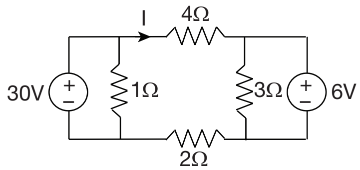
Networks Test 5

Number of Questions: 25 **Time: 60 min.**

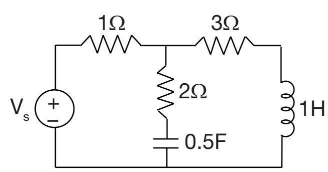
Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. For the circuit shown in figure below the value of current I is ________



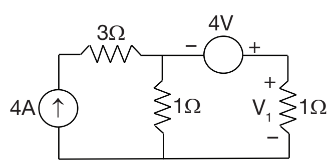
(A) 2A (B) 6A
(C) 8A (D) 4A

2. If the power dissipated in the circuit shown below is 16W, then the value of V_s will be________



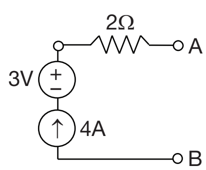
(A) 8V (B) 4V
(C) 2V (D) 6V

3. The value of V_1 in the circuit shown in the given figure is



(A) –4V (B) 2V
(C) 4V (D) 0

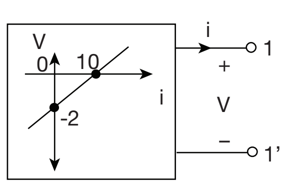
4. Consider the network shown in below figure.



The Thevenin's voltage across the terminals '*A*' and '*B*' is _______.

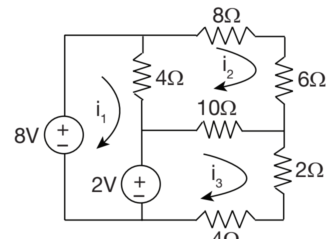
(A) 3V (B) –3V
(C) 10V (D) Indeterminate

5. The resistance seen from the terminals 1 and 1' of the device whose characteristic is shown in the figure below is



(A) 5 Ω (B) 0.2 Ω
(C) 0.25 Ω (D) 0.4 Ω

6. Consider the circuit shown in below figure

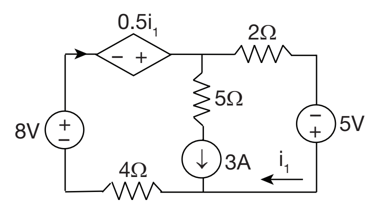


Figure

Determine the values of i_1 and i_3.

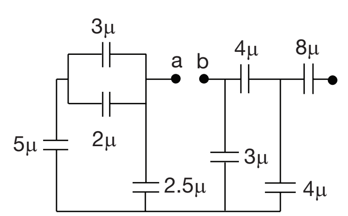
(A) 1.9A and 0.38A (B) 1.9A and 0.78A
(C) 0.4A and 0.38A (D) 0.78A and 1.4A

7. The current i_1 is _______



(A) –1.2A (B) 0.15A
(C) 0.1816A (D) 2.15A

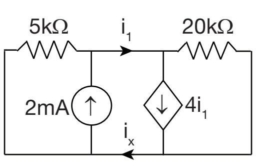
8.



The equivalent capacitance between the terminals '*a*' and '*b*'______.

(A) 2.5 μF (B) 5 μF
(C) 10 μF (D) 12.5 μF

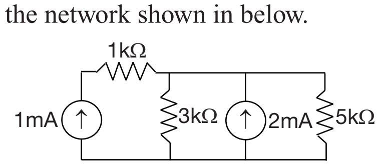
9.



Determine the value of i_x?

(A) –0.18 mA (B) –1.8 mA
(C) 2.8 mA (D) –2.25 mA

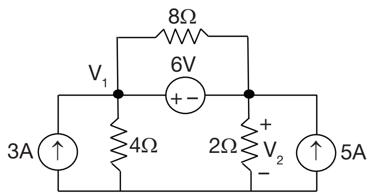
10. Consider the network shown in below.



Determine the power dissipated by the 5kΩ resistor

(A) 1.58 mW
(B) 2.5 mW
(C) 6.328 mW
(D) 12.5 mW

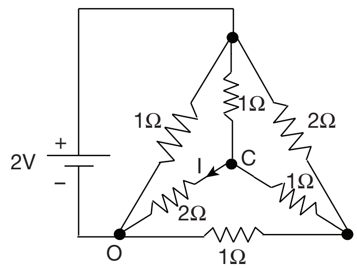
11. Consider the circuit shown below.



The values of V_1 and V_2 are respectively _____.

(A) –8.66V and –14.66V (B) 2.32 and –4.32V
(C) 14.66V and 8.66V (D) 24V and 18V

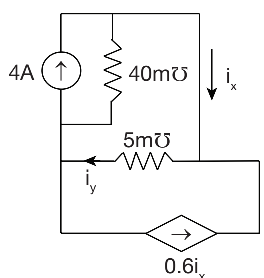
12.



The current (I) through the branch (OC) is _____.

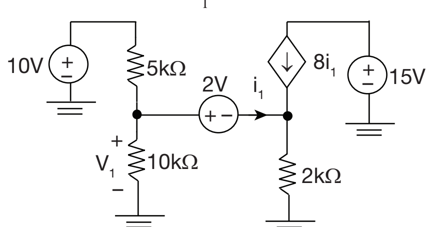
(A) 0.3A (B) 0.5714A
(C) 3.44A (D) 0.8572A

13. The power across the dependent source is ______.



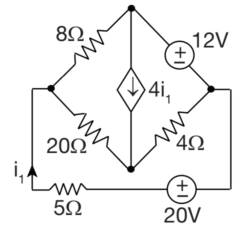
(A) zero (B) 15.42W
(C) 26.8W (D) –16.13W

14. Find the value of current i_1?



(A) 0.317 mA (B) 0.5 mA
(C) 0.218 mA (D) 1.23 mA

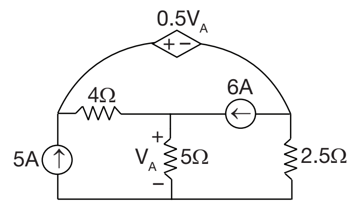
15. Consider the circuit shown in below.



If only 20V voltage source is acting alone. Then the current i_1 is ______.

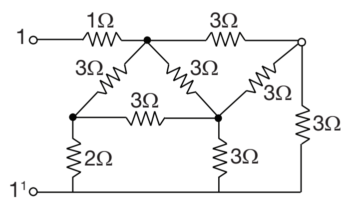
(A) 0.72A (B) 4.2A
(C) 0.32A (D) 0.648A

16. The voltage across the 5 Ω resistor is _____.



(A) 20.28V (B) 10.4V
(C) 12.5V (D) 3.42V

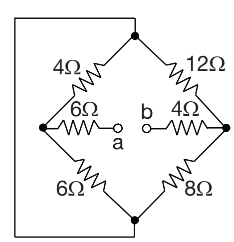
17.



The input resistance of the given circuit is _____.

(A) 5.4 Ω (B) 1.5 Ω
(C) 3.2 Ω (D) 2.57 Ω

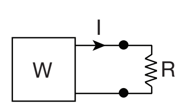
18.



The equivalent resistance R_{ab} is _______.

(A) 16.42 Ω (B) 11.6 Ω
(C) 17.2 Ω (D) 20 Ω

19. The block-box, W contains and independent sources. If I = 4A and 2A for R = 0 and 3 Ω, respectively, then what is the value of R for I = 3A?



(A) 1 Ω (B) 2 Ω
(C) 2.5 Ω (D) 1.5 Ω

20. For the circuit as shown in figure 1, the current through the ammeter is 4 ∠–30ºA. What is the current in the ammeter for the circuit in figure 2?

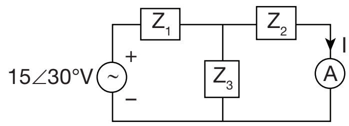


Figure 1

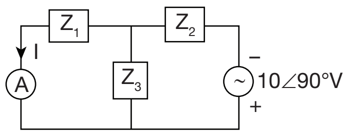
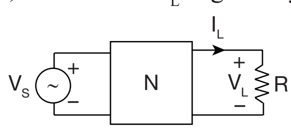


Figure 2

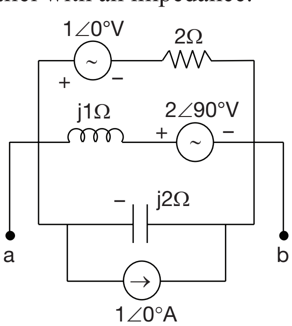
(A) –2.66 ∠30ºA (B) 2.66∠–30ºA
(C) 1.5 ∠60ºA (D) –1.5 ∠30ºA

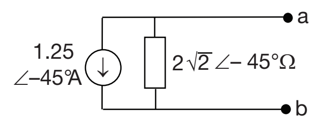
21. In the circuit shown below, for different values of R, the values of V and I are given, others remaining same.
When $R = \infty$, $V_L = 7.5$V
When $R = 0$, $I_L = 3$A
When $R = 5$ Ω, the value of V_L is given by

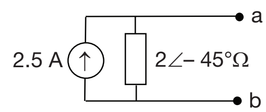


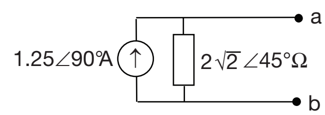
(A) 2.5V (B) 6V
(C) 5V (D) 3V

22. Replace the below shown circuit by a single current source in parallel with an impedance.



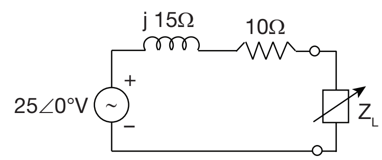
(A)


(B)


(C)


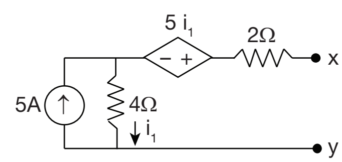
(D) None of these

23. The maximum power that can be transferred in the load Z_L in the below circuit is ______.



(A) 15.625W (B) 7.8125W
(C) 4.75W (D) 8.66W

Data for questions 24 and 25:
Consider the circuit shown in below.



24. Find the thevenin's equivalent network across the load terminals 'x' and 'y'.
(A) $V_{th} = 45$V and $R_{th} = 3Ω$
(B) $V_{th} = 45$V and $R_{th} = 11Ω$
(C) $V_{th} = 5$V and $R_{th} = 11Ω$
(D) $V_{th} = –5$V and $R_{th} = 8Ω$

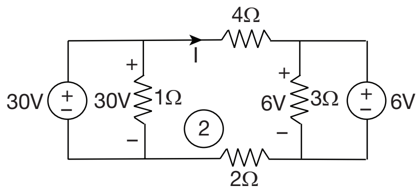
25. The maximum power transferred to the load terminals 'x' and 'y' is _______.
(A) 184W (B) 46W
(C) 96W (D) 102W

Answer Keys

1. D	**2.** A	**3.** C	**4.** D	**5.** B	**6.** A	**7.** C	**8.** A	**9.** A	**10.** C
11. C	**12.** B	**13.** D	**14.** C	**15.** D	**16.** A	**17.** D	**18.** C	**19.** A	**20.** A
21. C	**22.** A	**23.** D	**24.** C	**25.** B					

Hints and Explanations

1. Redrawing the given circuit



Apply mesh in loop 2 – 4I – 6 – 2I + 30 = 0

6I = 24

I = 4 Amps Choice (D)

2. From the given data P_d = 16W

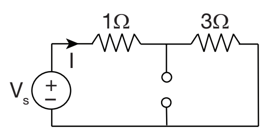
But source is *d.c*

∴ f = 0 or circuit is in steady state

$$C = \frac{1}{2\pi fc} = \infty \Rightarrow o.c$$

$L \rightarrow S.C$

It becomes



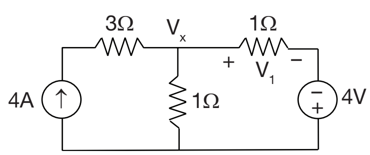
$P = I^2.R$

$16 = I^2 \times 4$

$I = 2A$

$V_s = I.R = 2 \times 4 = 8$V Choice (A)

3.



$$-4 + \frac{V_x}{1} + \frac{V_x + 4}{1} = 0$$

V_x = 0V

∴ $-V_1 + 4 = 0$

V_1 = 4 volts Choice (C)

4. $V_{th} = V_{OC}$

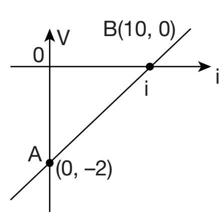
∴ current flowing through the circuit is zero.

But given I = 4A

∴ KCL is not statiesfying

∴ We can't determine V_{th} value Choice (D)

5. Given that V–I characteristics of circuit is



A(0, –2), B(10, 0)

x-axis → current

y-axis → voltage

we know

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}.(x - x_1)$$

$$V + 2 = \frac{0+2}{10-0}[i - 0]$$

$$V = \frac{1}{5}i - 2$$

$V = iR + V^1$

∴ R = 1/5 Ω = 0.2 Ω Choice (B)

6. Applying mesh analysis

Apply KVL in each mesh

$-8 + 4(i_1 - i_2) + 2 = 0$

$4(i_1 - i_2) = 6$

$i_1 - i_2 = 1.5$ → (i)

$14i_2 + 10(i_2 - i_3) + 4(i_2 - i_1) = 0$

$28i_2 - 4i_1 - 10i_3 = 0$

$i_1 - 7i_2 + 2.5i_3 = 0$ → (ii)

$10(i_3 - i_2) + 6i_3 - 2 = 0$

$-10i_2 + 16i_3 = 2$

$-5i_2 + 8i_3 = 1$ → (iii)

From (i), (ii) and (iii) we get

i_1 = 1.9 Amp, i_2 = 0.4 Amp and i_3 = 0.38 Amp

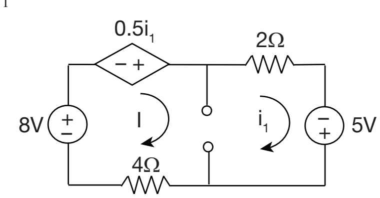
Choice (A)

7. The current source existing between two meshes.

∴ Apply super mesh concept

Let current in mesh I.

∴ $I - i_1$ = 3A



$8 + 0.5i_1 - 2i_1 + 5 - 4I = 0$

$13 = 4I + 1.5i_1$

$I = 3 + i_1$

$13 = 12 + 4i_1 + 15i_1$

$5.5i_1 = 1$

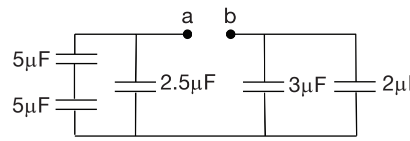
i_1 = 0.1818 Amp Choice (C)

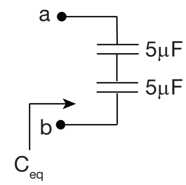
2nd method:-

Calculate i_1 value by using Nodal Analysis.

8. 8μF capacitor does effect on the circuit

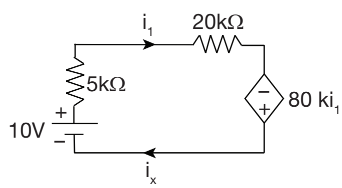
∴ the simplified circuit becomes





$\Rightarrow$ $C_{eq} = (5\|5)\ \mu F = 2.5\ \mu F$ Choice (A)

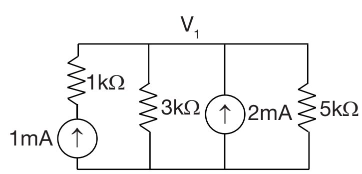
9. Simplify the given network, by this source transformation



$\therefore$ $10 - 25k\, i_1 + 80\, k\, i_1 = 0$

$i_1 = -\frac{10}{55}\text{mA} = -0.1818\text{ mA}$ Choice (A)

10.



Apply nodal analysis at node V_1

$-1\text{mA} + \frac{V_1}{3k} - 2\text{m} + \frac{V_1}{5k} = 0$

$\frac{V_1}{3} + \frac{V_1}{5} = 3$

$8V_1 = 3 \times 3 \times 5$

$V_1 = 5.625$

$P = V.I = \frac{V^2}{R} = 6.328\text{ mW}$ Choice (C)

11. From the given network Ideal voltage source exciting between two nodes V_1 and V_2.

$\therefore$ It is super node

$V_1 - 6 - V_2 = 0$

$V_1 - V_2 = 6$ $\rightarrow$ (i)

Apply node equations at V_1 and V_2 [super node]

$-3 + \frac{V_1}{4} + \frac{V_1 - V_2}{8} + \frac{V_2 - V_1}{8} + \frac{V_2}{2} - 5 = 0$

$\therefore \frac{V_1}{4} + \frac{V_2}{2} = 8$

$V_1 + 2V_2 = 32$ $\rightarrow$ (ii)

From (i) and (ii)

$2V_1 - 2V_2 = 12$

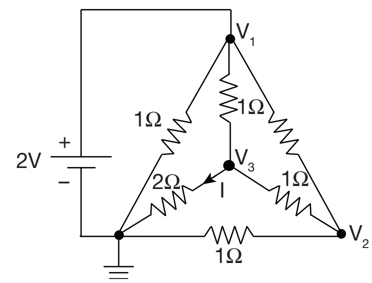
$V_1 + 2V_2 = 32$

$3V_1 = 44$

$V_1 = \frac{44}{3}$ volts = 14.66 volts

$V_2 = V_1 - 6 = \frac{26}{3} = 8.66\text{V}$ Choice (C)

12. Redraw the given circuit



From the circuit $V_1 = 2$ $\rightarrow$ (i)

Apply nodal analysis at node V_2 and V_3

$\frac{V_2 - V_1}{2} + \frac{V_2 - 0}{1} + \frac{V_2 - V_3}{1} = 0$

$5V_2 - V_1 - 2V_3 = 0$

$V_1 - 5V_2 + 2V_3 = 0$ $\rightarrow$ (ii)

$\frac{V_3 - V_1}{1} + \frac{V_3}{2} + \frac{V_3 - V_2}{1} = 0$

$5V_3 - 2V_1 - 2V_2 = 0$

$2V_1 + 2V_2 - 5V_3 = 0$ $\rightarrow$ (iii)

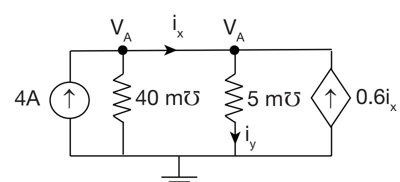
From (i), (ii) and (iii) we get

$V_1 = 2V$ and $V_2 = 0.857$ V

$V_3 = 1.1428$ V

$I = \frac{V_3}{2} = 0.5714$ Amp Choice (B)

13. Redraw the given circuit



Apply nodal analysis at node V_A

$-4 + V_A \times 40 \times 10^{-3} + V_A \times 5 \times 10^{-3} - 0.6\, i_x = 0$

$45 \times 10^{-3}\, V_A = 4 + 0.6\, i_x$

$i_x = 4 - V_A \times 40 \times 10^{-3}$

$0.6i_x = 2.4 - 24 \times 10^{-3}\, V_A$

$69\, V_A = (4 + 2.4) \times 10^3$

$V_A = 92.75$ volts

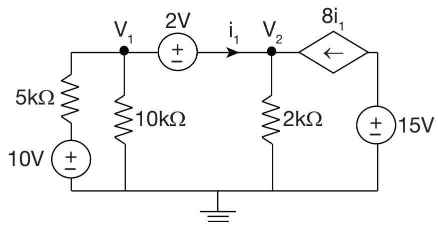
$P = V.I$

$= -92.75 \times 0.6\, i_x$

$I_x = 0.289$ Amp

$P = -16.13\text{W}$ Choice (D)

14. Redraw the given circuit.



Applying supernode concept

$\therefore \quad V_1 - V_2 = 2V \qquad \rightarrow$ (i)

$\frac{V_1 - 10}{5k} + \frac{V_1}{10k} + \frac{V_2}{2k} = 8i_1$

$V_2 = 18\ ki_1$

$2V_1 - 20 + V_1 + 5V2 = 80k\ i_1$

$3V_1 + 5V_2 - 20 = \frac{80}{18} V_2$

$3V_1 + 0.555V_2 = 20 \qquad \rightarrow$ (ii)

$V_1 = 5.94$ volts

$V_2 = 3.94$ volts

$V_2 = 9\ i_1 \times 2k$

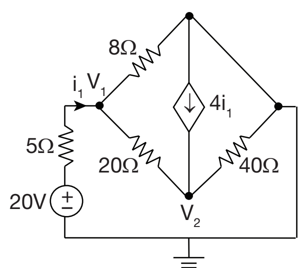
$i_1 = \frac{3.94}{18}\text{mA} = 0.218$ mA

2nd Method:–

Simplify the given circuit by using Source transformation and get the value. Choice (C)

15. Apply super position theorem to the given network.

Case (i) only 20V acting alone



$\frac{V_1}{8} + \frac{V_1 - 20}{5} + \frac{V_1 - V_2}{20} = 0$

$5V_1 + 8V_1 - 160 + 2V_1 - 2V_2 = 0$

$15V_1 - 2V_2 = 160 \rightarrow$ (i)

As node V_2

$\frac{V_2 - V_1}{20} + \frac{V_2}{40} = 4i_1 \quad i_1 = \frac{20 - V_1}{5}$

$2V_2 - 2V_1 + V_2 = 4 \times 40 \times \left[\frac{20 - V_1}{5}\right]$

$3V_2 - 2V_1 = 640 - 32\ V_1$

$30V_1 + 3V_2 = 640 \rightarrow$ (ii)

From (i) and (ii)

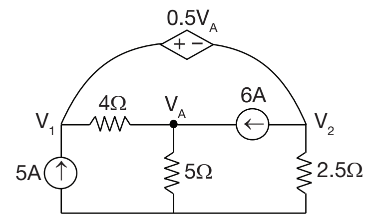
$V_1 = 16.76$ volts

$V_2 = 45.71$ volts

$i_1 = \frac{20 - 16.76}{5}$

$i_1 = 0.648$ Amp Choice (D)

16.



$V_1 - V_2 = 0.5V_A$

Applying super node concept at node V_1 and V_2

$-5 + \frac{V_1 - V_A}{4} + \frac{V_2}{2.5} + 6 = 0$

$2.5(V_1 - V_A) + 4V_2 + 10 = 0$

$2.5V_1 + 4V_2 - 2.5V_A + 10 = 0$

$2.5V_1 + 4V_2 - 5(V_1 - V_2) + 10 = 0$

$-2.5V_1 + 9V_2 + 10 = 0$

$2.5V_1 - 9V_2 = 10 \rightarrow$ (i)

Apply nodal analysis at node V_A

$\frac{V_A - V_1}{4} + \frac{V_A}{5} - 6 = 0$

$5V_A - 5V_1 + 4V_A = 120$

$9V_A - 5V_1 = 120$

$V_A = 2(V_1 - V_2)$

$18(V_1 - V_2) - 5V_1 = 120$

$13V_1 - 18V_2 = 120 \rightarrow$ (ii)

From (i) and (ii)

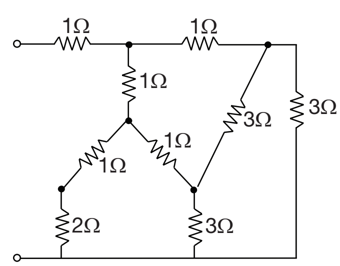
$V_1 = 12.5$ volts

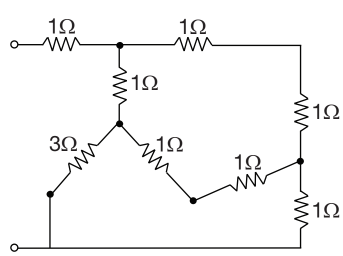
$V_2 = 2.36$ volts

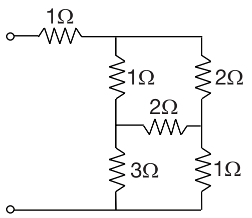
$\therefore \quad V_A = 2(V_1 - V_2)$

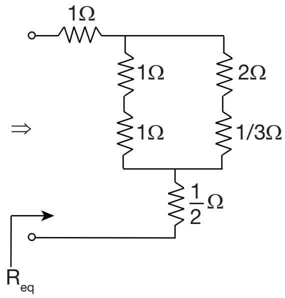
$= 20.28$ volts Choice (A)

17. Simply the given network by using Δ-y conversion.



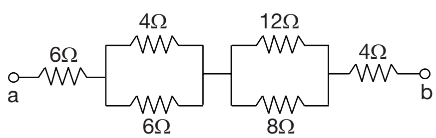






$R_{eq} = 1 + \{2 \,||\, 7/3\} + \frac{1}{2} = 2.57\ \Omega$ Choice (D)

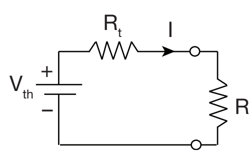
18. Redraw the given network



$\therefore \quad R_{ab} = 10 + \{4||6\} + \{12||8\}$

$= 10 + 2.4 + 4.8 = 17.2\ \Omega$ Choice (C)

19. Represent the block box its thevenin's model it becomes



$I = \frac{V_{th}}{R_{th} + R}$

If $R = 0$ and I = 4A

$\frac{V_{th}}{R_{th}} = 4 \;\Rightarrow V_{th} = 4\, R_{th}$ → (i)

$2 = \frac{V_{th}}{R_{th} + 3}$

$V_{th} = 2\, R_{th} + 6$ → (ii)

From (i) and (ii)

$R_{th} = 3\ \Omega$ and $V_{th} = 12$V

$\therefore I = \frac{V_{th}}{R_{th} + R}$

$3 = \frac{12}{3 + R}$

$9 + 3R = 12$

$3R = 3$

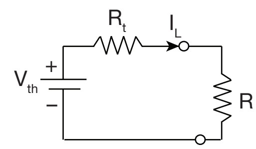
$R = 1\ \Omega$ Choice (A)

20. From the Reciprocity theorem $\frac{V_1}{V_2} = \frac{I_1}{I_2} = \text{constant}$

$\frac{15\angle 30^o}{-10\angle 90^o} = \frac{4\angle -30^o}{I_2}$

$\therefore I_2 = \frac{-40\angle 60^o}{15\angle 30^o} = -2.66\ \angle 30^o$ Amp Choice (A)

21. The equivalent model of given network is



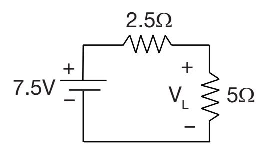
$\therefore \quad R = \infty$; open circuit

$\therefore \quad V_{OC} = V_{th} = 7.5$V

$R = 0$; short circuit

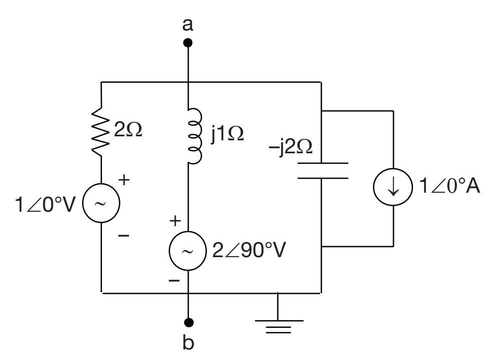
$\therefore \quad I_{SC} = I_N = 3$A

$R_N = R_{th} = \frac{V_{oc}}{I_{sc}} = 2.5\ \Omega$



$V_L = \frac{5}{7.5} \times 7.5 = 5$ volts Choice (C)

22. Redrawing the given circuit



$\frac{V_A - 1}{2} + \frac{V_A - 2\angle 90^\circ}{j1} + \frac{V_A}{-j2} + 1 = 0$

$0.5V_A - 0.5 - jV_A + 2 + j0.5\ V_A + 1 = 0$

$V_A\ \{0.5 - j0.5\} = -2.5$

$V_A = \frac{-5}{1 - j1} = -3.53\angle 45°$V

R_{th}:–

(i) Deactive all the Independent sources.

$\therefore \quad V \rightarrow S.C., I \rightarrow O.C.$

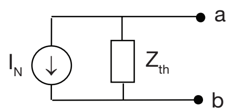
$Rab = R_{th} = [2||(j1)||\,(-j2)] = 2\{1 - j1\}.$

$= 2\sqrt{2}\ \angle -45°\Omega$

$V = I.\ R.$

$\therefore \quad I_N = -1.248 \angle -45°\text{A}$

$Z_{\text{th}} = 2\sqrt{2} \angle -45°\Omega$



Choice (A)

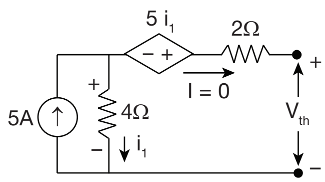
23. $Z_L = Z^*_S$

$$P = \frac{|V_{th}|^2}{4|Z_{th}|} = \frac{(25)^2}{4 \times \sqrt{100+225}} = \frac{625}{72.111}$$

$= 8.66$ watts

Choice (D)

24.



$\therefore \quad V_{\text{th}} - 2 \times 0 - 5i_1 - 4i_1 = 0$

But $i_1 = 5$A

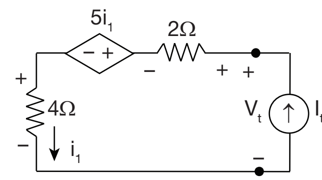
$V_{\text{th}} = 45$ volts

R_{th}:–

To calculate R_{th}

(i) Deactivate all the independent sources

(ii) Connect one test source across the terminals 'x' and 'y'.



$\therefore \quad V_t - 2I_t - 5I_t - 4I_t = 0$

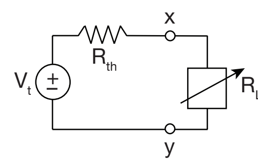
$V_t = 11\ I_t$

$$\frac{V_t}{I_t} = R_{th} = 11\ \Omega$$

$\therefore \quad V_{\text{th}} = 45\text{V}$ and $R_{th} = 11\ \Omega$

Choice (C)

25.



$$\therefore P_{\max} = \frac{V_{th}^2}{4\,R_{th}} = \frac{(45)^2}{4 \times 11} = 46 \text{ watts.}$$

Choice (B)