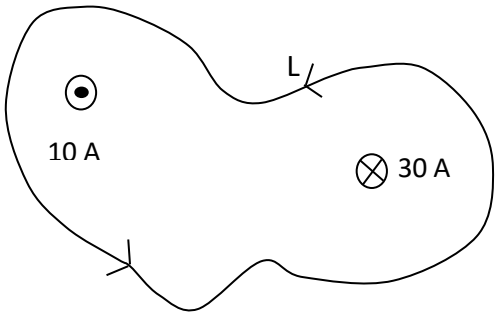
Network Theory

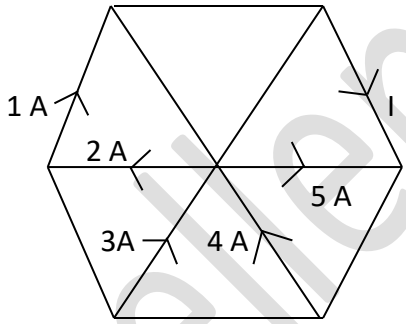
1) The value of $\oint_L \vec{H}.d\vec{l}$ for the figure shown below is



(a) -20 A (b) 30 A (c) 10 A (d) -10 A

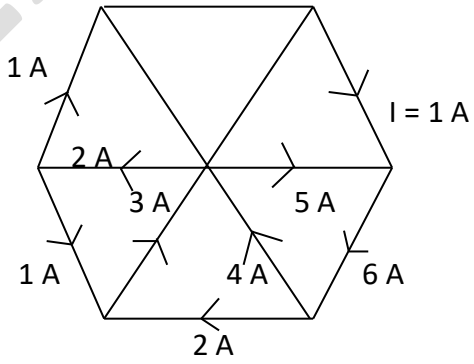
= Answer (a) -20 A

2) Find the current I flowing in the given figure.

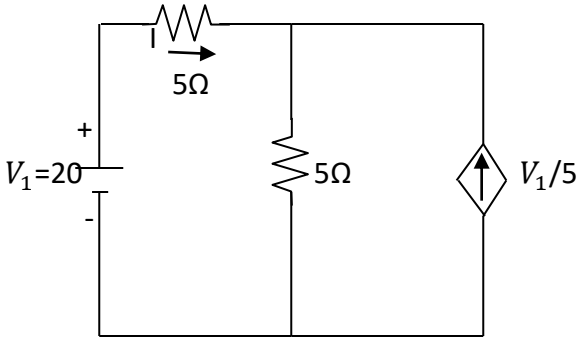


(a) 1 A (b) 2 A (c) 3 A (d) 4 A

= Answer (a) 1 A



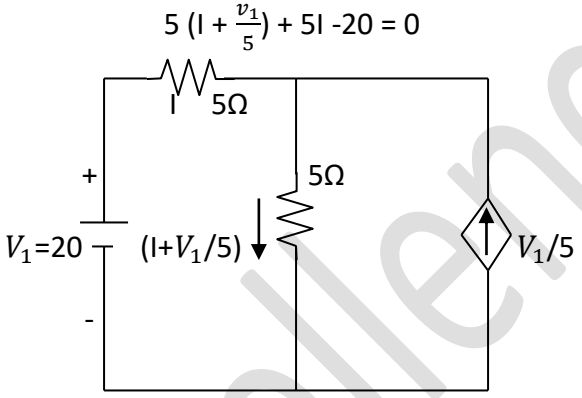
3) The dependent current source shown in figure is



(a) delivers 80 W (b) absorb 80 W (c) delivers 40 W (d) absorb 40 W

= Answer (a) delivers 80 W

Applying KVL,



=> 5I + v_1 + 5I – 20 = 0

=> 10I + v_1 - 20 = 0

=> 10I + 20 – 20 = 0

=> 10I = 0

∴ I = 0

∴ Only dependent source acts = $\frac{v_1}{5}$

= $\frac{20}{5}$

= 4 A

Power delivered = I^2R

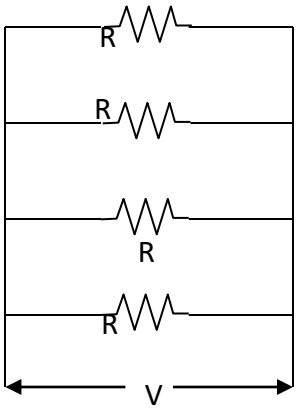
= $(4)^2$ 5

= 80 W

4) For a given voltage,four heating coils will produce maximum heat,when connected

(a) all in parallel (b) all in series (c) with two parallel pairs in series (d) one pair in parallel with the other two in series

= Answer (a) all in parallel



R_{eq} = R II R II R II R

= $\frac{R}{4}$

Maximum heat produced = $\frac{V^2}{R_{eq}}$

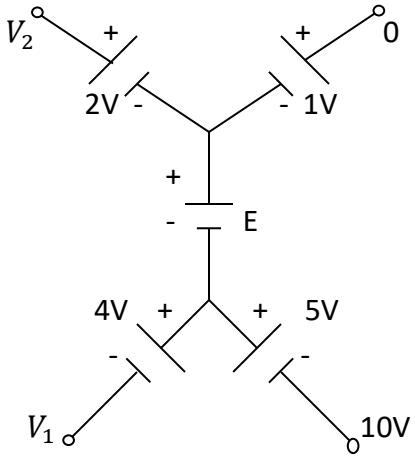
= $\frac{V^2}{\left(\frac{R}{4}\right)}$

= $\frac{4V^2}{R}$

So,for a given parallel network R_{eq} is minimum and hence,maximum heat produced because

$$P \propto \frac{1}{R_{eq}}$$

5) In the circuit of the figure,the value of the voltage source E is



(a) – 16 V (b) 4 V (c) -6 V (d) 16 V

= Answer (a) – 16 V

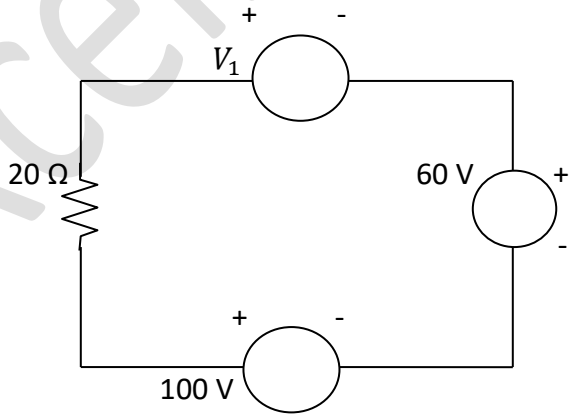
Going from 10 V to 0 V

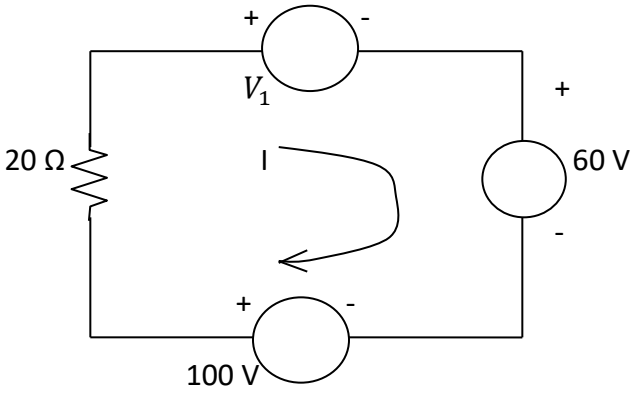
$10 - 0 = -5 - E - 1$

⇨ $10 = -6 - E$

∴ $E = -16$ V

6) In the circuit of the figure a charge of 600 C is delivered to the 100 V source in 1 min. The value of V_1 must be





(a) 240 V (b) 120 V (c) 60 V (d) 30 V

= Answer (a) 240 V

We know that

$$I = \frac{dQ}{dt}$$

$$= \frac{600}{60}$$

= 10 A

Charge is delivered to 100 V source,hence the current must be anti-clockwise.

Applying KVL

$$60 + V_1 - 100 - 20 \text{ X } 10 = 0$$

$$\Rightarrow V_1 + 60 - 100 - 200 = 0$$

$$\Rightarrow V_1 + 60 - 300 = 0$$

$$\therefore V_1 = 240 \text{ V}$$

7) Which one of the following is applicable to any network linear or non-linear,active or passive,time varying or invariant as long as Kirchhoff's laws are not violated ?

(a) Tellegen's theorem (b) Reciprocity theorem (c) Maximum power transfer theorem

(d) Superposition theorem

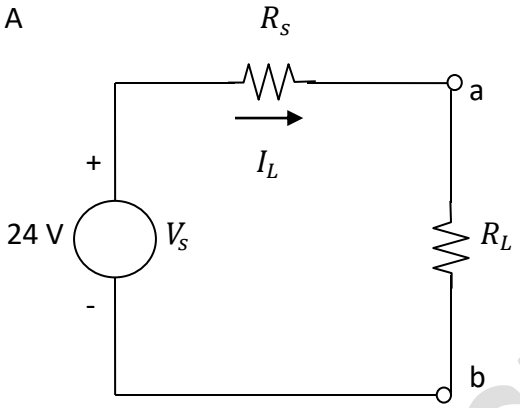
= Answer (a) Telegen's theorem

8) Which of the following truly represents the Thevenin's equivalent circuit when a voltage source of 24 V undergoes a voltage drop 0.6 V due to a load current of 1 A ?

(a) V_{Th} = 24 V , R_{Th} = 0.6 Ω (b) V_{Th} = 24 V , R_{Th} = 24 Ω
(b) V_{Th} = 23.4 V , R_{Th} = 0.6 Ω (d) V_{Th} = 23.4 V , R_{Th} = 23.4 Ω

= Answer (a) V_{Th} = 24 V , R_{Th} = 0.6 Ω

I_L = 1 A



Voltage drop across voltage source = 0.6 V

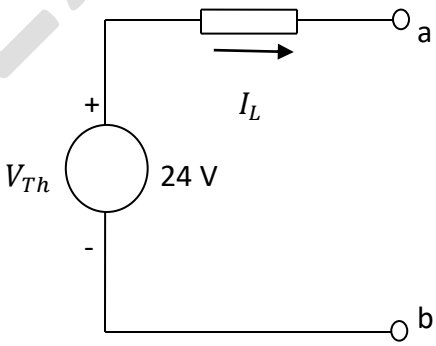
$$R_s = \frac{V}{I_L}$$

$$= \frac{0.6}{1}$$

= 0.6 Ω

Now,to draw Thevenin equivalent circuit,

R_{Th} = R_s when calculate R_{eq} across ab when voltage source is short-circuited and V_{Th} = 24 V 0.6 Ω=R_{Th}



9) For which type of the following Thevenin's and Norton's equivalents cannot be developed ?
   (a) DC independent sources
   (b) AC independent sources
   (c) Indendent and dependent sources
   (d) Indendent and dependent sources with all controlling current and voltage contained within the network whose equivalent is being developed

= Answer (c) Indendent and dependent sources

10) Which of the following is essential for the reciprocity theorem to be applicable ?
(a) Linearity (b) Bilateralism (c) No initial history (d) Both (a) and (b)

= Answer (d) Both (a) and (b)

11) Which of the following is not a condition for maximum power transfer across a load $Z_L < \theta_L$ in an AC Thevenin equivalent circuit of voltage $V_{Th} < 0^0$ and $Z_{Th} < \theta_{Th}$?
   (a) $Z_L = Z_{Th}$ (b) $\theta_L = -\theta_{Th}$ (c) $\theta_L = \theta_{Th}$ (d) All of these

   = Answer (c) $\theta_L = \theta_{Th}$

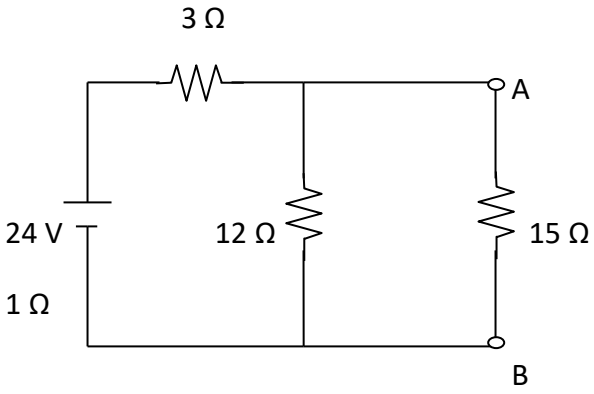
12) In which of the following,it is not desired to attain the condition for maximum power transfer ?
   (a) Electronic circuits
   (b) Communicational circuits
   (c) Computer circuits
   (d) Electric circuits

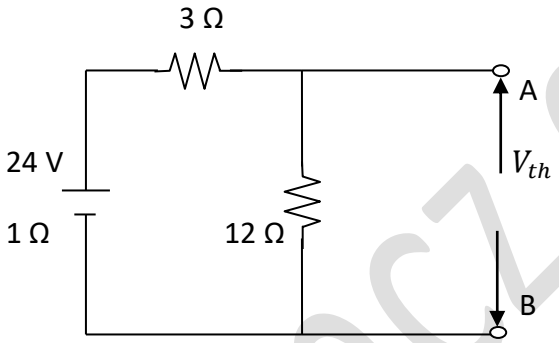
   = Answer (d) Electric circuits

13) A generator of internal impedance $|Z_G|$ delivers maximum power to a load impedance Z_p,only if
   (a) $Z_p < Z_G$ (b) $Z_p > Z_G$ (c) $Z_p = Z_G$ (d) $Z_p = 2Z_G$

   = Answer (c) $Z_p = Z_G$

14) Thevenise the following circuit,





= A and B terminal open.

V = IR

=>24 = I (1 + 3 + 12) [1 Ω = Internal Resistance]

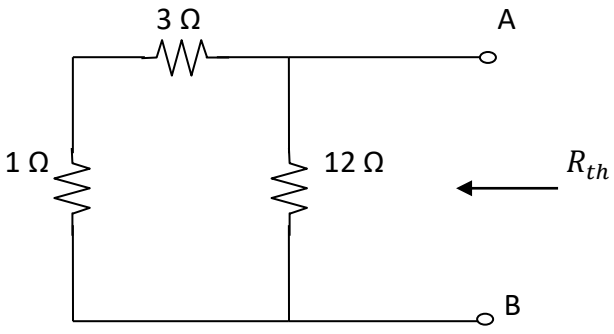
=>I = 24/16

∴I = 1.5 A

Voltage across A and B terminal = Voltage across 12 Ω resistance = V_{th} = 1.5 X 12

∴ V_{th} = 18

Thevenin voltage V_{th} = 18



When finding R_{th}. 24 V is short circuited

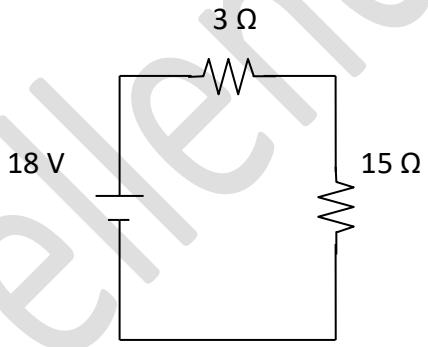
R_{th} = (3 + 1) II 12

= 4 II 12

= $\frac{4\ X\ 12}{4+12}$

= $\frac{48}{16}$

= 3

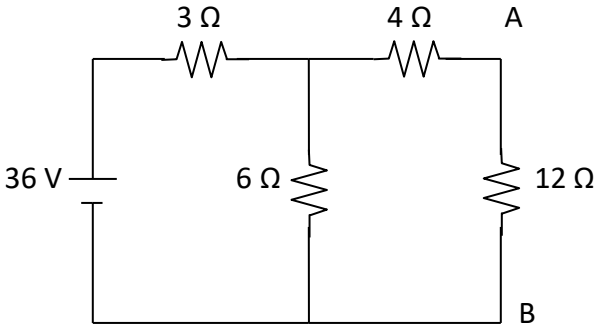


Load current

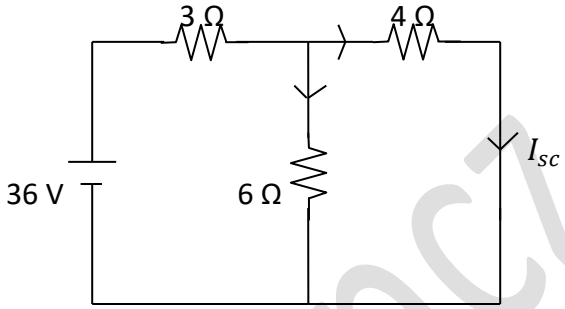
I_L = $\frac{18}{15+3}$

= 1 A

15) Nortonise the following circuit



=

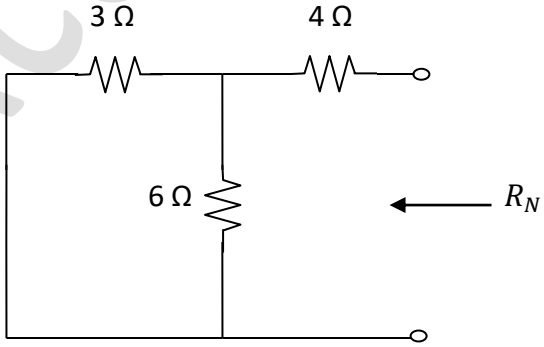


A and B terminal short circuited.

V = I_{sc}R

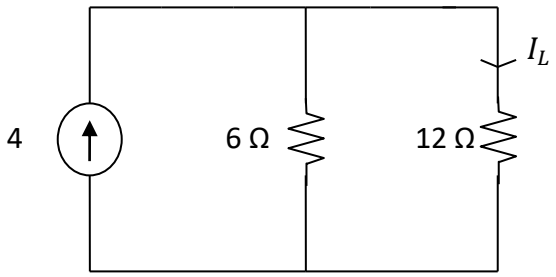
=>I_{sc} = ($\frac{36}{3+6II\,4}$) X $\frac{6}{6+4}$

∴ I_{sc} = 4 A



R_N = 4 + (3 II 6)

=6



Load current

I_L = 4 X $\frac{6}{6+12}$

= 1.33 A

16) Laplase transform analysis gives

(a) Time domain response only

(b) Frequency domain response only

(c) Both (a) and (b)

(d) None of the above

= Answer (c) Both (a) and (b)

17) Which of the following is an advantage of using Laplase transform techniques ?

(a) Permits use of simple algebra

(b) Convert functions in the t-domain into s-domain

(c) Initial conditions are are automatically taken care of

(d) All of the above

= Answer (d) All of the above

18) Which of the following correctly defines Laplace transform of a function in the time domain ?

(a) L{f(t)} = $\int_{0^-}^{\infty} f(t)\, e^{-st} dt$

(b) L{f(t)} = $\int_{0^-}^{\infty} f(t)\, e^{+st} dt$

(c) L{f(t)} = $\int_{0^-}^{\infty} f(t)^{-st}\, e^{-st} dt$

(d) L{f(t)} = $\int_{0^-}^{\infty} f(t)\, e^{+st} dt$

= Answer (a) L{f(t)} = $\int_{0^-}^{\infty} f(t)\, e^{-st} dt$

19) The initial value theorem does not hold good for which of the following functions ?

(a) Ramp function (b) Delta function

(c) Step function (d) Hyperbolic function

= Answer (b) Delta function

20) The Laplace transform of f(t) is given by I(s) = $\frac{5}{s(s^2+2)}$. As t→∞ the value of I(t) tends to

(a) Zero (b) 1 (c) 5/2 (d) infinite

= Answer (c) 5/2

$\lim_{\substack{s\to 0 \\ t\to\infty}} s.I(s)$

= $\lim_{s\to 0}$ s . $\frac{5}{s(s^2+2)}$

= $\lim_{s\to 0} \frac{5}{(s^2+2)}$

= $\frac{5}{0+2}$

= $\frac{5}{2}$

21) Consider the signal e^{-t}U(t) . The Laplace transform of the derivative of the signal is

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

= Answer (b) $\frac{s}{s+1}$

22) Inverse Laplace transform of the function $\frac{s}{s^2+3s+2}$ is

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

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

= Answer (a) - e^{-t} + $2e^{-2t}$

= $\frac{s}{s^2+3s+2}$

= $\frac{s}{s^2+2s+s+2}$

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

= $\frac{s}{(s+2)(s+1)}$ --------(i)

$= \frac{A}{s+1} + \frac{B}{s+2}$

$= \frac{A(s+2)+B(s+1)}{(s+2)(s+1)}$----------(ii)

Comparing (i) and (ii) –

A(s+2)+B(s+1) = s

=>As+2A+Bs+B = s

=>(A+B)s+(2A+B) = s.1

Comparing both side –

A+B = 1

2A+B = 0

$\therefore B = -2A$

A-2A = 1

$\therefore A = -1$

B = +2

$= \frac{s}{s^2+3s+2}$

$= \frac{A}{s+1} + \frac{B}{s+2}$

$= -\frac{1}{s+1} + \frac{2}{s+2}$

$= -e^{-t} + 2e^{-2t}$

23) In a series RLC high Q circuit,the current peak 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

= (a) equal to the resonant frequency

24) A DC voltage source is connected across a series RLC circuit.Under steady state conditions,the applied DC voltage drop entirely across the

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

= Answer (c) C only

25) Given two coupled inductors L_1 and L_2 their mutual inductance M satisfies

(a) M = $\sqrt{{L_1}^2 + {L_2}^2}$ (b) M > $\frac{(L_1+L_2)}{2}$

(c) M > $\sqrt{L_1 L_2}$ (d) M ≤ $\sqrt{L_1 L_2}$

= Answer (d) M ≤ $\sqrt{L_1 L_2}$

25) Two two-port networks are connected in casecade.The combination is to represent as a single two-port netwoeks.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

= Answer (d) ABCD – Parameter matrix

26) For a two-port network to be reciprocal

(a) $Z_{11} = Z_{22}$ (b) $Y_{21} = Y_{12}$

(c) $h_{21} = - h_{12}$ (d) AD – BC = 0

= Answer (b) $Y_{21} = Y_{12}$, (c) $h_{21} = - h_{12}$

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

(a) AD – BC = 1 (b) AD – BC = 0

(c) AD – BC > 1 (d) AD – BC < 1

= Answer (a) AD – BC = 1

28) Two coils having equal resistance but different inductances are connected in series.The time constant of the series combination is

(a) sum of the time constants of the individual coils

(b) average of the time constant of the individual coils

(c) geometric mean of the time constant of the individual coils

(d) product of the time constant of the individual coils

= Answer (b) average of the time constant of the individual coils

29) When a charge is given to a conductor

(a) it distributes uniformly all over the surface

(b) it distributes uniformly all over the volume

(c) it distributes on the surface,inversely proportional to the radius of curvature

(d) it stays where it was placed

= Answer (a) it distributes uniformly all over the surface

30) For any network,having n nodes,number of trees possible for that network is

(a) 2^n (b) 2^{2n} (c) n^2 (d) n^{n-2}

= Answer (d) n^{n-2}

31) Two coils in differential connection have self inductance of 2 mH and 4 mH and a mutual inductance of 0.15 mH.The equivalent inductance of the combination is

(a) 5.7 mH (b) 5.85 mH (c) 6 mH (d) 6.15 mH

= Answer (a) 5.7 mH

When two inductors are connected in series,the effective inductance L_{eff} = L_1+$L_2 \pm 2M$

In this case , L_{eff} = L_1+L_2-2M

=2+4-2X0.15

= 5.7 mH

32) The tieset matrix gives the relation between

(a) branch currents and loop currents

(b) branch voltages and loop currents

(c) branch voltages and node currents

(d) None of the above

= Answer (a) branch currents and loop currents

33) The cutest Schedule gives the relation between

(a) branch currents and link currents

(b) branch voltage and tree branch voltages

(c) branch voltage and link voltages

(d) branch current and tree current

= Answer (b) branch voltage and tree branch voltages

34) A coil is designed for high Q performance at a rated voltage and a specified frequency.If the frequency of operation is doubled and the coil is operated at the same rated voltage,then the Q factor and the active power P consumed by the coil will be affected as

(a) P is doubled,Q is halved

(b) P is halved,Q is doubled

(c) P remains constant,Q is doubled

(d) P dreases 4 times,Q is doubled

= Answer (d) P dreases 4 times,Q is doubled

35) Let a signal $a_1\sin(\omega_1 t+\varphi_1)$ be applied to a stable linear time-invariant system.Let the corresponding steady state output be represented as $a_2 F(\omega_2 t+\varphi_2)$.Then,which of the following statement is true ?

(a) F is not necessarily a sine or cosine function but must be periodic with $\omega_1 = \omega_2$

(b) F must be a sine or cosine function with $a_1 = a_2$

(c) F must be a sine function $\omega_1 = \omega_2$ and $\varphi_1 = \varphi_2$

(d) F must be a sine or cosine function with $\omega_1 = \omega_2$

= Answer (d) F must be a sine or cosine function with $\omega_1 = \omega_2$

36) A sine wave voltage is applied across a capacitor.When the frequency of the voltage is increased,the current through capacitor

(a) increases (b) decreases (c) remains the same (d) is zero

= Answer (a) increases

37) A unit step voltage is applied at t = 0 to a series RL circuit with zero initial conditions.

(a) It is possible for the current to be Oscillatory

(b) The voltage across the resistor at t = 0^+ is zero

(c) The energy stored in the inductor in the steady state is zero

(d) The resistor current eventually falls to zero

= Answer (b) The voltage across the resistor at t = 0^+ is zero

38) When the plate area of a parallel plate capacitor is increased keeping the capacitor voltage constant,the force between the plates

(a) increases (b) decreases

(c) remains constant (d) may increase or decrease depending on the metal making up the plate

= Answer (a) increases

39) Two incandescent light bulbs of 40 W and 60 W rating are connected in series across the mains.Then,

(a) the bulbs together consume 100 W

(b) the bulbs together consume 50 W

(c) the 60 W bulb glows brighter

(d) the 40 W bulb glows brighter

= Answer (d) the 40 W bulb glows brighter

40) How many 200 W/220 V incandescent lamps connected in series would consume the same total power as a single 100 W/220 V incandescent lamp ?

(a) Not possible (b) 4 (c) 3 (d) 2

= Answer (d) 2

41) Two networks are connected in series parallel connection.Then,the forward short-circuit current gain of the network is

(a) product of Z – parameter matrices

(b) sum of h - parameter matrices

(c) sum of Z - parameter matrices

(d) product of h – parameter matrices

= Answer (b) sum of h - parameter matrices

42) A two-port network is reciprocal if and only if

(a) $Z_{11} = Z_{22}$ (b) BC – AD = - 1

(c) $Y_{12} = -Y_{21}$ (d) $h_{12} = h_{21}$

= Answer (b) BC – AD = - 1

43) 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) any type of network i.e.,both active and passive networks

(b) passive but not reciprocal networks

(c) active and reciprocal networks

(d) passive and reciprocal networks

= Answer (d) passive and reciprocal networks

44) A two-port network whose transmission parameters are give as 10,9,11 and 10 corresponds to A,B,C and D.

Following two statements are made :

(1) Network satisfies reciprocity property.

(2) Network satisfies symmetry property.

Choose the correct option.

(a) 1 – True,2 – True (b) 1 – True,2 – False

(c) 1 – False,2 – False (d) 1 – False,2 – True

= Answer (a) 1 – True,2 – True

45) If a two-port network is passive,then we have,with the usual notation,the following relationship

(a) $h_{12} = h_{21}$ (b) $h_{12} = -h_{21}$

(c) $h_{11} = h_{22}$ (d) $h_{11}h_{22} - h_{12}h_{22} = 1$

= Answer (d) $h_{11}h_{22} - h_{12}h_{22} = 1$

46) A passive 2-port network is in a steady state.Compared to its input,the steady state output can never offer

(a) higher voltage (b) lower impedance

(c) greater power (d) better regulation

= Answer (c) greater power

47) For parallel RLC circuit,which one of the following statements is not correct ?

(a) The bandwidth of the circuit decreases if R is increased

(b) The bandwidth of the circuit remains same if L is increased

(c) At resonance,input impedance is a real quantity

(d) At resonance,the magnitude of input impedance attains its minimum value

= Answer (c) At resonance,input impedance is a real quantity

48) 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

= Answer (b) KCL and Ohm's law

49) Twelve 1 Ω resistors are used as edge to form a cube.The resistance between two diagonally opposite corners of the cube is

(a) $\frac{5}{6}$ Ω (b) $\frac{6}{5}$ Ω (c) 1 Ω (d) None of these

= Answer (a) $\frac{5}{6}$ Ω

50) Twelve 1 H inductors are used as edge to form a cube.The inductance between two diagonally opposite corners of the cube is

(a) $\frac{5}{6}$ H (b) $\frac{10}{6}$ H (c) 2 H (d) $\frac{3}{2}$ H

= Answer (a) $\frac{5}{6}$ H