**ESE- 2020 (Prelims) - Offline Test Series Test - 17**

**ELECTRICAL ENGINEERING**

## SUBJECT: ELECTRIC CIRCUITS & FIELDS + ELECTRICAL MATERIALS + ELECTRICAL MACHINES

**01. Ans: (d)**

**Sol:** The cylinder ρ = 20 mm don't encloses the cylinder of radius 40 mm. Hence $\overline{K} = 200\hat{a}_z$ will not contribute in $\overline{H}$,but due to olenoid$\left(\rho = 80\text{mm}, \overline{K} = 160\hat{a}_\phi \text{A/m}\right)$there will be a magnetic field intensity so we have $\overline{H} = 160\hat{a}_z \text{A/m}$.

$$\therefore \left|\overline{H}\right| = 160\,\text{A/m}.$$

**02. Ans: (b)**

**Sol:** $Q = \int_V \overline{\nabla}.\overline{D}dv$

$$\overline{\nabla}.\overline{D} = \frac{\partial}{\partial x}\left(6xyz^2\right) + \frac{\partial}{\partial y}\left(3x^2z^2\right) + \frac{\partial}{\partial z}\left(6x^2yz\right)$$

$$= 6yz^2 + 6x^2y$$

$$\therefore Q = \int_1^3\int_0^1\int_{-1}^1\left(6yz^2 + 6x^2y\right)dxdydz$$

$$= 6[x]_1^3\left[\frac{y^2}{2}\right]_0^1\left[\frac{z^3}{3}\right]_{-1}^1 + 6\left[\frac{x^3}{3}\right]_1^3\left[\frac{y^2}{2}\right]_0^1[z]_{-1}^1 = 56\,\text{C}$$

**03. Ans: (c)**

**Sol:** $\overline{G}.\overline{dL} = \left(x^2\hat{a}_x - xyz\hat{a}_z\right).\left(dx\hat{a}_x + dy\hat{a}_y + dz\hat{a}_z\right)$

$$= x^2dx - xyzdz$$

$$\therefore \int_{P_1}^{P_2}\overline{G}.\overline{dL} = \int_1^5 x^2dx - \int_3^4 xyzdz$$

Path of integration is P(1, 2, 3) to (5, 2, 3) to (5, 0, 3) to (5, 0, 4). Between first and second point, y and z coordinates are constant where as x coordinate varies from x = 1 to x = 5. Hence in the first integral, if required substitute y = 2 and z = 3.

Between third and fourth point, x and y coordinates are constant where as z coordinate varies from z = 3 to z = 4. Hence in the second integral, substitute x= 5 and y = 0

$$\therefore \int_{P_1}^{P_2}\overline{G}.\overline{dL} = \int_1^5 x^2dx = \left[\frac{x^3}{3}\right]_1^5 = \frac{125-1}{3} = 41.333$$

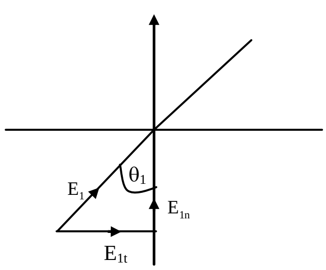
**04. Ans: (b)**

**Sol:** from boundary condition, $D_{1n} = D_{2n}$

and $E_{t1} = E_{t2}$

Now $E_{t1} = E_1 \sin\theta_1$

so $E_{t2} = E_1 \sin\theta_1$




$$D_{2n} = D_{1n} \Rightarrow E_{2n} = \frac{\varepsilon_1}{\varepsilon_2} E_{1n}$$

$$E_{2n} = \frac{\varepsilon_1}{\varepsilon_2} E_1 \cos\theta_1$$

$$\therefore E_2 = \sqrt{(E_1 \sin\theta_1)^2 + \left(\frac{\varepsilon_1}{\varepsilon_2} E_1 \cos\theta_2\right)^2}$$

$$= E_1 \sqrt{\sin^2\theta_1 + \left(\frac{\varepsilon_1}{\varepsilon_2}\right)^2 \cos^2\theta_1}$$

**05. Ans: (b)**

**Sol:** Given : Interface z = 0 (xy plane)

$$\vec{E}_1 = -3\hat{a}_x + 4\hat{a}_y - 2\hat{a}_z \text{ (for } z < 0)$$

$$\varepsilon_{r_1} = 2$$

$$\varepsilon_{r_2} = 8$$

$\vec{E}_{t_1} = -3\hat{a}_x + 4\hat{a}_y$

$\vec{E}_{n_1} = -2\vec{a}_z$

From boundary conditions:

$\vec{E}_{t_2} = \vec{E}_{t_1} = -3\hat{a}_x + 4\hat{a}_y$

$\varepsilon_1 \vec{E}_{n_1} = \varepsilon_2 \vec{E}_{n_2}$

$\vec{E}_{n_2} = \left(\dfrac{\varepsilon_{r_1}}{\varepsilon_{r_2}}\right)\vec{E}_{n_1}$

$= \left(\dfrac{2}{8}\right)(-2\hat{a}_z) = -0.5\hat{a}_Z$

$\therefore \vec{E}_2 = \left(-3\hat{a}_x + 4\hat{a}_y - 0.5\hat{a}_z\right) \text{V/m} \quad (\text{for } Z > 0)$

**06. Ans: (c)**

**Sol:** →stationary charges produces electrostatic fields.

→A steady current produces magneto static field.

→ An emf-produced field $\overline{E}_f$ is a non-conservative field.

→Magneto static field is not conservative but magnetic flux is conserved.

**07. Ans: (b)**

**Sol:** Fifth harmonic pitch factor, $K_{p5} = \cos\dfrac{5\alpha}{2}$

To eliminate this harmonic in the induced emf, $K_{p5}$ should be zero.

$\Rightarrow \dfrac{5\alpha}{2} = 90^\circ$

$\Rightarrow \alpha = \dfrac{180^\circ}{5}$

Winding pitch = $180° - \dfrac{180^\circ}{5} = \dfrac{4}{5}(180^\circ)$

**08. Ans: (a)**

**Sol:** $V_L = V_{ph} = 400$ V (for $\Delta$ -connection)

$I_{ph} = \dfrac{12000}{3 \times 400} = 10$ A

$\phi = 90^o$, since ZPf lead.

$E = \sqrt{(V\cos\phi + I_{ph}R_a)^2 + (V\sin\phi - I_{ph}X_s)^2}$

$= \sqrt{(0)^2 + (400 \times 1 - 10 \times 20)^2}$

$= 200$ V

% Regulation = $\dfrac{E - V}{V} \times 100$

$= \dfrac{200 - 400}{400} \times 100 = -50$ %

**09. Ans: (b)**

**Sol:** In the figure, given in the question, BC = $I_aX_l$ (=$V_x$) = Leakage reactance drop.

It is equal to the voltage induced by an mmf DB, as per the unsaturated part of the OCC.

The base of the triangle DB = $I_{fl}$ is the field current required to compensate the drop due to leakage reactance.

**10. Ans: (d)**

**Sol: Advantages of Distributed winding:**

1. The effect of Harmonics are reduced thereby Generated e.m.f is more sinusoidal.
2. With the Elimination of Harmonics, Iron losses are reduced and efficiency increased.
3. Temperature rise is uniformly distributed.
4. Cooling is effective.
5. Armature winding is mechanically balanced well.

**11. Ans: (d)**

**Sol:** A pole pitch = 180° electrical

$\theta_m = ?$

we know that $\theta_e = \dfrac{P}{2}\theta_m$

$$\theta_m = \frac{2\times\theta_e}{P} = \frac{2\times180}{6} = 60^o$$

**12. Ans: (c)**

**Sol:** During rotor blocked test, the rotor does not rotate. There cannot be any friction and windage loss.

There will be copper losses in stator and rotor, as well as core losses in both stator core and rotor core.

Since the test is usually done at reduced voltage, core losses are usually neglected.

**13. Ans: (c)**

**Sol:** For an induction motor operating at a fixed voltage and frequency.

1. Slip for maximum torque = $r_2/x_2$
2. Value of the maximum torque = $3V^2/(2\omega_s x_2)$
3. Starting torque $T_{st} \propto r_2$

In the problem all three curves have the same maximum torque, so $x_2$ is the same in all cases.

For curve P, slip for maximum torque as well as the starting torque, are large. So P is associated with high rotor resistance. Q is associated with low rotor resistance.

With deep bar type conductors for the rotor cage, skin effect confines the current at starting to the outer edges of the bar, increasing the rotor resistance substantially, there by giving a substantially high starting torque. During running, rotor frequency is very low, skin effect is negligible and current is distributed over the entire bar corss-section, resulting in a very low rotor resistance, slip for maximum torque is the lowest. So, Motor (R) is a deep bar rotor motor.

**14. Ans: (b)**

**Sol:** Rotor input

$$= \frac{\text{Mechanical Power developed}}{1-s}$$

$$= \frac{8}{0.8} = 10 \text{ kW}$$

**15. Ans: (a)**

**Sol:** $sV^2$ = constant

$s_1 V_1^2 = s_2 V_2^2$

$0.03V^2 = s_2(1.1)^2V^2$

$s_2 = \frac{0.03}{1.1^2} = 2.48\%$

**16. Ans: (d)**

**Sol:** As the Induction motor is fed from the 3-phase alternator:

Supply frequency to 3-phase induction motor = alternator frequency

$\Rightarrow f = \frac{P.N_S}{120} = \frac{6x1000}{120} = 50\text{Hz}$

We know; rotor current frequency ($f_r$) = s.f

$\Rightarrow s = \frac{f_r}{f} = \frac{2}{50} = 0.04$

$\therefore$ The speed of the motor

$\Rightarrow N = N_S(1-s)$

As, 8 - pole, 3-phase Induction motor operated at 50Hz,

The speed of RMF, $N_S = \frac{120f}{p} = \frac{120 \times 50}{8}$

= 750rpm

Then, N = 750 (1–0.04) = 720 rpm.

**17. Ans: (d)**

**Sol:** Oxidation is the main reason for sludge formation in transformer oil.

**18. Ans: (b)**

**Sol:** Short-circuit test on a transformer can be performed either by short-circuiting the hv winding, or the lv winding. The same results will be obtained.

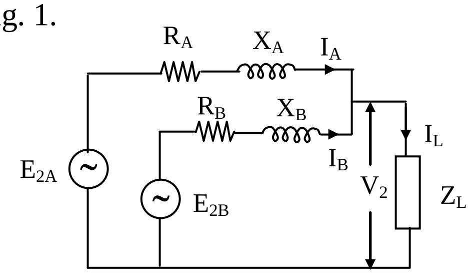
But by shorting the lv winding and applying voltage to the hv winding, the rated current that has to be delivered by the supply becomes small. Hence the test is usually performed by shorting the lv winding.

But if rated voltage is applied to the hv winding while the lv winding is shorted, a very high current (several times its rated value) will be drawn by the hv winding, and this can destroy both the windings. Hence a very small percentage of the rated hv voltage, just sufficient for the hv winding to draw its rated current, is applied to the hv winding.

With such a low voltage core flux is small. Iron losses (hysteresis eddy current losses) become negligible.

**19. Ans: (c)**

**Sol:** The secondaries of the two transformers in parallel, and the common load are shown in fig. 1.




The transformer primaries are assumed to be ideal and in parallel, and they receive the same supply. Hence the secondary induced voltages are identical, though their leakage impedances are not.

$V_2 = E_{2A} - I_A Z_A$ ……… (1)

$V_2 = E_{2B} - I_B Z_B$ ………..(2)

From (1) and (2)

$E_{2A} - I_A Z_A = E_{2B} - I_B Z_B$

$\Rightarrow \quad I_A Z_A = I_B Z_B$

$$\Rightarrow \quad \frac{I_A}{I_B} = \frac{Z_B}{Z_A}$$

The load sharing is inversely proportional to their respective impedances.

**20. Ans: (d)**

**Sol:** In a single phase transformer the induced emf is always sinusoidal under loaded condition, because of sinusoidal flux. To produce sinusoidal flux during saturation condition of transformer, the current drawn from supply should be a peaky wave.

**21. Ans: (b)**

**Sol:** If the switch is closed at zero point of applied voltage, the flux demanded by transformer core at the instant of switching is $\phi_m$ to satisfy normal phase relation between applied voltage and flux. Because of inertia the flux actually produced in transformer core doesn't start from $-\phi_m$, but it starts from zero and it attains an amplitude of twice the max value of normal flux and this effect in transformers is called doubling effect.

In this transient period transformer demands very high magnetizing component of current from source due to deep saturation of the core. This high magnetizing component of current during transient period is called magnetic inrush current.

**22. Ans: (d)**

**Sol:** 1. induced emf = E = $K\phi\omega$ volts, developed torque = T $K\phi I_a$ N-m/r and

K = armature constant $\left(\frac{PZ}{2\pi A}\right)$,

where $\phi$ is the flux/pole,

$I_a$ = armature current and

$\omega$ is the speed in rad/s

2. From given data, $K = \dfrac{4\times 400}{2\pi\times 4} = \dfrac{200}{\pi}$ units

3. Speed torque characteristics:

$$E = K\phi\omega = V - I_aR_a \Rightarrow \omega = \frac{V}{K\phi} - \frac{R_a}{(K\phi)^2}T$$

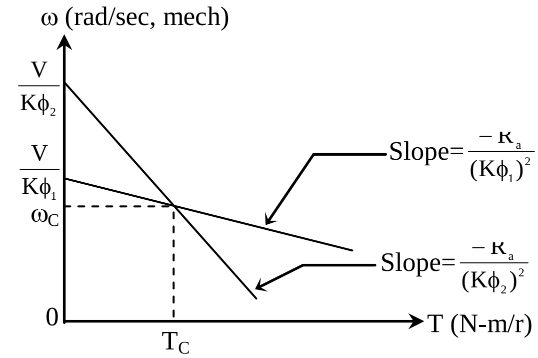



Fig:1

4. **Operation with $\phi_1$ = 0.02 Wb:**

Speed = $\omega_c$ ; $E_1 = K\phi\,\omega_c$ ;

$$I_1 = \frac{V - K\phi_1\omega_C}{R_a}$$

$$\text{Torque } T_{C1} = \frac{K\phi_1(V - K\phi_1\omega_C)}{R_a} \quad \text{…. (1)}$$

**5. Operation with $\phi_2$ = 0.01 Wb:**

Speed = $\omega_C$ (unchanged) ; $E_2 = K\phi_2\,\omega_C$

$E_2 = V - K\phi_2\omega_C$

$$T_{C2} = \frac{K\phi_2(V - K\phi_2\omega_C)}{R_a} \quad \text{………….. (2)}$$

6. Since the load needs a constant torque,

$T_{C1} = T_{C2}$.

From Eq. (1) and (2),

$$\frac{\phi_1}{\phi_2} = \frac{V - K\phi_2\omega_C}{V - K\phi_1\omega_C} \quad \text{………….. (3)}$$

From given data,

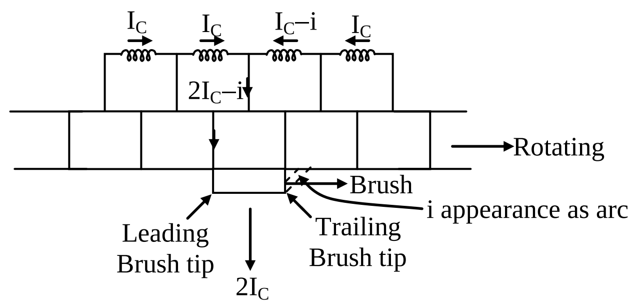
$$\frac{\phi_1}{\phi_2} = 2 = \frac{250 - \frac{200}{\pi}(0.01)\omega_C}{250 - \frac{200}{\pi}(0.02)\omega_C} \quad \text{…. (4)}$$

Solve eq. (4) for $\omega_C$.

$\omega_C = \dfrac{125\pi}{3}$ r/s = 1250 rpm.

**23. Ans: (c)**

**Sol:**




$$V_c = L\frac{di_c}{dt}$$

The current changes from $\dfrac{I_a}{a}$ to $-\dfrac{I_a}{a}$ in commutation period.

$\therefore$ An emf developed (self & mutual) called reaction voltage.

**24. Ans: (d)**

**Sol:** $P_{mech} = E_bI_c$

$= (V - I_aR_c)I_c$

for max o/p $\dfrac{dp}{dI_a} = V - 2I_aR_a = 0$

$$I_a = \frac{V}{2R_a} = \frac{200}{2\times 10} = 10\text{A}$$

**25. Ans: (a)**

**26. Ans: (c)**

**Sol:** $E = \frac{\phi ZN}{60} \times \frac{P}{A}$

$$500 = \frac{\phi \times 240 \times 1000}{60} \times \frac{6}{2}$$

(For wave connected winding A = 2)

$\phi = 0.04166 \simeq 0.042$ Wb

**27. Ans: (d)**

**Sol: Motor operation before plugging:**

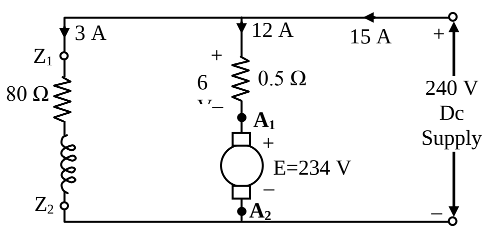



Fig.1

Circuit immediately after plugging (reversing supply to the armature, while shunt field current direction is unchanged):

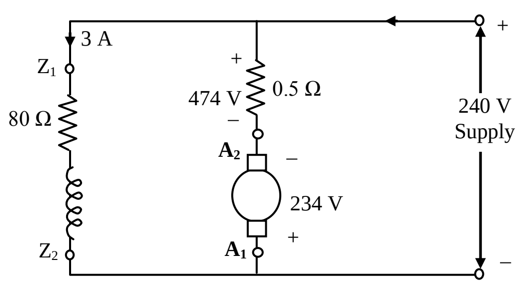



Fig.2.

Since field flux direction is unchanged, and speed also is unchanged (speed cannot change instantaneously due to inertia) the induced emf does not change in magnitude or polarity and is as shown in fig.2. The voltage drop across the armature resistance (by KVL) is then (240 + 234) = 474 V.

**28. Ans: (b)**

**Sol: Case (i):**

$V_t = 230$ V, $r_a = 0.2\ \Omega$, $r_b = 0.1\ \Omega$

$I_{L1} = I_{a1} = I_{f1} = 40$ A

$N_1 = 1000$ rpm

$\Rightarrow E_{b1} = V_t - I_{a1}(r_a + r_f)$

$= 230 - 40(0.3)$

$= 218$ V

**Case (ii):**

$V_t = 230$ V, $I_{a2} = 20$ A

$\Rightarrow \quad \phi_2 = 0.6\phi_1$

$E_{b2} = V_t - I_{a2}(r_a + r_f)$

$= 230 - (20)(0.3) = 224$ V

$E_b = K_a \phi \omega$

$E_b \propto \phi N$

$$\Rightarrow \frac{E_{b2}}{E_{b1}} = \frac{\phi_2}{\phi_1} . \frac{N_2}{N_1}$$

$$\Rightarrow \frac{224}{218} = \frac{0.6\phi}{\phi} \frac{N_2}{1000}$$

$N_2 \approx 1700$ rpm

**29. Ans: (c)**

**Sol:** Electronic and Ionic polarizations does not depends on temperature.

**30. Ans: (b)**

**Sol:** $R_H = \frac{1}{nq}$

$$= \frac{1}{10^{22} \times 1.6 \times 10^{-19}} = 6.25 \times 10^{-4}\ m^3/C$$

**31. Ans: (c)**

**Sol:** Polarization = $D\left(1-\frac{1}{\varepsilon}\right)$

$$= 3\left(1-\frac{1}{4}\right) = 2.2\ c/m^2$$

**32. Ans: (a)**

**Sol:** $M_3Fe_5O_{12}$ is a general formula of garnets.

$CuOFe_2O_3$ is a ferri magnetic material.

Ferrox cube has square hysteresis loop.

**33. Ans: (d)**

**Sol:** Anti ferromagnetic material has zero susceptibility.

$\mu_r = 1 + \chi$

$\mu_r = 1$ ($\because \chi = 0$)

**34. Ans: (b)**

**Sol:** The materials used for magnetic shielding must have high saturation induction and low coercivity.

**35. Ans: (d)**

**Sol:** Alnico is a permanent magnet, remaining all are soft magnetic materials.

**36. Ans: (b)**

**Sol:** The material used for cores of electromagnets must have low hysteresis loss, low coercivity, high retentivity, high initial permeability, maximum flux density.

**37. Ans: (a)**

**Sol: Super conductor properties:**

1. A super conductor is a perfect diamagnetic with magnetic susceptibility $= -1$.
2. A super conductor has bound electron pairs also known as cooper pairs within it cooper pair showed that an arbitrarily small attraction between electrons.
3. A super conductor becomes a normal conductor when
   (a) Increasing temperature above transition temperature
   (b) Increasing magnetic field above critical field
   (c) Increasing current above critical current

**38. Ans: (d)**

**Sol** A superconductor is used to generate magnetic field.

**39. Ans: (b)**

**Sol:** The bond length of grain boundary is more compare to inside grain and hence they have low energy and easily react with chemical.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**40. Ans: (a)**

**Sol:** Hot working does not vary the recrystallisation temperature (RCT) and cold working reduces RCT.

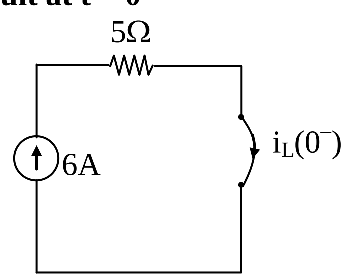
**41. Ans: (a)**

**Sol:** The correct ascending order of the resistivity of Fe, Ag, Constantan, Mica and Aluminium is given below

| **Metal** | **Resistivity(in μΩ-cm)** |
|---|---|
| 1 Fe | 8.85 |
| 2 Ag | 1.51 |
| 3 Constantan | 49 |
| 4 Mica | $\sim 10^{21}$ |
| 5 Aluminium | 2.62 |

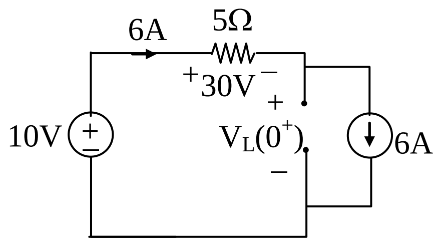
**42. Ans: (a)**

**Sol:** **Circuit at $t = 0^-$**




$i_L(0^-) = i_L(0^+) = 6A$

**Circuit at $t = 0^+$**




By KVL, $10 - 30 - V_L(0^+) = 0$

$\Rightarrow V_L(0^+) = -20$ Volts

**43. Ans: (b)**

**Sol:** Hence, $Y_C + Y_A = 4$

$\Rightarrow Y_A = 4 - Y_C = 4 + 5 = 9℧$

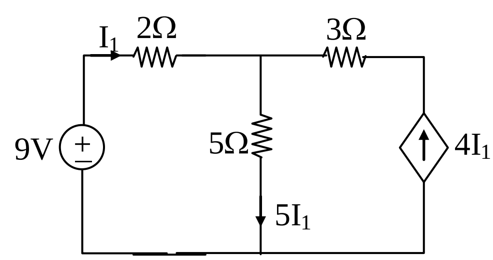
$Y_C = -5℧$

$Y_B + Y_C = 8$

$\Rightarrow Y_B = 8 - Y_C = 8 + 5 = 13℧$

**44. Ans: (c)**

**Sol:**




By KVL, $9 - 2I_1 - 25\, I_1 = 0$

$\Rightarrow 27I_1 = 9$

$$\Rightarrow I_1 = \frac{9}{27} = \frac{1}{3}$$

$$\therefore P_{2\Omega} = I_1^2 R = \left(\frac{1}{3}\right)^2 \times 2 = \frac{2}{9} W$$

$= 0.22$ Watts

**45. Ans: (d)**

**Sol:** By KCL, $8 = I + I + 4I + \frac{I}{2}$

$$\Rightarrow I = \frac{8}{6.5} = \frac{80}{65} = \frac{16}{13} A$$

**46. Ans: (d)**

**Sol:** Q-factor = $\frac{1}{R}\sqrt{\frac{L}{C}} = \frac{1}{10}\sqrt{\frac{25\times10^{-3}}{0.1\times10^{-6}}}$

$$= \frac{1}{10}\sqrt{\frac{25\times10^{-2+6}}{1}} = \frac{5\times100}{10} = 50$$

**47. Ans: (d)**

**Sol:** V(0) = 5×10 = 50 Volts

$V(\infty) = \frac{15\times10}{15} = 10\ \text{Volts}$

$\tau = R_{eq}C$

$= \frac{50}{15}\times10^{3}\times3\times10^{-6}$

$= 10\times10^{-3}$

$= 10^{-2}\ \text{sec}$

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

$= 10 + [50 - 10]e^{-100t}$

$= 10 + 40e^{-100t}$

$V(t) = 10\,(1 + 4e^{-100t})$ Volts

**48. Ans: (a)**

**Sol:** Equivalent Voltage,

V = 40 – 15 + 20 – 15 = 30 Volts

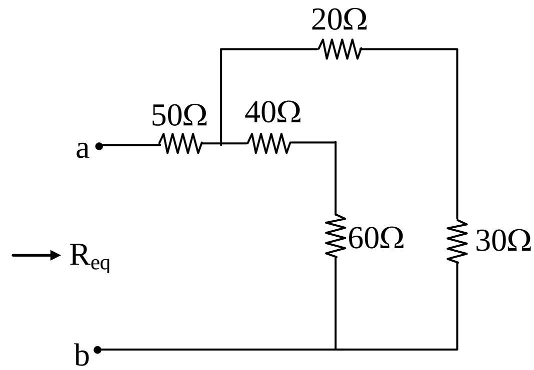
Equivalent Resistance,

R = 5 + 8 + 7 + 5 + 3 = 28 Ω

**49. Ans: (b)**

**50. Ans: (d)**

**Sol:** Using bridge balance condition given circuit can be modified as




$R_{eq} = 50 + [100//50] = 50 + \frac{100\times50}{150}$

$= 50 + \frac{100}{3}$

$= 50 + 33.33 = 83.33\Omega$

**51. Ans: (a)**

**Sol:** $L_1 = 4 - 2 + 1 = 3H$

$L_2 = 8 - 2 + 4 = 2H$

$L_3 = 11 + 1 - 4 = 8H$

$\therefore L_{eq} = 3 + 2 + 8 = 13H$

**52. Ans: (D)**

**Sol:** By observing figure (A) & (B) we can directly say that figure (B) is derivative of figure (A)

V(t) waveform is derivative of i(t) waveform

$V(t) = k\frac{d}{dt}i(t)$ ----(1) k = constant (any)

This equation exactly similar to inductive nature element response

$$V_L(t) = L\frac{di(t)}{dt} \text{----(2)}$$

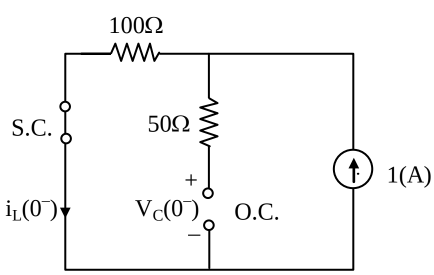
$$L = \frac{V_L(t)}{\frac{di_L(t)}{dt}}$$

$$L = \left.\frac{V_L(t)}{\frac{di_L(t)}{dt}}\right|_{t=10\text{ to }15}$$

$$\Rightarrow L = \frac{-20}{\frac{d}{dt}[-4(t-15)]} = 5H$$

**53. Ans: (D)**

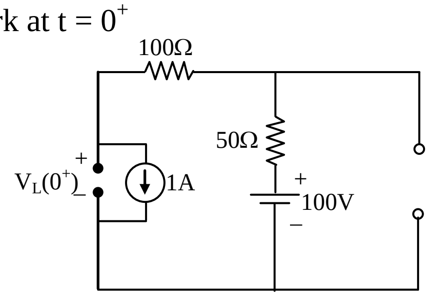
**Sol:** Network at $t = 0^-$ inductor short circuit capacitor open circuit




$V_C(0^-) = 100$ V

$i_L(0^-) = 1$A

network at $t = 0^+$




$-100 + (50\times1)+(100\times1)+V_L(0^+) = 0$

$V_L(0^+) = -50$ V

$$V_L(0^+) = L\frac{di_L(0^+)}{dt}$$

$$\frac{di_L(0^+)}{dt} = \frac{V_L(0^+)}{L} = \frac{-50}{1}$$

$$\frac{di_L(0^+)}{dt} = -50\left(\frac{A}{sec}\right)$$

**54. Ans: (c)**

**55. Ans: (d)**

**Sol:** $V_1 = -20\cos(\omega t+70^0) = 20\cos(\omega t+70-180^0)$

$= 20\cos(\omega t-110^0)$

$V_2 = 40\sin(\omega t-20^0) = 40\cos(\omega t-20-90^0)$

$= 40\cos(\omega t-110^0)$

Hence the phase angle between $V_1$ and $V_2$ is $110 - 110 = 0^0$

**56. Ans: (d)**

**Sol:** By applying superposition theorem

$i_x = 5A$, $i_y = 10A$

**57. Ans: (c)**

**Sol:** $$I_s = \frac{6}{6}+\frac{6}{12}+\frac{6}{3}$$

$$I_s = 1+\frac{1}{2}+2 = 3.5A$$

**58. Ans: (a)**

**Sol:** By KVL $18-2I-3V_0+7-4I = 0$

$18+7 = 6I+3V_0$

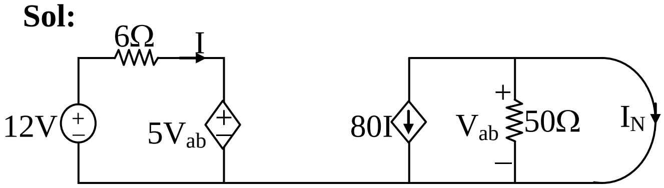
Here $V_0 = 4I$

$6I + 12I = 25$

$$I = \frac{25}{18} A$$

**59. Ans: (b)**

**Sol:**




Hence $V_{ab} = 0$

$$\therefore\ I = \frac{12}{6} = 2A$$

$I_N = -80I$

$I_N = -160A$

**60. Ans: (a)**

**Sol:** In active filter inductor is absent which is bulky and expensive at lower frequency.

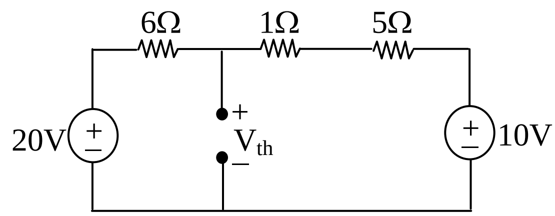
**61. Ans: (b)**

**Sol:** In the given circuit $R_3$ decrease means increase the current through $R_3$ and decrease the current through $R_2$ because $R_2$ and $R_3$ are parallel connection, so power dissipated in $R_2$ decrease.

**62. Ans: (b)**

**63. Ans: (a)**

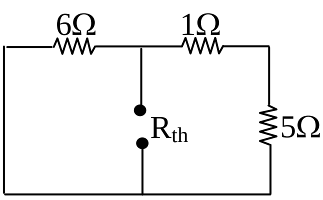
**Sol:** Calculation for $V_{th}$




$$\therefore \frac{V_{th} - 20}{6} + \frac{V_{th} - 10}{6} = 0$$

$\Rightarrow V_{th} = 15$ Volts

**Calculation for $R_{th}$**




$$\therefore R_{th} = 6 // 6 = \frac{6}{2} = 3\Omega$$

$$\therefore P_{max} = \frac{V_{th}}{4R_{th}} = \frac{15^2}{4 \times 3} = \frac{15 \times 15}{4 \times 3}$$

$$= \frac{15 \times 5}{4} = \frac{75}{4} = 18.75W$$

**64. Ans: (a)** **65. Ans: (b)**

**66. Ans: (c)**

**Sol:** reciprocity theorem cannot applied to the non linear network

**67. Ans: (d)**

**Sol:** $BaTiO_3$ can not be used as an amplifier because it is an insulator.

**68. Ans: (c)**

**Sol:** The dielectric constant of the vacuum is less than that of any other medium.

**69. Ans: (d)**

**Sol:** The change in dimension of material (i.e. strain produced in it) when it is magnetized is called 'Magnetostiction'. The deformation is different along different directions and is independent of direction of field.

Based on weiss- Domain Theory, the magnetic

1. Expand at initial field. If is a reversible process
2. Rotate the dipoles in domains in the direction of fields high magnetic field. It is an irreversible process.

**70. Ans: (a)**

**Sol:** Entropy and thermal conductivity decreases with decreasing temperature.

**71. Ans: (c)**

**Sol:** The electrical resistivity of silver is lower than that copper. So the statement II is incorrect.

The electrical conductivity of metal decreases by adding impurities to the host material, even though by adding high conductivity (silver) atoms added to copper as an impurity, it's overall conductivity decreases than pure host material

**72. Ans: (b)**

**Sol:** Internal voltage E becomes lesser than terminal voltage V for low leading power factor, i.e (E – V) is negative. **Statement (I)** is correct.

When the alternator delivers a lagging current, armature reaction can be shown to be demagnetizing. Also the voltage regulation can be shown to be high. **Statement (II)** is true. But it is not the correct explanation for **Statement (I)**.

**73. Ans: (a)**

**Sol:** $\Delta$-Connected tertiary winding offers path to flow of zero sequence current. Such that if any unbalance in secondary load zero sequence current, In tertiary winding eliminates zero sequence EMF in individual phases and makes EMF's balanced.

**74. Ans: (d)**

**Sol:** The main function of a starter in a 3-$\phi$ induction motor is to limit high starting current to reasonable values.

**75. Ans: (a)**

**Sol:** As magnetic monopole does not exist, always magnetic flux lines are continuously closed loops.

Therefore magnetic flux leaving any closed surface is equal to zero

$$\phi\Big|_{\text{closed surface}} = \oint_s \vec{B}.\vec{ds} = 0$$

From divergence theorem

$$\oint_v \nabla.\vec{B}.dv = 0$$

$$\nabla.\vec{B} = 0$$

Hence magnetic flux density is said to be solenoidal.