BYJU'S EXAM PREP

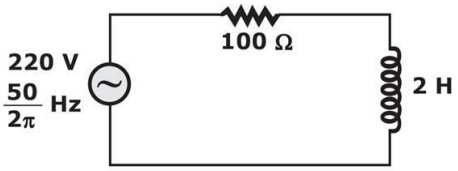
# AE/JE Foundation

## Electrical Engineering

## Circuit theory

## 100 Most Important Questions

1. In the given circuit, the voltage across the inductor is.




A. 155.56 V
B. 220 V
C. 0 V
D. 110 V

Ans. A

Sol. $X_L = \omega L$

$$X_L = 2\pi \times \frac{50}{2\pi} \times 2 = 100\Omega$$

$X_L = R = 100\ \Omega$

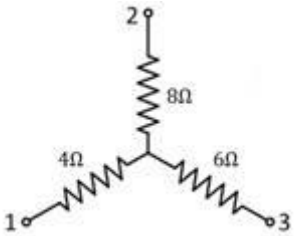
$\therefore V_L = V_R$

$$V_s = \sqrt{V_R^2 + V_L^2}$$

$$V_s = \sqrt{2}V_L$$

$$V_L = \frac{V_S}{\sqrt{2}} = \frac{220}{\sqrt{2}} = 155.56V$$

2. For the given impedance in a star network, determine the sum of its equivalent delta impedances.




A. 54.67 Ω
B. 56.33 Ω
C. 60.99 Ω
D. 64.5 Ω

Ans. B

Sol. Given,

$$Z_1 = 4\Omega, Z_2 = 8\Omega, Z_3 = 6\Omega$$

The equivalent delta impedances are computed as,

$$Z_{12} = Z_1 + Z_2 + \frac{Z_1 Z_2}{Z_3} = 4 + 8 + \frac{4 \times 8}{6} = 12 + 5.33 = 17.33\Omega$$

$$Z_{23} = Z_2 + Z_3 + \frac{Z_2 Z_3}{Z_1} = 8 + 6 + \frac{8 \times 6}{4} = 14 + 12 = 26\Omega$$

$$Z_{31} = Z_3 + Z_1 + \frac{Z_3 Z_1}{Z_2} = 6 + 4 + \frac{6 \times 4}{8} = 10 + 3 = 13\Omega$$

Hence, the sum of delta impedances is,

$$Z_{12} + Z_{23} + Z_{31} = 17.33 + 26 + 13 = 56.33\Omega$$

3. Which of the following is NOT correct for series resonance circuit?

A. Impedance at resonance is minimum. B. It magnifies the voltage across inductor.

C. The power factor is unity. D. It is also known as rejector circuit.

Ans. D

Sol. Series resonance circuit is known as acceptor circuit not the rejector circuit.

4. An RLC series circuit has a Q of 25 and a source voltage of 100 V. The voltage across the capacitor at resonance is-

A. 2.5 kV B. 250 V

C. 25 kV D. 0.25 V

Ans. A

Sol. At resonance;

$V_L = V_C$

$$Q = \frac{V_c}{V} \Rightarrow V_c = QV$$

$V_c = 25 \times 100 = 2500$ V = 2.5kV

5. Consider the following statements:

P: Kirchhoff's current law is applicable to both lumped and distributed elements.

Q: Kirchhoff's current law is only applicable for lumped circuit parameters.

R: KCL follows conservation of charge.

S: KCL is applicable for linear, bilateral, & time invariant systems.

T: KCL is also applicable for nonlinear & time-varying elements.

Which of the following statement is/are correct?

A. P, R, S & T B. Q, S & T

C. Q, R, S & T D. R, S & T

Ans. C

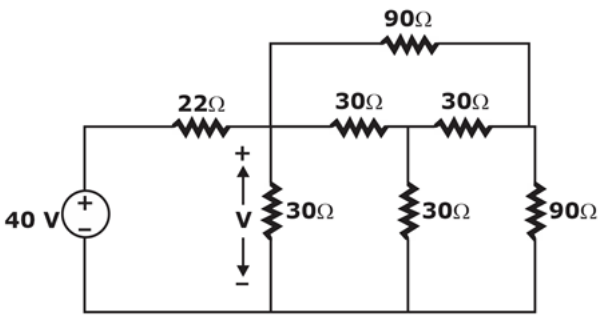
Sol. Kirchhoff's current law is only applicable for lumped circuit parameters.

KCL follows conservation of charge.

KCL is applicable for linear, bilateral, & time invariant systems.

KCL is also applicable for nonlinear & time-varying elements.

6. Determine voltage V of the given circuit?

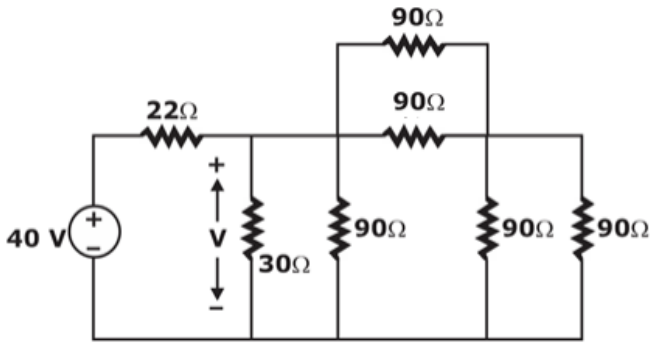


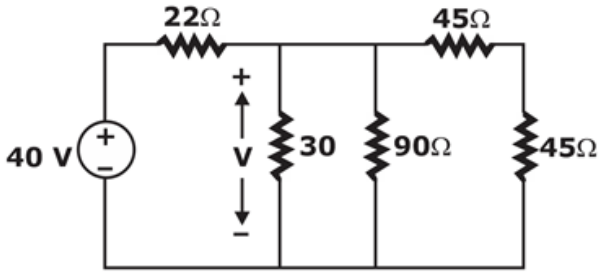

A. 20V B. 25 V

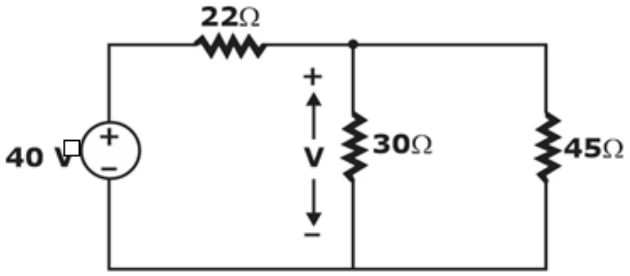
C. 15 V D. 18 V

Ans. D

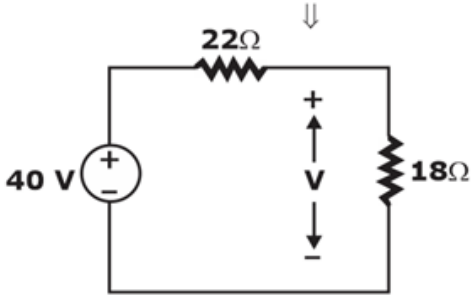
Sol. Converting Star into Delta:




⇓




$$V = \left(\frac{18}{22+18}\right) \times 40$$

V = 18 V

7. The frequency of instantaneous power in a purely capacitive circuit is:

A. Independent of the applied voltage frequency.

B. Double in frequency of the applied voltage.

C. Half the frequency of the applied voltage.

D. Same as the frequency of the applied voltage.

Ans. B

Sol. Let; $V = V_m \sin\omega t$

$I = I_m \sin(\omega t + 90°)$

Due to capacitive load.

Instantaneous power at any instant

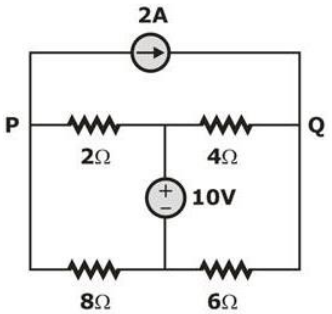
$P = V \times I$

$P = V_m \sin\omega t \times I_m \cos\omega t$

$$P = \frac{V_m I_m}{2} \sin 2\omega t$$

It is double the frequency of the applied voltage.

8. Consider the following network



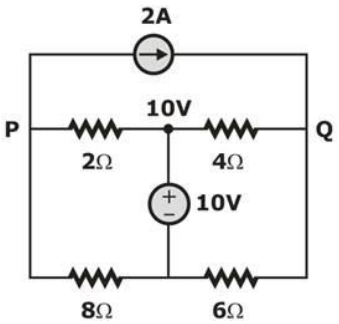

Determine the potential difference between P and Q.

A. – 6 V
B. – 4 V
C. – 2 V
D. – 8 V

Ans. A

Sol. Potential difference between P and Q ($V_{PQ}$):

$V_{PQ} = V_P - V_Q$




Applying KCL at node P:

$$\frac{V_p - 10}{2} + \frac{V_p}{8} + 2 = 0$$

$$V_p = \frac{24}{5} V$$

Applying KCL at node Q:

$$\frac{V_Q - 10}{4} + \frac{V_Q}{6} = 2$$

$$V_Q = \frac{54}{5} V$$

$V_{PQ} = V_P - V_Q$

$$V_{PQ} = \frac{24}{5} - \frac{54}{5}$$

$V_{PQ} = -6$ V

9. If a network consists of 'n' number of nodes and 'b' numbers of branches. At what condition, mesh analysis equations becomes lesser than nodal analysis equations?

A. n>b-1 B. n>b+1

C. n>b/2 -1 D. n>b/2 +1

Ans. D

Sol. Mesh analysis becomes simpler than nodal analysis means number of equation required in mesh analysis should be less than that of number of equation required in nodal analysis.

Number of equation required in mesh analysis = b – n+1

Number of equation required in nodal analysis = n – 1

According to the given condition –

b – n +1 <n – 1

b+1+1< n +n

b+2< 2n

$n > \frac{b}{2} + 1$

10. Which of the following Statements is incorrect?

A. Graph can be constructed completely from incidence matrix.

B. Degree of node implies the no. of loops in which node is includes.

C. A basic cut-set consists of only one twig.

D. The cut set and tie set matrices are not unique.

Ans. B

Sol. Degree of a node implies the number of branches incident on that node.

11. Which of the following is NOT true about reactive power?

A. It is measured in VAR

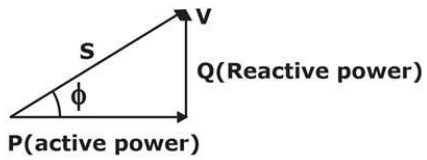
B. The component of apparent of power that does not do any useful work in the circuit.

C. The component of apparent power responsible for useful work in the circuit.

D. The energy exchanged between the magnetic/electric field and the source.

Ans. C

Sol. In power triangle:




S: Apparent power

Q: S sinφ (VAR)

The component of apparent power which is neither consumed nor does any useful work in the circuit is called reactive power.

12. Two coils having equal resistances, but different inductances are connected in series. The times constant of the series combination is the

A. Sum of time constant of the individual coils.

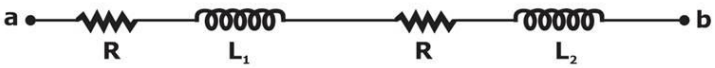
B. Average of time constants of the individual coils.

C. Geometric mean of time constants of the individual coils.

D. Product of time constant of the individual coils.

Ans. B

Sol. Let coils have inductances $L_1$ and $L_2$ and resistance R.




Total inductance = $(L_1 + L_2)$

Total Resistance = 2R

Total time constant $\left(\frac{L_1 + L_2}{2R}\right)$ while individual time constants $\frac{L_1}{R}$ and $\frac{L_2}{R}$.

So, It's the average of individual time constants.

13. An AC voltage is given by V = 100sin 50πt. It will achieve a value of 75 V after_____msecond. ($\sin^{-1} 0.75 = 48.6°$)

A. 10.8 B. 8.1

C. 2.7 D. 5.4

Ans. D

Sol. V = 100sin 50πt

Given (V = 75 V)

75 = 100 sin 50πt

$$\frac{3}{4} = \sin 50\pi t$$

$50\pi t = \sin^{-1}(0.75)$

$$50\pi t = 48.6;\ t = \frac{48.6}{50 \times 180^\circ}$$

t = 5.4 m sec.

14. Four equal resistors are connected across voltage source power absorbed in the circuit is P. If the value of any two resistors are halved, then the power dissipated in the circuit will be

A. 0.5 P B. 0.25 P

C. 1.5 P D. 3 P

Ans. C

Sol. Initially assumed that four resistors (R) are connected across to voltage source V.

$$R_{eq} = \frac{R}{4}$$

$$P = \frac{V^2}{R_{eq}} = \frac{4V^2}{R}$$

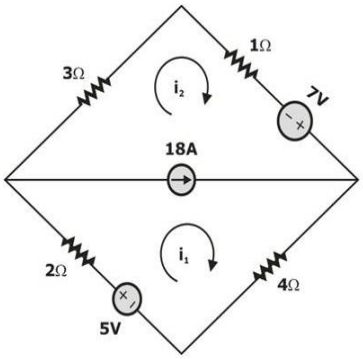
When the value of two resistors are halved.

$R_{eq}$ = R || R || 0.5R || 0.5R

$$P_{absorbed} = \frac{V^2}{R_{eq}} = \frac{6V^2}{R}$$

$$P_2 = \frac{3P}{2} = 1.5P$$

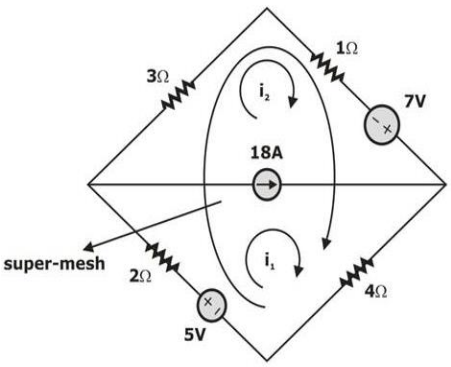
15. In the circuit given below, the value of current $i_2$ will be:




A. 8.4 A
B. – 9.6 A
C. 10.6 A
D. – 11.6 A

Ans. B

Sol. Consider the circuit:




Applying KVL in super-mesh

$-5 + 2i_1 + 3i_2 + i_2 + 4i_1 - 7 = 0$

$6i_1 + 4i_2 = 12$ …. (1)

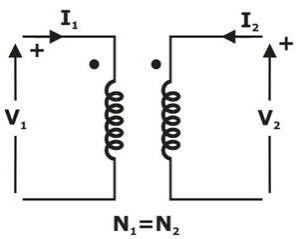
$i_1 - i_2 = 18$ …. (2)

Solving equation (1) and (2);

$i_1 = 8.4$ A

$i_2 = -9.6$ A

16.




Correct Relations for above circuit are

A. $\frac{V_1}{V_2} = \frac{I_2}{I_1} = \frac{N_1}{N_2}$

B. $\frac{V_1}{V_2} = \frac{I_2}{I_1} = \frac{-N_1}{N_2}$

C. $\frac{V_1}{V_2} = \frac{-I_2}{I_1} = \frac{N_1}{N_2}$

D. None

Ans. C

Sol. Dots coincides with positive polarize of voltage so, $\frac{V_1}{V_2} = \frac{N_1}{N_2}$

Both the currents are enters into dots so $\frac{I_2}{I_1} = \frac{-N_1}{N_2}$

17. What is the value of the total admittance (in mho) of a tank circuit working at resonance frequency having a capacitance of 0.1 mF and an inductance of 0.1mH?

A. 0

B. ∞

C. 1

D. None of the above

Ans. A

Sol. Impedance (Z) of a tank circuit $= \frac{(j\omega L)\left(\frac{-j}{\omega C}\right)}{j\omega L - \frac{j}{\omega C}}$

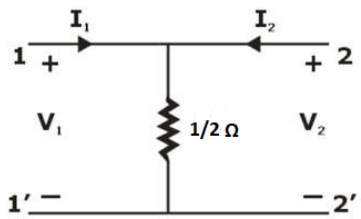
$z = \frac{j\omega L}{1 - \omega^2 LC}$ where

at resonance frequency $\omega_o$

$\omega_0 = \frac{1}{\sqrt{LC}} \Rightarrow z = \infty$

Y = 0

18. Which one of the following is the transmission matrix for the network shown in the fig. given below?




A. $\begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix}$

B. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 0.5 \\ 0.5 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 2 & 0 \\ 1 & 1 \end{bmatrix}$

Ans. A

Sol. $V_1 = AV_2 — BI_2$

$I_1 = CV_2 — DI_2$

When $I_2 = 0$, $A = \frac{V_1}{V_2} = 1$

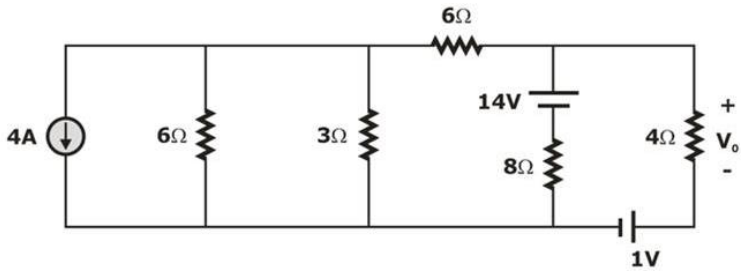
$$C = \frac{I_1}{V_2} = \frac{I_1}{\frac{1}{2}I_1} = 2$$

When $V_2 = 0$, $B = \frac{-V_1}{I_2} = 0$

$$D = \frac{-I_1}{I_2} = 1$$

$$T = \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix}$$

19. Find $V_0$ of the circuit shown




A. 1 V

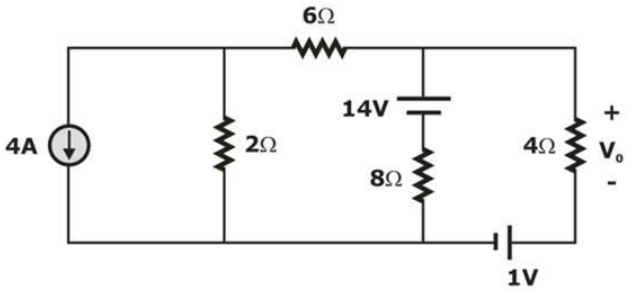
B. 2 V

C. 3 V

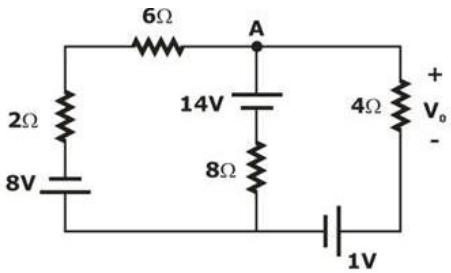
D. 4 V

Ans. A

Sol. In the circuit shown, 6Ω and 3Ω are in parallel.




By source transformation:




Applying KCL at node A;

$$\Rightarrow \frac{V_A + 8}{8} + \frac{V_A - 14}{8} + \frac{V_A - 1}{4} = 0$$

$\Rightarrow V_A = 2V$

$V_A = 1 + V_0$

$V_0 = 2 - 1$

$V_0 = 1V$

20. Consider the following statements:

(i) Two ideal current sources cannot be connected in series.

(ii) Active element has ability to deliver power for infinite duration.

(iii) Voltage & current source are active elements.

(iv) Series resonance circuit is called current rejector circuit.

Which of the above statements are correct?

A. (i), (ii) & (iv)
B. (i), (ii), (iii)
C. (ii), (iii) & (iv)
D. All of the above

Ans. B

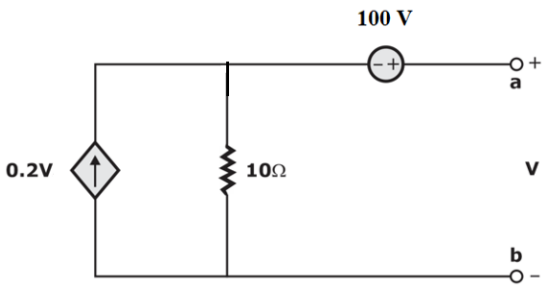
Sol. (1) Two ideal current sources cannot be connected in series.

(2) active element has ability to deliver power for infinite duration.

(3) Voltage and current source are active elements.

(4) Series resonance circuit is current accepter circuit while parallel resonance circuit are current rejecter circuit.

21. Consider the following circuit.



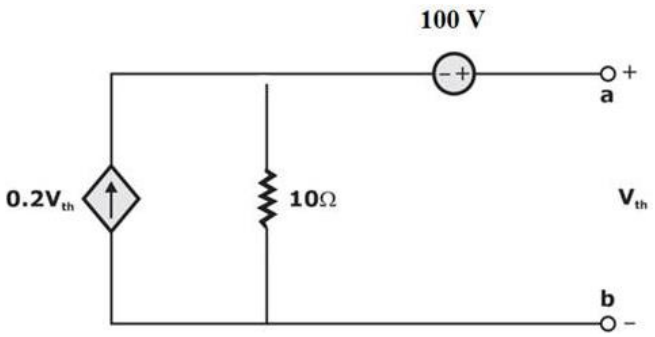

If a resistance of 40 Ω is connected between a and b terminal, then what will be the magnitude of current through the resistor.

A. -2 A
B. -1 A
C. 2 A
D. 1 A

Ans. C

Sol. By using thevenin equivalent circuit:

For $V_{th}$,



Voltage across resistor (10 Ω):

$V = 10\ (0.2\ V_{th})$

$V = 2\ V_{th}$

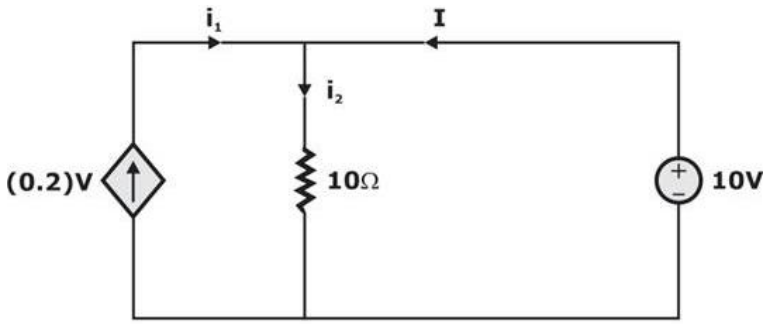
By applying KVL:

$2\ V_{th} + 100 = V_{th}$

Vth = -100 V

For $R_{th}$:

Connecting 10V voltage source across a-b:




Applying KCL:

$I + i_1 = i_2$

$i + 0.2\ (10) = 10/10$

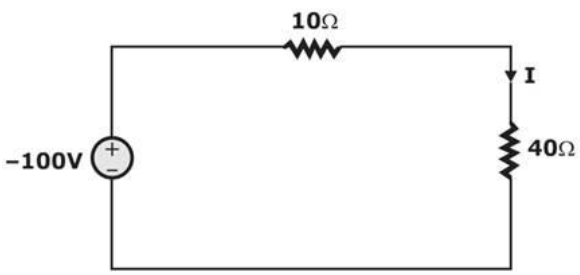
$i + 2 = 1$

$i = -1$

$$R_{th} = \left|\frac{V_{dc}}{i_{dc}}\right|$$

$$R_{th} = \left|\frac{10}{-1}\right| = 10\Omega$$

Thevenin circuit:

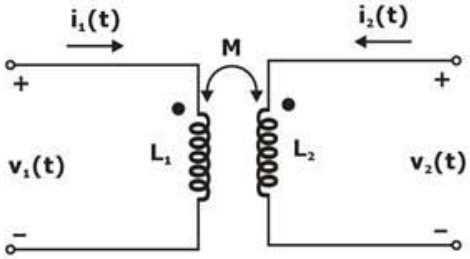



$$i = \frac{-100}{40+10}$$

i = -2A

Magnitude, i = 2A

22. The circuit shown in figure which of the following expression give the total energy E(t) stored in the coupled coils.




A. $E(t) = \frac{1}{2}L_1 i_1^2(t) + \frac{1}{2}L_2 i_2^2(t) + Mi_1(t)i_2(t)$

B. $E(t) = \frac{1}{2}L_1 i_1^2(t) + \frac{1}{2}L_2 i_2^2(t) + M\left(i_1^2(t) + i_2^2(t)\right)$

C. $E(t) = \frac{1}{2}L_1 i_1^2(t) + \frac{1}{2}L_2 i_2^2(t) - Mi_1(t) + i_2(t)$

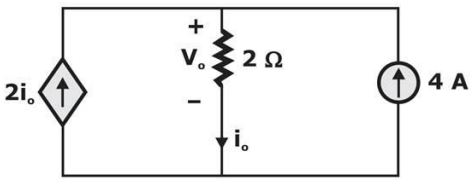
D. $E(t) = \frac{1}{2}L_1 i_1^2(t) + \frac{1}{2}L_2 i_2^2(t) - Mi\left(i_1^2(t) + i_2^2(t)\right)$

Ans. A

Sol. By dot convention mutual energy $Mi_1(t)\ i_2(t)$ is positive, so total energy

$$E(t) = \frac{1}{2}L_1 i_1^2(t) + \frac{1}{2}L_2 i_2^2(t) + Mi_1(t)i_2(t)$$

23. The value of voltage $V_0$ in the circuit will be:




A. 4 V
B. 8 V
C. –8 V
D. –4 V

Ans. C

Sol. By applying KCL:

$2i_o + 4 = i_o$

$I_o = -4$ A

$v_o = 2i_o = -8$V

$v_o = -8$ V

24. Which of the following are satisfied in a linear network?

1. Superposition
2. Associative
3. Homogenity
4. Bilaterally

Which of the following codes are correct?

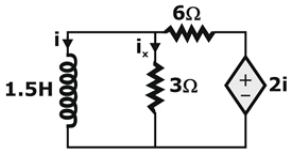
A. 1 and 2 only
B. 1 and 3 only
C. 2 and 3 only
D. 1 and 4 only

Ans. B

Sol. The network is linear if it satisfies superposition and homogeneity.

Hence, option B is correct.

25. Given that the current through the inductor is $i(t) = 5e^{-(0.887)t}$ A then the value of current $i_x(t)$ in the given circuit is,




A. $-2.2175\ e^{-(0.887)t}$ A

B. $2.2175\ e^{-(0.887)t}$ A

C. $-2.2175\ e^{(0.887)t}$ A

D. $2.2175\ e^{(0.887)t}$ A

Ans. A

Sol. The voltage across the inductor is,

$$v = L\frac{di}{dt} =$$

$$= 1.5(5)(-0.887)e^{-(0.887)t}$$

$$= -6.6525e^{-(0.887)t}\ V$$

Since the inductor and 3Ω resistor are in parallel.

$i_x(t) = v/3 = -2.2175\ e^{-(0.887)t}$ A.

26. Which of the following is not measured by the help of superposition theorem in the circuit?

A. Current

B. Voltage

C. Power

D. None of the above

Ans. C

Sol. Superposition theorem is used for measuring linear elements.

Power cannot be measured by superposition theorem as it is not used to measure non-linear element.

27. The relation AD – BC = 1, (where A, B, C and D are the elements of a transmission matrix of a network) is valid for _____

A. Both active and passive networks

B. Passive but not reciprocal networks

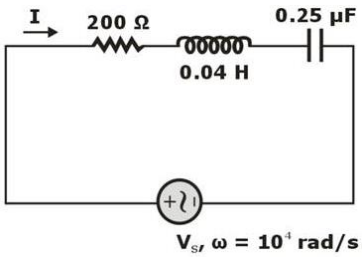
C. Active and reciprocal networks

D. Passive and reciprocal networks

Ans. D

Sol. AD – BC = 1, is the condition for reciprocity for ABCD parameters, which shows that the relation is valid for reciprocal network. The ABCD parameters are obtained for the network which consists of resistance, capacitance and inductance, which indicates that it is a passive network.

28. In the shown circuit, if I = 30∠45° mA then phasor voltage $V_S$ is



A. 6 ∠0° V
B. 17 ∠45° V
C. 12 ∠−45° V
D. 6 ∠45° V

Ans. D

Sol. R = 200 Ω

$j\omega L = j\,(10^4)\,(0.04) = j400\ \Omega$

$$\frac{1}{j\omega C} = \frac{1}{j\left(10^4\right)\left(0.25\times10^{-6}\right)} = -j400\Omega$$

$V_S = IZ = (30\angle45° \times 10^{-3})\,(200 + j400 - j400)$

$= 30\angle45° \times 10^{-3} \times 200 = 6\ \angle45°$ V

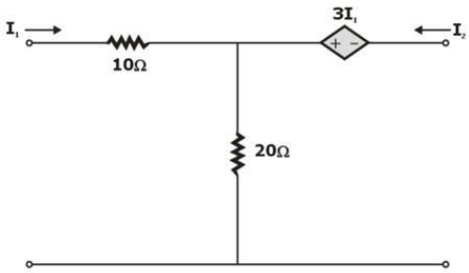
29. Which of the following circuit theorem is applicable to the linear, non-linear, active, passive elements.

A. Superposition theorem
B. Thevenin theorem
C. Tellegen's theorem
D. Milliman's theorem

Ans. C

Sol. Tellegen's theorem is applicable to all elements like linear, non-linear, active, passive elements.

30. Find the transmission parameter A for the two-port network shown in figure



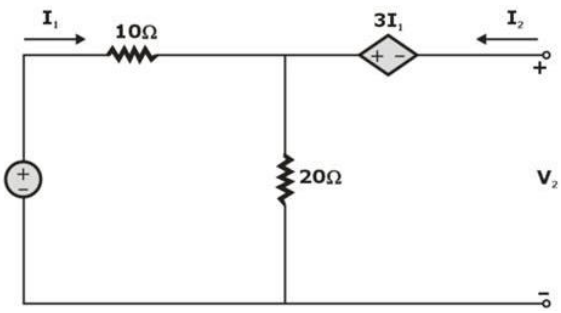

A. 2.25
B. 1.76
C. 2.5
D. 4.25

Ans. B

Sol. To determine A and C, we leave the output port open. So that $I_2 = 0$ and place a voltage source $V_1$ at the input port. We have

$V_1 = (10 + 20)\ I_1 = 30\ I_1$ and

$V_2 = 20I_1 - 3I_1 = I7\ I_1$




Thus, $A = \frac{V_1}{V_2} = \frac{30I_1}{17I_2} = 1.765$

31. In a circuit, a voltage source of (V) in series with resistance (R) can be converted into:

A. Current source (I) in parallel with (R) resistance where I = V

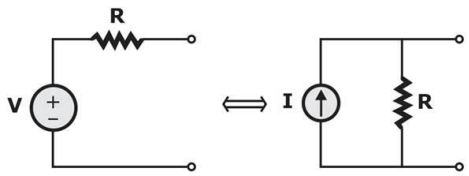
B. Current source (I) in series with resistance (R) where $I = \frac{v}{R}$

C. Current source (I) in parallel with resistance (R) where $I = \frac{V}{R}$

D. Current (I) in series with resistance (R) where I = V.

Ans. C

Sol. By source transformation:




where, $I = \frac{V}{R}$

32. The rms value of the current in a wire is 17.32A due to the combine effect of DC current and a sinusoidal alternating current of peak value 20 A. Find out the DC current in the wire.

A. 5 A

B. 10 A

C. 10/√2 A

D. None of the above

Ans. B

Sol. $$Ims = \sqrt{\underbrace{(I_{DC})^2}_{\text{DC component}} + \underbrace{\left(\frac{I_m}{\sqrt{2}}\right)^2}_{\text{AC component}}}$$

$$17 \cdot 32 = \sqrt{(I_{DC})^2 + \left(\frac{20}{\sqrt{2}}\right)^2}$$

$$\sqrt{300} = \sqrt{(I_{DC})^2 + 200}$$

On squaring both sides:

$300 = (I_{DC})^2 + 200$

$100 = (I_{DC})^2$

$I_{DC} = 10$ A

33. If a two-port network is reciprocal as well as symmetrical, which one of the following relationship is correct?

A. $Z_{12} = Z_{21}$ and $Z_{11} = Z_{22}$

B. $Y_{12} = Y_{21}$ and $Y_{11} = Y_{22}$

C. AD — BC = 1 and A = D

D. All of the above

Ans. D

Sol. Condition for reciprocity:

$Z_{12} = Z_{21}$

$Y_{12} = Y_{21}$

AD — BC = 1

Condition for symmetry:

$Z_{11} = Z_{22}$

$Y_{11} = Y_{22}$

A = D

34. Which of the following is correct?

Symbols as:

FF: Form factor

PF: Peak factor

RF: Ripple factor

A. $RF = \sqrt{(FF)^2 + 1}$

B. $FF = \sqrt{(RF)^2 + 1}$

C. $FF = \frac{\text{Average value}}{\text{Rms value}}$

D. $PF = \frac{\text{Rmsvalue}}{\text{Peak value}}$

Ans. B

Sol. $\text{Forms factor} = \frac{\text{Rms value}}{\text{Average value}}$

$\text{Peak factor} = \frac{\text{Maximum value}}{\text{Rms value}}$

Ripple Factor (RF):

$(RF) = \sqrt{(FF)^2 - 1}$

$(FF) = \sqrt{(RF)^2 + 1}$

35. Which of the following statement is NOT true in case of charging of series RC circuit having DC excitation?

A. Charging current is a decaying function of time.

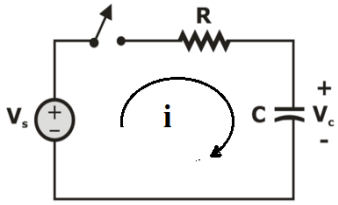
B. Time constant = R/C (R=resistance, C=capacitance)

C. During first time constant, the capacitor attains 63.2% of steady state voltage.

D. All of these

Ans. B

Sol.




The equation of capacitor voltage is:

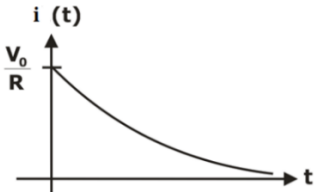
$$V_c = V_s\left(1 - e^{-t/RC}\right)$$

$$i_c(t) = C\frac{dv_c(t)}{dt}$$

$$i_c(t) = \frac{V_s}{R}e^{-t/RC}$$

Charging current is a decaying function.

As the capacitor is getting charged, the charging current dies out.




Time constant = RC

As, t/RC = 1

Or, t= RC

Voltage across the capacitor, $V_c$= V ( 1- 0.368) = 0.632V

Hence the voltage is 63.2%.

36. Consider an element with characteristic is expressed by the curve, i = $4V^2$.

The element is.

A. Passive, Unilateral, Linear.

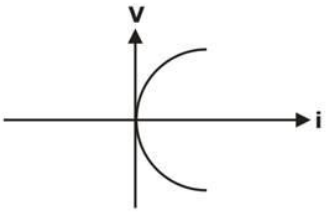
B. Active, Bilateral, Linear.

C. Passive, Bilateral, Non-Linear.

D. Active, Unilateral, Non-Linear.

Ans. D

Sol. The characteristic, i = $4V^2$ can be graphed as:




From graph,

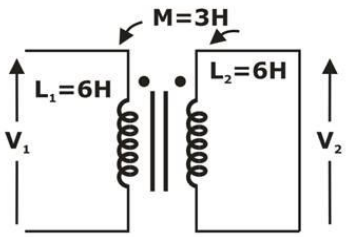
Slope is negative;

So, element is active.

As characteristic is not similar in opposite quadrant.

So, it is also unilateral and non linear.

37.




Equivalent inductance of above circuit is

A. 9 H

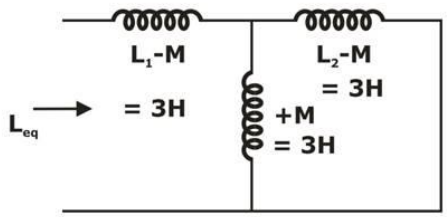
B. 6 H

C. 4.5 H

D. 3 H

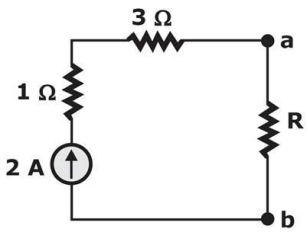
Ans. C

Sol.




$L_{eg}$ = 3||3 + 3 = 4.5 H

38. Determine the value of thevenin voltage source terminal ab of the circuit given.




A. 8 V

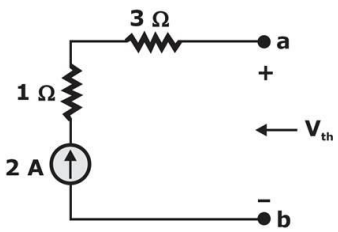
B. −8 V

C. 0 V

D. Not applicable

Ans. D

Sol. Calculation of $V_{th}$:




As terminal is open, current will be zero but independent current source is also present.

Hence, KCL is not applied.

Thevenin theorem is not applicable in this circuit.

39. What will be the ratio of peak factors of half wave rectifier and full wave rectifier for a sine wave?

A. 1
B. √2
C. 1/√2
D. 2

Ans. B

Sol. For half wave rectifier:

$$\text{Average value} = \frac{V_m}{\pi}$$

$$\text{Rms value} = \frac{V_m}{2}$$

For full wave rectifier:

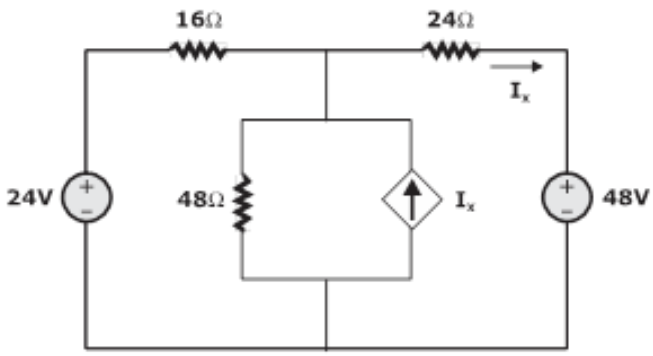
$$\text{Average value} = \frac{2V_m}{\pi}$$

$$\text{Rms value} = \frac{V_m}{\sqrt{2}}$$

$$\text{Peak factor} = \frac{\text{Maximum value}}{\text{Rms value}}$$

$$\frac{(PF)_{Hw}}{(PF)_{Fw}} = \frac{V_m / \left(\frac{V_m}{2}\right)}{V_m / \left(\frac{V_m}{\sqrt{2}}\right)} = \sqrt{2}$$

40. The magnitude of current $I_x$ in the following circuit equals to




A. 2.75 A
B. 2.5 A
C. -1.25 A
D. zero

Ans. C

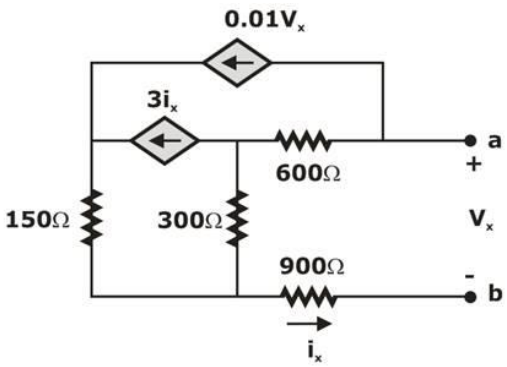
Sol. Let voltage at top centre node is $V_1$, writing nodal equation

$$\frac{V_1 - 24}{16} + \frac{V_1 - 0}{48} + I_x = I_x$$

$$\frac{V_1}{12} = \frac{24}{16} \Rightarrow V_1 = 18V$$

$$I_x = \frac{V_1 - 48}{24} = \frac{18 - 48}{24} = -1.25A$$

41. In the following circuit the value of open circuit voltage and thevenin resistance at terminals a, b are:




A. $V_{oc}$ = 100 V, $R_{th}$ = 1800 Ω

B. $V_{oc}$ = 0 V, $R_{th}$ = 270 Ω

C. $V_{oc}$ = 100 V, $R_{th}$ = 90 Ω

D. $V_{oc}$ = 0 V, $R_{th}$ = 90 Ω

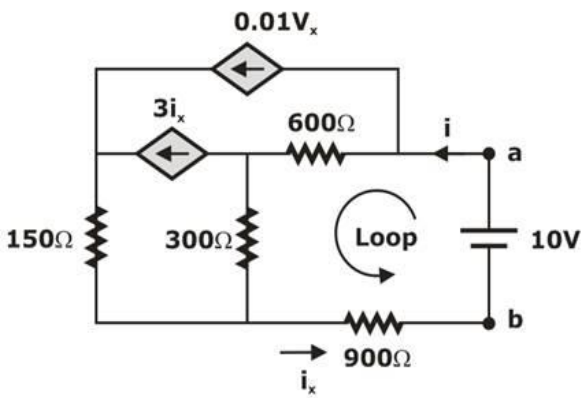
Ans. D

Sol. For open circuit voltage across a-b:

$V_{oc}$ will be zero because there is not independent source present in the circuit.

Hence, $V_{oc}$ = 0V

For $R_{th}$, Connect a 10V dc source across ab.




Applying KVL in the Loop;

$-10 + (i - 0.01V_x)600 + (i - 0.01V_x - 3i_x)300 + 900\, i_x = 0$

Where, $V_x$ = 10V

$i_x = i$

So, $-10 + (i - 0.1)600 + (-2i - 0.1)300 + 900i = 0$

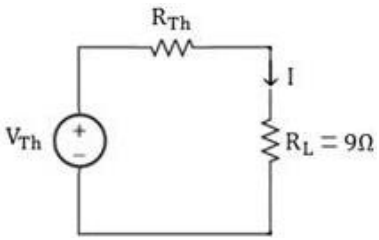
$-10 + 600i - 60 - 600i - 30 + 900i = 0$

$$i = \frac{1}{9}\text{A}$$

$$R_{th} = \frac{V_{ac}}{i}$$

$R_{th}$ = 90 Ω

42. In the given network, if the maximum power absorbed by the load resistance of 9Ω is 4W, find the current I in the circuit.




A. 0.33 A
B. 0.67 A
C. 0.75 A
D. 1.21 A

Ans. B

Sol. Maximum power absorbed by the load resistance is given by,

$$P_{max} = \frac{V_{Th}^2}{4R_L}$$

$$\Rightarrow 4 = \frac{V_{Th}^2}{4 \times 9}$$

$$\Rightarrow V_{Th}^2 = 144$$

$$\Rightarrow V_{Th} = 12V$$

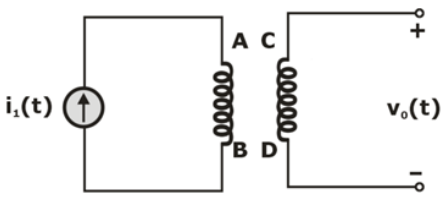
For maximum power transfer,

$$R_{Th} = R_L = 9\Omega$$

Hence, current in the circuit,

$$I = \frac{V_{Th}}{R_{Th} + R_L} = \frac{12}{9+9} = \frac{12}{18} = 0.67A$$

43. Consider the following circuit:




If the current $i_1(t)$ and voltage $v_0(t)$ are given as:

$i_1(t) = 4\ t\ u(t)$

$v_0(t) = -20\ u(t)$

Then positions of dots and mutual inductance are

A. A and C, 2H
B. A and D, 5H
C. A and C, 5H
D. B and D, 5H

Ans. B

Sol. $V_0(t)$ is negative so current direction is opposite in the coils. Dots position are A and D

$$v_0(t) = M\frac{di_1(t)}{dt}$$

Mutual inductance, $M = \frac{|v_0(t)|}{\left|\frac{di}{dt}\right|} = \frac{20}{4} = 5H$

44. In a series RLC circuit, resistance R = 0.5 Ω, inductance L = 4 H. Capacitance C = 1 F. What is the value of magnitude of voltage across inductor at resonance frequency. If circuit is excited with voltage of 20 V.

A. 120 V
B. 20 V
C. 80 V
D. 200 V

Ans. C

Sol. At the resonance, the voltage across inductor is given by

$|V_L| = QV_s$

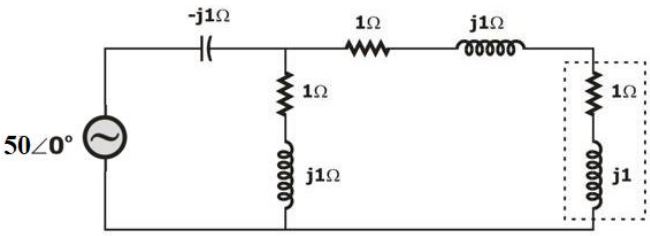
$Q = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{0.5}\sqrt{\frac{4}{1}} = 4$

Q = 4

$V_s = 20$

$|V_L| = 4 \times 20 = 80$ V

45. Find the current i in the load shown by dotted box in the below given circuit.

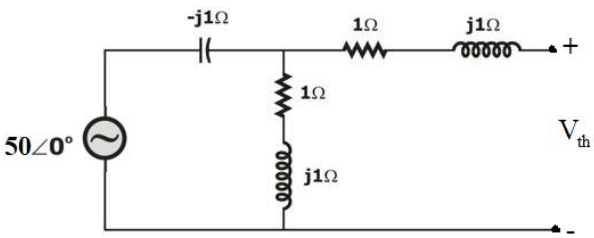



A. $50\angle 0^\circ$ A
B. $22.36\angle 26.56^\circ$ A
C. $3162\angle 0^\circ$ A
D. $50\angle 18.43^\circ$ A

Ans. B

Sol. Obtaining the thevenin equivalent circuit.

For $V_{th}$;

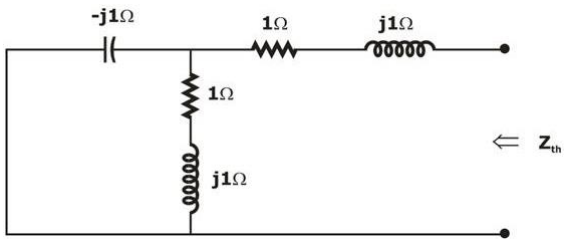



$V_{th} = \frac{1 + j1}{1 + j1 - j1} \times 50$

= (1 + j1) 50

$V_{th} = 50\sqrt{2}\angle 45^\circ$ V

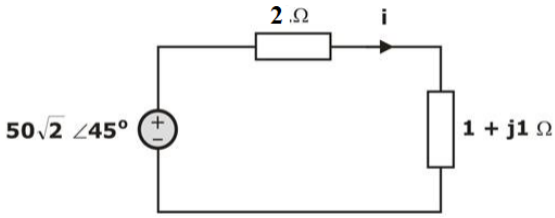
For $Z_{th}$:




$Z_{th} = [(1 + j1) || -j1] + j1 + 1$

$Z_{th} = 2\ \Omega$

Thevenin circuit:




$$i = \frac{50\sqrt{2}\angle 45^\circ}{3 + j1}$$

$i = 22.36\angle 26.56^{O} A$

46. Which of the following circuit theorem states that power delivered in the circuit is equal to the power absorbed in the circuit.

A. Superposition theorem

B. Thevenin's theorem

C. Tellegen's theorem

D. Milliman's theorem

Ans. C

Sol. Tellegen's theorem states that power delivered in the circuit is equal to the power absorbed in the circuit.

47. For maximum power transfer to load, the value of load impedance should be equal to

A. Thevenin impedance

B. Conjugate of Thevenin impedance

C. Magnitude of Thevenin impedance

D. None of the above

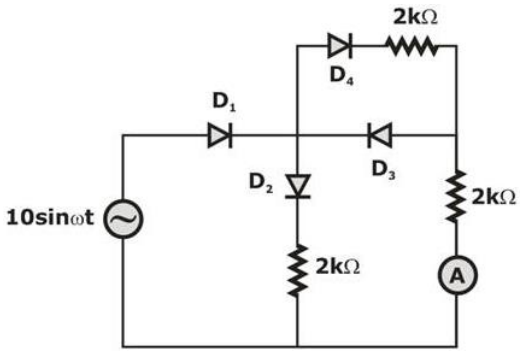
Ans. B

Sol. For maximum power transfer to load,

$Z_L = Z_{th}^*$

Hence, load impedance is equal to conjugate of Thevenin impedance.

48. In the circuit shown all devices are ideal. The ammeter reads average value. What is the reading of ammeter?




A. $2.5 / \sqrt{2}$mA

B. $2.5 / \pi$mA

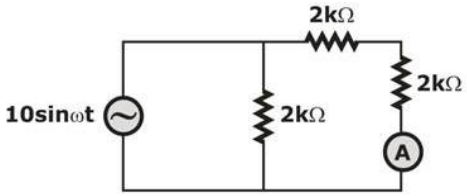
C. $5 / \sqrt{2}$mA

D. 5/p mA

Ans. B

Sol. During negative cycle no current flows through ammeter

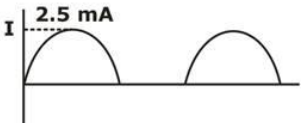
During positive cycle




Current through ammeter

$$I = \frac{10}{4 \times 10^3} \sin \omega t$$

I = 2.5 sinωt mA




$$I_{avg} = \frac{2.5}{\pi} \text{mA}$$

49. If the value of Thevenin voltage and Norton current across the load of 2Ω is 10 V and 5 A respectively. Then the value of current across load will be

A. 5 A

B. 2.5 A

C. 10 A

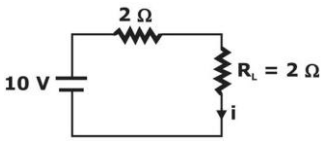
D. 1.25 A

Ans. B

Sol. Thevenin resistance,

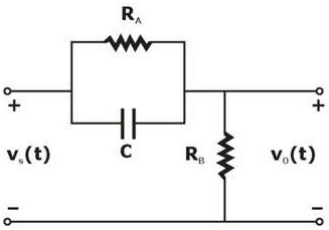
$$R_{th} = \frac{V_{th}}{I_N} = \frac{10}{5} = 2\Omega$$

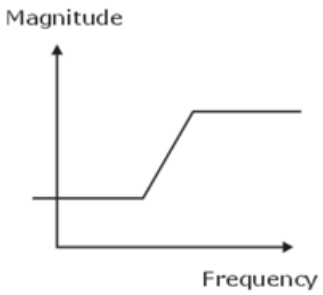
Thevenin equivalent circuit:

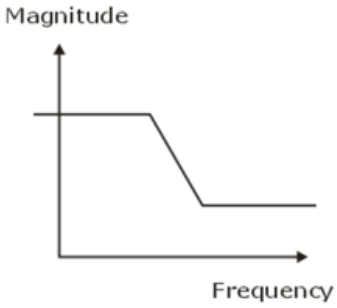


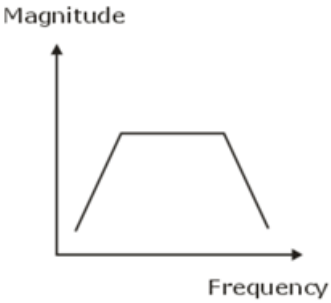
$$i = \frac{10}{4} = 2 \cdot 5\text{Amp}$$

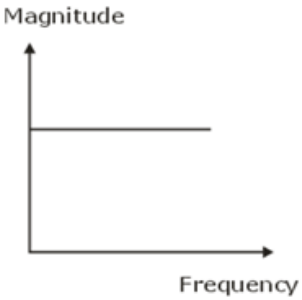
50. Which of the following plot represents the magnitude of transfer function versus frequency of the circuit shown in figure.




A. 


B. 


C. 


D. 


Ans. A

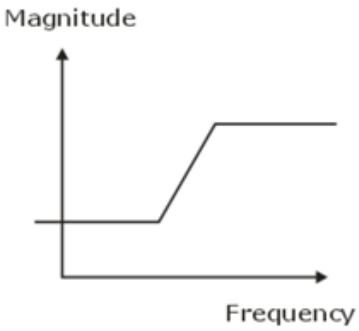
Sol. $$V_0(j\omega) = \frac{R_B}{\left(R_A \parallel \frac{1}{\omega C}\right) + R_B} V_0(j\omega) = \frac{R_S}{\frac{R_A}{(j\omega CR_A + 1)} + R_B} V_S(j\omega)$$

$$\frac{R_S(j\omega CR_A + 1)}{R_A + R_B(j\omega CR_A + 1)} V_S(j\omega) = \frac{j\omega CR_A R_S + R_B}{j\omega CR_A R_S + R_A + R_S} V_S(j\omega)$$

Transfer function of the circuit is given as following

$$H(j\omega) = \frac{j\omega + \frac{1}{R_A C}}{j\omega + \frac{1}{R_A C} + \frac{1}{R_B C}}$$

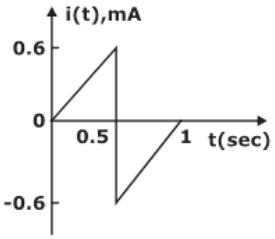
This is high pass filter, so the response is shown in figure below

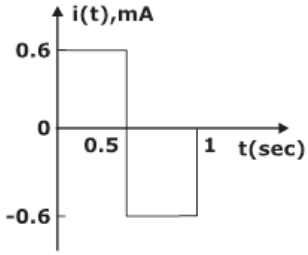


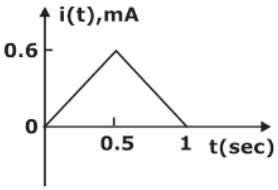

51. The voltage across a 20 μF capacitor is defined as follows.

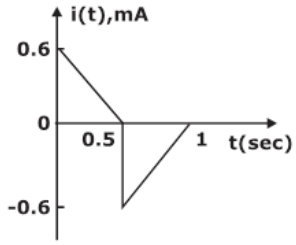
$$v(t) = \begin{cases} (30t^2)\,V, & 0 < t < 0.5\,s \\ 30(t-1)^2\,V, & 0.5 < t < 1\,s \\ 0 & \text{Otherwise} \end{cases}$$

The waveform of current, through the capacitor is

A.



B.



C.



D.



Ans. A

Sol. Current, $i(t) = C\dfrac{dv(t)}{dt}$

For 0 < t < 0.5s, $v(t) = 30t^2$ V

$I(t) = 20 \times 10^{-6}\,(60t) = 1.2$tmA

For 0.5s < t < 1s,

$v(t) = 30\,(t-1)^2$

$i(t) = (20 \times 10^{-6})\,[60\,(t-1)] = 1.2\,(t-1)$ mA

52. The low-frequency circuit impedance and the high-frequency circuit impedance for a series resonant circuit respectively are

A. capacitive and inductive
B. inductive and capacitive
C. resistive and inductive
D. capacitive and resistive

Ans. A

Sol. $Q = \frac{\omega_0}{\Delta\omega} = \frac{f_0}{\Delta f} = Q - \text{factor}$

$\Delta f = B \cdot W. = \frac{1.5X10^6}{150} = 10kHz$

53. **Assertion(A):** All networks cannot be reduced to Thevenin's equivalent, but those reduced to Thevenin's equivalent are capable of being converted into Norton's equivalent.

**Reason (R):** Thevenin's and Norton's equivalents are duals of each other.

A. Both A and R are individually true and R is the correct explanation of A

B. Both A and R are individually true but R is not the correct explanation of A

C. A is true but R is false

D. A is false but R is true

Ans. A

Sol. Thevenin's Theorem is applicable only to linear networks to simplify it, and convert it into an equivalent circuit with just a single voltage source and series resistance completely. For determining Norton's equivalent,

$I_N = \frac{V_{th}}{R_{th}}$

$R_N = R_{th}$

Hence, from one equivalent we can determine the other one.

54. What is the difference between the transient-state analysis and steady-state analysis of LTI systems?

A. Transient-state analysis deals with the nature of response of the system, while steady-state analysis estimates the magnitude of error.

B. Transient-state analysis is done immediately after applying an input, while, steady-state analysis is done after the system becomes settled.

C. Both A and B

D. None of the above

Ans. C

Sol. Transient-state analysis deals with time response of the system from the initial state to the final state. The transient response is the response of the system when subjected to an input, and as the time increases the transient response decays to zero. On the other hand, steady-state analysis is done after the system has settled. It estimates the magnitude of the steady-state error between the output and the input.

55. If the Thevenin impedance of the circuit is $Z_{th}$ = 6 + j5 Ω. The load connected at the terminal of load is $R_L$ + j3Ω. The value of $R_L$ for which maximum power is transferred to the load.

A. $\sqrt{61}\Omega$

B. 10Ω

C. 6Ω

D. 5Ω

Ans. B

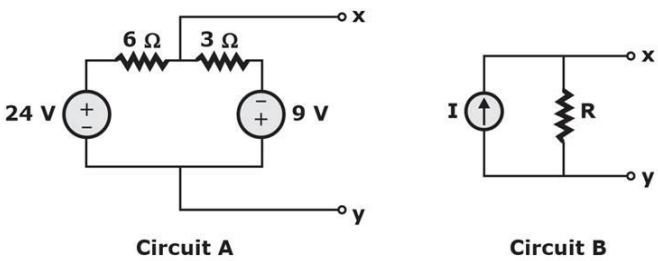
Sol. Condition for maximum power transfer to load when only load resistance is varied.

$$P_L = \sqrt{(R_{th})^2 + (X_{th} + X_L)^2}$$

$$R_L = \sqrt{6^2 + (5+3)^2}$$

$$R_L = 10\Omega$$

56. Consider the circuits A and B given below




For what values respectively I and R, the circuit B is equivalent to circuit A?

A. 7A, 2Ω

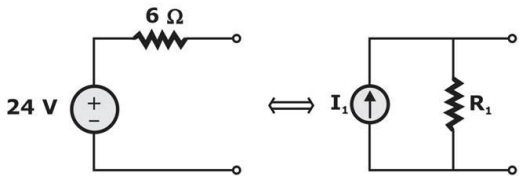
B. 1A, 2Ω

C. 4A, 6Ω

D. $R_L = 10\Omega$ 3A, 3Ω

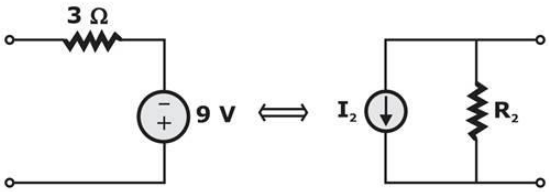
Ans. B

Sol. By Source transformation:



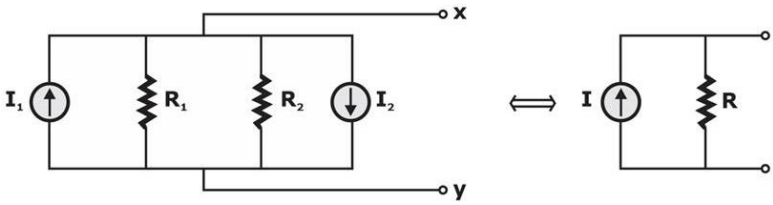

$I_1 = 24/6 = 4$ A

$R_1 = 6\Omega$




$I_2 = \frac{9}{3} = 3A$

$R_2 = 3\Omega$

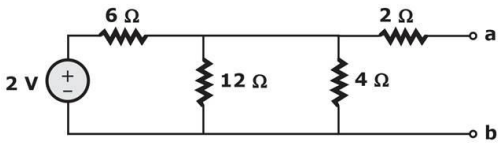



$I = I_1 - I_2 = 1A$

$R = R_j \square R_2 = 6 \square 3$

$R = 2\Omega$

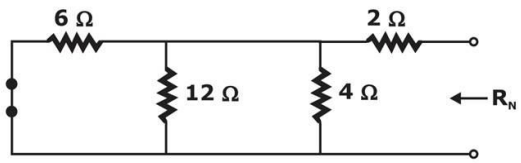
57. The value of Norton resistance across terminal ab.




A. 4 Ω
B. 2 Ω
C. 6 Ω
D. 10 Ω

Ans. A

Sol. For Norton resistance, voltage source is short circuited




$R_H = (6 \square 12 \square 4) + 2$

$R_N = (4 \square 4) + 2 = 4\Omega$

$R_N = 4\Omega$

58. A coil having a resistance of 30Ω in series with an inductance of 5mH is connected to 200V, 50 Hz supply. What will be the equivalent current & power factor of the circuit?

A. I = 6.65; power factor close to unity

B. I = 5.65; power factor close to 0.8

C. I = 4.65; power factor close to unity

D. I = 3.65; power factor close to 0.8

Ans. A

Sol. Inductive Reactance, $X_L = 2\pi fL = 2 \times 3.14 \times 50 \times 5 \times 10^{-3} = 1.57\ \Omega$

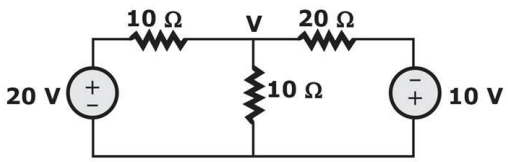
$\because Z^2 = X_L^2 + R^2 = (1.57)^2 + 30^2 = 902.467$

$Z = 30.04\ \Omega$

Then circuit current $I = V_m/Z = 200/30.04 = 6.65$

Power factor $\cos\varphi = R/Z = 30/30.04 \approx 1$

59. The Node voltage V in the circuit is




A. 6 V

B. 10 V

C. 20 V

D. 4 V

Ans. A

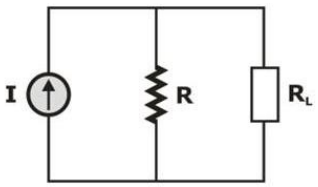
Sol. Applying KCL at node.

$$\frac{v-20}{10} + \frac{v+10}{20} + \frac{v}{10} = 0$$

$2v - 40 + v + 10 + 2v = 0$

$v = 6$ V

60.




In a constant load $R_L$, what will be the condition for maximum power transfer

A. $R_L = R$

B. $R_L = \infty$

C. $R_L = R = \infty$

D. $R = \infty$

Ans. D

Sol. For constant load, all current must pass through $R_L$ for maximum power transfer. And for more current in load, value of R must be very high. Ideally it must be infinity.

61. Consider the following statements:

(i) Super position theorem is valid for linear network

(ii) Kirchhoff's laws is valid for unilateral network

(iii) Tellegen's theorem is based on the charge conservation principle.

Which of the above statement is correct?

A. Only (i)
B. (i) and (ii)
C. (i) and (iii)
D. (i), (ii) and (iii)

Ans. B

Sol. Super-position theorem is valid for the linear network. Kirchhoff's laws in independent of the nature of elements so it is valid for unilateral network.

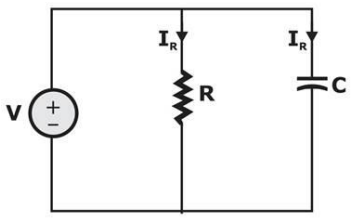
Tellegen's theorem is based on the energy conservation principle.

62. In a parallel R-C circuit. If $I_R$ is the current through the resistor and $I_C$ is the current through the capacitor then:

A. $I_R$ lags $I_C$ by 90°.
B. $I_R$ lead $I_C$ by 90°
C. $I_R$ and $I_C$ are out of phase
D. None

Ans. A

Sol.




$$I_R = \frac{V}{R}\angle 0^\circ$$

$$I_C = \frac{V}{X_C} = jV\omega C$$

$I_C = V\omega C \angle 90°$

Hence, $I_C$ leads $I_R$ by 90° or

$I_R$ lags $I_C$ by 90°.

63. The admittance of the circuit is Y = (0.8 + j0.6) mho. The power factor of the circuit is____.

A. 0.8 lead
B. 0.8 lag
C. 0.6 lead
D. 0.6 lag

Ans. A

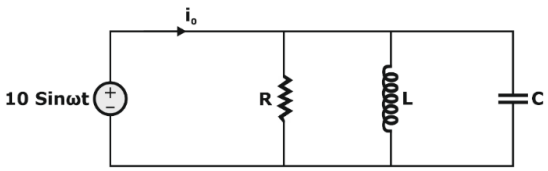
Sol. $Y = \frac{1}{Z} = (0.8 + j0.6)$

Z = (4 – j3) ohm

$$\phi = \tan^{-1}\frac{3}{4} = 36.87^\circ$$

pf = cosφ = 0.8 lead

64. In parallel R, L, C circuit Let R = 8 kΩ, L = 0.2 mH & C = 8 μF find the lower half power frequency in rad/sec



A. 24.992 k rad/sec
B. 27 k rad/sec
C. 28 k rad/sec
D. 50 k rad/sec

Ans. A

Sol. $\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.2 \times 10^{-3} \times 8 \times 10^{-6}}}$

$= \frac{10^5}{4} = 25\text{krad / sec}$

Quality Factor $= Q = \frac{R}{\omega_0 L} = \frac{8 \times 10^3}{25 \times 10^3 \times 8 \times 10^{-6}} = 1600$

$B = \frac{\omega_0}{Q} = 15.625\text{rad / sec}$

Since Q > > 10 So $\omega_1 = \omega_0 - \frac{B}{2}$

$\omega_1 = 25000 - 7.812 = 24992\text{rad / sec}$

= 24.992 krad/sec

65. If the Thevenin impedance of the circuit is 12+j5. If the load of circuit is purely resistive. The value of load resistor for which maximum power is transferred to the load.

A. 12 Ω
B. 13 Ω
C. 5 Ω
D. 169 Ω

Ans. B

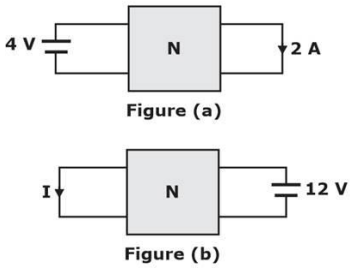
Sol. Maximum power transfer to load for purely resistive load.

$R_2 = |Z_{th}| = \sqrt{(R_{th})^2 + (X_{th})^2}$

$R_2 = \sqrt{12^2 + 5^2} = 13\Omega$

$R_2 = 13\Omega$

66. Consider the following circuits below.




What will be the value of I if network N contains resistors and dependent sources.

A. 6 A
B. −6 A
C. 2 A
D. Cannot be determined

Ans. D

Sol. Condition for Milliman theorem is

1. The response to excitation ratio should be either ohm or mho.
2. It should not contain any dependent source
3. Initial contains of energy element should be zero.

As network N contains dependent source in it.

Milliman theorem cannot be applied.

Hence, option D is correct.

67. What is the dynamic Impedance offered by Ideal tank circuit in a network?

A. Zero
B. Resistive
C. Infinity
D. None of the above

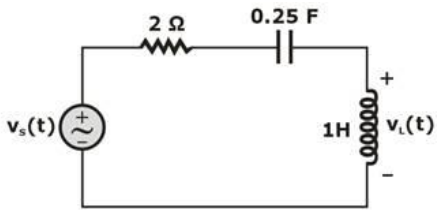
Ans. C

Sol. Dynamic impedance of tank circuit = $\frac{L}{CR}$

For ideal tank circuit, R =0

∴ Dynamic impedance of ideal tank circuit will be infinity.

68. The sinusoidal voltage applied to the circuit below is $V_S(t)$ = 10 cos(2t) V. The voltage $V_L(t)$ across the inductor is




A. –10 sin 2t V
B. 10 cos 2t V
C. 10 sin (2t – 45°) V
D. 10cos (2t – 45°) V

Ans. A

Sol. $V_S = 10\angle 0°$, ω = 2 rad/s

Impedance, jωL = j (2) (1) = j2 Ω

$$\frac{1}{j\omega C} = \frac{1}{j(2)(0.25)} = -j2\Omega$$

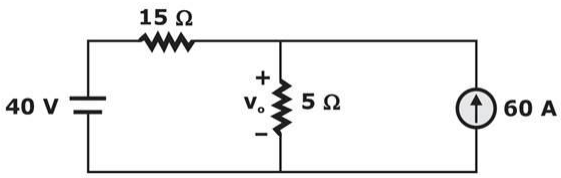
$$V_L = \frac{V_S}{R + j\omega + \frac{1}{j\omega C}}(j\omega L) \quad \text{(Using voltage division)}$$

$$= \frac{1\angle 0^\circ}{2 + j2 - j2}(j2) = 10j = 10\angle 90^\circ$$

$V_L(t)$ = 10cos (2t + 90°)

$V_L(t)$ = – 10 sin 2t V cos (θ + 90°) = – sin θ

69. The value of voltage $v_o$ for the circuit given below is:

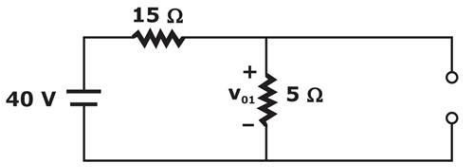



A. 225 V
B. 10 V
C. 235 V
D. 0 V

Ans. C

Sol. By applying superposition theorem,

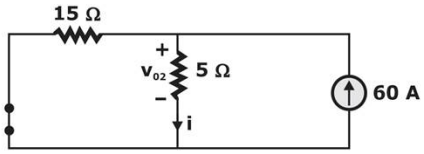
Only 40 V voltage source is active,




$$V_{01} = \frac{5}{5+15} \times 40$$

$$V_{o1} = 10V$$

When only current source is active,




$$i = \frac{15}{5+15} \times 60 = 45A$$

$$V_{02} = 45 \times 5 = 225V$$

$$V_0 = V_{01} + V_{02} = 10 + 225$$

$$V_0 = 235V$$

70. A network consists only of independent current sources and resistors. If the values of all the current sources are tripled, then values of node voltages

A. Remains same
B. Will be tripled
C. Will be 1/3rd
D. Changes in some other way

Ans. B

Sol. From superposition theorem, it is known to us that if all the source values are multiplied by a factor x, then node voltages will also get multiplied by a factor x.
Hence, in this case x is 3.

71. An LC circuit resonant at 1000 kHz has a Q-factor of 100. The lower half power frequency will be_____.

A. 995 kHz
B. 1005 kHz
C. 990 kHz
D. 1010 kHz

Ans. A

Sol. $\text{Band width} = \frac{\text{Re sonance frequency}}{\text{Q-factor}}$

$$B.W. = \frac{1000}{100} = 10kHz$$

Lower half power frequency;

$$= f_0 - \frac{B \cdot W}{2} = \left(1000 - \frac{10}{2}\right)kHz$$

(LHP) frequency = 995 kHz

72. What is quality factor of a parallel RLC circuit?

A. $\frac{1}{R}\sqrt{\frac{L}{C}}$

B. $R\sqrt{\frac{C}{L}}$

C. $\sqrt{\frac{1}{LC}}$

D. $\sqrt{LC}$

Ans. B

Sol. $Q = \frac{\text{Reactive component of current}}{\text{Active component of current}}$

$$Q = \frac{I_c}{I_R} = \frac{I_L}{I_R} = \frac{V/X_L}{V/R} = \frac{V/X_c}{V/R}$$

$$Q = \frac{R}{X_L} \text{ or } \frac{R}{X_c}$$

$$Q = \frac{R}{\omega L} = \omega RC$$

$$\omega = \frac{1}{\sqrt{LC}}$$

$$Q = R\sqrt{\frac{C}{L}}$$

73. How many 6μF, 200V capacitor are needed to make a capacitor of 18μF, 600V?

A. 18

B. 9

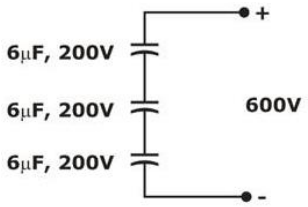
C. 3

D. 27

Ans. D

Sol. To make a 600V capacitor,

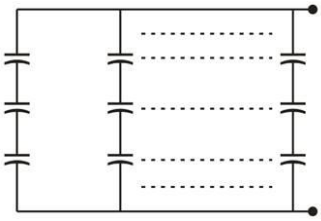
Three 200V capacitor had to be connected in series.




Capacitance of single branch;

$$C' = \frac{C}{3} = \frac{6\mu F}{3} = 2\mu F$$

To make 18μF, 9 similar branches had to be connected in parallel.

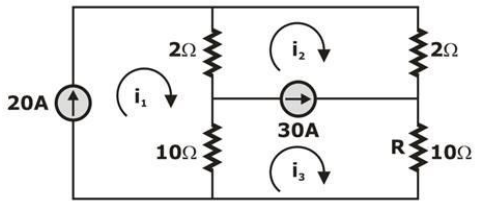


$$C_{total} = 9 \times \frac{C}{3} = 9 \times \frac{6}{3} = 18\mu F$$

Total capacitor = 3 × 9 = 27

Number of capacitor = 27

74. In the circuit shown, find the power dissipated in R resistor will be:




A. 1250 W

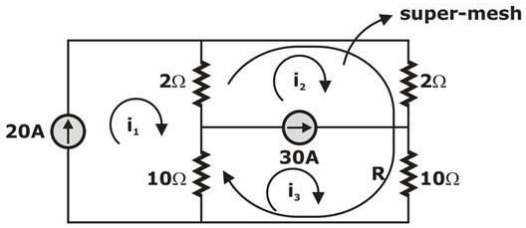
B. 2250 W

C. 1000 W

D. 3250 W

Ans. B

Sol. Consider the circuit




$i_1 = 20A$

Applying KVL in super-mesh.

$2(i_2 - 20) + 2i_2 + 10i_3 + 10(i_3 - 20) = 0$

$4i_2 + 20i_3 = 240$ …. (1)

Also, $-i_2 + i_3 = 30$ …. (2)

Solving equation (1) and (2);

$i_3 = 15$ A

$i_2 = -15$ A

Power in R will be:

$P = 15^2 \times 10$

P = 2250 W

75. Which of the following is True for Bartlett Bisection theorem?

A. It is used for designing the network

B. It is applicable for symmetrical networks only

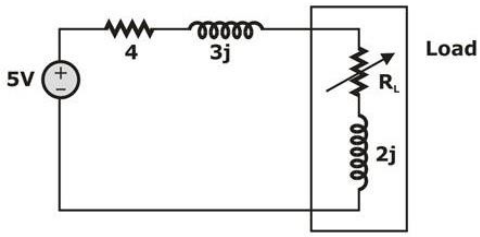
C. Network is separated into 2 equal parts and then bisected from middle

D. All of the above

Ans. D

Sol. All the Statements about Bartlett bisection theorem are True.

76. In the given circuit, what is the value of RL for maximum power transfer?




A. 4 Ω
B. $\sqrt{41}\Omega$
C. (4 – 3j) Ω
D. (4 – 5j) Ω

Ans. B

Sol. Power transferred to load

$$P = \frac{V_{th}^2 R_L}{(R_{th} + R_L) + (x_{th} + x_L)^2}$$

$$\frac{dp}{dR_L} = 0 \text{ for maximum power}$$

Because only $R_L$ is variable and the load is complex:

On solving,

$$R_L = \sqrt{R_{th}^2 + (x_{th} + x_L)^2}$$

$$= \sqrt{4^2 + (3+2)^2}$$

$$= \sqrt{16 + 25} = \sqrt{41}$$

77. Which of the following network theorem is not applicable when only dependent source is present in circuit?

A. Superposition theorem
B. Norton's theorem
C. Thevenin's theorem
D. Maximum power transfer theorem

Ans. A

Sol. Superposition theorem is the theorem which requires more than one independent sources in the circuit.

78. A load is connected to an active network. At the terminal of load, $R_{th}$ = 5Ω and $V_{th}$ = 20 V. Then the maximum power supplied to load is

A. 80 W
B. 40 W
C. 20 W
D. 1 W

Ans. C

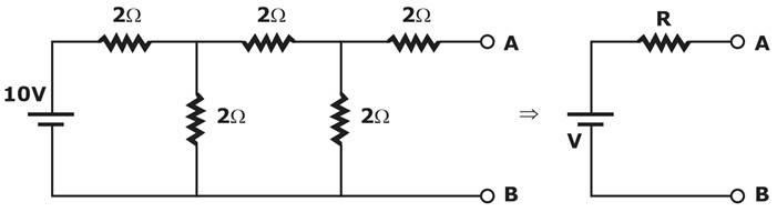
Sol. Maximum power transfer to load:

$$P_{max} = \frac{V_{th}^2}{4R_{th}}$$

$$P_{min} = \frac{20^2}{4 \times 5} = 20W$$

$P_{max}$ = 20 W

79. Consider the following circuit:




What will be the value of v and R respectively?

A. 2V, 3.2 Ω

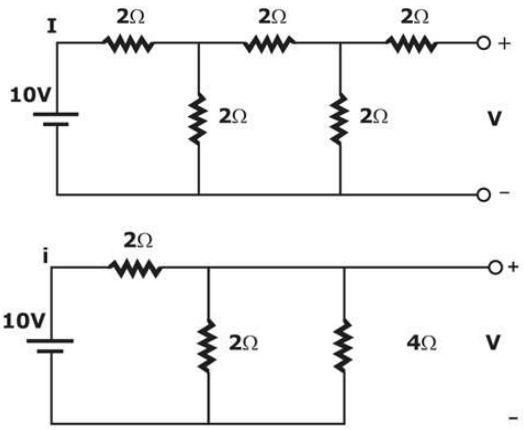
B. 2V, 1.6 Ω

C. 4V, 3 Ω

D. 6V, 4 Ω

Ans. A

Sol. Calculation of thevenin voltage (v):




$$i = \frac{10}{2 + (2 \parallel 4)}$$

i = 3A

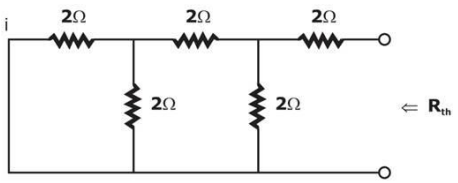
V = i(2||4)

V = 4V

$V_{TH}$ = 2v/4

$V_{TH}$ = 2volt

Calculation of $R_{th}$:

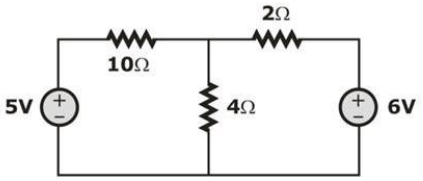


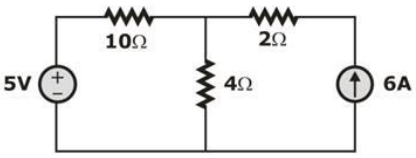

$$R_{th} = [((2 \parallel 2) + 2) \parallel 2] + 2$$

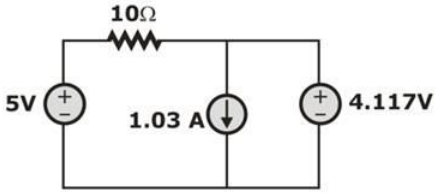
= (3||2) + 2

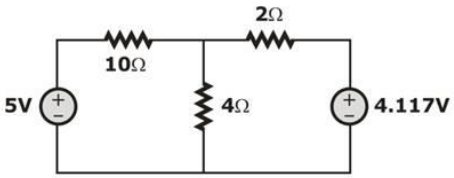
$R_{th}$ = 3.2 Ω

80. Which circuit is equivalent to the circuit shown in figure?




A.


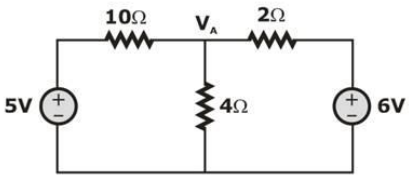

B.



C.



D. Both B and C

Ans. D

Sol.




Applying KCL at node A

$$\frac{V_A - 5}{10} + \frac{V_A - 0}{4} + \frac{V_A - 6}{2} = 0$$

$V_A$ = 4.117V

Current is 4 Ω resistor = $\frac{V_A}{4}$ = 1.03A

Hence by Substitution theorem, the combination of 6V voltage source and 2 W resistance is replaced by single voltage source. Also 4 W resistance is replaced by equivalent current source.

81. If the impedance is given by Z = (4 + j3), what will be its susceptance?

A. 0.6 mho
B. 0.8 mho
C. 0.12 mho
D. 1/3 mho

Ans. C

Sol. Z = R + jX

$$Y = \frac{1}{Z} = \frac{R}{Z^2} + \frac{jX}{Z^2}$$

Y = G + jB

G → Conductance = $\frac{R}{Z^2}$

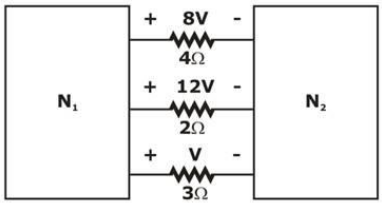
B → Susceptance $= \frac{X}{Z^2}$

Z = 4 + j3

|Z| = 5

B(Susceptance) = 3/25 = 0.12 mho.

82. The two electrical networks $N_1$ and $N_2$ are connected through three resistors as shown. The voltage across 3 ohm resistor is




A. 24 V
B. 20 V
C. -24 V
D. - 20 V

Ans. C

Sol. Current through 4 Ω resistor = $\frac{8}{4} = 2A = I_1$ current through 2 Ω resistor = $\frac{12}{2}$ = 6 A = $I_2$

Current through 3 Ω resistor = $I_1 + I_2$ = 8A

[current leaving $N_1$ = current entering $N_1$]

Voltage across 3 Ω resistor = (-8) × 3 = - 24 V

83. The charge flowing in the coil is given q = $5t^2 + 2t + 10$ C having inductance of 10H determine the voltage across the coil.

A. 100 t V
B. 100 V
C. $t^2/2$ V
D. 50 V

Ans. B

Sol. As we know that

$$i = \frac{dq}{dt}$$

$$i = \frac{d}{dt}\left(5t^2 + 2t + 10\right)$$

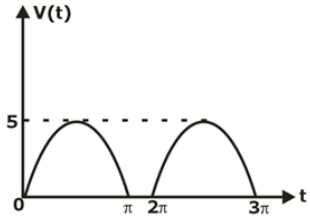
I = 10t + 2 Amp

Since voltage induced $E = L\frac{di}{dt}$

$$E = 10 \times \frac{d}{dt}(10t + 2)$$

E = 10 × 10 = 100 volt

84. Half wave rectified sine wave is shown in the waveform below. Then rms value of the voltage v(t) will be.




A. 6.25 V

B. 2.5 V

C. 3.56 V

D. 5 V

Ans. B

Sol. The Time period of the above waveform:

$T = 2\pi$

$$V_{rms}^2 = \frac{1}{T}\int_0^T v^2(t)dt$$

$$= \frac{1}{2\pi}\left[\int_0^{\pi}(5\sin t)^2 dt + \int_{\pi}^{2\pi} 0.dt\right]$$

$$\because \sin^2 t = \frac{1}{2}(1-\cos 2t)$$

$$V_{rms}^2 = \frac{1}{2\pi}\int_0^{\pi}\frac{25}{2}(1-\cos 2t)dt$$

$$V_{rms}^2 = \frac{25}{4}$$

$$V_{rms} = 2.5V$$

85. Under the conditions of maximum power transfer from an ac source to a variable load

A. The load impedance must also be inductive, if the generator impedance is inductive.

B. The sum of the source and load impedance is zero.

C. The sum of the source and load reactance is zero.

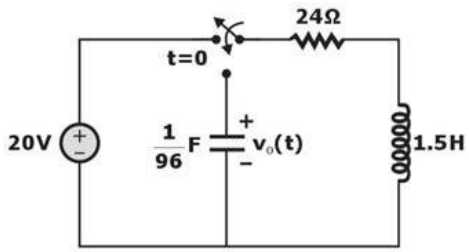
D. The load impedance has same phase angle as the generator impedance.

Ans. C

Sol. In the ac networks, the maximum power transfer theorem can be stated as follows: In a linear network having energy sources and impedances, maximum amount of power is transferred from source to load impedance if load impedance is the complex conjugate of the total impedance of the network, i.e., if the source impedance is $R_g \pm jX_g$ ohm, to have maximum power transfer, the load impedance must be Rg ∓ jXgohm.

Here we can see, the source reactance is always of opposite sign to that of load reactance. Hence, their sum must be zero.

86. The response $v_o(t)$ for t > 0 in the following network is of the form, when the switch is moved from source to capacitor terminal




A. $v_o(t) = (Ae^{-8t} + Be^{-8t})$ V

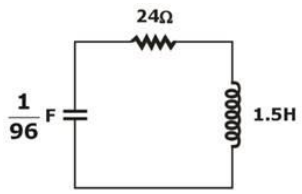
B. $v_o(t) = (A + Bt)\, e^{-8t}$ V

C. $v_o(t) = (A \cos 8t + B \sin 8t)\, e^{-8t}$ V

D. None of these

Ans. B

Sol. For t > 0, the switch is closed, and the circuit is same as an RLC series network.




For a series RLC network

$$\alpha - \frac{R}{2L} = \frac{24}{2 \times 1.5} = 8$$

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\frac{1}{96} \times 1.5}} = 8$$

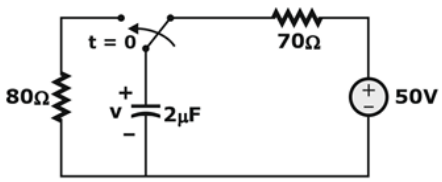
$$\alpha = \omega_0$$

So, the response $V_o(t)$ will be critically damped.

$$V_0(t) = (A + Bt)e^{\alpha t}$$

$V_o(t) = (A + Bt)\, e^{-8t}$, t > 0

87. For the circuit diagram shown below, calculate the voltage across capacitor v(t) at t = 160 μsec?




A. 16.5 V

B. 18.4 V

C. 20.2 V

D. None of the above

Ans. B

Sol. At $t = 0^-$

$V_C(0^-) = V_C(0^+) = 50$ V,

At t tending to ∞,

$V_C(\infty) = 0$ V

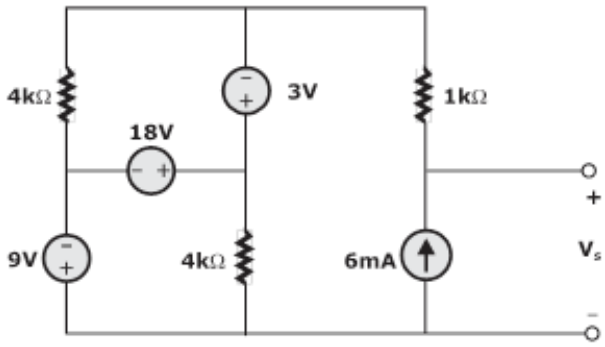
$\tau = 80 \times 2 \times 10^{-6} = 160$ μsec

$V_C(t) = V_C(\infty) + [V_C(0^+) - V_C(\infty)e^{-(t/\tau)}]$

$V_C(t) = 50e^{-(t \times 106/160)}$ V

$V_C(160\mu sec) = 50e^{-1}$ V = 18.4 V

88. Consider the circuit shown in the figure below:




Voltage $V_5$ across the current source is equal to

A. zero

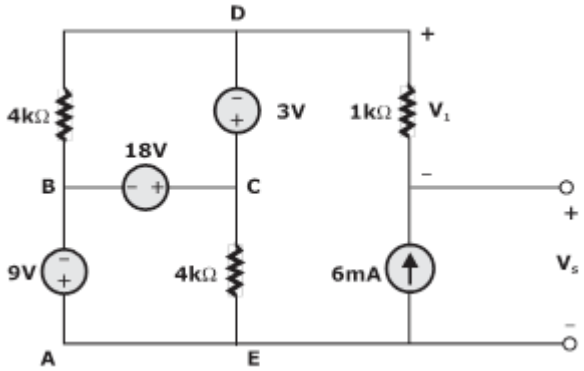
B. 12 Volt

C. 24 Volt

D. 18 volts

Ans. B

Sol. We can solve this problem directly using KVL as shown




Around loop ABCDEA

$-9 + 18 - 3 - V_1 - V_s = 0$

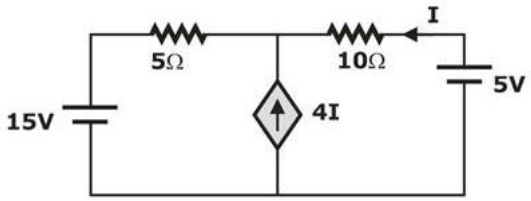
Using Ohm's Law,

$V_1 = -6 \times 10^{-3} \times 1 \times 10^3 = -6$ volt

So, $-9 + 18 - 3 + 6 - V_s = 0$

$V_s = 12$ Volt

89. The value of current through 10 ohm resistor is:



A. -2/7 A

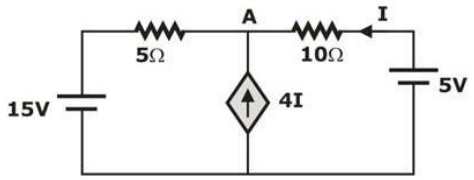
B. 2/7 A

C. 1 A

D. -1 A

Ans. A

Sol.




KCL at node A

$$\frac{V_A - 15}{5} + \frac{V_A - 5}{10} = 4I \text{ .... (1)}$$

$$I = \frac{5 - V_A}{10} \text{ .... (2)}$$

Using (2) in (1)

$$\frac{V_A - 15}{5} + \frac{V_A - 5}{10} = 4\left(\frac{5 - V_A}{10}\right)$$

$3V_A - 35 = 20 - 4V_A$

$7V_A = 55$

$$V_A = \frac{55V}{7}$$

$$I = \frac{5 - \frac{55}{7}}{10}$$

$$= -2/7A$$

90. If $Z_{i1}$ and $Z_{i2}$ are the image impedances at input and output side respectively of a two port network. Which of the following is correct?

A. $Z_{i1} = \sqrt{Z_{is}Z_{i0}}, z_{i2} = \sqrt{Z_{is}Z_{00}}$

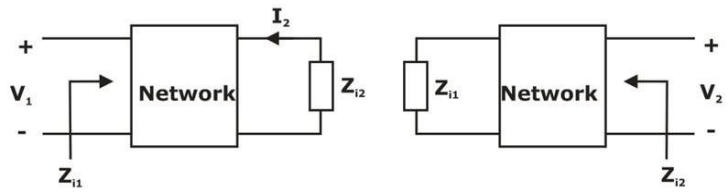
B. $Z_{i1} = \sqrt{Z_{0s}Z_{i0}}, Z_{i2} = \sqrt{Z_{is}Z_{i0}}$

C. $Z_{i1} = \sqrt{Z_{is}Z_{0s}}, z_{i2} = \sqrt{Z_{i0}Z_{00}}$

D. $Z_{i1} = \sqrt{Z_{i0}Z_{00}}, Z_{i2} = \sqrt{Z_{is}Z_{0s}}$

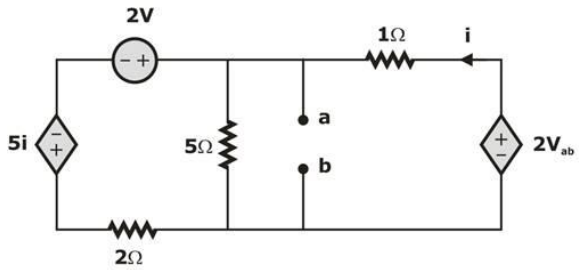
Ans. A

Sol. $Z_{i1}$ and $Z_{i2}$ are image impedances




$Z_{i1} = \sqrt{Z_{is}Z_{i0}}, Z_{i2} = \sqrt{Z_{is}Z_{00}}$

91. Consider the below circuit, find the Norton current and Norton resistance across a-b terminal.




A. 1 A, 11/5 Ω

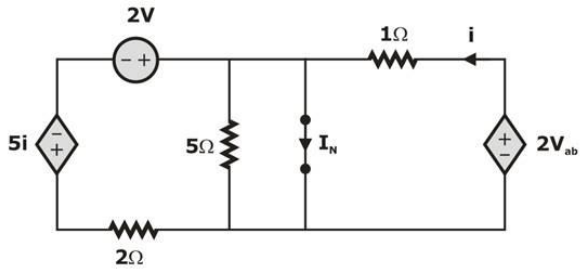
B. 5 A, 11/5 Ω

C. 5 A, 5/11 Ω

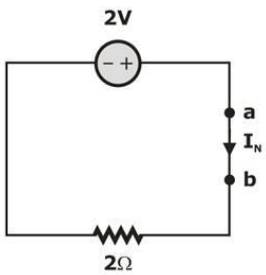
D. 1 A, 5/11 Ω

Ans. D

Sol. Calculation of Norton current, $I_N$:



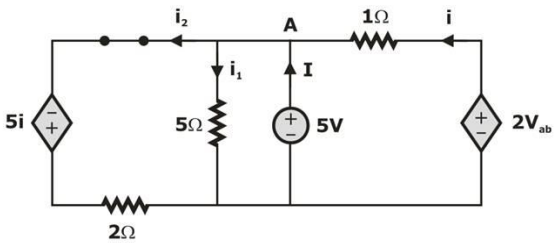

Current i will be zero because the branch is short.




$I_N = \frac{2}{2} = 1A$

Calculation of $R_N$:

Connect a 5V dc voltage source across ab.




$$i = \frac{2V_{ab} - 5}{1} = \frac{10 - 5}{1}$$

i = 5 A

Applying KCL at node A:

$I + i = i_1 + i_2$

$$I + 5 = \frac{5}{5} + \frac{5 + 5i}{2}$$

I + 5 = 1 + 15

I = 11 A

$$R_N = \frac{V_{dc}}{I} = \frac{5}{11}$$

$$R_N = \frac{5}{11}\Omega$$

92. Two inductors each of 50 Ω reactance and negligible resistance are connected in series across the 200 V 50 Hz supply. Determine what value of resistance connected in parallel with one coil dissipates maximum power.

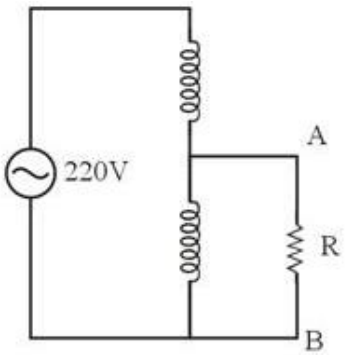
A. 20 Ω
B. 15 Ω
C. 25 Ω
D. 35 Ω

Ans. C

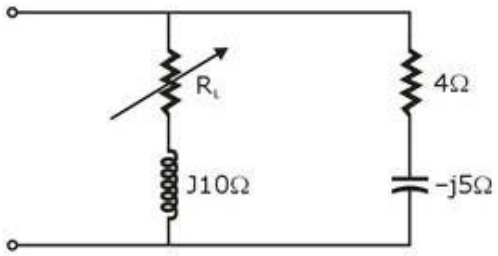
Sol. With R removed

$$Z_{AB} = \frac{j50}{2} = j25\Omega$$

The power in R will be maximum when R = |j25| = 25 Ω



93. For the circuit shown below, which of the following statement is true




A. The resonance is possible when $R_L$ = 4Ω only

B. The resonance is possible when $R_L$ = 10

C. The resonance is possible for all positive values of $R_L$

D. The resonance is not possible with any value of $R_L$

Ans. D

Sol. The total admittance is

$$Y_T = \frac{1}{R + j10} + \frac{1}{4 - 5j}$$

$$= \left(\frac{R_L}{R_L^2 + 100} + \frac{4}{41}\right) + j\left(\frac{5}{41} - \frac{10}{R_L^2 + 100}\right)$$

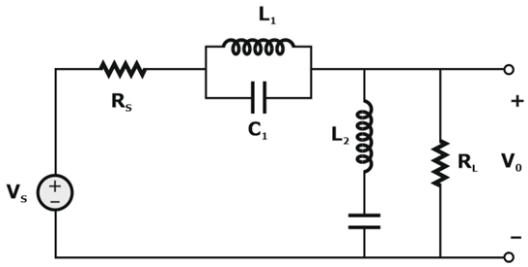
∴ For resonance imaginary part must be zero

ie. $\frac{5}{41} = \frac{10}{R_1^2 + 100}$,

$R_L^2 = -18$

∴ Thus, there is no value of $R_L$ which results in resonance.

94. The circuit shown in figure below represents a




A. Low pass filter

B. High pass filter

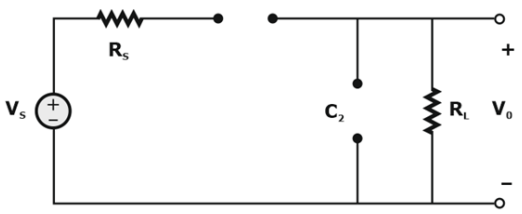
C. Band pass filter

D. Band reject filter

Ans. D

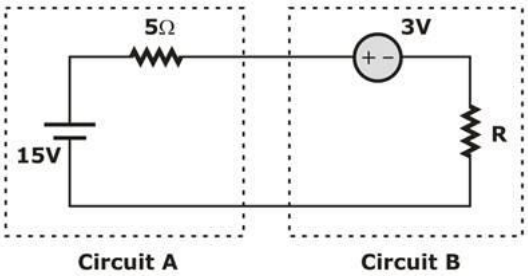
Sol. Either for w =0 or w = ∞, the behaviour of the circuit is shown in figure below.

$$V_0 = V_S \frac{R_L}{R_L + R_S}$$




Resonant frequency of parabola LC combination it offers open circuit and hence $V_0 = 0$. At resonant frequency of series LC combination, it offers short circuit and hence $V_0 = 0$. So, the filter is and band reject filter.

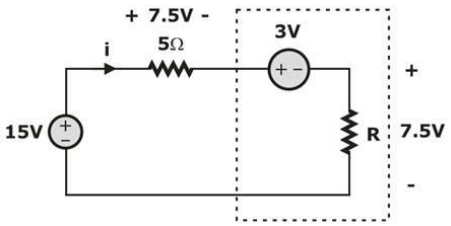
95. Consider the circuit below, the value of R for which maximum power is transferred from circuit A to circuit B is.




A. 5 Ω
B. 2 Ω
C. 1 Ω
D. 3 Ω

Ans. D

Sol. For maximum power transfer to circuit B, the value of load resistance will be equal to thevenin resistance that is 5 Ω.




Value of current i;

$$i = \frac{7.5}{5} = 1.5A$$

i = 1.5 A

voltage across R resistance:

$V_R = 7.5 - 3$

$V_R = 4.5$ V

$$R = \frac{V_R}{i} = \frac{4.5}{1.5}$$

R = 3Ω

96. Norton equivalent circuit consists of

A. Current source in series with equivalent resistance.

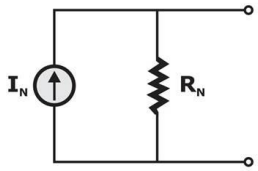
B. Voltage source in series with equivalent resistance.

C. Voltage source in parallel with equivalent resistance.

D. Current source in parallel with equivalent resistance.

Ans. D

Sol. Norton equivalent circuit:




Hence. Option D is correct.

97. If transfer function is given by $H(s) = \frac{s^2+1}{s^2+s+1}$, then it represents _____ filter.

A. Band stop filter

B. Band pass filter

C. All pass filter

D. High pass filter

Ans. A

Sol. At low frequency,

$w = 0, H(0) = 1$

At high frequency,

$w = \infty H(\infty) = 1$

At $w = 1$ $H(1) = 0$

Band stop filter.

98. The KCL and KVL is applicable for

A. Distributed circuit parameters

B. Lumped circuit parameters

C. Both Distributed and Lumped circuit parameters

D. Neither Distributed nor Lumped circuit parameters

Ans. B

Sol. KCL and KVL fails for Distributed parameters, since for distributed parameters, electrically it is not possible to separate resistance, capacitance and inductance effect.

KCL and KVL are applied for Lumped parameters (Linear, Non-linear, Uni-directional, bi-directional, time variant and invariant elements, Planer & non-planer)

99. Dual circuit represents that:

A. Both the circuits have same KCL equation.

B. Both the circuits have same KVL equation.

C. These circuit diagrams are exactly same.

D. One's KCL equation becomes KVL equation of other.

Ans. D

Sol. In dual circuit KVL equation of first circuit depicts similarity with KCL other circuit.

100. A graph in which at least one path (disregarding orientation) exists between any two nodes of the graph is a

A. connected graph

B. directed graph

C. sub-graph

D. fundamental graph

Ans. A

Sol. A connected graph is a graph in which atleast one path exists between any two nodes.

****