrix}$ (B) $\begin{bmatrix} Z_a - Z_{ab} & Z_{ab} \\ Z_{ab} & Z_b - Z_{ab} \end{bmatrix}$

(C) $\begin{bmatrix} Z_a + Z_{ab} & -Z_{ab} \\ -Z_{ab} & Z_b + Z_{ab} \end{bmatrix}$ (D) $\begin{bmatrix} Z_{ab} - Z_a & Z_{ab} \\ Z_{ab} & Z_{ab} - Z_b \end{bmatrix}$

27. $[y] = ?$

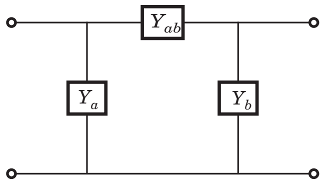

Fig. P.1.10.27

(A) $\begin{bmatrix} Y_a + Y_{ab} & -Y_{ab} \\ -Y_{ab} & Y_b + Y_{ab} \end{bmatrix}$ (B) $\begin{bmatrix} Y_a - Y_{ab} & Y_{ab} \\ Y_{ab} & Y_b - Y_{ab} \end{bmatrix}$

(C) $\begin{bmatrix} Y_{ab} - Y_a & Y_{ab} \\ Y_{ab} & Y_{ab} - Y_a \end{bmatrix}$ (D) $\begin{bmatrix} Y_a - Y_{ab} & -Y_{ab} \\ -Y_{ab} & Y_b - Y_{ab} \end{bmatrix}$

28. The y-parameters of a 2-port network are

$$[y] = \begin{bmatrix} 5 & 3 \\ 1 & 2 \end{bmatrix} \text{S}$$

A resistor of 1 ohm is connected across as shown in fig. P.1.10.2 8. The new y –parameter would be

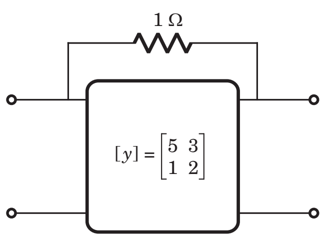

Fig. P.1.10.28

(A) $\begin{bmatrix} 6 & 4 \\ 2 & 3 \end{bmatrix}$ S (B) $\begin{bmatrix} 6 & 2 \\ 0 & 3 \end{bmatrix}$ S

(C) $\begin{bmatrix} 5 & 4 \\ 2 & 2 \end{bmatrix}$ S (D) $\begin{bmatrix} 4 & 4 \\ 2 & 1 \end{bmatrix}$ S

29. For the 2-port of fig. P.1.10.29, $[y_a] = \begin{bmatrix} 2 & 0 \\ 0 & 10 \end{bmatrix}$ mS

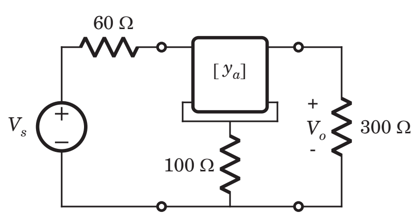

Fig. P.1.10.29

The value of $\frac{V_o}{V_s}$ is

(A) $\frac{3}{32}$ (B) $\frac{1}{16}$

(C) $\frac{2}{33}$ (D) $\frac{1}{17}$

30. The T-parameters of a 2-port network are

$$[T] = \begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}.$$

If such two 2-port network are cascaded, the z –parameter for the cascaded network is

(A) $\begin{bmatrix} 2 & -2 \\ -\frac{1}{2} & 1 \end{bmatrix}$ (B) $\begin{bmatrix} \frac{5}{3} & -\frac{1}{3} \\ -\frac{1}{3} & \frac{2}{3} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{5}{3} & \frac{1}{3} \\ \frac{1}{3} & \frac{2}{3} \end{bmatrix}$ (D) $\begin{bmatrix} 2 & 2 \\ \frac{1}{2} & 1 \end{bmatrix}$

31. $[y] = ?$

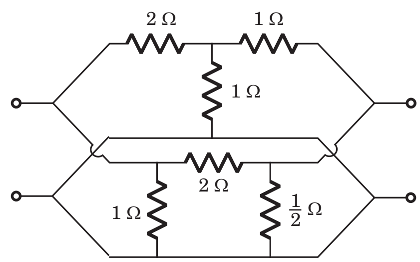

Fig. P.1.10.31

(A) $\begin{bmatrix} \frac{19}{10} & \frac{-9}{10} \\ -\frac{9}{10} & \frac{31}{10} \end{bmatrix}$ (B) $\begin{bmatrix} \frac{19}{10} & \frac{-7}{10} \\ -\frac{7}{10} & \frac{31}{10} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{19}{10} & \frac{9}{10} \\ \frac{9}{10} & \frac{31}{10} \end{bmatrix}$ (D) $\begin{bmatrix} \frac{19}{10} & \frac{7}{10} \\ \frac{7}{10} & \frac{31}{10} \end{bmatrix}$

32. $[y] = ?$

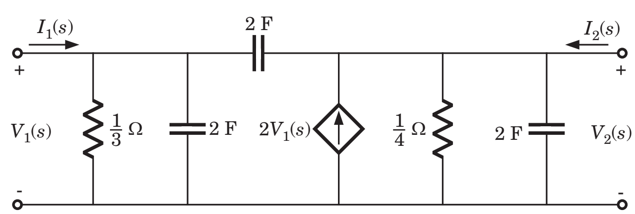

Fig. P.1.10.32

(A) $\begin{bmatrix} s+3 & 2s \\ 2s+2 & 4 \end{bmatrix}$ (B) $\begin{bmatrix} s+3 & -2s \\ -2s-2 & 4s+4 \end{bmatrix}$

(C) $\begin{bmatrix} s+3 & -2s \\ -2s-2 & 4 \end{bmatrix}$ (D) $\begin{bmatrix} 3s+3 & -2s \\ -2s-2 & 4s+4 \end{bmatrix}$

33. $h_{21} = ?$

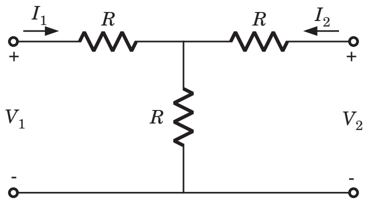

Fig. P.1.10.33

(A) $-\frac{3}{2}$ (B) $\frac{1}{2}$

(C) $-\frac{1}{2}$ (D) $\frac{3}{2}$

34. In the circuit shown in fig. P.1.10.34, when the voltage V_1 is 10 V, the current I is 1 A. If the applied voltage at port-2 is 100 V, the short circuit current flowing through at port 1 will be

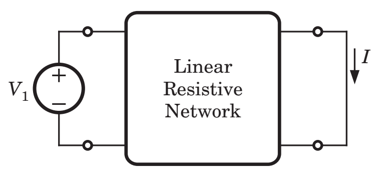

Fig. P.1.10.34

(A) 0.1 A (B) 1 A

(C) 10 A (D) 100 A

35. For a 2-port symmetrical bilateral network, if transmission parameters $A = 3$ and $B = 1\ \Omega$, the value of parameter C is

(A) 3 (B) 8 S

(C) 8 Ω (D) 9

36. A 2-port resistive network satisfy the condition $A = D = \frac{3}{2} B = \frac{4}{3} C$. The z_{11} of the network is

(A) $\frac{4}{3}$ (B) $\frac{3}{4}$

(C) $\frac{2}{3}$ (D) $\frac{3}{2}$

37. The circuit shown in fig. P.1.10.37 is reciprocal if a is

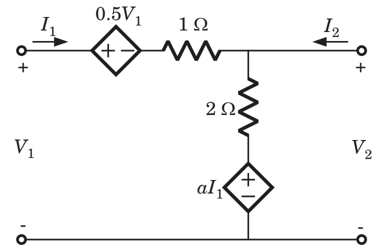

Fig. P.1.10.37

(A) 2 (B) −2

(C) 1 (D) −1

38. $Z_{in} = ?$

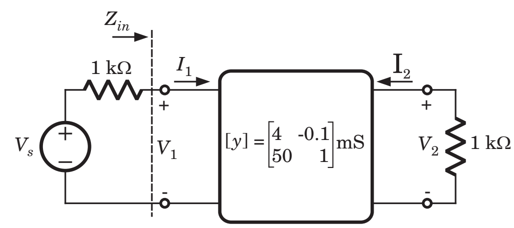

Fig. P.1.10.38

(A) 86.4 Ω (B) 64.3 Ω

(C) 153.8 Ω (D) 94.3 Ω

39. V_1 , V_2 = ?

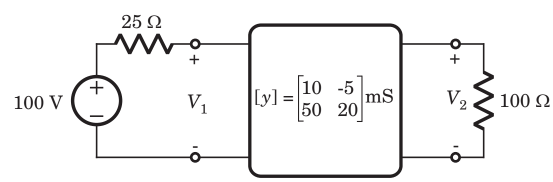

Fig. P.1.10.39

(A) −68.6 V, 114.3 V (B) 68.6 V, −114.3 V

(C) 114.3 V, −68.6 V (D) −114.3 V, 68.6 V

40. A 2-port network is driven by a source $V_s = 100$ V in series with 5 Ω, and terminated in a 25 Ω resistor. The impedance parameters are

$$[z] = \begin{bmatrix} 20 & 2 \\ 40 & 10 \end{bmatrix} \Omega$$

The Thevenin equivalent circuit presented to the 25 Ω resistor is

(A) 80 V, 2.8 Ω (B) 160 V, 6.8 Ω

(C) 100 V, 2.4 Ω (D) 120 V, 6.4 Ω

$$[z]=\begin{bmatrix}\frac{7}{4} & 1\\ \frac{1}{2} & 3\end{bmatrix}$$

18. (D) Let I_3 be the clockwise loop current in center loop

$$I_1=\frac{V_2}{10}+I_3,\qquad V_2=4(I_2+I_3)\quad\Rightarrow\quad I_3=0.25V_2-I_2$$

$$\Rightarrow\quad I_1=0.35V_2-I_2 \qquad \text{...(i)}$$

$$V_1=4I_1-0.2V_1+V_2$$

$$1.2V_1=4(0.35V_2-I_2)+V_2=2.4V_2-4I_2$$

$$\Rightarrow\quad V_1=2V_2-3.33I_2 \qquad \text{...(ii)}$$

19. (A) $V_2=4\left(I_2+I_1-\frac{I_2}{2}\right)\Rightarrow\quad I_2=-2I_1+\frac{1}{2}V_2$ ...(ii)

$$I_1=\frac{I_2}{2}+\frac{(V_1-V_2)-V_2}{2}=-I_1+\frac{V_2}{4}+\frac{V_1}{2}-V_2$$

$$\Rightarrow\quad V_1=4I_1+\frac{3}{2}V_2 \qquad \text{...(i)}$$

20. (B) $I_1=-V_2+\frac{V_1}{1}+\frac{V_1-V_2}{2}=\frac{3}{2}V_1-\frac{3}{2}V_2$ ...(i)

$$I_2=2V_1+\frac{V_2}{1}+\frac{V_2-V_1}{2}=\frac{3}{2}V_1+\frac{3}{2}V_2 \qquad \text{...(ii)}$$

21. (D) $I_1=2V_1+jV_1+j(V_1-V_2)$

$$\Rightarrow\quad I_1=(2+j2)V_1-jV_2 \qquad \text{...(i)}$$

$$I_2=\frac{V_2}{1}+V_1+j(V_2-V_1)=(1-j)V_1+(1+j)V_2 \qquad \text{...(ii)}$$

22. (B) $V_1=\frac{I_1}{s}+sI_1+sI_2=\left(\frac{1}{s}+s\right)I_1+sI_2$ ...(i)

$$V_2=2I_2+2s\,I_2+sI_1\quad\Rightarrow\quad V_2=sI_1+(2+2s)I_2 \qquad \text{...(ii)}$$

23. (D) $Z_R=\frac{9}{n^2}=\frac{9}{9}=1$

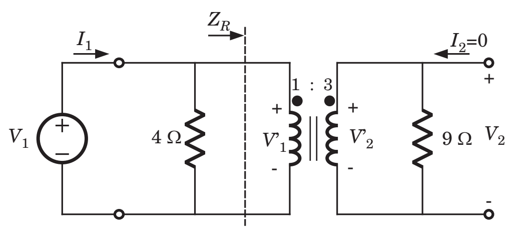

Fig. S1.10.23a

$$V_1=(4\,||\,1)I_1=\frac{4}{5}I_1\quad\Rightarrow\quad z_{11}=\frac{V_1}{I_1}=0.8$$

$$V_2=V'_2=nV'_1=3\left(\frac{4}{5}I_1\right)\quad\Rightarrow\quad z_{21}=\frac{V_2}{I_1}=2.4,$$

$$Z'_R=n^2 4=36$$

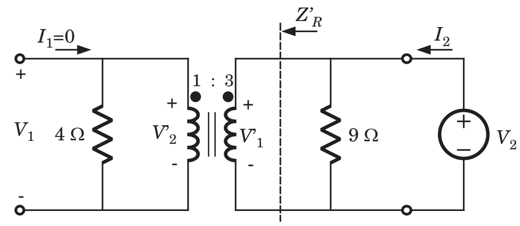

Fig. S1.10.23b

$$V_2=(36\,||\,9)I_2=7.2I_2\quad\Rightarrow\quad z_{22}=\frac{V_2}{I_2}=7.2,$$

$$z_{12}=z_{21}=2.4$$

24. (C) $V_1=3sI_1+3sI_1-3sI_1+3sI_1+2sI_2$

$$\Rightarrow\quad V_1=6sI_1+2sI_2 \qquad \text{...(i)}$$

$$V_2=3sI_2+2sI_1\quad\Rightarrow\quad V_2=2sI_1+3sI_2 \qquad \text{...(ii)}$$

25. (C) $V_1=\frac{V_2}{5}+0(-I_2),\qquad I_1=(0)V_2+5(-I_2)$

26. (A) $V_1=(Z_a+Z_{ab})I_1+Z_{ab}I_2$ ...(i)

$$V_2=(Z_a+Z_{ab})I_2+Z_{ab}I_1=Z_{ab}I_1+(Z_a+Z_{ab})I_2 \qquad \text{....(ii)}$$

27. (A) $I_1=(V_1-V_2)Y_{ab}+V_1Y_a$

$$\Rightarrow\quad I_1=V_1(Y_a+Y_{ab})-V_2Y_{ab} \qquad \text{...(i)}$$

$$I_2=(V_2-V_1)Y_{ab}+V_2Y_b=-V_1Y_{ab}+V_2(Y_b+Y_{ab}) \qquad \text{...(ii)}$$

28. (B) y-parameter of 1 Ω resistor network are $\begin{bmatrix}1 & -1\\ -1 & 1\end{bmatrix}$

New y-parameter $=\begin{bmatrix}5 & 3\\ 1 & 2\end{bmatrix}+\begin{bmatrix}1 & -1\\ -1 & 1\end{bmatrix}=\begin{bmatrix}6 & 2\\ 0 & 3\end{bmatrix}$.

29. (A) $[z_a]=\begin{bmatrix}2\text{ mS} & 0\\ 0 & 10\text{ mS}\end{bmatrix}^{-1}=\begin{bmatrix}5000 & 0\\ 0 & 100\end{bmatrix}$

$$[z]=\begin{bmatrix}5000 & 0\\ 0 & 100\end{bmatrix}+\begin{bmatrix}100 & 100\\ 100 & 100\end{bmatrix}=\begin{bmatrix}600 & 100\\ 100 & 200\end{bmatrix}$$

$$V_1=600I_1+100I_2\ ,\ V_2=100I_1+200I_2$$

$$V_s=60I_1+V_1=660I_1+100I_2\ ,\ V_2=V_o=-300I_2$$

$$V_o=100I_1-\frac{2}{3}V_o\quad\Rightarrow\quad I_1=\frac{V_o}{60}$$

$$V_s=11V_o-\frac{V_o}{3}\quad\Rightarrow\quad \frac{V_o}{V_5}=\frac{3}{32}$$

30. (C) $[T_N]=\begin{bmatrix}2 & 1\\ 1 & 1\end{bmatrix}\begin{bmatrix}2 & 1\\ 1 & 1\end{bmatrix}=\begin{bmatrix}5 & 3\\ 3 & 2\end{bmatrix}$

$$V_1=5V_2-3I_2\ ,\ I_1=3V_2-2I_2$$

$3V_1 - 5I_1 = I_2 \quad \Rightarrow \quad V_1 = \frac{5}{3}I_1 + \frac{1}{3}I_2$ ...(i)

$V_2 = \frac{1}{3}I_1 + \frac{2}{3}I_2$ ...(ii)

31. (B)

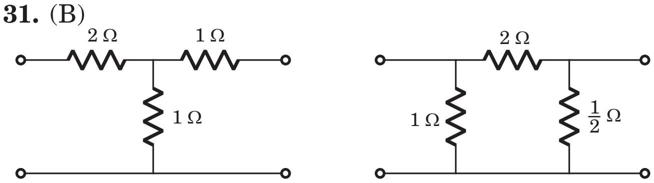

Fig. S.1.10.31a & b

$$[z_a] = \begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix}, \; [y_a] = \begin{bmatrix} \frac{2}{5} & -\frac{1}{5} \\ -\frac{1}{5} & \frac{3}{5} \end{bmatrix}, \; [y_b] = \begin{bmatrix} \frac{3}{2} & -\frac{1}{2} \\ -\frac{1}{2} & \frac{5}{2} \end{bmatrix}$$

$$[y] = [y_a] + [y_b] = \begin{bmatrix} \frac{19}{10} & -\frac{7}{10} \\ -\frac{7}{10} & \frac{31}{10} \end{bmatrix}$$

32. (D) $[y_a] = \begin{bmatrix} 3s & -2s \\ -2s & 4s \end{bmatrix}, [y_b] = \begin{bmatrix} 3 & 0 \\ -2 & 4 \end{bmatrix}$

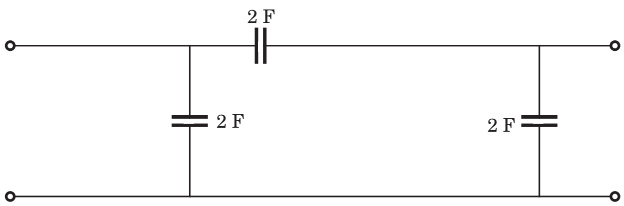

Fig. S.1.10.32a

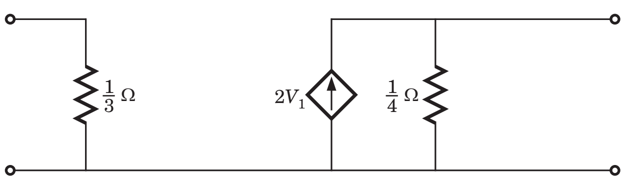

Fig. S.1.10.32b

$$[y] = [y_a] = [y_b] = \begin{bmatrix} 3s + 3 & -2s \\ -2s - 2 & 4s + 4 \end{bmatrix}$$

33. (C) $h_{21} = \left.\frac{I_2}{I_1}\right|_{V_2=0}, \; -I_2 = \frac{I_1 R}{R + R}, \; \frac{I_2}{I_1} = -\frac{1}{2}$

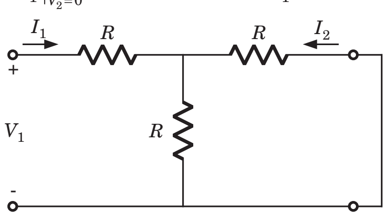

Fig. S.1.10.33

34. (C) $\left.\frac{I_2}{V_1}\right|_{V_2=0} = y_{21} = \frac{1}{10} = 0.1$

Interchanging the port $\frac{I_2'}{V_1'} = 0.1, \; I_2' = 100 \times 0.1 = 10$

35. (B) For symmetrical network $A = D = 3$

For bilateral $AD - BC = 1, \; 9 - C = 1, \quad C = 8$ S

36. (A) $z_{11} = \frac{A}{C} = \frac{4}{3}$

37. (A) $V_1 = 0.5V_1 + I_1 + 2(I_1 + I_2) + aI_1$

$\Rightarrow \quad V_1 = (6 + 2a)I_1 + 4I_2$ ...(i)

$V_2 = 2(I_1 + I_2) + aI_1 \quad \Rightarrow \quad V_2 = (2 + a)I_1 + 2I_2$ ...(ii)

For reciprocal network

$z_{12} = z_{21}, \; 4 = 2 + a \quad \Rightarrow \quad a = 2$

38. (C) $I_1 = 4 \times 10^3 V_1 - 0.1 \times 10^{-3} V_2$

$I_2 = 50 \times 10^{-3} V_1 + 10^{-3} V_2, \; V_2 = -10^3 I_2$

$-10^{-3} V_2 = 50 \times 10^{-3} V_1 + 10^{-3} V_2, \; V_2 = -25V_1$

$10^3 I_1 = 4V_1 + 2.5V_1, \; \frac{V_1}{I_1} = \frac{10^3}{6.5} = 153.8$

39. (B) $I_1 = 10 \times 10^{-3} V_1 - 5 \times 10^{-3} V_2,$

$100 = 25I_1 + V_1$

$100 - V_1 = 0.25V_1 - 0.125V_2 \quad \Rightarrow \quad 800 = 10V_1 - V_2$ ...(i)

$I_2 = 50 \times 10^{-3} V_1 + 20 \times 10^{-3} V_2, \; V_2 = -100I_2$

$V_2 = -5V_1 - 2V_2 \quad \Rightarrow \quad 3V_2 + 5V_1 = 0$ ...(ii)

From (i) and (ii) $V_1 = 68.6$ V, $\; V_2 = -114.3$ V.

40. (B) $100 = 5I_1 + V_1, \quad V_1 = 20I_1 + 2I_2$

$\Rightarrow \quad 100 = 25I_1 + 2I_2, \; V_2 = 40I_1 + 10I_2$

$800 - 5V_2 = -34I_2 \quad \Rightarrow \quad V_2 = 160 + 6.8I_2$

$V_{TH} = 160$ V, $R_{TH} = 6.8\ \Omega$

41. (B) $V_1 = z_{11}I_1, \; V_2 = z_{21}I_1, \; \frac{V_2}{V_1} = \frac{z_{21}}{z_{11}}$

42. (B) $I_2 = y_{21}V_1 + y_{22}V_2, \; I_2 = -V_2 Y_L$

$y_{21}V_1 + (y_{22} + Y_L)V_2 = 0, \; \frac{V_2}{V_1} = \frac{-y_{21}}{(y_{22} + y_L)}$

43. (A) $V_2 = z_{21}I_1 + z_{22}I_2, \quad V_2 = -Z_L I_2$

$V_2 = z_{21}I_1 + z_{22}\left(-\frac{V_2}{Z_L}\right)$

$V_2(Z_L + z_{22}) = z_{21}Z_L I_1, \; \frac{V_2}{I_1} = \frac{z_{21}Z_L}{z_{22} + Z_L}$

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