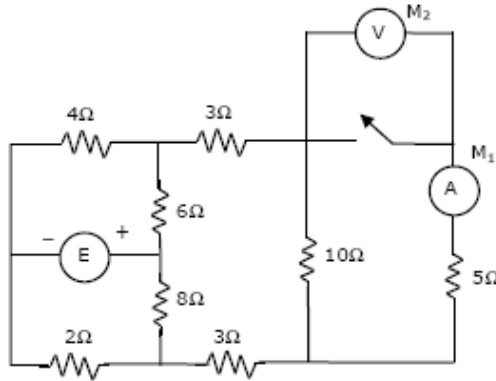


Resistive Networks

[1993]

In the circuit of figure, when switch S_1 is closed, the ideal ammeter M_1 reads 5A. What will be ideal voltmeter M_2 read when S_1 is kept open? (The value of E is not specified).



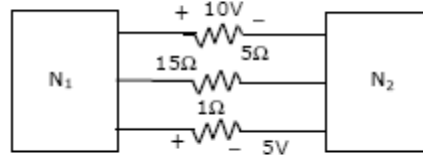
IsC given, calculate the R_{th} and find V_{th}

A network contains linear resistors and ideal voltage sources. If values of all the resistors are doubled, then the voltage across each resistor is

- (a) halved (b) doubled
(c) increased by four times (d) not changed

The voltage across each resistor remains unchanged because voltage division depends on ratio rather than actual value. As doubling all the resistance value keeps the ratio unchanged the voltage across each remains unchanged.

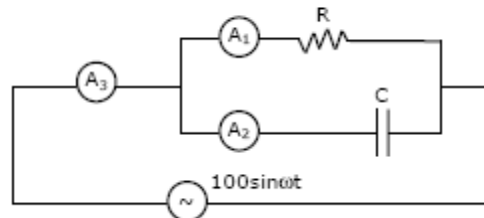
The two electrical sub network N_1 and N_2 are connected through three resistors as shown in figure. The voltage across 5 ohm resistor and 1 ohm resistor are given to be 10 V and 5V, respectively. Then voltage across 15 ohm resistor is



- (a) - 105 V (b) + 105 V (c) - 15 V (d) + 15 V

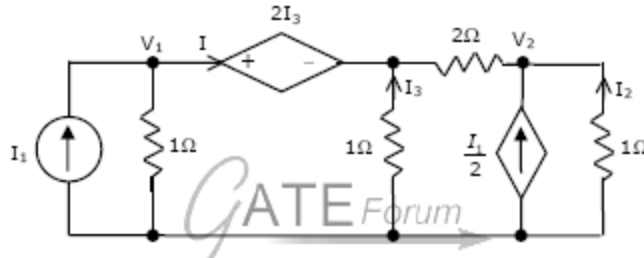
In figure, A_1, A_2 and A_3 are ideal ammeters? If A_1 reads 5A, A_2 reads 12A, then A_3 should read.

- (a) 7 A
(b) 12 A
(c) 13 A
(d) 17 A



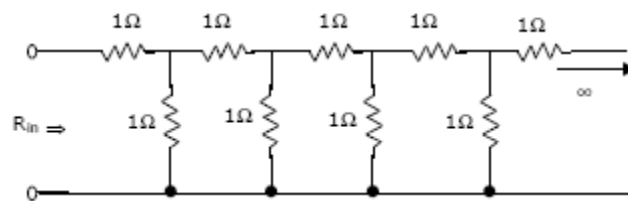
[1995]

Find the current transfer-ratio, $\frac{I_2}{I_1}$, for the network shown below (figure). Also, mark all branch currents



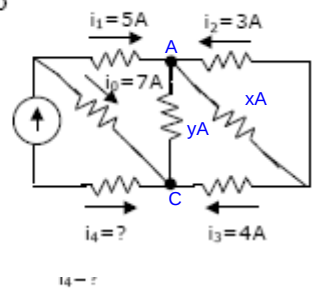
[1996]

Find the input resistance R_{in} of the infinite section network shown in Fig.15.



The current i_4 in the circuit of Fig.1.1 is equal to

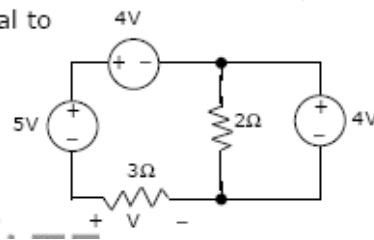
- (a) 12 A
- (b) -12 A
- (c) 4A
- (d) None of the above



The current i_4 is equal to -18A.
Apply KCL to node a,b and c.

The voltage V in Fig.1.2 is equal to

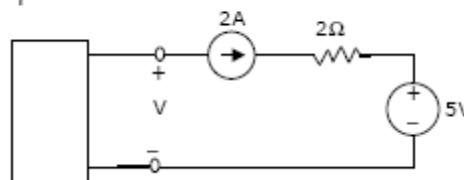
- (a) 3V
- (b) -3V
- (c) 5V
- (d) None of the above



ans is (a) 3V.Apply KVL.

The voltage V in Fig.1.3 is always equal to

- (a) 9V
- (b) 5V
- (c) 1V
- (d) None of the above



Maybe 9V,not sure,have to check.

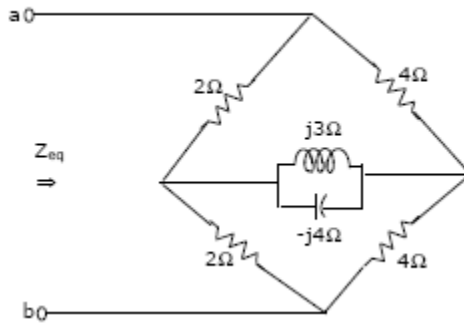
In the circuit of Fig.3.2, the equivalent impedance seen across terminals a,b is

(a) $\left(\frac{16}{3}\right)\Omega$

(b) $\left(\frac{8}{3}\right)\Omega$

(c) $\left(\frac{8}{3} + 12j\right)\Omega$

(d) None of the above



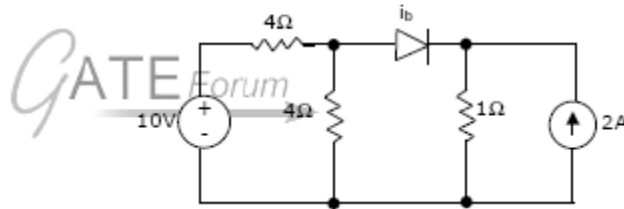
In the circuit of Fig.3.3, the current i_D through the ideal diode (zero cut in voltage and forward resistance) equals

(a) 0 A

(b) 4 A

(c) 1 A

(d) None of the above



The current I_d is 1A. Convert current source to voltage source. Then apply KVL.

[1998]

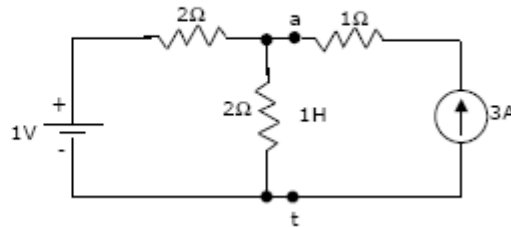
The voltage across the terminals a and b in Fig.1.11 is

(a) 0.5 V

(b) 3.0 V

(c) 3.5 V

(d) 4.0 V



[2000]

In the circuit of Fig.P1.2, the value of the voltage source E is

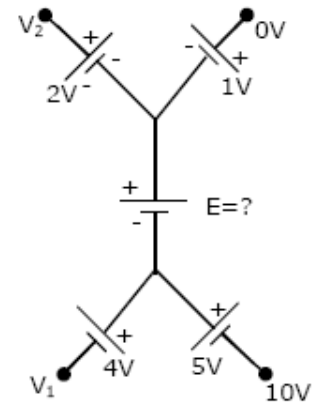
(a) -16 V

(b) 4 V

(c) -6V

(d) 16 V

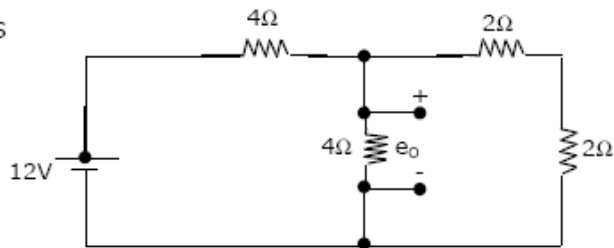
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[2001]

The voltage e_o in figure 1.1 is

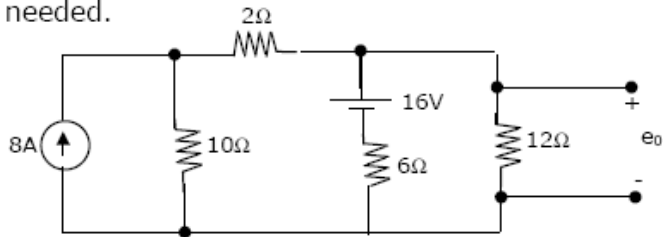
- (a) 2V
- (b) $\frac{4}{3}$ V
- (c) 4V ans is 4V
- (d) 8V



provided for any rough work, if needed.

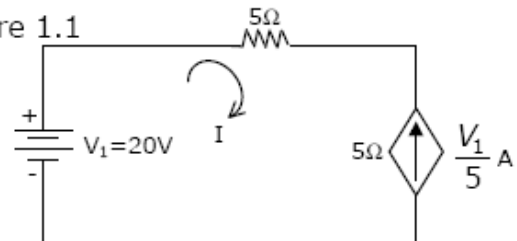
The voltage e_o in figure 2.1 is

- (a) 48 V
- (b) 24 V
- (c) 36 V
- (d) 28 V



The dependent current source shown in Figure 1.1

- (a) delivers 80 W
- (b) absorbs 80 W
- (c) delivers 40 W
- (d) absorbs 40 W



[2003]

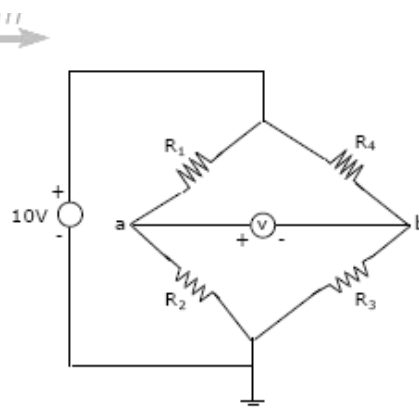
Twelve 1Ω resistances are used as edges to form a cube. The resistance between two diagonally opposite corners of the cube is

- (a) $\frac{5}{6}\Omega$
- (b) $\frac{1}{6}\Omega$
- (c) $\frac{6}{5}\Omega$
- (d) $\frac{3}{2}\Omega$

[2005]

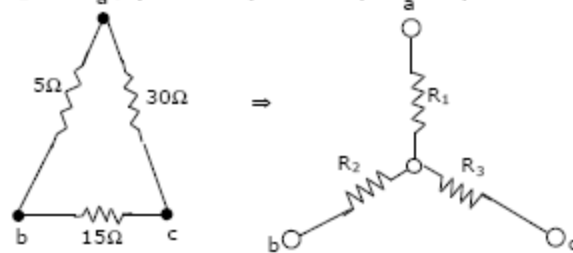
If $R_1 = R_2 = R_4$ and $R_3 = 1.1R$ in the bridge circuit shown in figure, then the reading in the ideal voltmeter connected between **a** and **b** is

- (a) 0.238 V
- (b) 0.138 V
- (c) -0.238 V
- (d) 1 V



[1999]

A Delta-connected network with its Wye-equivalent is shown in Fig.P2.4. The resistance R_1 , R_2 and R_3 (in ohms) are respectively



(a) 1.5, 3 and 9

(b) 3, 9 and 1.5

(c) 9, 3 and 1.5

(d) 3, 1.5 and 9

[2001]

If each branch of a Delta circuit has impedance $\sqrt{3}Z$, then each branch of the equivalent Wye circuit has impedance.

(a) $\frac{Z}{\sqrt{3}}$

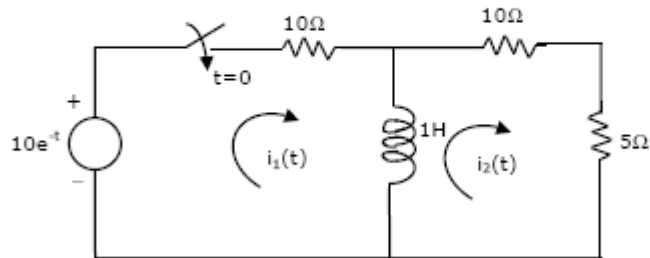
(b) $3Z$

(c) $3\sqrt{3}Z$

(d) $\frac{Z}{3}$

[1994]

Write down the mesh equations of the following network in term of $i_1(t)$ and $i_2(t)$. Derive the differential equation for $i_1(t)$ from these and solve it.



[1998]

The nodal method of circuit analysis is based on

- | | |
|-----------------------|----------------------------|
| (a) KVL and Ohm's law | (b) KCL and Ohm's law |
| (c) KCL and KVL | (d) KCL, KVL and Ohm's law |

Network Graphs

[1992]

Relative to a given fixed tree of a network,

- (a) Link currents form an independent set
- (b) Branch voltage from an independent set
- (c) Link currents from an independent set
- (d) Branch voltage from an independent set

[1996]

The number of independent loops for a network with a n nodes and b branches is

- (a) $n - 1$
- (b) $b - n$
- (c) $b - n + 1$
- (d) independent of the number of nodes

[1998]

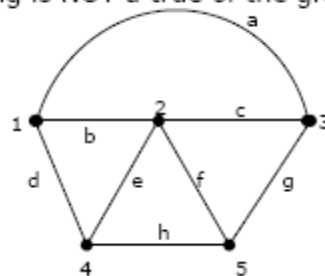
A network has 7 nodes and 5 independent loops. The number of branches in the network is

- (a) 13
- (b) 12
- (c) 11
- (d) 10

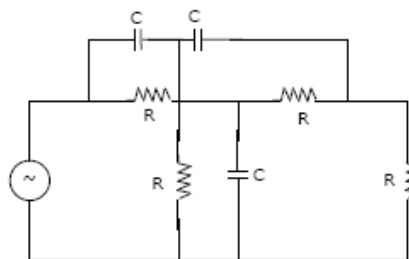
[1999]

Identify which of the following is NOT a true of the graph shown in Fig.P1.1

- (a) begh
- (b) defg
- (c) adfg
- (d) aegh



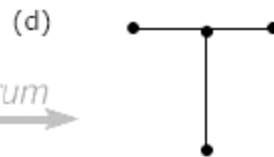
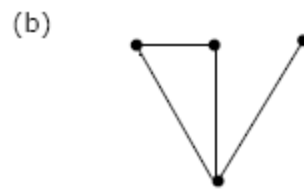
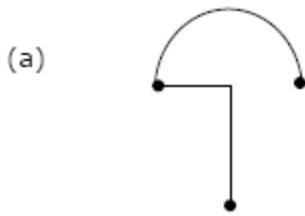
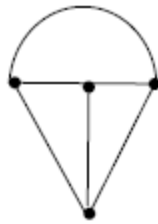
The minimum number of equations required to analyze the circuit shown in Fig.Q.1 is



- (a) 3
- (b) 4
- (c) 6
- (d) 7

[2004]

Consider the network graph shown in figure. Which one of the following is NOT a 'tree' of this graph?

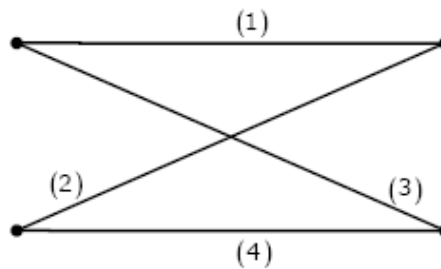


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[2008]

In the following graph, the number of trees (P) and the number of cut-sets (Q) are

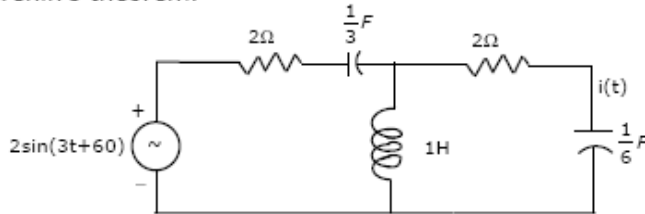
- (A) $P=2, Q=2$
- (B) $P=2, Q=6$
- (C) $P=4, Q=6$
- (D) $P=4, Q=10$



Network Theorems

[1995]

Determine the current, $i(t)$, in the circuit given below, (in figure below), using the Thevenin's theorem.



[1998]

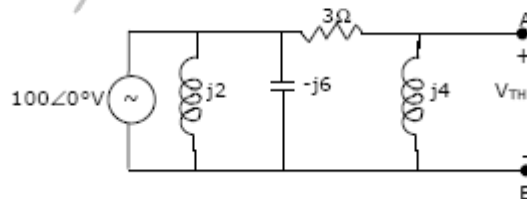
Superposition theorem is NOT applicable to networks containing

- | | |
|-------------------------------|-------------------------------|
| (a) nonlinear elements | (b) dependent voltage sources |
| (c) dependent current sources | (d) transformers |

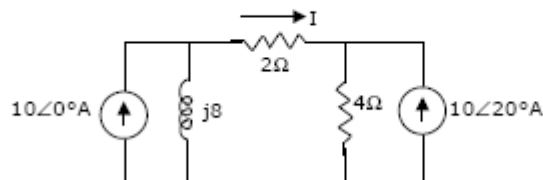
[1999]

The Thevenin equivalent voltage V_{TH} appearing between the terminals A and B of the network shown in Fig.P2.2 is given by

- (a) $j16(3-j4)$
- (b) $j16(3+j4)$
- (c) $16(3+j4)$
- (d) $16(3-j4)$



For the network shown in Fig.P4, evaluate the current I flowing through the 2Ω resistor using superposition theorem.



For the circuit in Fig.P3

- (a) Find the Thevenin equivalent of the sub circuit faced by the capacitor across the terminals a, b.
- (b) Find $v_c(t)$, $t > 0$, given $v_c(0) = 0$
- (c) Find $i(t)$, $t > 0$

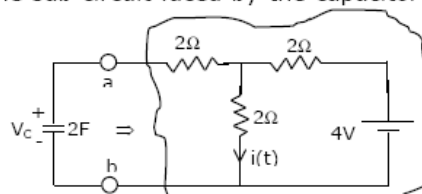
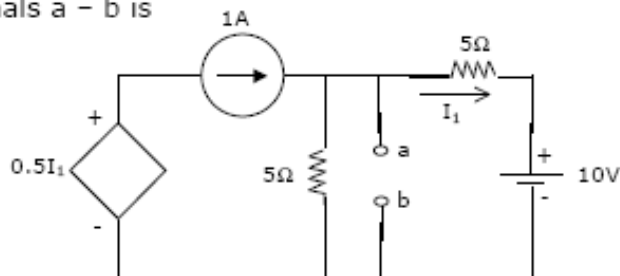


Fig.P3

[2005]

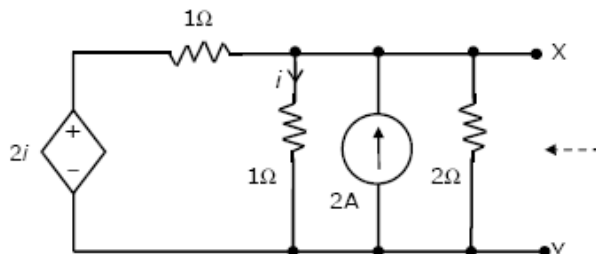
For the circuit shown in figure, Thevenin's voltage and Thevenin's equivalent resistance at terminals a - b is



- (a) 5 V and $2\ \Omega$
 (c) 4 V and $2\ \Omega$

- (b) 7.5 V and $2.5\ \Omega$
 (d) 3 V and $2.5\ \Omega$

For the circuit shown in the figure, the Thevenin voltage and resistance looking into X-Y are:



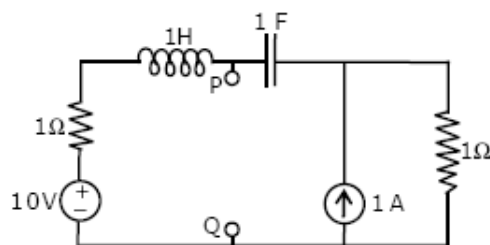
(A) $\frac{4}{3}V, 2\Omega$

(B) $4V, \frac{2}{3}\Omega$

(C) $\frac{4}{3}V, \frac{2}{3}\Omega$

(D) $4V, 2\Omega$

The Thevenin equivalent impedance Z_{th} between the nodes P and Q in the following circuit is



(A) 1

(B) $1 + s + \frac{1}{s}$

(C) $2 + s + \frac{1}{s}$

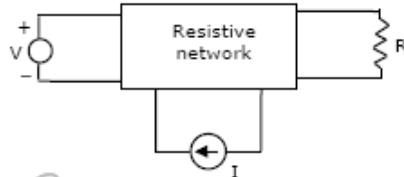
(D) $\frac{s^2 + s + 1}{s^2 + 2s + 1}$

Maximum Power Transfer

[1993]

A dc circuit shown in figure has a voltage source V , a current source I and several resistors. A particular resistor R dissipates a power of 4 Watts when V alone is active. The same resistor R dissipates a power of 9 Watts when I alone is active. The power dissipated by R when both sources are active will be

- (a) 1 W
- (b) 5 W
- (c) 13 W
- (d) 25 W

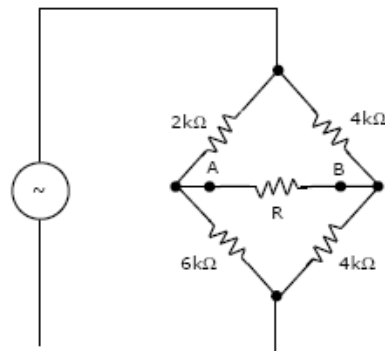


[1994]

A generator of internal impedance, Z_G , deliver maximum power to a load impedance, Z_L , only if $Z_L =$ _____

[1995]

The value of the resistance, R , connected across the terminals, A and B, (ref. figure), which will absorb the maximum power, is

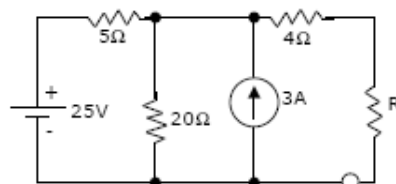


- (a) 4.00 kΩ
- (b) 4.11 kΩ
- (c) 8.00 kΩ
- (d) 9.00 kΩ

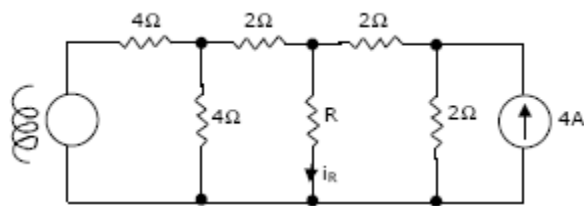
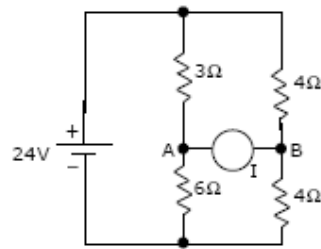
A voltage source of internal impedance $R_s + jX_s$ supplies power to a load of impedance $R_L + jX_L$ in which only R_L is variable. Determine the value of R_L for maximum power transfer from the source to the load. Also, find the numerical value of R_L if the source impedance is 3.0Ω (purely resistive) and X_s is 4.0Ω .

The value of R (in ohms) required for maximum power transfer in the network shown in Fig.P2.3 is

- (a) 2
- (b) 4
- (c) 8
- (d) 10



In the circuit shown in Fig.7, it is known that the variable current source I absorbs power. Find I (in magnitude and direction) so that it receives maximum power and also find the amount of power absorbed by it.

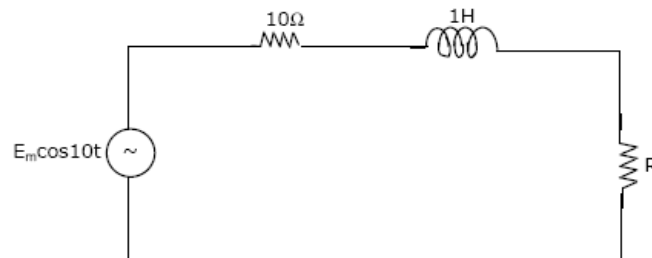


In the circuit of Fig.22 when $R = 0\Omega$, the current i_R equals 10A

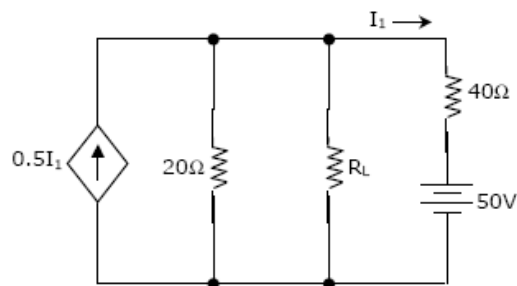
- Find the value of R for which it absorbs maximum power
- Find the value of ϵ
- Find V_2 when $R = \infty$ (open circuit)

In figure 2.2, the value of the load resistor R which maximizes the power delivered to it is

- 14.14Ω
- 10Ω
- 200Ω
- 28.28Ω



In the network of Figure 2.1, the maximum power is delivered to R_L if its value is



- 16Ω
- $\frac{40}{3}\Omega$
- 60Ω
- 20Ω

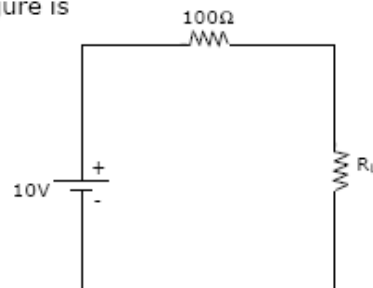
[2003]

A source of angular frequency 1 rad/sec has a source impedance consisting of 1Ω resistance in series with 1 H inductance. The load that will obtain the maximum power transfer is

- (a) 1Ω resistance
- (b) 1Ω resistance in parallel with 1 H inductance
- (c) 1Ω resistance in series with 1 F capacitor
- (d) 1Ω resistance in parallel with 1 F capacitor

[2005]

The maximum power that can be transferred to the load resistor R_L from the voltage source in figure is

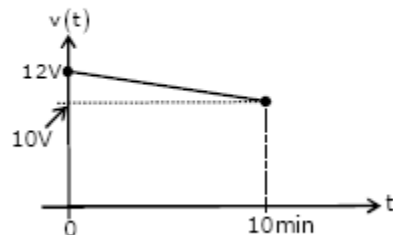


- (a) 1 W
- (b) 10 W
- (c) 0.25 W
- (d) 0.5 W

An independent voltage source in series with an impedance $Z_s = R_s + jX_s$ delivers a maximum average power to a load impedance Z_L when

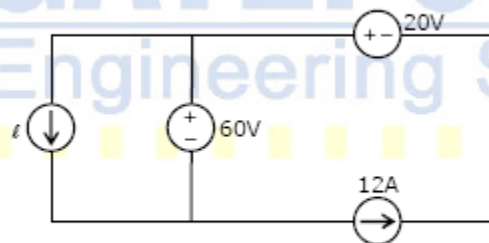
- (A) $Z_L = R_s + jX_s$
- (B) $Z_L = R_s$
- (C) $Z_L = jX_s$
- (D) $Z_L = R_s - jX_s$

A fully charged mobile phone with a 12V battery is good for a 10minute talk-time. Assume that, during the talk-time, the battery delivers a constant current of 2A and its voltage drops linearly from 12 V to 10V as shown in the figure. How much energy does the battery deliver during this talk-time?



- (A) 220J
- (B) 12kJ
- (C) 13.2kJ
- (D) 14.4kJ

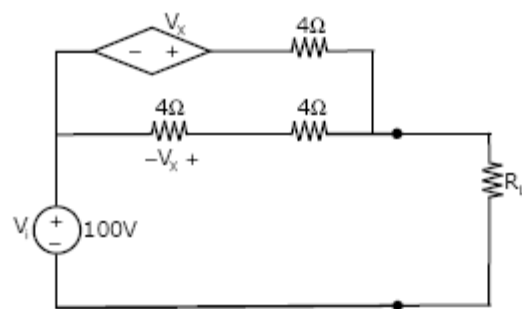
In the interconnection of ideal sources shown in the figure, it is known that the 60V source is absorbing power



Which of the following can be the value of the current source I ?

- (A) 10A (B) 13A (C) 15A (D) 18A

In the circuit shown, what value of R_L maximizes the power delivered to R_L ?

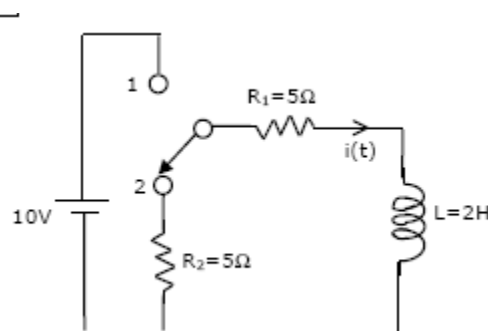


- (A) 2.4Ω (B) $\frac{8}{3}\Omega$ (C) 4Ω (D) 6Ω

Time-domain analysis

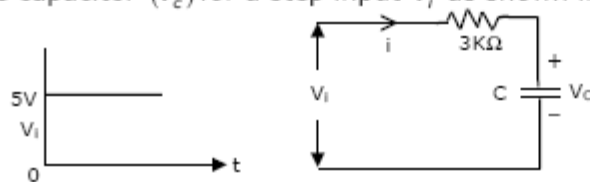
[1991]

The network shown in figure is initially under steady state condition with the switch in position 1. The switch is moved from position 1 to position 2 at $t = 0$. Calculate the current $i(t)$ through R_1 after switching.



[1993]

In the following circuit the capacitance varies as $C = KQ$, where K is a constant equal to $0.5 \text{ Farads/Coulomb}$ and Q , the charge on the capacitor in Coulombs. Determine the current through the circuit and sketch the voltage waveform across the capacitor (V_c) for a step input V_i as shown in figure.

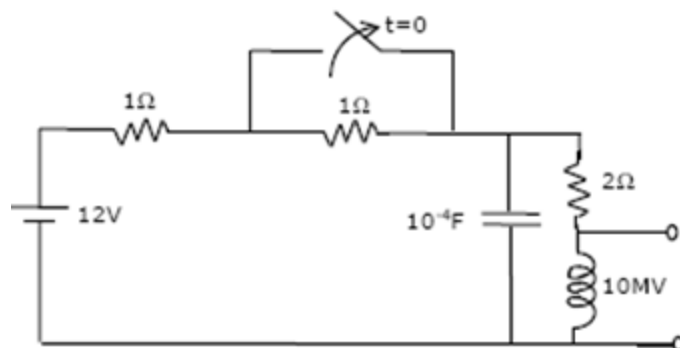


[1994]

A ramp voltage, $v(t) = 100t$ volts, is applied to an RC differentiating circuit with $R = 5k\Omega$ and $C = 4\mu\text{F}$. The maximum output voltage is:

- (a) 0.2 volts (b) 2.0 volts (c) 10.0 volts (d) 50.0 volts

The circuit shown in the figure, is initially in its steady state. Switch is opened at $t = 0$.



- (1) Determine the initial voltage, $V_c(0^-)$ across the capacitor, and the initial current, $i(0^-)$, through the inductor.
- (2) Calculate the voltage, $V_1(t)$, across the inductance for $t > 0$.

A DC voltage source is connected across a series R-L-C circuit. Under steady-state conditions, the applied DC voltage drops entirely across the

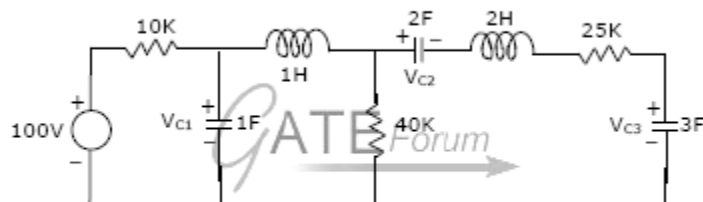
- (a) R only
- (b) L only
- (c) C only
- (d) R and L combination

Consider a DC voltage source connected to a series R-C circuit. When the steady state reaches, the ratio of the energy stored in the capacitor to the total energy supplied by the voltage source, is equal to

- (a) 0.362
- (b) 0.500
- (c) 0.632
- (d) 1.000

[1996]

The voltages V_{C1} , V_{C2} , and V_{C3} across the capacitors in the circuit in Fig.2.3, under steady state, are respectively



- (a) 80V, 32V, 48V
- (b) 80V, 48V, 32V
- (c) 20V, 8V, 12V
- (d) 20V, 12V, 8V

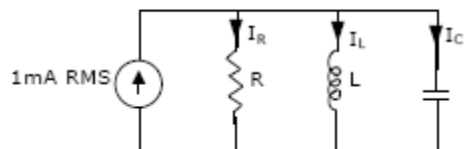
In the circuit of Fig.3.1 the energy absorbed by the 4Ω resistor in the time interval $(0, \infty)$ is

- (a) 36 Joules
- (b) 16 Joules
- (c) 256 Joules
- (d) None of the above

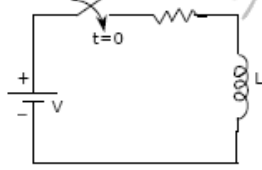
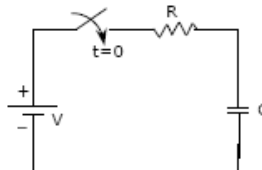
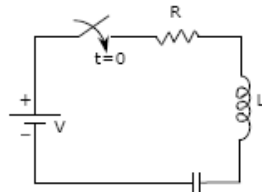


The parallel RLC circuit shown in Fig.1.7 is in resonance. In this circuit

- (a) $|I_R| < 1mA$
- (b) $|I_R + I_L| > 1mA$
- (c) $|I_R + I_C| < 1mA$
- (d) $|I_R + I_C| > 1mA$



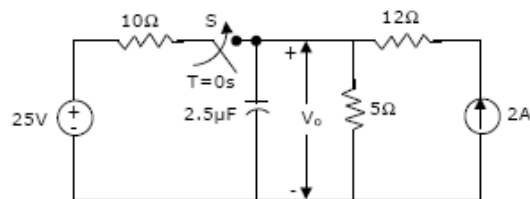
In the circuit shown in Fig.3.1(a) - (c), assuming initial voltage and capacitors and currents through the inductors to be zero at the time of switching ($t = 0$), then at any time $t > 0$.

- (a)  (1) Current increases monotonically with time
- (b)  (2) Current decreases monotonically with time
- (c)  (3) Current remains constant at V/R
(4) Current first increases then decreases
(5) No current can ever flow

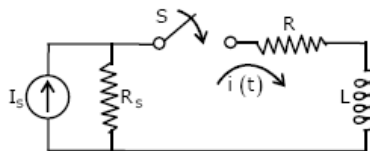
[1999]

In the circuit of Fig.P3, the switch 'S' has remained open for a long time. The switch closes instantaneously at $t = 0$

- (a) Find V_o for $t \leq 0$ and as $t \rightarrow \infty$
(b) Write an expression for V_o as function of time for $0 \leq t \leq \infty$
(c) Evaluate V_o at $t = 25 \mu\text{sec}$.



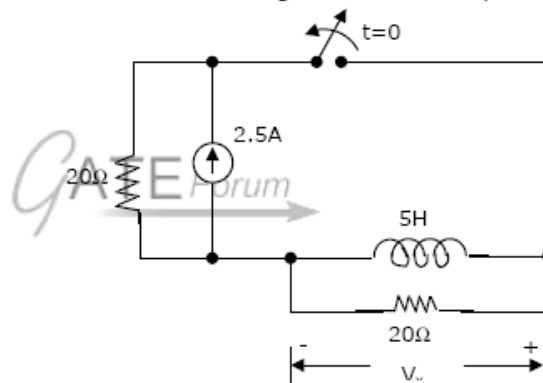
In the following circuit, the switch S is closed at $t=0$. The rate of change of current $\frac{di}{dt}(0+)$ is given by



- (A) 0 (B) $\frac{R_s I_s}{L}$ (C) $\frac{(R + R_s) I_s}{L}$ (D) ∞

In figure 1.2, the switch was closed for a long time before opening at $t = 0$. the voltage V_x at $t = 0^+$ is

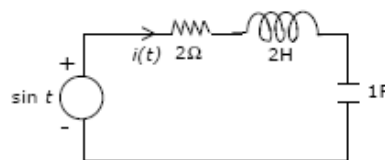
- (a) 25 V
- (b) 50 V
- (c) -50 V
- (d) 0 V



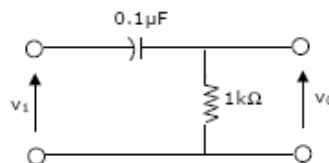
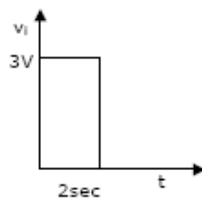
[2003]

The differential equation for the current $i(t)$ in the circuit of Figure Q.5 is

- (a) $2 \frac{d^2 i}{dt^2} + 2 \frac{di}{dt} + i(t) = \sin t$
- (b) $\frac{d^2 i}{dt^2} + 2 \frac{di}{dt} + 2i(t) = \cos t$
- (c) $2 \frac{d^2 i}{dt^2} + 2 \frac{di}{dt} + i(t) = \cos t$
- (d) $\frac{d^2 i}{dt^2} + 2 \frac{di}{dt} + 2i(t) = \sin t$



A square pulse of 3 volts amplitude is applied to C-R circuit shown in figure. The capacitor is initially uncharged. The output voltage v_0 at time $t=2$ sec is



- (a) 3 V
- (b) -3V
- (c) 4 V
- (d) -4V

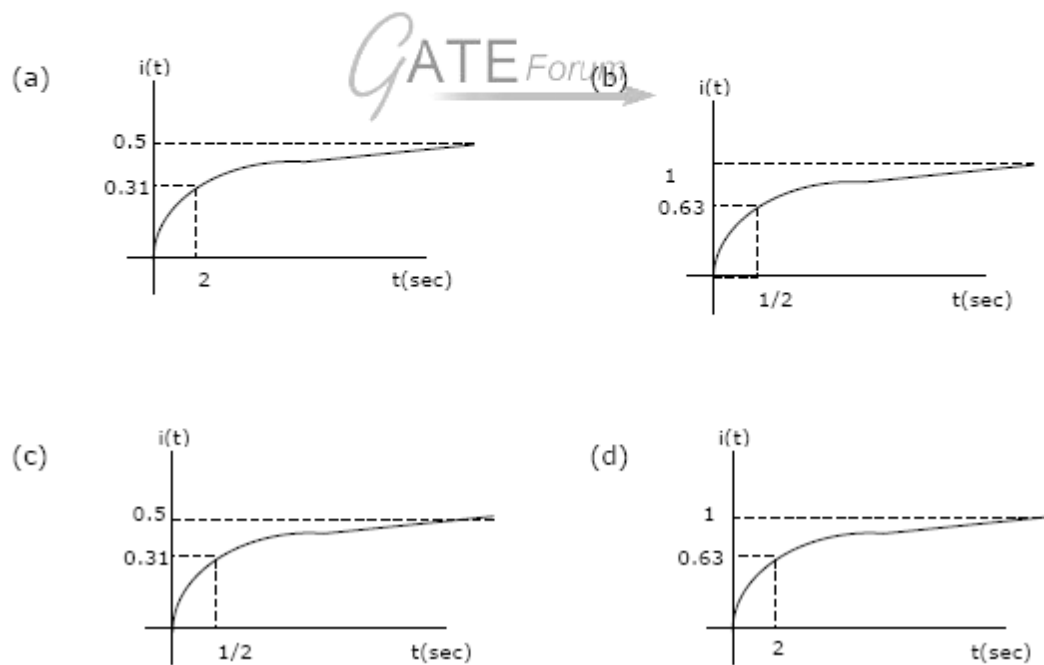
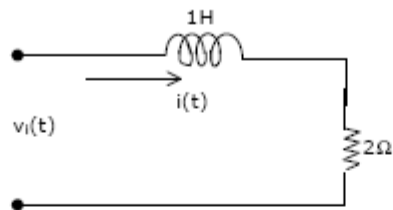
The time domain behavior of an RL circuit is represented by

$$L \frac{di}{dt} + Ri = V_0 (1 + Be^{-Rt/L} \sin t) u(t).$$

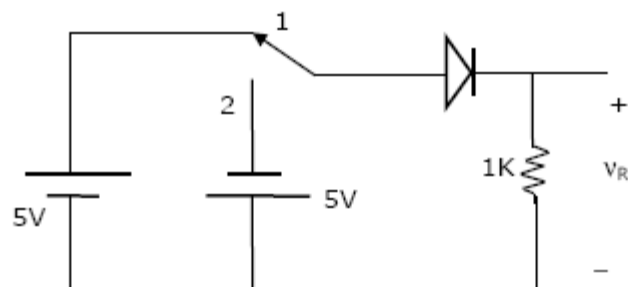
For an initial current of $i(0) = \frac{V_0}{R}$, the steady state value of the current is given by

- (A) $i(t) \rightarrow \frac{V_0}{R}$
- (B) $i(t) \rightarrow \frac{2V_0}{R}$
- (C) $i(t) \rightarrow \frac{V_0}{R} (1 + B)$
- (D) $i(t) \rightarrow \frac{2V_0}{R} (1 + B)$

For the R-L circuit shown in Fig.Q.5, the input voltage $v_i(t) = u(t)$. The current $i(t)$ is

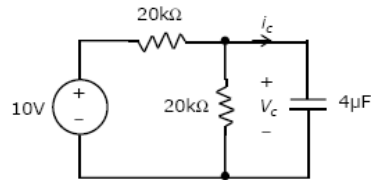


In the circuit shown below, the switch was connected to position 1 at $t < 0$ and at $t = 0$, it is changed to position 2. Assume that the diode has zero voltage drop and a storage time t_s . For $0 < t \leq t_s$, v_R is given by (all in Volts)



- (A) $v_R = -5$
- (B) $v_R = +5$
- (C) $0 \leq v_R < 5$
- (D) $-5 < v_R < 0$

In the circuit shown, V_C is 0 volts at $t = 0$ sec. For $t > 0$, the capacitor current $i_C(t)$, where t is in seconds, is given by

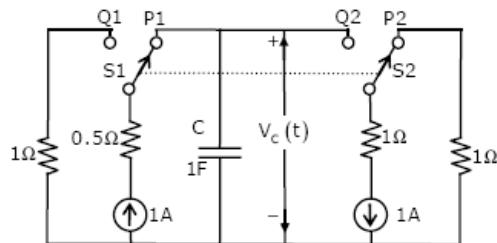


- (A) $0.50 \exp(-25t)$ mA (B) $0.25 \exp(-25t)$ mA
(C) $0.50 \exp(-12.5t)$ mA (D) $0.25 \exp(-6.25t)$ mA

The circuit shown in the figure is used to charge the capacitor C alternately from two current sources as indicated. The switches S1 and S2 are mechanically coupled and connected as follows

For $2nT \leq t < (2n+1)T$, $(n = 0, 1, 2, \dots)$ S1 to P1 and S2 to P2

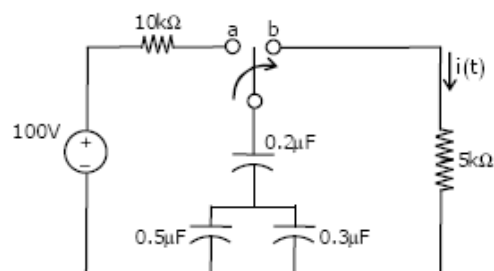
For $(2n+1)T \leq t < (2n+2)T$, ($n = 0, 1, 2, \dots$) S1 to Q1 and S2 to Q2



Assume that the capacitor has zero initial charge. Given that $u(t)$ is a unit step function, the voltage $V_c(t)$ across the capacitor is given by

- (A) $\sum_{n=0}^{\infty} (-1)^n t u(t - nT)$ (B) $u(t) + 2 \sum_{n=0}^{\infty} (-1)^n u(t - nT)$
(C) $t u(t) + 2 \sum_{n=0}^{\infty} (-1)^n (t - nT) u(t - nT)$ (D) $\sum_{n=0}^{\infty} \left[0.5 - e^{-(t-2nT)} + 0.5e^{-(t-2nT-T)} \right]$

The switch in the circuit shown was on position a for a long time, and is moved to position b at time $t=0$. The current $i(t)$ for $t>0$ is given by



- (A) $0.2e^{-125t}u(t)$ mA (B) $20e^{-1250t}u(t)$ mA
(C) $0.2e^{-1250t}u(t)$ mA (D) $20e^{-1000t}u(t)$ mA

Laplace Transform

[1993]

If $\tau F(s) = [f(t)] = \frac{K}{(s+1)(s^2+4)}$ then $\lim_{t \rightarrow \infty} f(t)$ is given by

- (a) $\frac{K}{4}$ (b) zero (c) $0 < A < 12$ (d) $5 < A < 12$

[1995]

If $L[f(t)] = \frac{2(s+1)}{s^2+2s+5}$, then $f(0+)$ and $f(\infty)$ are given by

- (a) 0, 2 respectively (b) 2, 0 respectively
(c) 0, 1 respectively (d) $\frac{2}{5}$, 0 respectively

Note: 'L' stands for 'Laplace Transform' of]

$$V_0(s) = \frac{A}{s^2+1} \coth(\alpha s)$$

Where α is a constant. Determine the value of α .

GATE Forum

[1996]

The inverse Laplace transform of the function $\frac{s+5}{(s+1)(s+3)}$ is

- (a) $2e^{-t} - e^{-3t}$ (b) $2e^{-t} + e^{-3t}$ (c) $e^{-t} - 2e^{-3t}$ (d) $e^{-t} + e^{-3t}$

[1998]

If $f(t) = \frac{\omega}{s^2 + \omega^2}$, then the value of $\lim_{t \rightarrow \infty} f(t)$

- (a) cannot be determined (b) is zero
(c) is unity (d) is infinite

[2000]

Given that $L[f(t)] = \frac{s+2}{s^2+1}$, $L[f(t)] = \frac{s^2+1}{(s+3)(s+2)}$, $h(t) = \int_0^t f(\tau)g(t-\tau)d\tau$.

$L[h(t)]$ is

- (a) $\frac{s^2+1}{s+3}$ (b) $\frac{1}{s+3}$
(c) $\frac{s^2+1}{(s+3)(s+2)} + \frac{s+2}{s^2+1}$ (d) None of the above

Solving Network in s-domain

[1991]

The voltage across an impedance in a network is $V(s) = z(s)I(s)$, where $V(s)$, $Z(s)$ are the Laplace transforms of the corresponding time function $v(t)$, $z(t)$ and $i(t)$. The voltage $v(t)$ is:

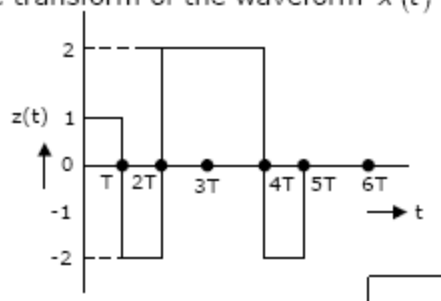
(a) $v(t) = z(t) \cdot i(t)$

(c) $v(t) = \int_0^1 i(t) \cdot z(t + \tau) d\tau$

(b) $v(t) = \int_0^1 i(t) \cdot z(t - \tau) d\tau$

(d) $v(t) = z(t) + i(t)$

Find the Laplace transform of the waveform $x(t)$ shown in figure.



[1992]

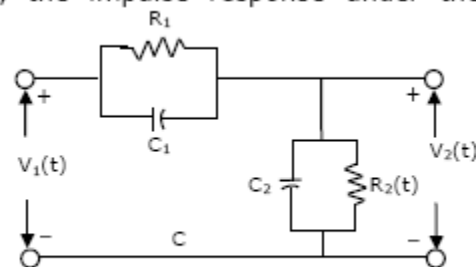
For the compensated attenuator of figure, the impulse response under the condition $R_1 C_1 = R_2 C_2$ is:

(a) $\frac{R_2}{R_1 + R_2} \left[1 - e^{-\frac{t}{R_1 C_1}} \right] u(t)$

(b) $\frac{R_2}{R_1 + R_2} \delta(t)$

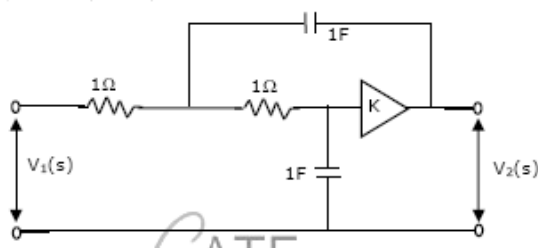
(c) $\frac{R_2}{R_1 + R_2} u(t)$

(d) $\frac{R_2}{R_1 + R_2} 1 - e^{-\frac{t}{R_1 C_1}} u(t)$



Assuming that the amplifier shown in the figure below, is a voltage controlled voltage source, show that the voltage transfer function of the network is given by

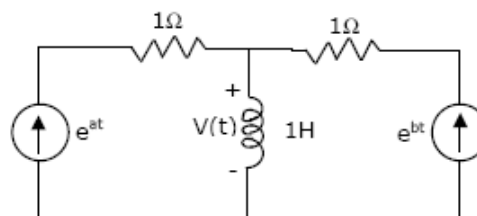
$$T(s) = \frac{V_2(s)}{V_1(s)} = \frac{K}{2 + (3 - K)s + 1}$$



[2000]

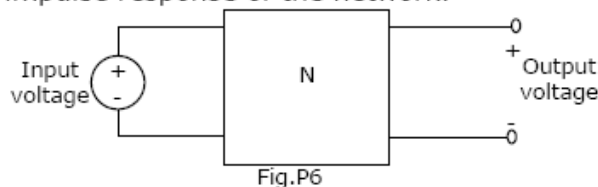
In the circuit of Fig.P.11, the voltage $v(t)$ is

- (a) $e^{at} - e^{bt}$ (b) $e^{at} + e^{bt}$
 (c) $ae^{at} - be^{bt}$ (d) $ae^{at} + be^{bt}$



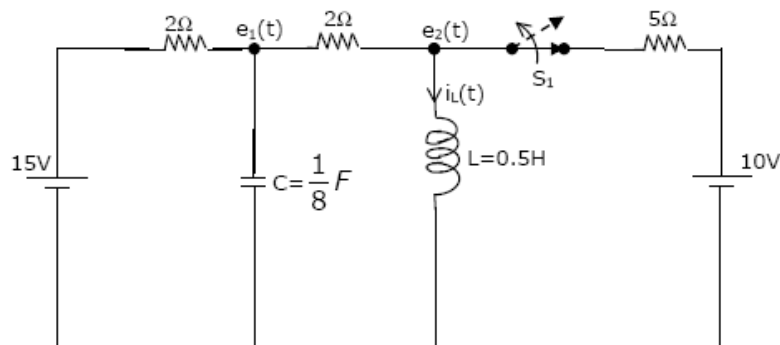
The network N in Fig.P6 consists only of two elements: a resistor of 1Ω and an inductor of L Henry. A 5 V source is connected at the input at $t = 0$ seconds. The inductor current is zero at $t = 0$. The output voltage is found to be $5e^{-3t}\text{V}$, for

- (a) Find the voltage transfer function of the network.
 (b) Find L , and draw the configuration of the network.
 (c) Find the impulse response of the network.



The circuit shown in Figure 4 is operating in steady-state with switch S_1 closed. The switch S_1 is opened at $t = 0$.

- (a) Find $i_L(0^+)$.
 (b) Find $e_1(0^+)$.
 (c) Using nodal equations and Laplace transform approach, find an expression for the voltage across the capacitor for all $t > 0$.

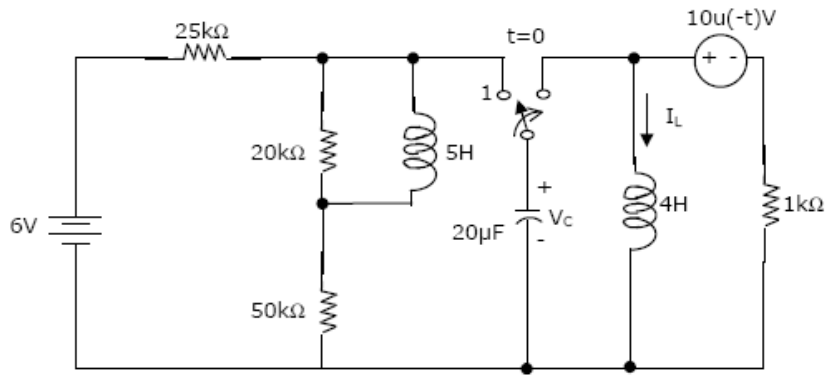


A system described by the following differential equation

$\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = x(t)$ is initially at rest. For input $x(t) = 2u(t)$, the output $y(t)$ is

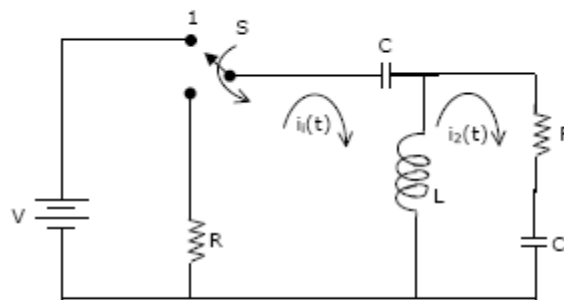
- (a) $(1 - 2e^{-t} + e^{-2t})u(t)$ (b) $(1 + 2e^{-t} - e^{-2t})u(t)$
 (c) $(0.5 + e^{-t} + 1.5e^{-2t})u(t)$ (d) $(0.5 + 2e^{-t} + 2e^{-2t})u(t)$

The switch in Figure 3 has been in position 1 for a long time and is then moved to position 2 at $t = 0$.



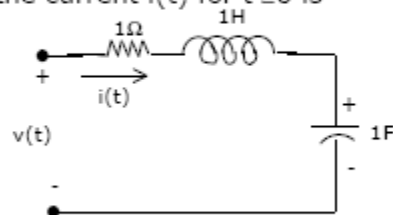
- (a) Determine $V_C(0^+)$ and $I_L(0^+)$ (b) Determine $\frac{dV_C(t)}{dt}$ at $t = 0^+$
 (c) Determine $V_C(t)$ for $t > 0$

The circuit for **Q.33-34** is given in figure. For both the questions, assume that the switch S is in position 1 for a long time and thrown to position 2 at $t = 0$.



33. At $t = 0^+$, the current i_1 is
 (a) $\frac{-V}{2R}$ (b) $\frac{-V}{R}$ (c) $\frac{-V}{4R}$ (d) zero

The circuit shown in Fig.Q.32 has initial current $i_L(0^-) = 1A$ through the inductor and an initial voltage $V_C(0^-) = -1V$ across the capacitor. For input $v(t) = u(t)$, the Laplace transform of the current $i(t)$ for $t \geq 0$ is



- (a) $\frac{s}{s^2 + s + 1}$ (b) $\frac{s + 2}{s^2 + s + 1}$ (c) $\frac{s - 2}{s^2 + s + 1}$ (d) $\frac{s - 2}{s^2 + s - 1}$

$I_1(s)$ and $I_2(s)$ are the Laplace transforms of $i_1(t)$ and $i_2(t)$ respectively. The equations for the loop currents $I_1(s)$ and $I_2(s)$ for the circuit shown in figure Q.33-34, after the switch is brought from position 1 to position 2 at $t = 0$, are

(a)
$$\begin{bmatrix} R + Ls + \frac{1}{Cs} & -Ls \\ -Ls & R + \frac{1}{Cs} \end{bmatrix} \begin{bmatrix} I_1(s) \\ I_2(s) \end{bmatrix} = \begin{bmatrix} \frac{V}{s} \\ 0 \end{bmatrix}$$

(b)
$$\begin{bmatrix} R + Ls + \frac{1}{Cs} & -Ls \\ -Ls & R + \frac{1}{Cs} \end{bmatrix} \begin{bmatrix} I_1(s) \\ I_2(s) \end{bmatrix} = \begin{bmatrix} -\frac{V}{s} \\ 0 \end{bmatrix}$$

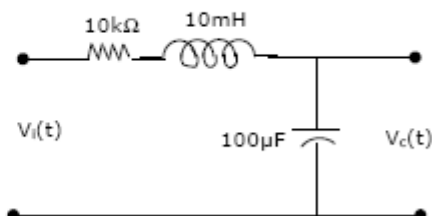
(c)
$$\begin{bmatrix} R + Ls + \frac{1}{Cs} & -Ls \\ -Ls & R + Ls + \frac{1}{Cs} \end{bmatrix} \begin{bmatrix} I_1(s) \\ I_2(s) \end{bmatrix} = \begin{bmatrix} \frac{V}{s} \\ 0 \end{bmatrix}$$

(d)
$$\begin{bmatrix} R + Ls + \frac{1}{Cs} & -Ls \\ -Ls & R + Ls + \frac{1}{Cs} \end{bmatrix} \begin{bmatrix} I_1(s) \\ I_2(s) \end{bmatrix} = \begin{bmatrix} -\frac{V}{s} \\ 0 \end{bmatrix}$$

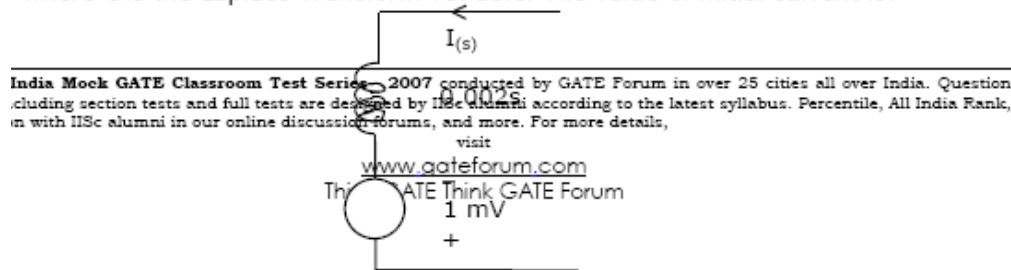
For the circuit shown in Fig.Q.35, the initial conditions are zero. Its transfer function $H(s) = \frac{V_c(s)}{V_i(s)}$ is

(a) $\frac{1}{s^2 + 10^6 s + 10^6}$ (b) $\frac{10^6}{s^2 + 10^3 s + 10^6}$

(c) $\frac{10^3}{s^2 + 10^3 s + 10^6}$ (d) $\frac{10^6}{s^2 + 10^6 s + 10^6}$

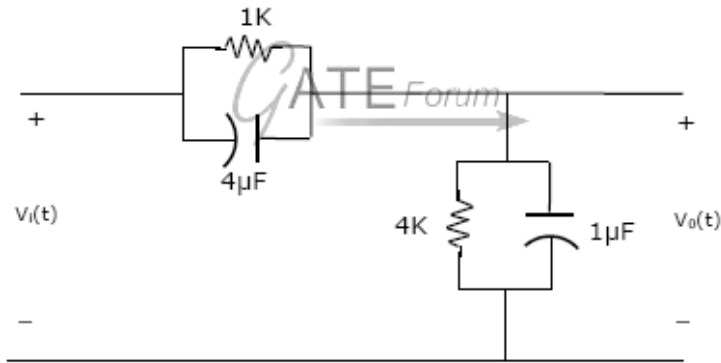


A 2mH inductor with some initial current can be represented as shown below, where s is the Laplace Transform variable. The value of initial current is:



- (A) 0.5 A
- (B) 2.0 A
- (C) 1.0 A
- (D) 0.0 A

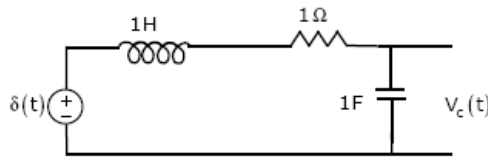
In the figure shown below, assume that all the capacitors are initially uncharged. If $v_i(t) = 10u(t)$ Volts, $v_o(t)$ is given by



- (A) $8e^{-0.004t}$ Volts
- (B) $8(1 - e^{-0.004t})$ Volts
- (C) $8u(t)$ Volts
- (D) 8 Volts

Common Data Questions 74 & 75

The following series RLC circuit with zero initial conditions is excited by a unit impulse function $\delta(t)$



74. For $t > 0$, the output voltage $V_c(t)$ is

- | | |
|---|---|
| (A) $\frac{2}{\sqrt{3}} \left(e^{-\frac{1}{2}t} - e^{\frac{\sqrt{3}}{2}t} \right)$ | (B) $\frac{2}{\sqrt{3}} t e^{-\frac{1}{2}t}$ |
| (C) $\frac{2}{\sqrt{3}} e^{-\frac{1}{2}t} \cos\left(\frac{\sqrt{3}}{2}t\right)$ | (D) $\frac{2}{\sqrt{3}} e^{-\frac{1}{2}t} \sin\left(\frac{\sqrt{3}}{2}t\right)$ |

75. For $t > 0$, the voltage across the resistor is

- | | |
|--|---|
| (A) $\frac{1}{\sqrt{3}} \left(e^{-\frac{\sqrt{3}}{2}t} - e^{-\frac{1}{2}t} \right)$ | (B) $e^{-\frac{1}{2}t} \left[\cos\left(\frac{\sqrt{3}t}{2}\right) - \frac{1}{\sqrt{3}} \sin\left(\frac{\sqrt{3}t}{2}\right) \right]$ |
| (C) $\frac{2}{\sqrt{3}} e^{-\frac{1}{2}t} \sin\left(\frac{\sqrt{3}t}{2}\right)$ | (D) $\frac{2}{\sqrt{3}} e^{-\frac{1}{2}t} \cos\left(\frac{\sqrt{3}t}{2}\right)$ |

Frequency-domain analysis

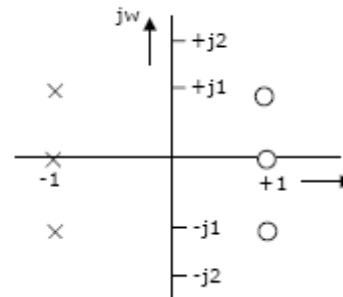
[1991]

In a series RLC high Q circuit, the current peaks at a frequency

- (a) equal to the resonant frequency
- (b) greater than the resonant frequency
- (c) less than the resonant frequency
- (d) none of the above

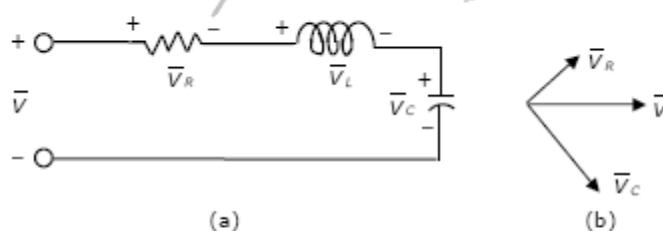
The pole-zero pattern of a certain filter is shown in the figure below. The filter must be of the following type.

- (a) low pass
- (b) high pass
- (c) all pass
- (d) band pass



[1992]

For the series R-L circuit of figure (a), the phasor diagram at a certain frequency is shown in figure (b). The operating frequency of the circuit is:



- (a) equal to the resonance frequency
- (b) less than the resonance frequency
- (c) greater than resonance frequency
- (d) not zero

[1993]

If $s^3 + 3s^2 + 4s + A = 0$, then all the roots of this equation are in the left half plane provided that

- (a) $A > 12$
- (b) $-3 < A < 4$
- (c) $0 < A < 12$
- (d) $5 < A < 12$

[1994]

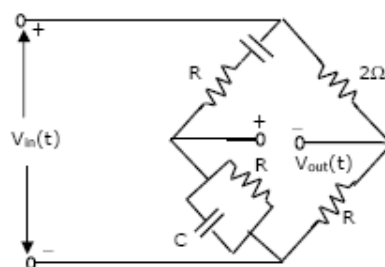
The response of an LCR circuit to a step input is

- (a) over damped
- (b) critically damped
- (c) oscillatory

If the transfer function has

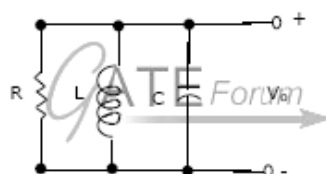
- (1) poles on the negative real axis
- (2) poles on the imaginary axis
- (3) multiple poles on the positive real axis
- (4) poles on the positive real axis
- (5) multiple poles on the negative real axis

Calculate the frequency at which zero-transmission is obtained from the Wien bridge shown in the figure below.



A series R-L-C circuit has a Q of 100 and an impedance of $(100 + j0)\Omega$ at its resonant angular frequency of 10^7 radian/sec. The values of R and L are: R = _____ ohms, L = _____ ohms.

In the circuit of Fig.10, $R=100\Omega$, $L = 20\text{nH}$ and $C = 32\text{ pF}$.



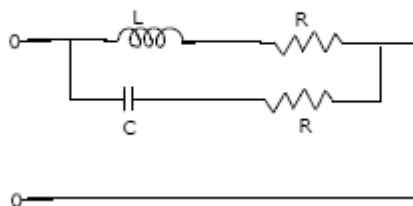
The circuit is maintained at a temperature of 300K. Derive and plot the power spectral density of the voltage V_o . Mark all the relevant points on the plot with numerical values. (The Boltzmann constant $k = 1.28 \times 10^{-23} \text{ J/K}$)

[1998]

A high Q-quartz crystal exhibits series resonance at the frequency ω_s and parallel resonance at the frequency ω_p . Then

- (a) ω_s is very close to, but less than ω_p .
- (b) $\omega_s \ll \omega_p$.
- (c) ω_s is very close to, but greater than ω_p .
- (d) $\omega_s \gg \omega_p$.

Determine the frequency of resonance and the resonant impedance of the parallel circuit shown in Fig.3. What happens when $L = CR^2$?

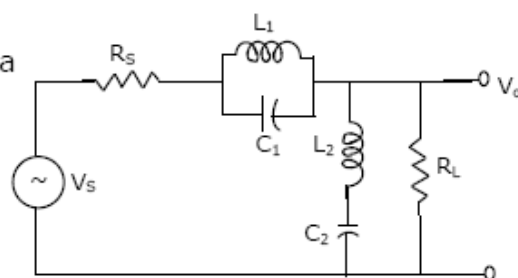


A coil with a quality factor (Q) of 10 is put in series with a capacitor C_1 of $10\ \mu\text{F}$, and the combination is found to draw maximum current when a sinusoidal voltage of frequency 50 Hz is applied. A second capacitor C_2 is now in parallel with the circuit. What should be the capacitance of C_2 for combined circuit to act purely as a resistance for a sinusoidal excitation at a frequency of 100Hz? Calculate the rms current drawn by the combined circuit at 100 Hz if the applied voltage is 100 V (rms).

[2000]

The circuit of Fig.P1.25 represents a

- (a) low pass filter
- (b) high pass filter
- (c) band pass filter
- (d) band reject filter



[2003]

A series RLC circuit has a resonance frequency of 1 kHz and a quality factor $Q = 100$. If each R , L and C is doubled from its original value, the new Q of the circuit is

- (a) 25
- (b) 50
- (c) 100
- (d) 200

[2004]

The transfer function $H(s) = \frac{V_o(s)}{V_i(s)}$ of an R-L-C circuit is given by

$$H(s) = \frac{10^6}{s^2 + 20s + 10^6}$$

the Quality factor (Q -factor) of this circuit is

- (a) 25
- (b) 50
- (c) 100
- (d) 5000

Consider the following statements S_1 and S_2

S_1 : At the resonant frequency the impedance of a series R-L-C circuit is zero.

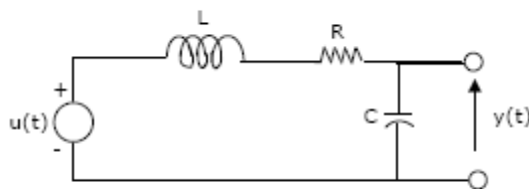
S_2 : In a parallel G-L-C circuit, increasing the conductance G results in increase in its Q factor.

Which one of the following is correct?

- (a) S_1 is FALSE and S_2 is TRUE (b) both S_1 and S_2 are TRUE
 (c) S_1 is TRUE and S_2 is FALSE (d) both S_1 and S_2 are FALSE

[2005]

The condition on R, L and C such that the step response $y(t)$ in figure has no oscillations, is



- (a) $R \geq \frac{1}{2} \sqrt{\frac{L}{C}}$ (b) $R \geq \sqrt{\frac{L}{C}}$ (c) $R \geq 2\sqrt{\frac{L}{C}}$ (d) $R = \frac{1}{\sqrt{LC}}$

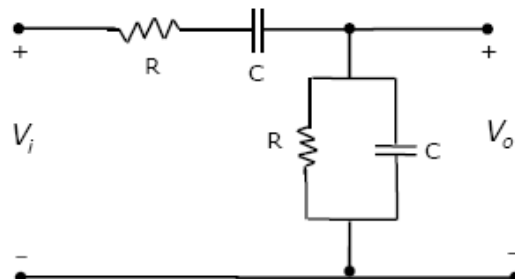
In a series RLC circuit $R = 2k\Omega$, $L=1H$, and $C = \frac{1}{400} \mu F$. The resonant frequency is

- (a) $2 \times 10^4 Hz$ (b) $\frac{1}{\pi} \times 10^4 Hz$ (c) $10^4 Hz$ (d) $2\pi \times 10^4 Hz$

The first and the last critical frequency of an RC-driving point impedance function must respectively be

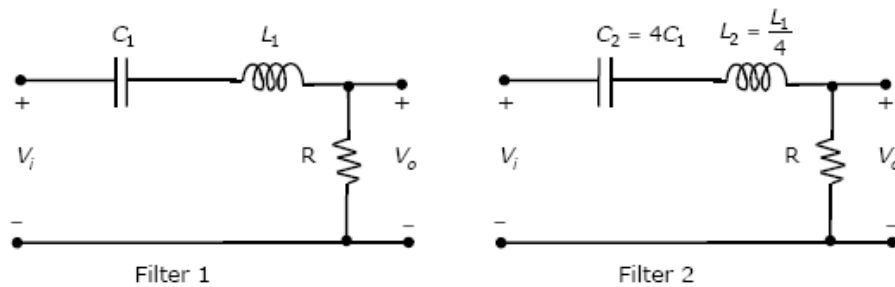
- (a) a zero and a pole (b) a zero and a zero
 (c) a pole and a pole (d) a pole and a zero

The RC circuit shown in the figure is



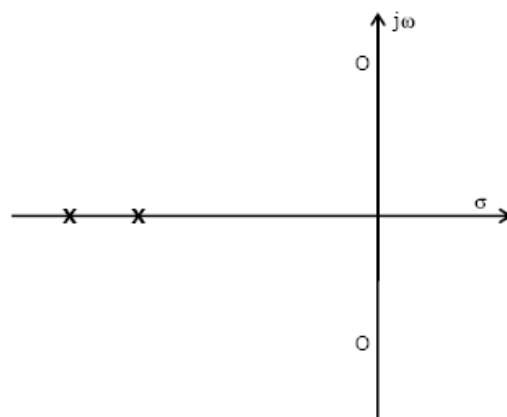
- (A) a low-pass filter (B) a high-pass filter
 (C) a band-pass filter (D) a band-reject filter

Two series resonant filters are as shown in the figure. Let the 3-dB bandwidth of Filter 1 be B_1 and that of Filter 2 be B_2 . The value of $\frac{B_1}{B_2}$ is:



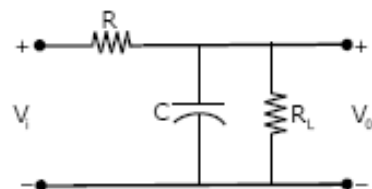
- (A) 4 (B) 1 (C) $\frac{1}{2}$ (D) $\frac{1}{4}$

The pole-zero plot given below corresponds to a



- (A) Low pass filter (B) High pass filter (C) Band pass filter (D) Notch filter

If the transfer function of the following network is $\frac{V_o(s)}{V_i(s)} = \frac{1}{2 + sCR}$



The value of the load resistance R_L is

- (A) $R/4$ (B) $R/2$ (C) R (D) $2R$

Steady-State Analysis

[1994]

A series LCR circuit consisting of $R = 10\Omega$, $|X_L| = 20\Omega$ and $|X_C| = 20\Omega$, is connected across an a.c. supply of 200V rms. The rms voltage across the capacitor is:

- (a) $200\angle -90^\circ V$ (b) $200\angle +90^\circ V$ (c) $400\angle -90^\circ V$ (d) $400\angle +90^\circ V$

[1995]

The RMS value of a rectangular wave of period T , having a value of $+V$ for a duration, $T_1 (< T)$ and $-V$ for the duration, $T - T_1 = T_2$, equals

- (a) V (b) $\frac{T_1 - T_2}{T} V$ (c) $\frac{V}{\sqrt{2}}$ (d) $\frac{T_1}{T_2} V$

The current, $i(t)$, through a 10Ω resistor in series with an inductance, is given by

$$i(t) = 3 + 4 \sin(100t + 45^\circ) + 4 \sin(300t + 60^\circ) \text{ Amperes}$$

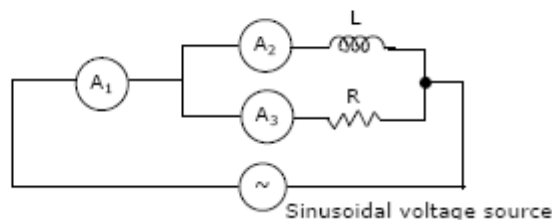
The RMS value of the current and the power dissipated in the circuit are:

- (a) $\sqrt{41}A$, 410 W, respectively (b) $\sqrt{35}A$, 350 W, respectively
(c) 5A, 250 W, respectively (d) 11A, 1210 W, respectively

[1996]

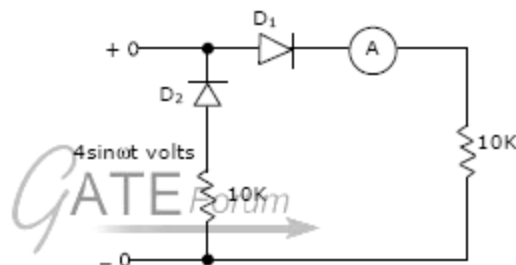
In Fig.1.1, A_1 , A_2 and A_3 are ideal ammeters? If A_2 and A_3 read 3A and 4A respectively, then A_1 should read

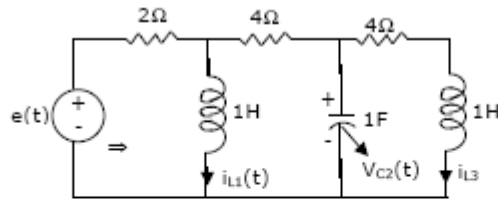
- (a) 1A
(b) 5A
(c) 7A
(d) None of the above



In the circuit of Fig.1.2, assume that the diodes are ideal and the meter is an average indicating ammeter. The ammeter will read

- (a) $0.4\sqrt{2}A$
(b) 0.4A
(c) $\frac{0.8}{\pi}A$
(d) $\frac{0.4}{\pi}$





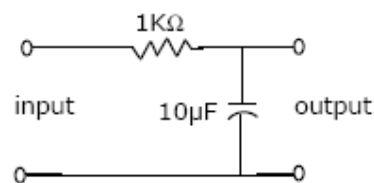
In the circuit of Fig.23, all currents and voltages are sinusoids of frequency ω rad/sec.

- Find the impedance to the right of (A,B) at $\omega = 0$ rad/sec and $\omega = \infty$ rad/sec.
- If $\omega = \omega_0$ rad/sec and $i_1(t) = I \sin(\omega_0 t) A$, where I is positive $\omega_0 \neq 0, \omega_0 \neq \infty$ then find I, ω_0 and $i_2(t)$

[2000]

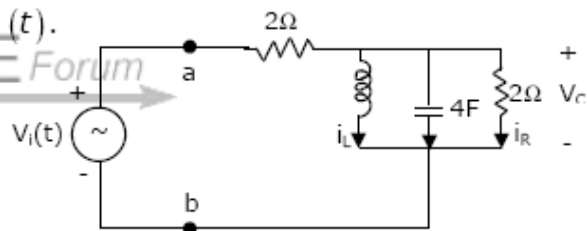
In Fig.P2.14, the steady state output voltage corresponding to the input voltage $3 + 4 \sin 100t$ V is

- $3 + \frac{4}{\sqrt{2}} \sin\left(100t - \frac{\pi}{4}\right) V$
- $3 + 4\sqrt{2} \sin\left(100t - \frac{\pi}{4}\right) V$
- $\frac{3}{2} + \frac{4}{\sqrt{2}} \sin\left(100t + \frac{\pi}{4}\right) V$
- $3 + 4 \sin\left(100t + \frac{\pi}{4}\right) V$



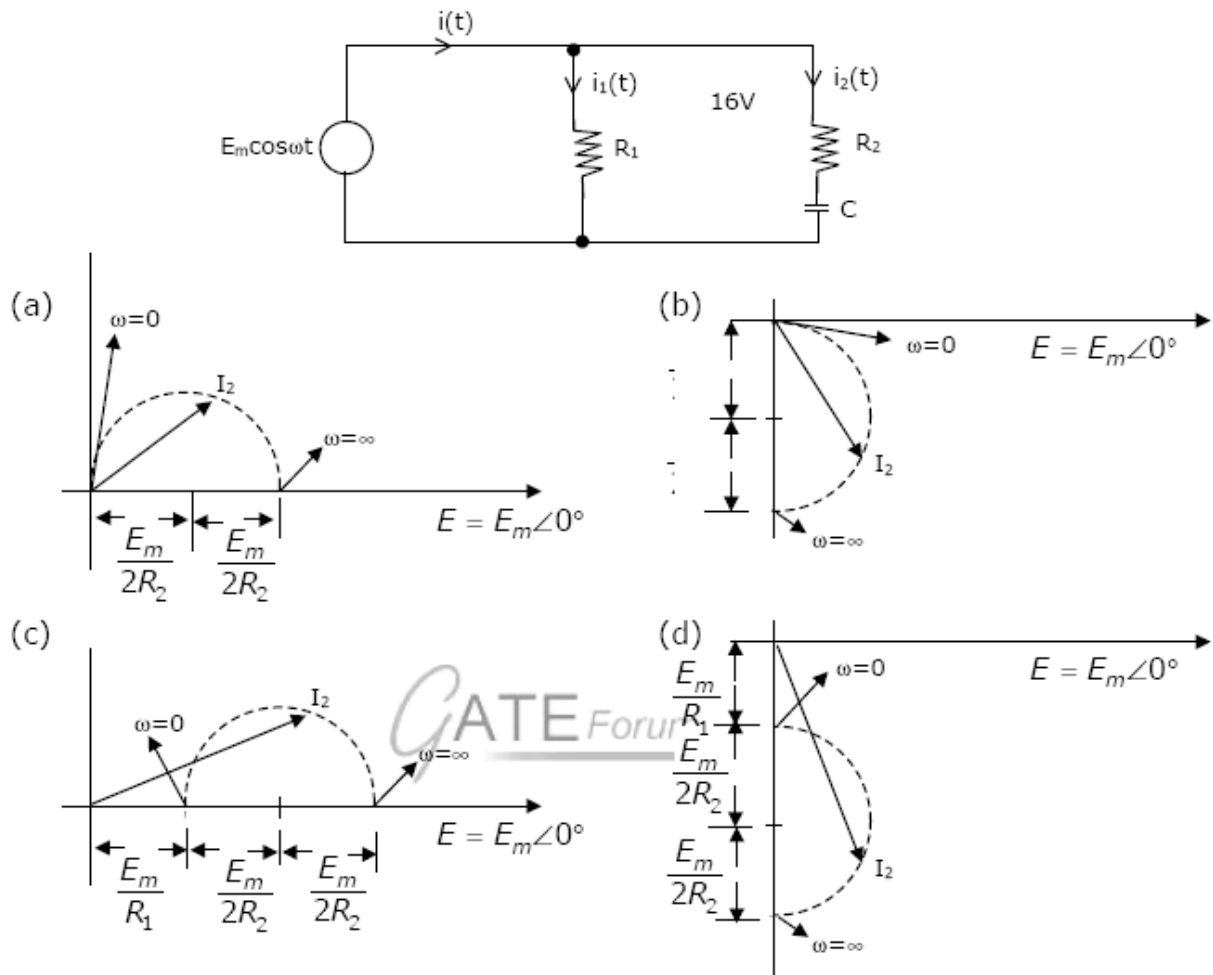
For the circuit in Fig.P4, which is in steady state

- Find the frequency ω_0 at which the magnitude of the impedance across terminals a, b reaches a maximum.
- Find the impedance across a, b at the frequency ω_0
- If $v_s(t) = V \sin(\omega_0 t)$, find $i_L(t), i_R(t)$.

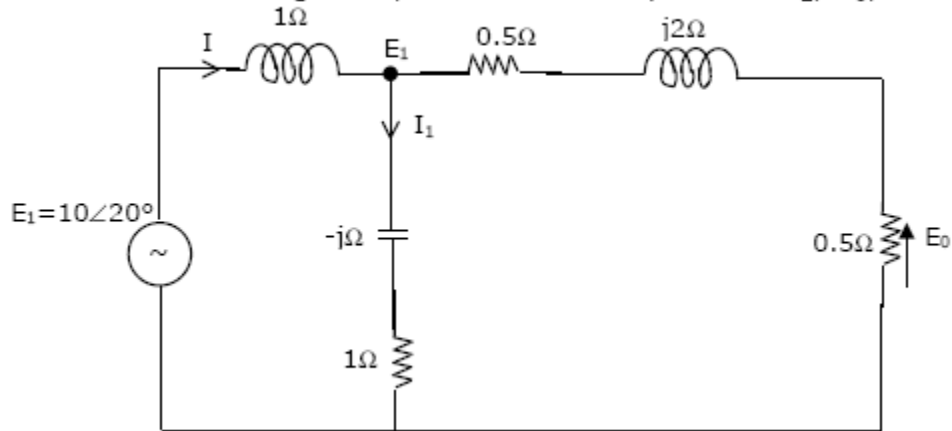


[2001]

When the angular frequency ω in Figure 2.3 is varied from 0 to ∞ , the locus of the current phasor I_2 is given by



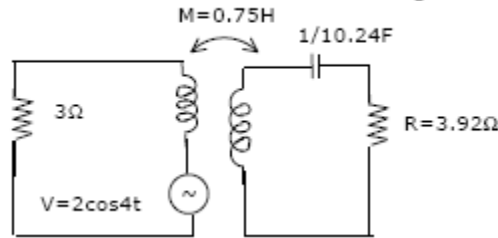
For the circuit shown in figure 3, determine the phasors E_2 , E_0 , I and I_1 .



[2003]

The current flowing through the resistance R in the circuit in figure has the form $P \cos 4t$, where P is

- (a) $(0.18 + j0.72)$
- (b) $(0.46 + j1.90)$
- (c) $-(0.18 + j1.90)$
- (d) $-(0.192 + j0.144)$

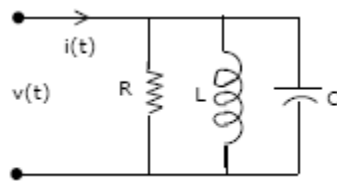


An input voltage $v(t) = 10\sqrt{2} \cos(t + 10^\circ) + 10\sqrt{3} \cos(2t + 10^\circ)V$ is applied to a series combination of resistance $R = 1\Omega$ and an inductance $L = 1H$. The resulting steady state current $i(t)$ in ampere is

- (a) $10 \cos(t + 55^\circ) + 10 \cos(2t + 10^\circ + \tan^{-1} 2)$
- (b) $10 \cos(t + 55^\circ) + 10\sqrt{\frac{3}{2}} \cos(2t + 55^\circ)$
- (c) $10 \cos(t - 35^\circ) + 10 \cos(2t + 10^\circ - \tan^{-1} 2)$
- (d) $10 \cos(t - 35^\circ) + 10\sqrt{\frac{3}{2}} \cos(2t - 35^\circ)$

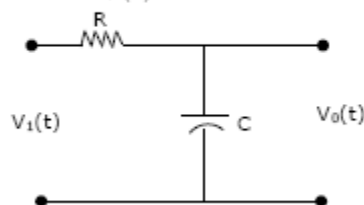
The circuit shown in Fig.Q.3, with $R = \frac{1}{3}\Omega, L = \frac{1}{4}H, C = 3F$ has input voltage $v(t) = \sin 2t$. The resulting current $i(t)$ is

- (a) $5 \sin(2t + 53.1^\circ)$
- (b) $5 \sin(2t - 53.1^\circ)$
- (c) $25 \sin(2t + 53.1^\circ)$
- (d) $25 \sin(2t - 53.1^\circ)$

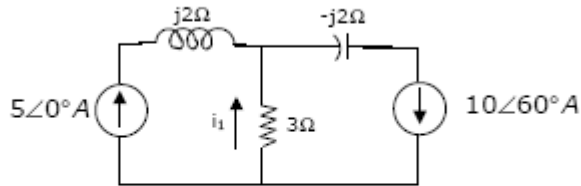


For the circuit shown in Fig.Q.4, the time constant $RC = 1\text{ms}$. The input voltage is $v_i(t) = \sqrt{2} \sin 10^3 t$. The output voltage $v_o(t)$ is equal to

- (a) $\sin(10^3 t - 45^\circ)$
- (b) $\sin(10^3 t + 45^\circ)$
- (c) $\sin(10^3 t - 53^\circ)$
- (d) $\sin(10^3 t + 53^\circ)$

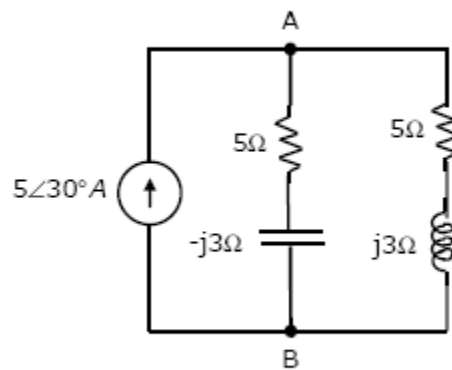


For the circuit in figure the instantaneous current $i_1(t)$ is



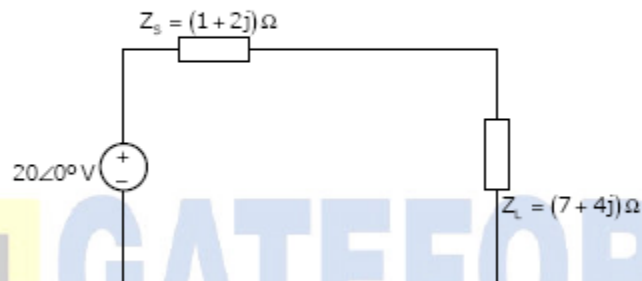
- (a) $\frac{10\sqrt{3}}{2} \angle 90^\circ \text{Amps}$ (b) $\frac{10\sqrt{3}}{2} \angle -90^\circ \text{Amps}$
 (c) $5 \angle 60^\circ \text{Amps}$ (d) $5 \angle -60^\circ \text{Amps}$

In the AC network shown in the figure, the phasor voltage V_{AB} (in Volts) is:



- (A) 0 (B) $5 \angle 30^\circ$ (C) $12.5 \angle 30^\circ$ (D) $17 \angle 30^\circ$

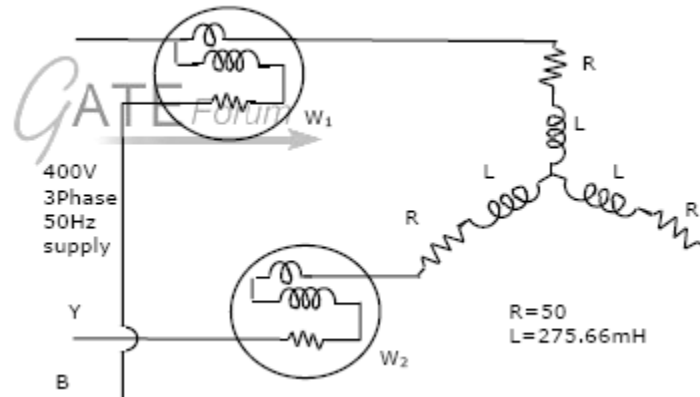
An AC source of RMS voltage 20V with internal impedance $Z_s = (1 + 2j) \Omega$ feeds a load of impedance $Z_L = (7 + 4j) \Omega$ in the figure below. The reactive power consumed by the load is



- (A) 8VAR (B) 16VAR (C) 28VAR (D) 32VAR

[1993]

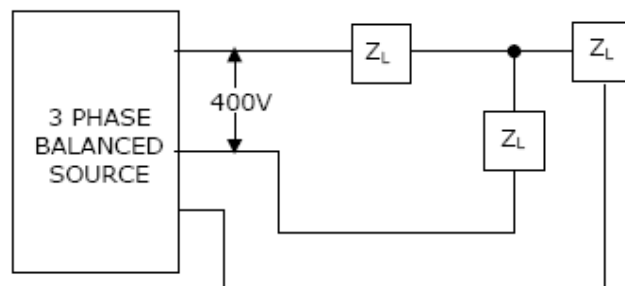
For the circuit shown in figure, determine the readings of the two wattmeters. Phase sequence is RYB.



[2002]

If the 3-phase balanced source in Figure 2.2 delivers 1500 W at a leading power factor of 0.844, then the value of Z_L (in ohm) is approximately

- (a) $90 \angle 32.44^\circ$
- (b) $80 \angle 32.44^\circ$
- (c) $80 \angle -32.44^\circ$
- (d) $90 \angle -32.44^\circ$



[1993]

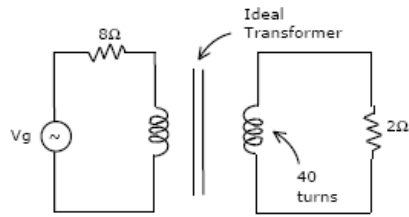
Two 500 kVA alternators operate in parallel to supply the following loads:

- (i) 250 KW at 0.95 p.f. lagging
- (ii) 100 KW at 0.85 p.f. leading

One machine is supplying 200 KW at 0.9 p.f. lagging. Calculate the p.f. of the other machine.

Mutual Inductance

If the secondary winding of the ideal transformer shown in the circuit of the figure has 40 turns, the number of turns in the primary winding for maximum power transfer to the 2Ω resistor will be



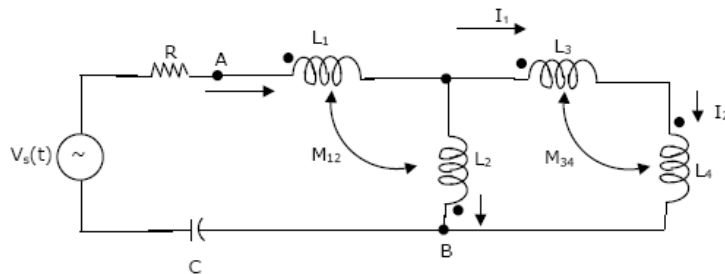
- (a) 20 (b) 40 (c) 80 (d) 160

Two 2H inductance coils are connected in series and are also magnetically coupled to each other the coefficient of coupling being 0.1. The total inductance of the combination can be

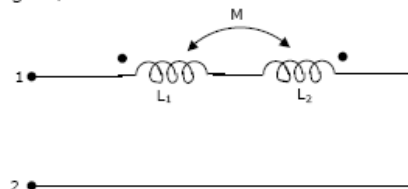
- (a) 0.4 H (b) 3.2 H (c) 4.0 H (d) 3.3 H

For the network shown in Figure 4, $R = 1\text{ K}\Omega$, $L_1 = 2\text{H}$, $L_2 = 5\text{H}$, $L_3 = 1\text{H}$, $L_4 = 4\text{H}$ and $C = 0.2\text{ }\mu\text{F}$. The mutual inductances are $M_{12} = 3\text{H}$ and $M_{34} = 2\text{H}$. Determine

- (a) the equivalent inductance for the combination of L_3 and L_4 .
 (b) the equivalent inductance across the points A and B in the network.
 (c) the resonant frequency of the network.



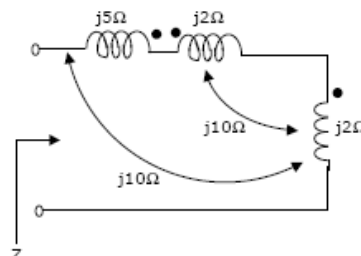
The equivalent inductance measured between the terminals 1 and 2 for the circuit shown in figure, is



- (a) $L_1 + L_2 + M$ (b) $L_1 + L_2 - M$ (c) $L_1 + L_2 + 2M$ (d) $L_1 + L_2 - 2M$

Impedance Z as shown in figure is:

- (a) $j29\Omega$
 (b) $j9\Omega$
 (c) $j19\Omega$
 (d) $j39\Omega$



Two-port Network

[1991]

Two two-port networks are connected in cascade. The combination is to be represented as a single two-port network. The parameters of the network are obtained by multiplying the individual

- (a) z-parameter matrix
- (b) h-parameter matrix
- (c) y-parameter matrix
- (d) ABCD parameter matrix

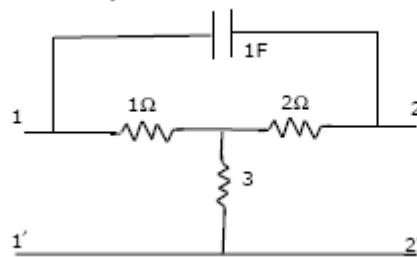
[1992]

For a 2-port network to be reciprocal

- (a) $z_{11} = z_{22}$
- (b) $y_{21} = y_{12}$
- (c) $h_{21} = -h_{12}$
- (d) $AD - BC = 0$

[1993]

Find the Y-parameters (short circuit admittance parameters) for the network shown in figure.

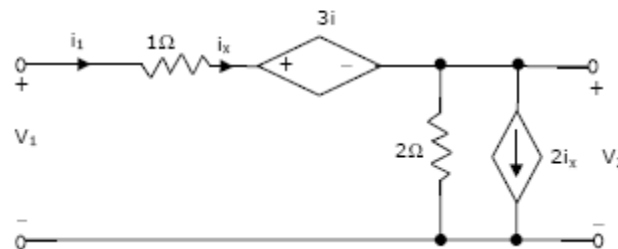


[1994]

The condition that a z-port network is reciprocal, can be expressed in terms of its ABCD parameters as _____

[1995]

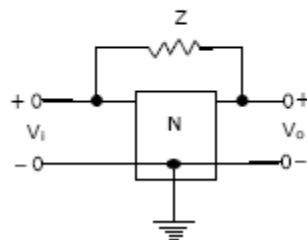
For the 2-port network shown in figure, determine the h-parameters. using these parameters, calculate the output (port '2') voltage, v_2 , when the output port is terminated in a 3Ω resistance and a 1V (DC) is applied at the input port ($V_1 = 1V$).



[1996]

In the circuit shown in Fig.2.1, N is a finite gain amplifier with a gain of k , a very large input impedance, and a very low output impedance. The input impedance of the feedback amplifier with the feedback impedance Z connected as shown will be

- (a) $Z\left(1 - \frac{1}{k}\right)$ (b) $Z(1 - k)$
 (c) $\frac{Z}{(k - 1)}$ (d) $\frac{Z}{(1 - k)}$



The open circuit impedance matrix Z_{oc} of a three-terminals two-port network with A as the input terminal, B as the output terminal and C as the common terminal, is given as

$$[Z_{oc}] = \begin{bmatrix} 2 & 5 \\ 3 & 7 \end{bmatrix}$$

Write down the short circuit admittance matrix Y_{sc} of the network viewed as a two port network, but now taking B as the input terminal, C as the common terminal and A as the common terminal.

[1998]

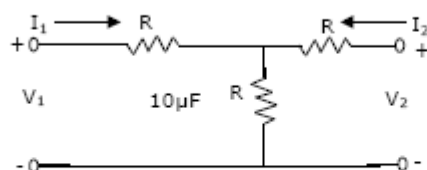
The short-circuit admittance matrix of a two-port network is $\begin{bmatrix} 0 & -\frac{1}{2} \\ \frac{1}{2} & 0 \end{bmatrix}$

The two port network is

- (a) non-reciprocal and passive (b) non-reciprocal and active
 (c) reciprocal and passive (d) reciprocal and active

[1999]

A 2-port network is shown in Fig.P1.4. the parameter h_{21} for this network can be given by

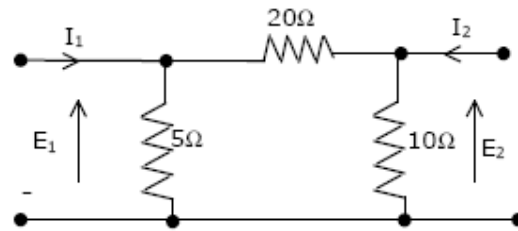


- (a) $-\frac{1}{2}$ (b) $+\frac{1}{2}$ (c) $-\frac{3}{2}$ (d) $+\frac{3}{2}$

[2001]

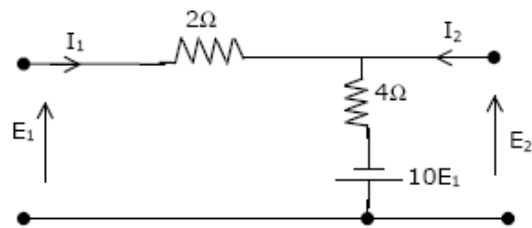
The admittance parameter Y_{12} in the 2-port network in Figure 1.4 is

- (a) -0.2 mho
- (b) 0.1 mho
- (c) -0.05 mho
- (d) 0.05 mho



The Z parameters Z_{11} and Z_{21} for the 2-port network in figure 2.4 are

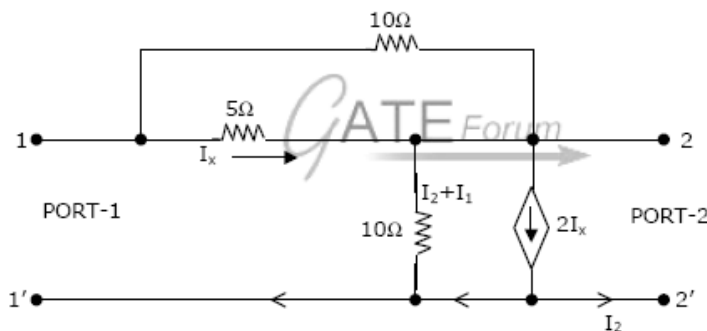
- (a) $Z_{11} = -\frac{6}{11} \Omega; Z_{21} = \infty \frac{16}{11} \Omega;$
- (b) $Z_{11} = \frac{6}{11} \Omega; Z_{21} = \frac{4}{11} \Omega;$
- (c) $Z_{11} = \frac{6}{11} \Omega; Z_{21} = -\frac{16}{11} \Omega;$
- (d) $Z_{11} = \frac{4}{11} \Omega; Z_{21} = \frac{4}{11} \Omega;$



The admittance parameters of a 2-port network shown in figure 5 are given by $Y_{11} = 2 \text{ mho}$, $Y_{12} = -0.5 \text{ mho}$, $Y_{21} = 4.8 \text{ mho}$, $Y_{22} = 1 \text{ mho}$. The output port is terminated with a load admittance $Y_L = 0.2 \text{ mho}$. Find E_2 for each of the following conditions?

- (a) $E_1 = 10 \angle 0^\circ \text{ V}$
- (b) $I_1 = 10 \angle 0^\circ \text{ A}$
- (c) A source $10 \angle 0^\circ \text{ V}$ in series with a 0.25Ω resistor is connected to the input port.

Consider the network in Figure 5.

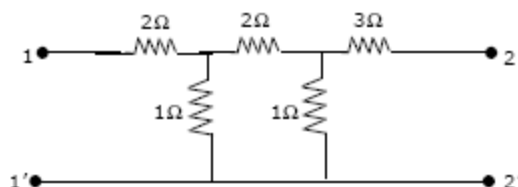


- (a) Find its short-circuit admittance parameters.
- (b) Find the open-circuit impedance Z_{22} .

[2003]

The impedance parameters Z_{11} and Z_{12} of the two-port network in figure are

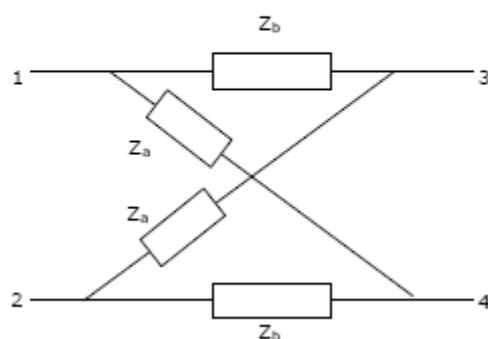
- (a) $Z_{11} = 2.75\Omega$ and $Z_{12} = 0.25\Omega$
- (b) $Z_{11} = 3\Omega$ and $Z_{12} = 0.5\Omega$
- (c) $Z_{11} = 3\Omega$ and $Z_{12} = 0.25\Omega$
- (d) $Z_{11} = 2.25\Omega$ and $Z_{12} = 0.5\Omega$



[2004]

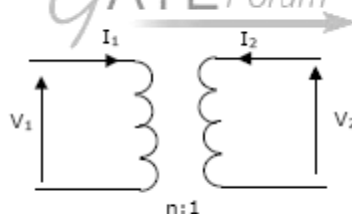
For the lattice circuit shown in Fig. Q.31, $Z_a = j2\Omega$ and $Z_b = 2\Omega$. The values of the open circuit impedance parameters $Z = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix}$ are

- (a) $\begin{bmatrix} 1-j & 1+j \\ 1+j & 1+j \end{bmatrix}$
- (b) $\begin{bmatrix} 1-j & 1+j \\ -1+j & 1-j \end{bmatrix}$
- (c) $\begin{bmatrix} 1+j & 1+j \\ 1-j & 1-j \end{bmatrix}$
- (d) $\begin{bmatrix} 1+j & -1+j \\ -1-j & 1-j \end{bmatrix}$



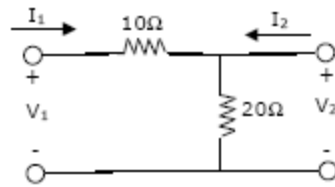
[2005]

The ABCD parameters of an ideal $n:1$ transformer shown in figure are $\begin{bmatrix} n & 0 \\ 0 & X \end{bmatrix}$. The value of X will be



- (a) n
- (b) $\frac{1}{n}$
- (c) n^2
- (d) $\frac{1}{n^2}$

The h parameters of the circuit shown in figure are



- (a) $\begin{bmatrix} 0.1 & 0.1 \\ -0.1 & 0.3 \end{bmatrix}$ (b) $\begin{bmatrix} 10 & -1 \\ 1 & 0.05 \end{bmatrix}$ (c) $\begin{bmatrix} 30 & 20 \\ 20 & 20 \end{bmatrix}$ (d) $\begin{bmatrix} 10 & 1 \\ -1 & 0.05 \end{bmatrix}$

[2006]

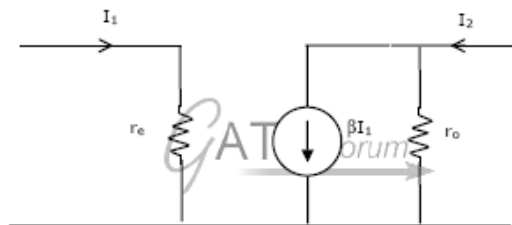
A two port network is represented by ABCD parameters given by

$$\begin{bmatrix} V_1 \\ I_1 \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_2 \\ -I_2 \end{bmatrix}$$

If port-2 is terminated by R_L , the input impedance seen at port-1 is given by

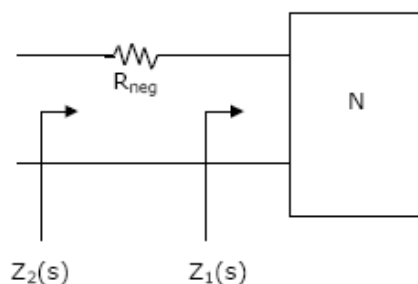
- (A) $\frac{A + BR_L}{C + DR_L}$
 (B) $\frac{AR_L + C}{BR_L + D}$
 (C) $\frac{DR_L + A}{BR_L + C}$
 (D) $\frac{B + AR_L}{D + CR_L}$

In the two port network shown in the figure below, z_{12} and z_{21} are, respectively



- (A) r_e and βr_o
 (B) 0 and $-\beta r_o$
 (C) 0 and βr_o
 (D) r_e and $-\beta r_o$

A negative resistance R_{neg} is connected to a passive network N having driving point impedance $Z_1(s)$ as shown below. For $Z_2(s)$ to be positive real,



(A) $|R_{neg}| \leq \text{Re } Z_1(j\omega), \forall \omega$

(B) $|R_{neg}| \leq |Z_1(j\omega)|, \forall \omega$

(C) $|R_{neg}| \leq \text{Im } Z_1(j\omega), \forall \omega$

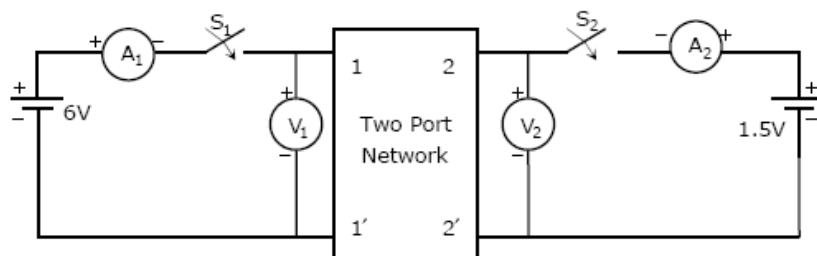
(D) $|R_{neg}| \leq \angle Z_1(j\omega), \forall \omega$

Statement for Linked Answer Questions: 76 & 77

A two-port network shown below is excited by external dc sources. The voltages and the currents are measured with voltmeters V_1 , V_2 and ammeters A_1 , A_2 (all assumed to be ideal), as indicated. Under following switch conditions, the readings obtained are:

i) S_1 - Open, S_2 - Closed $A_1 = 0\text{A}$, $V_1 = 4.5\text{V}$, $V_2 = 1.5\text{V}$, $A_2 = 1\text{A}$

ii) S_1 - Closed, S_2 - Open $A_1 = 4\text{A}$, $V_1 = 6\text{V}$, $V_2 = 6\text{V}$, $A_2 = 0\text{A}$



76. The z-parameter matrix for this network is

(A) $\begin{bmatrix} 1.5 & 1.5 \\ 4.5 & 1.5 \end{bmatrix}$ (B) $\begin{bmatrix} 1.5 & 4.5 \\ 1.5 & 4.5 \end{bmatrix}$ (C) $\begin{bmatrix} 1.5 & 4.5 \\ 1.5 & 1.5 \end{bmatrix}$ (D) $\begin{bmatrix} 4.5 & 1.5 \\ 1.5 & 4.5 \end{bmatrix}$

77. The h-parameter matrix for this network is

(A) $\begin{bmatrix} -3 & 3 \\ -1 & 0.67 \end{bmatrix}$ (B) $\begin{bmatrix} -3 & -1 \\ 3 & 0.67 \end{bmatrix}$ (C) $\begin{bmatrix} 3 & 3 \\ 1 & 0.67 \end{bmatrix}$ (D) $\begin{bmatrix} 3 & 1 \\ -3 & -0.67 \end{bmatrix}$

Driving point and Transfer Functions

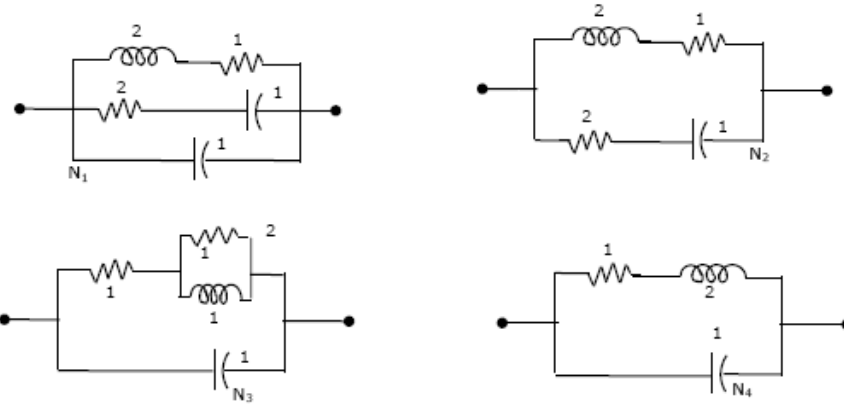
[1991]

The necessary and sufficient condition for a rational function of s , $T(s)$ to be driving point impedance of an RC network is that all poles and zeros should be

- (a) simple and lie on the negative axis in the s -plane
- (b) complex and lie in the left half of the s -plane
- (c) complex and lie in the right half of the s -plane
- (d) simple and lie on the positive real axis of the s -plane

[1992]

Of the four networks, N_1, N_2, N_3 and N_4 of figure, the networks having identical driving point functions are



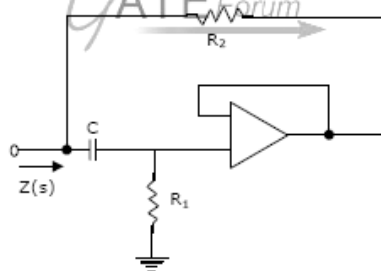
- (a) N_1 and N_1 (b) N_2 and N_4 (c) N_1 and N_3 (d) N_1 and N_4

True/False

$Z(s) = \frac{5}{s^2 + 4}$ represents the input impedance of a network.

[1998]

Determine the input impedance of the circuit of Fig.11 and investigate if it can be inductive.



[2003]

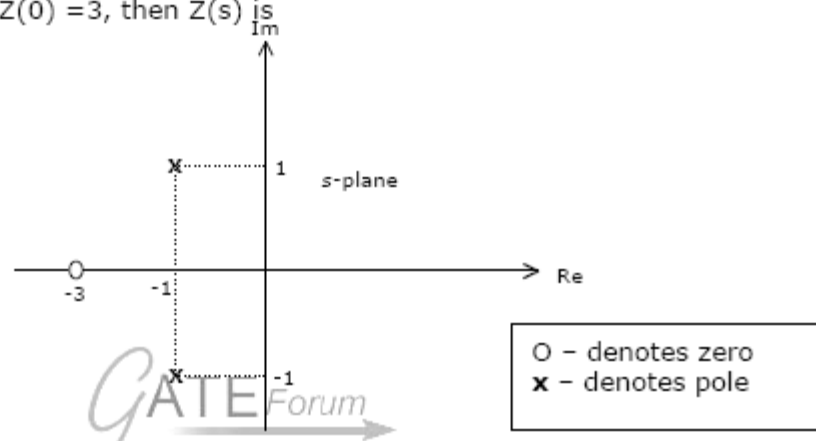
The driving point impedance $Z(s)$ of a network has the pole-zero locations as shown in figure. If $Z(0) = 3$, then $Z(s)$ is

(a) $\frac{3(s+3)}{s^2+2s+3}$

(b) $\frac{2(s+3)}{s^2+2s+2}$

(c) $\frac{3(s-3)}{s^2-2s-2}$

(d) $\frac{2(s-3)}{s^2-2s-3}$



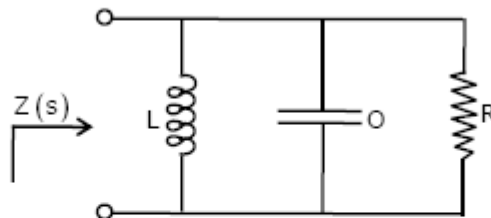
[2006]

The first and the last critical frequencies (singularities) of a driving point impedance function of a passive network having two kinds of elements, are a pole and a zero respectively. The above property will be satisfied by

- (A) RL network only
- (B) RC network only
- (C) LC network only
- (D) RC as well as RL networks

[2008]

The driving point impedance of the following network



is given by $Z(s) = \frac{0.2s}{s^2 + 0.1s + 2}$. The component values are

- | | |
|---|---|
| (A) $L = 5H$, $R = 0.5\Omega$, $C = 0.1F$ | (B) $L = 0.1H$, $R = 0.5\Omega$, $C = 5F$ |
| (C) $L = 5H$, $R = 2\Omega$, $C = 0.1F$ | (D) $L = 0.1H$, $R = 2\Omega$, $C = 5F$ |

State-Equation for Networks

[1995]

Obtain a state space representation in diagonal form for the following:

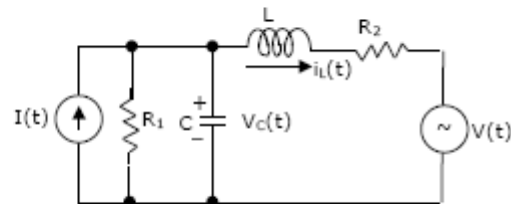
$$\frac{d^3 y}{dt^3} + 6 \frac{d^2 y}{dt^2} + 11 \frac{dy}{dt} + 6y = 6u(t)$$

[1996]

Refer to the circuit shown in Fig. 17.

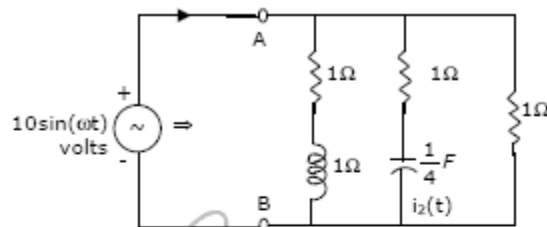
Choosing the voltage $v_C(t)$ across the capacitor, and the current $i_L(t)$ through the inductor as state variables, i.e.

$$[x(t)] = \begin{bmatrix} v_C(t) \\ i_L(t) \end{bmatrix}$$



Write the state equation in the form

$$\frac{d}{dt}[x(t)] = [A][x(t)] + [B][u(t)] \text{ and find } [A], [B], \text{ and } [u(t)]$$



For the circuit shown in Fig. 24, choose state variables X_1, X_2, X_3 , to be $i_{L1}(t), v_{C2}(t), i_{L3}(t)$

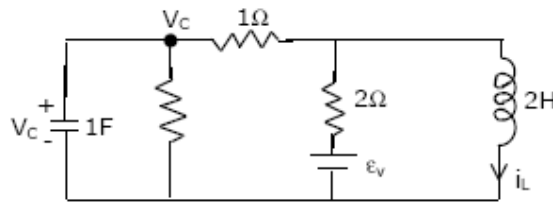
(a) Write the state equations

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = A \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + B[e(t)]$$

(b) If $e(t) = 0, t \geq 0, i_{L1}(0) = 0, v_{C2}(0) = 0, i_{L3}(0) = 1A$, then what would the total energy dissipated in the resistors in the interval $(0, \infty)$ be?

[2000]

For the circuit in Fig.P5, write the state equations using v_c and i_L as state variables.



Statement for Linked Answer Questions 80 & 81:

Consider a linear system whose state space representation is $\dot{x}(t) = Ax(t)$. If the initial state vector of the system is $x(0) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$, then the system response is $x(t) = \begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$.

If the initial state vector of the system changes to $x(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$, then the system response becomes $x(t) = \begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix}$.

80. The eigenvalue and eigenvector pairs (λ_i, v_i) for the system are

- (A) $\left(-1, \begin{bmatrix} 1 \\ -1 \end{bmatrix}\right)$ and $\left(-2, \begin{bmatrix} 1 \\ -2 \end{bmatrix}\right)$ (B) $\left(-1, \begin{bmatrix} 1 \\ -1 \end{bmatrix}\right)$ and $\left(2, \begin{bmatrix} 1 \\ -2 \end{bmatrix}\right)$
(C) $\left(-1, \begin{bmatrix} 1 \\ -1 \end{bmatrix}\right)$ and $\left(-2, \begin{bmatrix} 1 \\ -2 \end{bmatrix}\right)$ (D) $\left(-2, \begin{bmatrix} 1 \\ -1 \end{bmatrix}\right)$ and $\left(1, \begin{bmatrix} 1 \\ -2 \end{bmatrix}\right)$

81. The system matrix A is:

- (A) $\begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} 1 & 1 \\ -1 & -2 \end{bmatrix}$ (C) $\begin{bmatrix} 2 & 1 \\ -1 & -1 \end{bmatrix}$ (D) $\begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$