UPPCL AE 2018 EE 01 Jan 2019

Morning Shift Questions & Solutions

POWERED BY:

gradeup

UPPCL AE 2018 ELECTRICAL ENGINEERING MORNING SHIFT SOLUTIONS

ELECTRICAL ENGINEERING (1 Mark Each)

Q1. Consider a signal g (t), such that g (t) = 0 for t < 0. If the Laplace transform of g (t) is G(s), then with constant τ, the Laplace transform of g (t - τ) is

A. $e^{-s\tau}$ G (s)

B. $e^{s\tau}$ G (sτ)

C. G (s - τ)

D. G (s + τ)

Ans A

Sol –

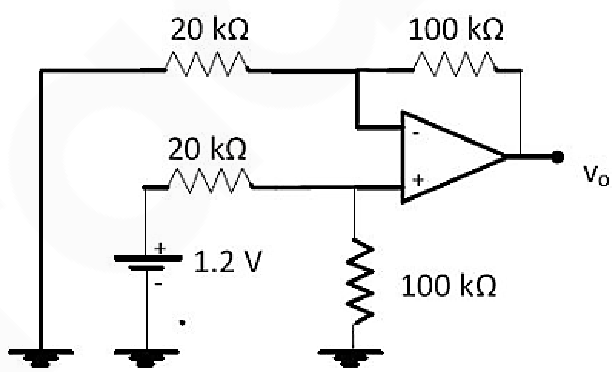
According to the time-shifting property of Laplace transform,

$$L\{x(t-t_0)\} = e^{-t_0 s} X(s)$$

Then,

$$L\{g(t-\tau)\} = e^{-\tau s} G(s)$$

Q2. The op-amp in the circuit shown in the figure works in linear mode. The output voltage v_0 is



A. 5 V

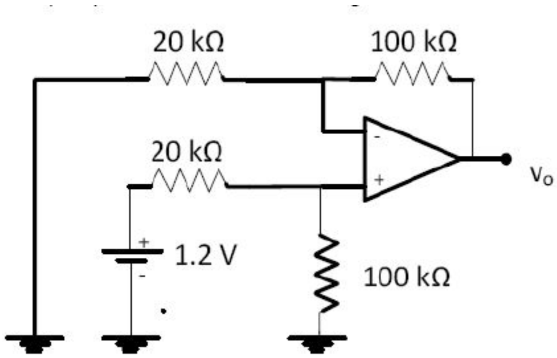
B. 4 V

C. 1 V

D. 6 V

Ans D

Sol –



Appling nodal analysis at terminal V^+

$$\frac{V^+ - 1.2}{20k\Omega} + \frac{V^+ - 0}{100k\Omega} = 0$$
$$V^+ = 1V$$

Appling nodal analysis at terminal V^-

$$\frac{V^- - 0}{20k\Omega} + \frac{V^- - V_{out}}{100k\Omega} = 0$$

According to virtual ground concept

$$V^+ = V^-$$

Therefore,

$$V_{out} = 6V$$

Q3. The causal system represented by $G(s) = \frac{9}{s^2 + 6s + 9}$ is

A. Overdamped
B. Critically damped
C. Undamped
D. Underdamped

Ans B

Sol –

$$G(s) = \frac{9}{s^2 + 6s + 9}$$

Comparing with the standard transfer function

$$G(s) = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

$$2\xi\omega_n = 6$$
$$\omega_n^2 = 9 \Rightarrow \omega_n = 3rad/\sec$$
$$2\times\xi\times3 = 6$$
$$\xi = 1$$

Hence the system is critically damped.

Q4. Auto-transformer is used in the transmission and distribution systems

A. When operator is not available

B. When the transformation ratio for voltage is small

C. When galvanic Isolation is needed.

D. When efficiency of transformer is not critical

Ans B

Sol –

Auto-transformer is used in the transmission and distribution systems where the transformation ratio for voltage is small.

Q5. The effective charge flowing through a wire is given by, q = 5t sin 4πt mC. Calculate the instantaneous current flowing at time t = 0.5 sec.

A. 2.5 mA

B. 3.14 A

C. 31.4 mA

D. 0 A

Ans C

Sol –

The effective charge flowing through a wire is given as $q = 5t\sin(4\pi t)mC$

The current at t = 0.5 seconds

$$i = \frac{dq}{dt}$$
$$i = \left(5\sin(4\pi t) + 5t\times4\pi\cos(4\pi t)\right)$$
$$t = 0.5$$
$$i = 10\pi = 31.4mA$$

Q6. A linear time-invariant system, initially at rest, when subjected to a unit-step input at t = 0, gives a response y (t) = te^{-t} for t ≥ 0. The transfer function of the system is

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

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

C. $\frac{1}{s^2}$

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

Ans A

Sol –

$y(t) = te^{-t}$ For $t \geq 0$

$$L\{e^{-t}\} = \frac{1}{s+1}$$

Applying differentiation property,

$$L\{tx(t)\} = -\frac{d}{ds}X(s)$$

$$L\{te^{-t}\} = -\frac{d}{ds}\left(\frac{1}{s+1}\right)$$

$$L\{te^{-t}\} = \frac{s}{(s+1)^2}$$

Q7. The following are various energy sources:

1. Solar
2. Wind
3. Tidal
4. Wave
5. Geothermal

From the above energy sources, the renewable energy sources are

A. 1, 2, and 4 only

B. All the energy sources mentioned above

C. 1, 2, and 3 only

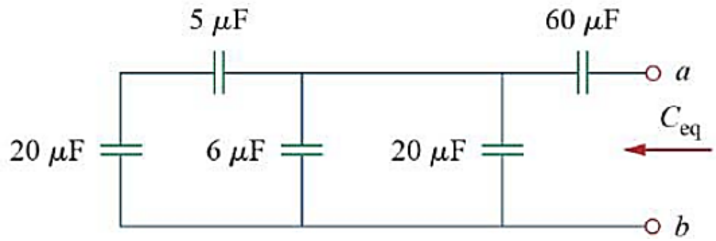
D. 1 and 2 only

Ans B

Sol –

Solar, Wind, Tidal, and Geo-thermal all are renewable energy sources.

Q8. Find the equivalent capacitance, C_{eq} at the terminals a-b of the circuit.

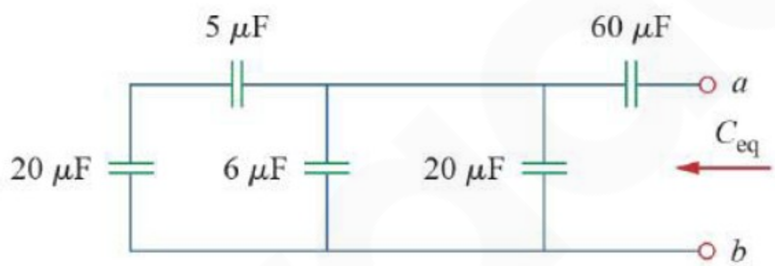


A. 80 μF
B. 85 μF
C. 46 μF
D. 20 μF

Ans D

Sol –

The equivalent capacitance between terminals a-b is:



$$C_{eq} = \{(((5+20) \| 6) \| 20) + 60\}$$
$$C_{eq} = 20\mu F$$

Q9. The average output voltage of a half controlled bridge converter is measured to be 103.53 V. If the bridge it supplied from a 230V, 50 Hz sinusoidal source, the triggering angle of the thyristor in the bridge ¡s approximately.

A. 90°
B. 30°
C. 60°
D. 120°

Ans A

Sol –

The average output voltage of a half wave controlled bridge converter

$$V_{out} = 103.53V$$

$$V_{out} = \frac{V_m}{\pi}(1+\cos\alpha)$$

$$103.53 = \frac{230\times\sqrt{2}}{\pi}(1+\cos\alpha)$$

$$\cos\alpha = 0$$

$$\alpha = 90^0$$

Q10. A sequence u[n] is defined as u[n] $= \begin{cases} 1, if\ n \geq 0 \\ 0, if\ n < 0 \end{cases}$ for $n = \{-\infty, ..., -1, 0, 1, ..., \infty\}$. the transform of u[n] is U (z). The region of convergence for which the z-transform of u[n] exists is

A. |z| > 0

B. |z| = 1

C. |z| > 1

D. |z| < 1

Ans C

Sol –

Consider a signal

$$u[n] = \begin{cases} 1, n \geq 0 \\ 0, n < 0 \end{cases}$$

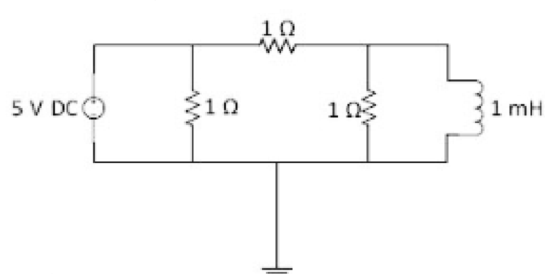
$$Z\{u[n]\} = \frac{1}{1-z^{-1}}$$

The region of convergence is

$$1 - z^{-1} > 0$$

$$|z| > 1$$

Q11. In the given circuit, with the shown Ideal 5V DC source, the magnitude of the total current drawn from the source at steady-state is



A. 2.5 A

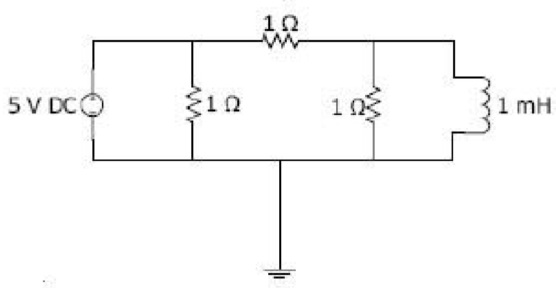
B. 7.5 A

C. 5 A

D. 10 A

Ans D

Sol –



Under steady state conditions, inductor is replaced by short circuited

Therefore, 1 ohm resistor parallel with inductor is neglected.

Therefore current drawn by the 5 V source is

$$I = \frac{5}{0.5} = 10A$$

Q12. In a balanced acb sequence, phase a to neutral voltage is $\bar{V}_{an} = 100\angle 20^\circ$V. Line-to-line voltage $\bar{V}_{ac}$ is given by

A. $\bar{V}_{ac} = \frac{100}{\sqrt{3}}\angle 150^\circ$ V

B. $\bar{V}_{ac} = 100\angle 50^\circ$ V

C. $\bar{V}_{ac} = 100\sqrt{3}\angle -50^\circ$ V

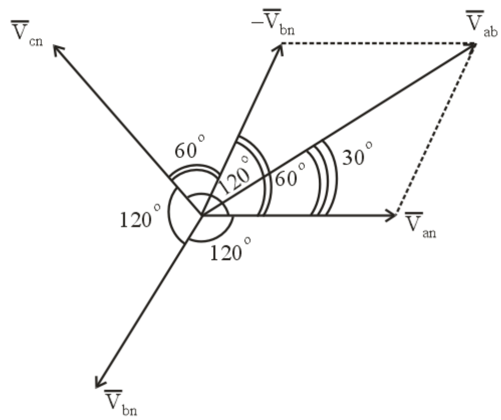
D. $\bar{V}_{ac} = 100\sqrt{3}\angle 50^\circ$ V

Ans D

Sol –

In a balanced acb sequence, $\bar{V}_{an} = 100\angle 20^\circ$

The line-to-line voltage $\bar{V}_{ac}$ is given by the phasor diagram



As, phase voltage is shifted by 20 degree and line to line voltage angle will lead by 50 degrees.

Therefore, $\overline{V}_{ac} = 100\sqrt{3}\angle 50°\text{V}$

Q13. The transfer function $G(s) = \frac{1}{s^2}$ has a 0 dB crossing in its Bode magnitude plot at

A. 100 rad/s

B. 0.1 rad/s

C. 1 rad/s

D. 10 rad/s

Ans C

Sol –

The transfer function is given by $G(s) = \frac{1}{s^2}$

For 0 dB crossing in its Bode plot

$$|G(s)| = 1$$

$$|G(s)| = \frac{1}{\omega^2} = 1$$

$$\omega = 1 rad/\sec$$

Q14. The Impulse response of a causal linear time-invariant system is given as h (t). Now consider the following two statements:

P: The system satisfies superposition principle.

Q: h (t) = 0 for t < 0.

Which of the following is true?

A. P is false and Q is false.

B. P is false and Q is true.

C. P is true and Q is true.

D. P is true and Q is false.

Ans C

Sol –

The impulse response of a causal linear time-invariant is given as h (t)

The first statement is true because only linear systems follows superposition principle.

The second statement is true because the given system is causal since

$$h(t) = 0 \quad t < 0$$

Q15. A water holler at a home in Lucknow is switched to the AC mains supply power. The frequency of instantaneous power consumed by the boiler is

A. 100 Hz

B. 50 Hz

C. 30 Hz

D. 0 Hz

Ans A

Sol –

The frequency of instantaneous power is twice the input supply frequency.

Q16. For an ideal single phase transformer with primary to secondary turns ratio of N: 1, the ratio of instantaneous input power to instantaneous output power is

A. N^2: 1

B. 1: 1

C. 1: N

D. N: 1

Ans B

Sol –

Given that

$$\frac{N_P}{N_S} = \frac{N}{1} = N:1$$

Then the instantaneous input power to instantaneous output power is given by

$$\frac{P_i}{P_o}=\frac{V_iI_i}{(NV_i)\left(\frac{1}{N}I_i\right)}=1:1$$

Q17. An electrostatic field is given by $\vec{E}=\left(\frac{x}{2}+2y\right)\hat{i}+2x\hat{j}$ V/m. Find the work done in moving a point charge Q = - 20 μC from the origin to (4, 0, 0) m. $(\hat{i},\hat{j})$ are the unit vectors along x, y axes.

A. 40 μJ

B. 80 J

C. 80 μJ

D. 40 kJ

Ans C

Sol –

An electrostatic field is given as

$$\vec{E}=\left(\frac{x}{2}+2y\right)\hat{i}+2x\hat{j}\quad V/m$$

The work done in moving a point charge $Q=-20\ \ \mu C$ from the origin to point (4, 0, 0)

$$W=V.Q$$
$$V=-\int E.dl$$

As y ordinate doesn't changes along the path therefore y = 0, then dy = 0

Putting y = 0 in Electric Field and integrating wrt to x,

$$V=-\int_0^4\frac{1}{2}xdx=-\frac{1}{4}\left[x^2\right]_0^4=-\frac{1}{4}[16]=-4V$$

$$W=-4\times-20$$

$$W=80\ \ \mu J$$

Q18. A parallel-plate capacitor has an area A = 2 × 10^{-4} m^2 and a plate separation d = 1 mm. Permittivity of free space, $\epsilon_0=8.85\times10^{-12}\frac{c^2}{Nm^2}$. its capacitance is,

A. 4.23 nF

B. 1.77 nF

C. 4.23 μF

D. 1.77 pF

Ans D

Sol –

$$A = 2 \times 10^{-4} m^2$$
$$d = 1mm$$
$$\in_o = 8.85 \times 10^{-12} \frac{C^2}{Nm^2}$$
$$C = \frac{\in_o A}{d}$$
$$C = \frac{8.85 \times 10^{-12} \times 2 \times 10^{-4}}{10^{-3}}$$
$$C = 17.7 \times 10^{-13} F$$
$$C = 1.77 \text{pF}$$

Q19. What is the total electric flux through the surface of a sphere that has a radius of 1 m and carries a charge of 1 μC at its center? Coulomb constant is given by $k_e = \frac{1}{4\pi \in_0} = 8.99 \times 10^9$ N-m²/C²; $\in_0$ is the permittivity of free space.

A. 0.28×10^5 N.m^2

B. 1.13×10^5 N.m^2

C. 3.98×10^3 N/C

D. 8.99×10^3 N.m^2/C

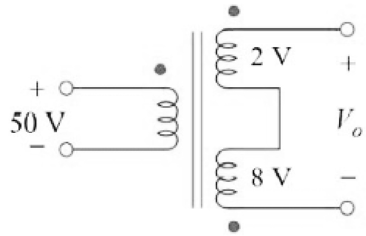
Ans B

Sol –

Total electric flux through the sphere is given by

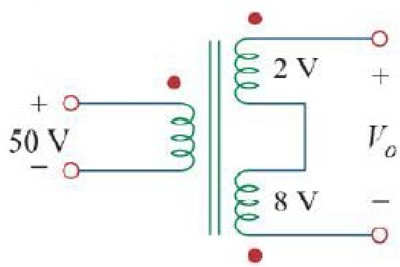
$$\phi = \frac{q}{\in_o}$$
$$\phi = \frac{10^{-6}}{\in_o} = \frac{10^{-6}}{8.85 \times 10^{-12}} = 0.113 \times 10^6 = 1.13 \times 10^5$$

Q20. A three-winding transformer is connected to an AC source with 50V rms as shown in the following figure. Voltages induced in the secondary windings are 2 V rms and 8V rms. The output rms voltage V_0 is,



A. -6 V
B. 10 V
C. -10 V
D. 6 V
Ans A

Sol –



Taking Dot side be positive end and apply KVL loop in secondary terminals

$$V_o - 2 + 8 = 0$$
$$V_o + 6 = 0$$
$$V_o = -6V$$

Q21. A DC-DC buck boost converter is operated with continuous current mode. If the Input voltage is 50 V and the duty cycle of the switch is 0.6, the output DC voltage is

A. 50 V
B. 35 V
C. 65 V
D. 75 V
Ans D

Sol –

The output DC voltage of Buck-Boost converter is given as

$$V_o = \frac{\delta V_s}{(1-\delta)}$$

Where,

$\delta = 0.6$

and

$V_S = 50V$

Putting the values of $\delta and V_S$

$$V_o = \frac{0.6 \times 50}{(1-0.6)} = \frac{30}{0.4} = 75\text{Volts}$$

Q22. A circuit with a resistor, inductor, and capacitor in series has a resonant frequency of f0 Hz. If all the component values are now doubled, the new resonant frequency is

A. $f_0/2$

B. $f_0/4$

C. 2 f_0

D. f_0

Ans A

Sol –

Resonating frequency = f_o

The formula for the resonating frequency for series R-L-C circuit is given by

$$f_o = \frac{1}{2\pi\sqrt{LC}}\text{Hz}$$

Now, both the values of inductor and capacitor is doubled.

Therefore, new resonating frequency is

$$\frac{f_o}{f_o^{'}} = \frac{1/2\pi\sqrt{LC}}{1/2\pi\sqrt{2L.2C}} = 2$$

$$\frac{f_o}{f_o^{'}} = 2$$

$$f_o^{'} = \frac{f_o}{2}$$

Q23. A single phase full bridge voltage source inverter is operated with SPWM (sinusoidal pulse width modulation). The input DC voltage is 100 V. If the amplitude modulation index is 1, the rms value of fundamental component of output voltage is

A. 141.4 V

B. 50. 3 V

C. 70.7 V

D. 90.7 V

Ans C

Sol –

For PWM full bridge inverter

$$V_{out_{fundamental}} = 0.707 \times m \times V_{dc}$$
$$V_{out_{fundamental}} = 0.707 \times 1 \times 100$$
$$V_{out_{fund.}} = 70.7\text{V}$$

Q24. The equation $e_f = -\frac{d\phi}{dt}$, where e_f is the emf and φ is the flux linkage in a single-turn coil, can best represent

A. Faraday's Law and Lenz Law

B. Faraday's Law

C. Lenz Law and Biot-Savart Law

D. Biot-Savart Law

Ans A

Sol –

The equation $e_f = -\frac{d\phi}{dt}$ represents the faraday's law of electromagnetic induction which states the rate of change of flux and Lenz's Law which states that the flux produced opposes the rate of change of flux.

Q25. A load-flow program is run twice. In the second run, the previous reference bus gets changed to a PQ bus. Which one of the following statements is true?

A. The system losses as well as complex bus voltages will change.

B. Load flow result will remain same in all aspects.

C. The system losses will be unchanged but the complex bus voltages will change.

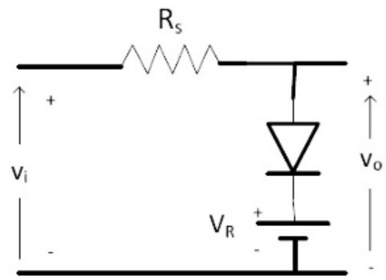
D. The system losses will change but the complex bus voltages will remain same.

Ans C

Sol –

When a load-flow program is run twice, in the second run, the previous reference bus gets changed to PQ bus then the losses in the system remains unchanged but the complex bus voltages will change.

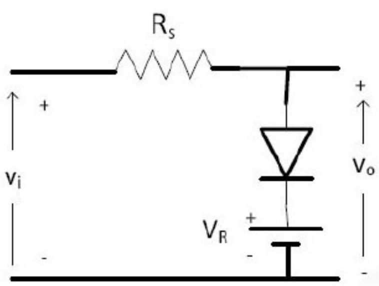
Q26. In the diode circuit shown v_i = 10 sin 314.159 t V and VR = 5 V. Assume the diode to be ideal. The maximum and minimum values of the output voltage (v_o) are, respectively,



A. +5 V and -10 V
B. +10 V and -5 V
C. 10 V and -10 V
D. +5 V and -5 V

Ans A

Sol –

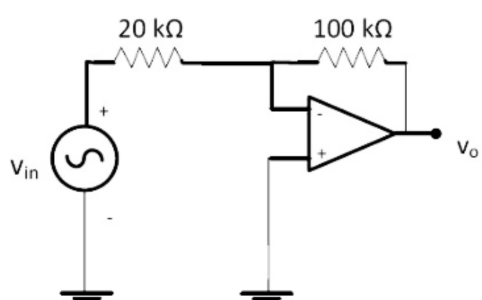


During the positive half cycle, when the input supply is below 5 V, then the diode will be reverse biased therefore the input voltage will be the output voltage. And when the input supply is greater than 5 V, then the diode will become forward biased therefore the output voltage becomes 5 V.

Therefore, the maximum value of output voltage is 5 V

Now, during the negative half cycle, the diode is always the reverse biased therefore the minimum value of output voltage can go up to 10 V.

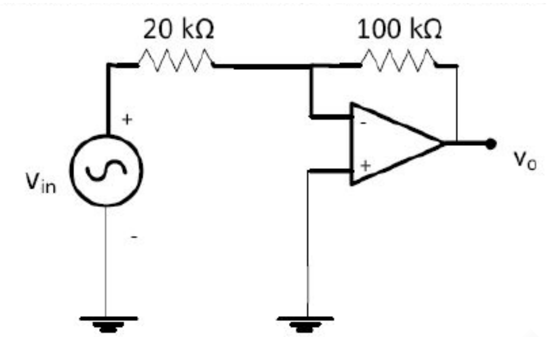
Q27. The open-loop gain-bandwidth product of an op-amp is given as 10,000 Hz. The op-amp is used in an inverting amplifier as shown in the figure. The bandwidth of the inverting amplifier is



A. 5000 Hz
B. 2000 Hz
C. 10,000 Hz
D. 1000 Hz

Ans B

Sol –



Gain x Bandwidth product = Constant = 10,000 Hz

Now, the gain can be calculated as

Applying nodal analysis at $V^{-} and$ $V^{-} = 0V$

$$\frac{V_{in} - 0}{20k\Omega} = \frac{0 - V_o}{100k\Omega}$$

$$Gain = \left|\frac{V_o}{V_{in}}\right| = 5$$

Bandwidth = $\frac{10,000}{5} = 2,000\text{Hz}$

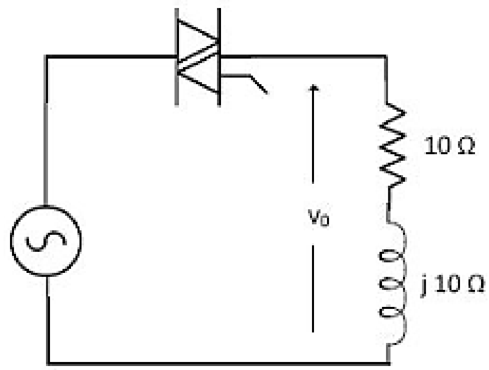
Q28. The compensating winding in a DC machine
A. is located a commutators.
B. ¡s located on pole shoes.
C. is located in armature slots.
D. is located on the commutating poles.

Ans B

Sol –

The compensating winding in the DC machines is located in the pole shoes.

Q29. A triac based single phase voltage regulator feeds an R-L load as shown in the figure. What is the range of triggering angle for which the output voltage v_o is not controllable?



A. 90° ≤ α ≤ 180°

B. 0° ≤ α ≤ 45°

C. 45° ≤ α ≤ 90°

D. 45° ≤ α ≤ 180°

Ans B

Sol –

For controlling the load the minimum value of firing angle must be greater than the load phase angle.

Therefore, $\phi = \tan^{-1}\left(\frac{\omega L}{R}\right) = \tan^{-1}\left(\frac{10}{10}\right) = 45°$

Firing angle for which the output voltage is uncontrollable is

$$0 \le \alpha_{\min} \le \phi$$
$$0 \le \alpha_{\min} \le 45°$$

Q30. A transmission line of surge impedance 300 Ω is connected to load of 300 Ω. The reflection coefficient of transmission line at the load end will be

A. -1

B. +1

C. 2

D. 0

Ans D

Sol –

Surge impedance = 300 ohms

Load impedance = 300 ohms

Reflection coefficient of transmission line at load end = $\frac{Z_C - Z_L}{Z_C + Z_L}$

Therefore, $\tau_r = 0$

Q31. To ensure successful turn-on of a thyristor, the minimum gate pulse width of the thyristor gate pulse should be sufficient to ensure the cathode current to reach

A. the holding value of thyristor current

B. the peak value of thyristor current

C. the latching value of thyristor current

D. 50% of the peak value of thyristor current

Ans C

Sol –

To ensure the successful turn-on of a thyristor, the minimum gate pulse width of the thyristor gate pulse should be sufficient to ensure the cathode current to reach the latching value of thyristor current.

Q32. For a non-ideal single-phase transformer, which of the following is not true?

A. Open circuit test can reveal resistance and leakage reactance of transformer windings.

B. Open circuit test reveals approximately the magnetizing inductance and the core-loss resistance.

C. Short circuit test reveals approximately the resistance and leakage reactance of the transformer windings.

D. Open circuit test is usually done on the low voltage side of a transformer.

Ans A

Sol –

For a non-ideal single-phase transformer, open circuit test can reveal resistance and leakage reactance of transformer windings.

Q33. The purpose of emitter bypass capacitor in a CE BJT amplifier is to

A. increase the mid band voltage gain of the amplifier

B. provide a stable biasing for the amplifier

C. place the Q-point of the transistor in active region

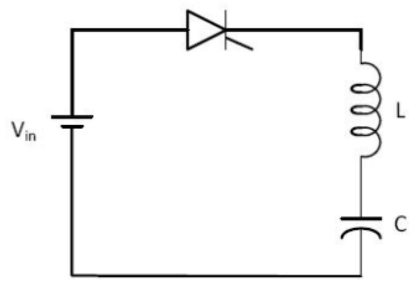
D. prevent saturation of the amplifier

Ans A

Sol –

The purpose of emitter bypass capacitor in a CE BJT amplifier is to increase the mid-band voltage gain of the amplifier.

Q34. The SCR in the circuit is turned on at t = 0. The conduction time duration of the SCR is



A. √LC

B. 2π√LC

C. π√LC

D. 1/(2π√LC)

Ans C

Sol –

The conduction time of the thyristor in one complete cycle is

$$t_c = \pi\sqrt{LC}$$

This can be seen by drawing the output voltage waveform.

Q35. Two inductors of 5 H and 4 H have mutual inductance of 2.5 H between them. The coupling coefficient is

A. 0.56

B. 1.78

C. 4.47

D. 0.125

Ans A

Sol –

$$L_1 = 5\text{H}$$
$$L_2 = 4\text{H}$$
$$M = k\sqrt{L_1 L_2}$$
$$M = 2.5\text{H}$$
$$2.5 = k\sqrt{5 \times 4}$$
$$k = \frac{2.5}{\sqrt{20}} = 0.56$$

Q36. A single phase power transformer is to be energized (switched on to the input supply) to have minimal inrush current. The switching-on instant should be at

A. Zero input voltage

B. 1/√2 of the maximum input voltage

C. ½ of the maximum input voltage

D. Maximum input voltage

Ans D

Sol –

When a single phase transformer is energized by input supply to have minimal inrush current, then the switching-on instant should be at maximum input voltage.

Q37. An ideal air-core coil has an inductance of 2 mH. The number of turns of the coil is doubled and its length is halved. Assuming that the inner cross-sectional area of the core remains constant, the new inductance of this altered air-core coil is

A. 4 mH

B. 16 mH

C. 32 mH

D. 8 mH

Ans B

Sol –

L $\alpha \left(\frac{N^2}{l}\right)$

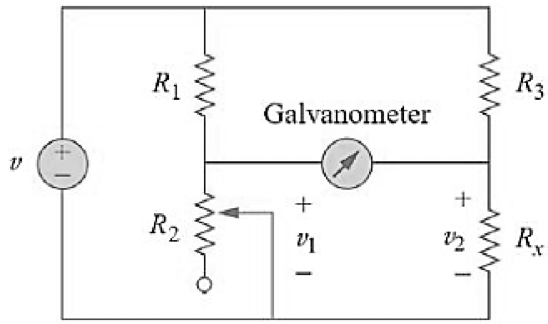
Where N is the total number turns and

L is the length of the coil

Putting the values and finding the ratio, we get

$$L^{'} = 16\text{mH}$$

Q38. In the given Wheatstone bridge, R_1 = 500 Ω, R_3 = 200 Ω. The bridge is balanced when R_2 is adjusted to 125 Ω. Determine the unknown resistance R_x.



A. R_x = 100 Ω

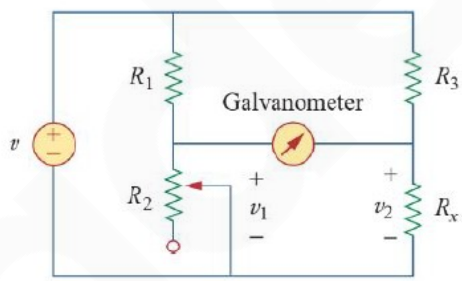
B. R_x = 125 Ω

C. R_x = 200 Ω

D. R_x = 50 Ω

Ans D

Sol –



By the condition of wheat stone bridge,

$$R_1 \cdot R_x = R_2 \cdot R_3$$
$$500 \times R_x = 200 \times 125$$
$$R_x = 50\Omega$$

Q39. The minimum phase attained for the frequency response of a causal system $G(s) = \frac{s+10}{(s+1)(s+2)}$ as the frequency varies from 0 to ∞ rad/s is

A. -90 degrees

B. -180 degrees

C. 180 degrees

D. 90 degrees

Ans A

Sol –

$$G(s) = \frac{s+10}{s^2+3s+2}$$

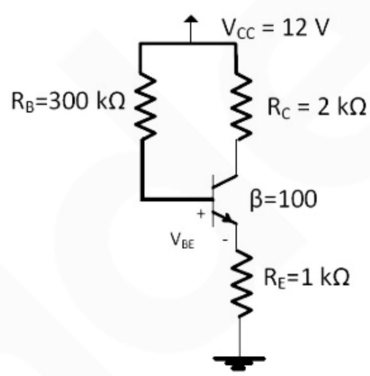
$$\angle G(j\omega) = \tan^{-1}\left(\frac{\omega}{10}\right) - \tan^{-1}\left(\frac{2-\omega^2}{3\omega}\right)$$

At $j\omega = 0 \Rightarrow \angle G(j\omega) = 0$

At $j\omega = \infty \Rightarrow \angle G(j\omega) = 90° - 180° = -90°$

Therefore, the minimum phase attained is $-90°$

Q40. A BJT biasing circuit is shown in the figure. The transistor is operating in the active region with V_{BE} = 0.7 V. The value of collector current in mA is



A. 1.210

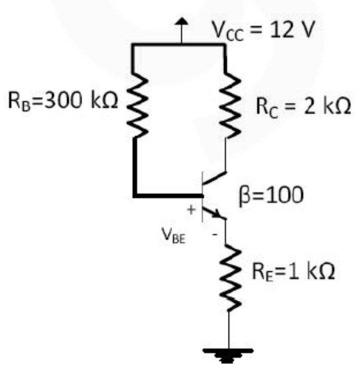
B. 4.813

C. 2.817

D. 3.512

Ans C

Sol –



$V_{BE} = 0.7\text{V}$

Applying KVL in input loop:

$$V_{CC} - (R_B \times I_B) - V_{BE} - ((\beta+1) I_B \times R_E) = 0$$
$$12 - (300 \times I_B) - 0.7 - 101 \times I_B = 0$$
$$11.3 - 402 I_B = 0$$
$$I_B = 0.0281\text{mA}$$
$$I_C = \beta I_B = 100 \times 0.0281 = 2.81\text{mA}$$

Q41. A Buchholz relay is used for

A. None of the options

B. Protection of a transformer against internal faults

C. Protection of a transformer against external faults

D. Protection of a transformer against internal and external faults

Ans B

Sol –

A Buchholz relay is used for protection of a transformer against internal faults.

Q42. Consider the following Laplace transforms of certain signals. For which of the following, final value theorem is not applicable?

A. $\frac{s-1}{s+2}$

B. $\frac{s+1}{(s+2)(s+3)}$

C. $\frac{s+1}{s-2}$

D. $\frac{s+1}{s+2}$

Ans C

Sol –

For the final value theorem of the Laplace transform to be holds good, the system must be stable.

Therefore, from the options $\frac{s+1}{s-2}$ is unstable because the pole lie on the right hand side of the s-plane and therefore the final value theorem cannot be applied.

Q43. The graph of an electrical network has N nodes and B branches. The number of links, L, for any tree spanning all nodes is given by

A. B – N + 1

B. B + N

C. N – 2B + 1

D. N – B + 1

Ans A

Sol –

The number of links in the graph is equal to the B – N + 1 which is also equal to the total number of KVL equations in the network.

Q44. For operation in the normal active mode for a BIT, which of the following conditions is true?

A. Both B-E and C-B junctions should be forward biased.

B. B-E junction should be forward biased and C-B junction should be reversed biased.

C. Both B-E and C-B junctions should be reversed biased.

D. B-E junction should be reversed biased and C-B junction should be forward biased.

Ans B

Sol –

For the operation of BJT in forward active mode or normal active mode, the base to emitter junction is forward biased and the collector to base junction is reversed biased.

Q45. Inductance of a power transmission line increases with

A. Increase in spacing between the phases conductors

B. Increase in diameter of the conductor

C. Decrease in line length

D. Increase in load current carried by the conductor

Ans A

Sol –

The inductance of a power transmission line is increased with increase in spacing between the phase conductors.

Q46.The inductance of a certain moving-iron ammeter is expressed as $L = 10 + 3\theta - \frac{\theta^2}{4}$ μH, where θ is the deflection in radians from the zero position. The control spring torque is 25 × 10^{-6}

Nm/radian. The deflection of the pointer in radians, when the meter carries current of 5 A rms, is

A. 2.0

B. 1.2

C. 2.4

D. 1.0

Ans B

Sol –

Given that the inductance of the moving-iron type ammeter is given as $L = 10 + 3\theta - \frac{\theta^2}{4}\,\mu\text{H}$

$K = 25\times10^{-6}\,\text{Nm/radian}$

$I = 5A$

For the balanced null operation,

Deflecting torque = Controlling torque

$$K\theta = \frac{1}{2}i^2\frac{dL}{d\theta}$$

$$25\times10^{-6}\times\theta = \frac{1}{2}\times(5)^2\times\left(3-\frac{\theta}{2}\right)\times10^{-6}$$

$$\theta = \frac{1}{2}\left(3-\frac{\theta}{2}\right)$$

$$2\theta = 3-\frac{\theta}{2}$$

$$\frac{5\theta}{2} = 3$$

$$\theta = 1.2\text{rad}$$

Q47. The time constant of the causal system represented by $G(s) = \frac{1}{s+5}$ is

A. 5 seconds

B. 0.2 seconds

C. π/10 seconds

D. 10/π seconds

Ans B

Sol –

Given system is $G(s) = \frac{1}{s+5}$

Comparing with the standard time constant system i.e. $G(s) = \frac{1}{1+\tau s}$

$\tau = 0.2\sec$

Q48. A 3-phase transformer bank is realized using three identical 1100/230 V, 10 kVA single phase transformers connected in delta-delta. If one of the single phase transformers develops a fault and is removed, the maximum load that the transformer bank in open delta can supply is

A. 5.77 kVA

B. 17.32 kVA

C. 11.54 kVA

D. 30 kVA

Ans B

Sol –

When the operation is carried out in V – V or open delta connection,

Only, 86.6 % of the rated capacity is available

Therefore, $20 \times 0.866 = 17.32\text{KVA}$

Q49. Kelvin double bridge is best suited for the measurement of

A. High resistance

B. Capacitance

C. Low resistance

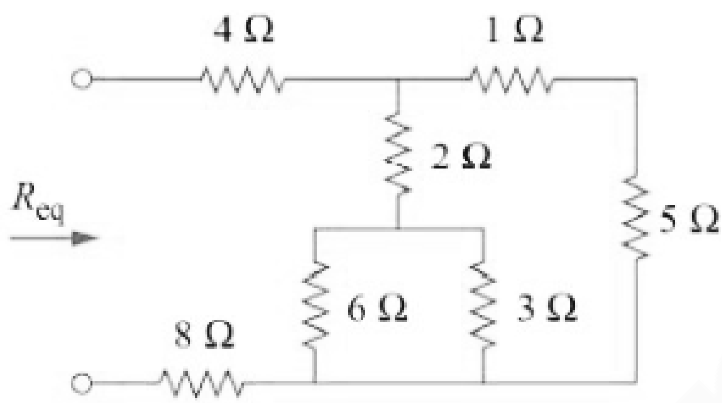
D. Inductance

Ans C

Sol –

Kelvin double bridge is best suited for the measurement of low resistance.

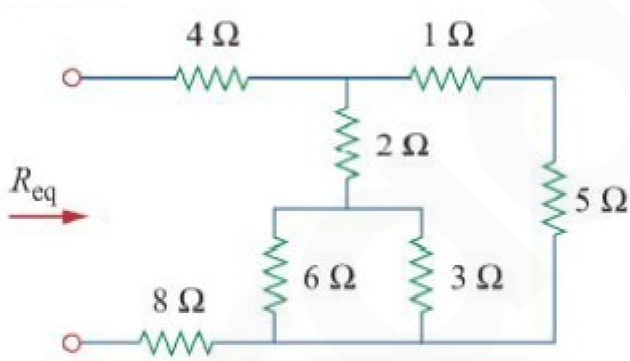
Q50. Find the equivalent resistance, R_{eq}, looking into the terminals of the following circuit as indicated.



A. 15.2 Ω
B. 12.4 Ω
C. 10 Ω
D. 14.4 Ω

Ans D

Sol –



For finding the equivalent resistance,

6 ohm and 3 ohms are in parallel

Then, parallel of 6 and 3 is in series with 2 ohm resistor and 5 and 1 are in series and whole combination of both branches are in parallel and combined to these two are in series with 4 and 8 ohms resistor.

Therefore, the value of equivalent resistance is calculated as

$R_{eq} = 14.4\Omega$

ELECTRICAL ENGINEERING (2 Mark Each)

Q1. A single phase full bridge voltage source inverter is operated in 180° mode with square wave output. If the input DC supply is 100 V, the rms value of the fundamental output voltage is

A. 90 V

B. 70 V

C. 50 V

D. 80 V

Ans A

Sol –

When a single phase full bridge voltage source inverter is operated in $180°$ conduction mode with square wave output.

$V_{dc} = 100\text{V}$

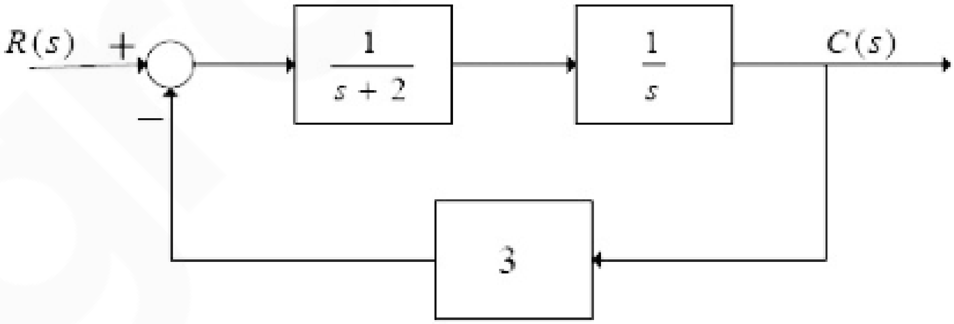
The fundamental value of the output voltage is given as

$$V_{out_{fundamental}} = \frac{2\sqrt{2}}{\pi} V_{dc}$$

$$= \frac{2\sqrt{2}}{\pi} \times 100$$

$$= 90.03\text{V}$$

Q2. Consider the system in the figure shown. The input to the system is R(s) and the output of the system is C(s). The system is of Type



A. 2

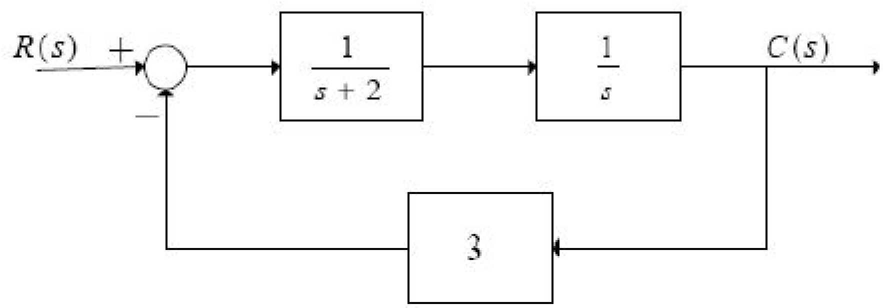
B. 3

C. 0

D. 1

Ans C

Sol –



The total open loop gain is $G(s)=\dfrac{1}{s(s+2)}$

Now, the closed loop transfer function is

$$T(s)=\frac{G(s)}{1+G(s)\cdot H(s)}$$

$$=\frac{1/s(s+2)}{1+\left[3/s(s+2)\right]}=\frac{1}{s^2+2s+3}$$

As seen from the closed loop transfer function, there is no pole at origin therefore the type of the system is zero.

Q3. A factory draws 100 kW at 0.8 p.f. lagging from a 3-phase, 11 kV supply. It is desired to raise the p.f. to unity using capacitor bank. The total power rating of the capacitor bank is

A. 62.5 kVAR

B. 75 kVAR

C. 100 kVAR

D. 50 kVAR

Ans B

Sol –

A factory consumes 100 KW of power at 0.8 p.f lagging

Now, to make the power factor to unity, the capacitor bank is inserted

The rating of the capacitor bank is

$P = S\cos\phi$

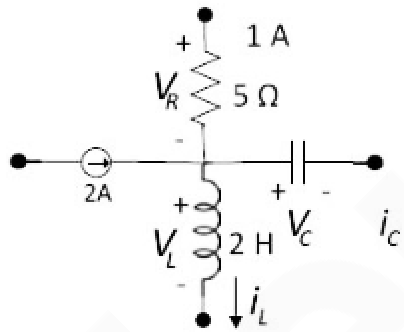
$100 = S \times 0.8$

$S = 125\text{KVA}$

$Q = S\sin\phi$

$Q = 125 \times 0.6 = 75\text{KVAR}$

Q4. A segment of a circuit is shown in the figure below. If V_R = 5V and V_C = 4sin2t V, the voltage V_L is



A. 3 – 8 cos 2t V

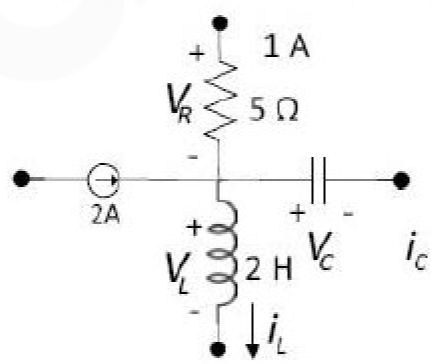
B. 16 cos 2t V

C. 16 sin 2t V

D. 32 sin 2t V

Ans D

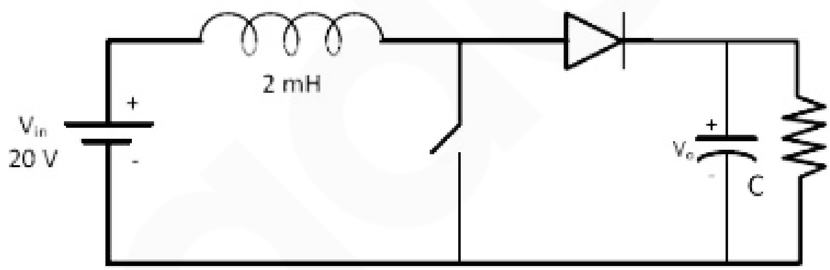
Sol –



Applying KCL at common node,

$$2-\frac{V_R}{5}+\frac{1}{L}\int V_L dt+C\frac{dV_C}{dt}=0$$
$$2-\frac{5}{5}+\frac{1}{2}\int V_L dt+1\cdot\frac{dV_C}{dt}=0$$
$$1+\frac{dV_C}{dt}=-\frac{1}{2}\int V_L dt$$
$$1+\frac{d}{dt}\left(4\sin 2t\right)=-\frac{1}{2}\int V_L dt$$
$$2\left(1+8\cos 2t\right)=-\int V_L dt$$
$$\frac{d}{dt}\left(2+16\cos 2t\right)=-V_L$$
$$0-32\sin 2t=-V_L$$
$$V_L=32\sin\left(2t\right)\text{V}$$

Q5. In a boost converter shown in the figure, the duty cycle is 0.5. The inductor current is assumed to be continuous. Capacitor C is assumed to be very large. If the switching frequency is 20 kHz, the peak to peak inductor current ripple is



A. 0.25 A

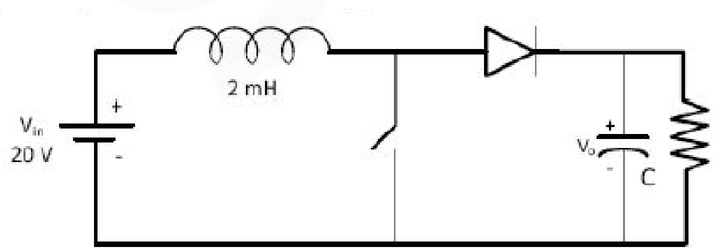
B. 0.35 A

C. 0.15 A

D. 0.45 A

Ans A

Sol –

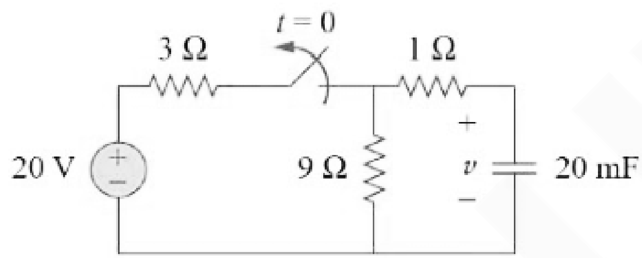


The peak to peak ripple inductor current is given as

$$\Delta I = \frac{\delta V_S}{fL}$$

$$\Delta I = \frac{0.5 \times 20}{20 \times 10^3 \times 2 \times 10^{-3}} = 0.25\text{A}$$

Q6. The switch in the circuit has been closed for a long time, and it is opened at time t = 0. Find v (t) for t ≥ 0.



A. v (t) = $15e^{-20t}$ V

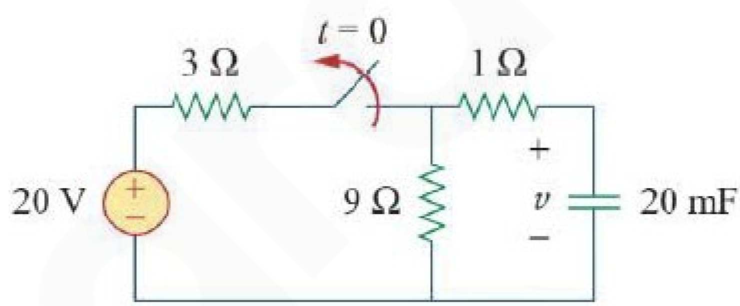
B. v (t) = 0 V

C. v (t) = $15e^{-5t}$ V

D. v (t) = 15 V

Ans C

Sol –



For $t < 0$ capacitor is open circuited

$$V_C(0^-) = 15\text{V}$$

For $t \geq 0$, the circuit becomes source free,

$$V_C(t) = V_C(0^+)e^{-t/\tau}\text{V}$$

$$\tau = RC = 10\times 20\times 10^{-3} = 0.2\sec$$

$$V_C(t) = 15\cdot e^{-t/0.2}V$$

$$V_C(t) = 15e^{-5t}\text{V}$$

Q7. A combinatorial circuit is described by a function as the sum of min-terms. The function is defined as f(A,B,C) = ∑m(0,1,2,3,4,5,6)

A is the MSB and C is the LSB. The minimized expression of the function is

A. $\overline{A}+\overline{B}+\overline{C}$

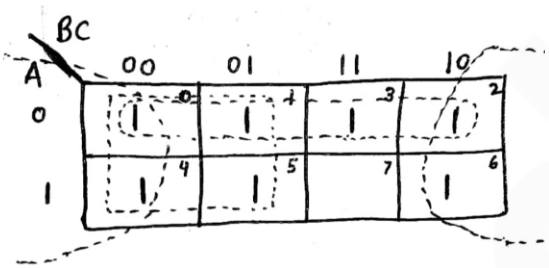
B. ABC

C. $\overline{A}+\overline{B}+C$

D. $\overline{B}+\overline{C}$

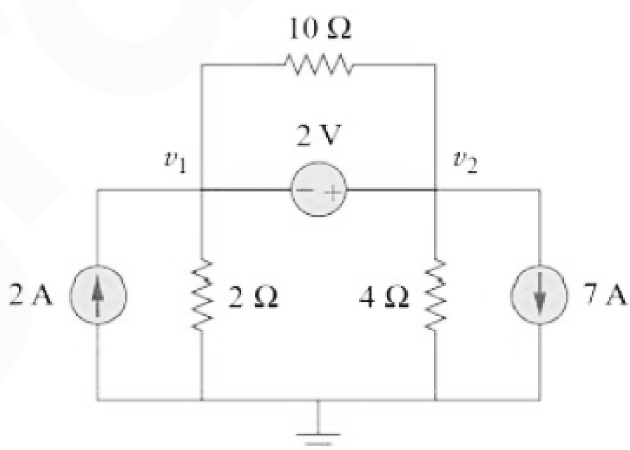
Ans A

Sol –



$\overline{A}+\overline{B}+\overline{C}$

Q8. For the circuit shown in the figure, find the node voltages v_1 and v_2.



A. v_1 = 4 V, v_2 = - 28 V

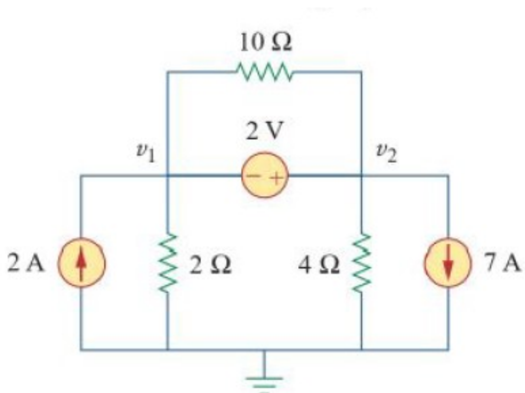
B. v_1 = 8.33 V, v_2 = 10.33 V

C. v_1 = 6 V, v_2 = 8 V

D. v_1 = - 7.33 V, v_2 = - 5.33 V

Ans D

Sol –



Applying the concept of super node i.e. KCL

$$2 = \frac{V_1 - 0}{2} + \frac{V_2 - 0}{4} + 7$$
$$8 = 2V_1 + V_2 + 28$$
$$V_2 = -20 - 2V_1$$

Now, applying KVL at super node:

$$-V_1 - 2 + V_2 = 0$$
$$V_2 = V_1 + 2$$

Equating both equations, we get

$$V_1 = -7.33\text{V}$$
$$V_2 = -5.33\text{V}$$

Q9. An open circuit test is conducted on an 1100/110 V, 50 Hz single-phase transformer with instruments connected on the low voltage side of the transformer. The voltmeter reads 110 V. The ammeter reads 2A. The wattmeter reading is 65 W. The approximate core-loss resistance and magnetizing reactance, referred to the low voltage side, are respectively,

A. 1.8615 Ω, 0.5757 Ω

B. 18615 Ω, 5757 Ω

C. 186.15 Ω, 57.57 Ω

D. 18.615 Ω, 5.757 Ω

Ans C

Sol –

A single phase transformer of 1100/110 V, 50 Hz

$$V_o = 110\text{V}$$
$$I_o = 2\text{A}$$
$$P_o = 65\text{W}$$

$$P_o = V_o I_o \cos\phi_o$$
$$\cos\phi_o = \frac{P_o}{V_o I_o} = \frac{65}{110\times 2} = 0.3$$
$$\phi_o = \cos^{-1}(0.3) = 72.81°$$
$$\sin\phi_o = 0.96$$
$$I_w = I_o\cos\phi_o = 0.6A$$
$$I_m = I_o\sin\phi_o = 1.9A$$
$$R_o = \frac{V_o}{I_w} = \frac{110}{0.6} = 183.33\Omega$$
$$X_m = \frac{V_o}{I_m} = 57.89\Omega$$

These options are not given in the questions but comparable to the option C

Q10. A 240 V DC shunt motor has an armature resistance of 0.6 Ω. The full load armature current is 30 A. The ratio of the stalling torque to the full load torque when a resistance of 1 Ω is connected in series with the armature is

A. 6

B. 5

C. 3

D. 4

Ans B

Sol –

The full load armature current is 30 A

When 1 ohm resistor is connected in series then the total resistance becomes 1.6 ohms.

Stalling torque is torque at which speed falls to zero i.e. N = 0

$$N \alpha \frac{E_b}{\phi} \Rightarrow E_b = 0$$

$$0 = E_b - I_{a_2} R_{eq}$$

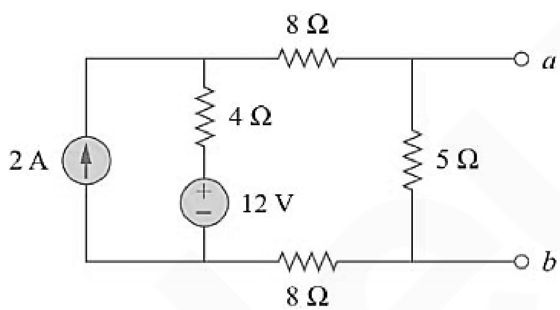
$$0 = 240 - I_{a_2} \times 1.6$$

$$I_{a_2} = 150\text{A}$$

$$\text{T} \alpha \text{I}_a$$

$$\frac{T_{stalling}}{T_{full-load}} = \frac{150}{30} = 5$$

Q11. Find Norton equivalent resistance, R_N, and equivalent current source, i_N, at terminals a and b of the circuit.



A. R_N = 4 Ω, I_N = 1 A

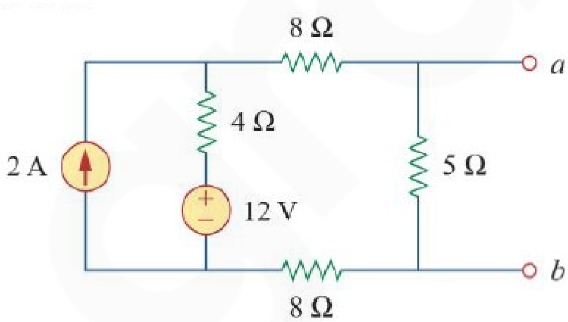
B. R_N = 5 Ω, I_N = 2 A

C. R_N = 3.53 Ω, I_N = 0.71 A

D. R_N = 12 Ω, I_N = 2 A

Ans A

Sol –



For Norton resistance, replace the sources by their internal resistance.

Voltage source is replaced by short-circuited and current source is replaced by open-circuited.

Then finding the equivalent resistance across terminals ab:

$$R_{eq} = R_N = R_{th} = 20 \,||\, 5 = 4\Omega$$

Then finding the Norton current I_N , a-b terminals is shorted and therefore the 5 ohm resistor is eliminated.

Then finding current in branch a-b

$I_N = 1\text{A}$

Q12. The positive value of K for which $\left[1+\frac{K}{(s+1)(s+2)}\right]$ will have zeroes on the right-half of the complex s-plane is

A. No such K exists

B. 20

C. 10

D. 0.1

Ans A

Sol –

Applying Routh-Hurwitz criterion,

$$(s+1)(s+2)+K=0$$
$$s^2+3s+(2+K)=0$$

For $K>0$, no such value exists so that zeros lies in the right half of the s-plane.

Q13. Incremental fuel costs in Rs/MWh for a plant consisting of two generating units are given by $\frac{dF_1}{dP_1}=0.4P_1+400$ and $\frac{dF_2}{dP_2}=0.48P_2+320$

The allocation of loads P_1 and P_2 between generating units 1 and 2, respectively, for minimum cost of generation to serve a total load of 900 MW, neglecting losses, is

A. 200 MW and 700 MW

B. 500 MW and 400 MW

C. 400 MW and 500 MW

D. 300 MW and 600 MW

Ans C

Sol –

The incremental fuel cost is Rs/MWh are:

$$\frac{dF_1}{dP_1} = 0.4P_1 + 400$$

$$\frac{dF_2}{dP_2} = 0.48P_2 + 320$$

The total load shared by both generating units is:

$$P_1 + P_2 = 900 \text{ ....eq}(1)$$

Equating the both incremental cost equations, we get

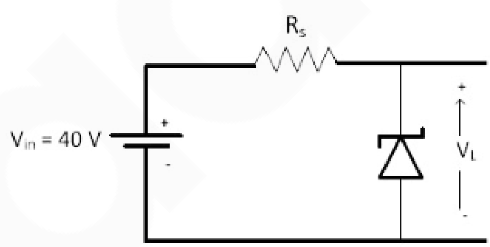
$$0.4P_1 + 400 = 0.48P_2 + 320$$

$$0.48P_2 = 0.4P_1 + 80 \text{ ....eq}(2)$$

Substituting the values, we get

$$P_1 = 400\text{MW}$$
$$P_2 = 500\text{MW}$$

Q14. The Zener diode in the circuit has a Zener voltage, V_u of 15 V and power rating of 0.5 Watt. If the input voltage is 40 V, what is the minimum value of R_S that prevents the Zener diode from being destroyed?



A. 150 Ω

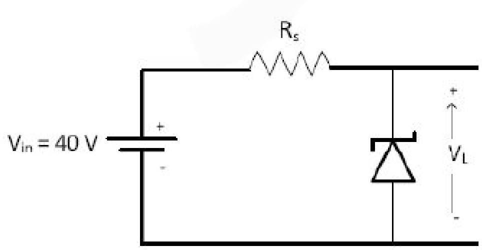
B. 550 Ω

C. 250 Ω

D. 750 Ω

Ans D

Sol –



$V_z = 15\text{V}$
$V_{in} = 40\text{V}$
$P_z = 0.5\text{W} = V_z \cdot I_z$
$I_z = \frac{1}{30}\text{A}$

The minimum value of R_S that prevents Zener diode from being destroyed.

$$I_z = \frac{V_{in} - V_z}{R_S}$$
$$\frac{1}{30} = \frac{40 - 15}{R_S}$$
$$R_S = 750\Omega$$

Q15. A current of $-8 + 6\sqrt{2}(\sin \omega t + 30^o)$ A is passed through three meters. These are a zero-centered PMMC meter, a true RMS meter, and a moving iron instrument. The respective readings (in A) will be

A. 8, 6, 10
B. -8, 6, 10
C. -8, 10, 10
D. 8, 6, 8

Ans C

Sol –

A current of $-8 + 6\sqrt{2}(\sin \omega t + 30°)\text{A}$ is passed through a zero-centered PMMC meter, a true RMS meter and a moving iron instrument.

In PMMC instruments only DC component of current is measured.

$$I_{PMMC} = -8\text{A}$$

In true RMS meter and moving iron instruments both measure AC current value and both values will be same.

$$I_{RMS} = I_{MI} = \sqrt{(-8)^2 + (6)^2} = 10\text{A}$$

Q16. $\int_{-\pi}^{\pi} \sin(t)\sin(3t)\,dt =$

A. 2π
B. π

C. π/2
D. 0

Ans D

Sol –

$$\int_{-\pi}^{\pi} \sin(t)\sin(3t)\,dt =$$

$\sin(t)\cdot\sin(3t)$ Is even function therefore the limits becomes,

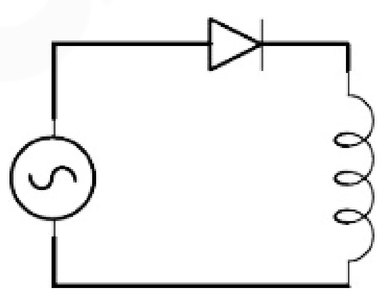
$$2\int_0^{\pi} \sin(t)\cdot\sin(3t)dt$$

Using the formula, $2\sin A\sin B = \cos(A-B) - \cos(A+B)$

$$\int_0^{\pi}\left[\cos(2t) - \cos(4t)\right]dt = \int_0^{\pi}\cos(2t)\,dt - \int_0^{\pi}\cos(4t)\,dt$$

$$\left[\frac{\sin(2t)}{2}\right]_0^{\pi} - \left[\frac{\sin(4t)}{4}\right]_0^{\pi} = 0$$

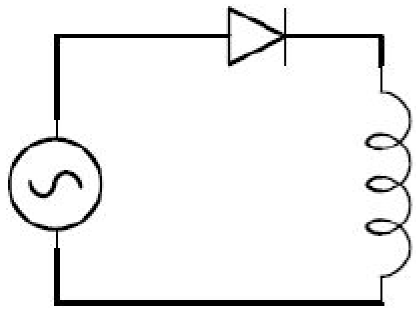
Q17. A sinusoidal AC voltage source feeds a pure inductor through a diode as shown in the figure. The duration of conduction (in degrees) of the diode in one input power cycle is



A. 90°
B. 30°
C. 360°
D. 180°

Ans C

Sol –



The duration of conduction of diode in one input cycle is $360°$.

Q18. An ammeter with range of 0 to 100 μA has an internal resistance of 100 Ω. For extending its range to 0 to 500 μA, the shunt resistance required is

A. 25 Ω

B. 20 Ω

C. 22.22 Ω

D. 50 Ω

Ans A

Sol –

An ammeter with a range of 0 to $100\mu A$ has an internal resistance of 100Ω

Now, the ammeter range is increased for the range of 0 to $500\mu A$, then the shunt resistance inserted is

$$R_{sh} = \frac{R_m}{m-1}$$

$$m = \frac{I_{new}}{I_{old}} = \frac{500}{100} = 5$$

$$R_{sh} = \frac{100}{5-1} = \frac{100}{4} = 25\Omega$$

Q19. A sequence u[n] is defined as $u[n] = \begin{cases} 1, if\ n \geq 0, \\ 0, if\ n < 0 \end{cases}$ for n = {-∞... -1.01,...., ∞}. Consider a sequence $x[n] = n^2 a^n u[n]$, where a is a positive constant. The z-transform of the sequence with appropriate region of convergence is

A. $\frac{z}{(z-\alpha)^2}$

B. $\frac{az(z+\alpha)}{(z-\alpha)^3}$

C. $\frac{ze^{-\alpha}}{\left(z-e^{-\alpha}\right)^2}$

D. $\frac{az}{(z-\alpha)^2}$

Ans B

Sol –

$u[n]=\begin{cases}1, n\geq 0\\ 0, n<0\end{cases}$ For $n=\{-\infty,......,-1,0,1,.....,\infty\}$

The z-transform of $a^n u[n]$ is $\frac{1}{1-az^{-1}}=\frac{z}{z-a}$

Using the multiplication by n property of z-transform i.e.

$$Z\{n\cdot x[n]\}=-z\frac{d}{dz}X(z)$$

$$Z\{n\cdot a^n u[n]\}=-z\frac{d}{dz}\left(\frac{z}{z-a}\right)=-z\left(\frac{1\cdot(z-a)-z\cdot 1}{(z-a)^2}\right)=-z\left(\frac{-a}{(z-a)^2}\right)=\frac{az}{(z-a)^2}$$

$$Z\{n^2\cdot u[n]\}=Z\{n\cdot(n\cdot u[n])\}$$

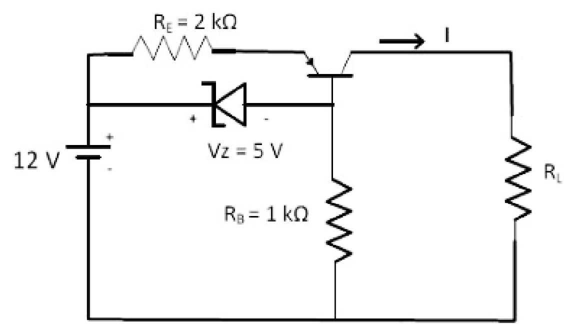
$$Z\{n^2\cdot u[n]\}=-z\frac{d}{dz}\left\{\frac{az}{(z-a)^2}\right\}$$

$$=-z\left\{\frac{a(z-a)^2-2\cdot(z-a)az}{\left((z-a)^2\right)^2}\right\}$$

$$=-z\left\{\frac{a^3-az^2}{(z-a)^4}\right\}=-z\left\{\frac{a\left(a^2-z^2\right)}{(z-a)^4}\right\}=-az\left\{\frac{(a+z)(a-z)}{(z-a)^4}\right\}$$

$$=az\left\{\frac{(a+z)(z-a)}{(z-a)^4}\right\}=\frac{az(a+z)}{(z-a)^3}$$

Q20. A BJT current source is given in the figure. Assume the Si-PNP transistor to operate in active region. The value of current I in mA is



A. 2.15

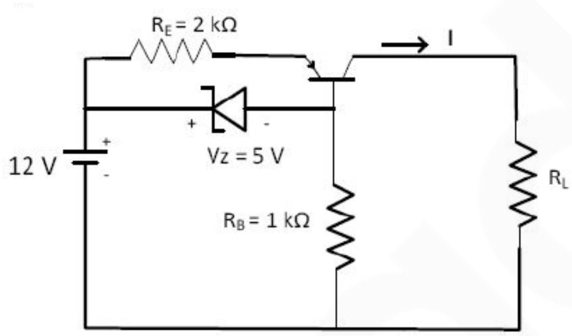
B. 5.25

C. 1.85

D. 4.1

Ans A

Sol –



Applying KVL loop at input side through Zener diode as it regulates the voltage across the emitter resistance.

$$V_z - I_E R_E - V_{BE} = 0$$
$$5 - I_E \times 2k\Omega - 0.7 = 0$$
$$4.3 = 2\times 10^3 \times I_E$$
$$I_E = 2.15\text{mA}$$

And as β is not given, we assume that β is very large.

Therefore, $I_E = I_C = I = 2.15\text{mA}$

Q21. A power system has three synchronous generators. The turbine-governor characteristics corresponding to the generators are

P1 = 50(50 – f), P2 = 100(51 – f), P3 = 150(52 – f)

Where, f denotes the system frequency in Hz, and P1, P2 P3 are the power outputs of the turbines in MW. Assuming generators and transmission network to be lossless, the system frequency for a load of 700 MW is

A. 49.5 Hz

B. 48 Hz

C. 47.5 Hz

D. 49 Hz

Ans D

Sol –

$$P_1 = 50(50 - f)$$
$$P_2 = 100(51 - f)$$
$$P_3 = 150(52 - f)$$

$$P_1 + P_2 + P_3 = 700$$

$$50(50 - f) + 100(51 - f) + 150(52 - f) = 700$$
$$2500 - 50f + 5100 - 100f + 7800 - 150f = 700$$
$$15400 - 300f = 700$$
$$15400 - 700 = 300f$$
$$f = 49\text{Hz}$$

Q22. A charge q1 = 7 µC is located at the origin, and a second charge q2 = - 5 µC is located on the positive x-axis, 0.3 m from the origin. Find the electric field at point P, which has coordinates (0, 0.4) m. Coulomb constant is given by, $k_e = \frac{1}{4\pi \in_0} = 8.99 \times 10^9 \text{N.m}^2/\text{C}^2$; $\in_0$ is the permittivity of free space; $(\hat{i}, \hat{j})$ are the unit vectors along x, y axes.

A. $-(2.5\hat{i} + 1.1\hat{j}) \times 10^5\ N/C$

B. $(2.5\hat{i} - 1.1\hat{j}) \times 10^5\ N/C$

C. $(1.1\hat{i} + 2.5\hat{j}) \times 10^5\ N/C$

D. $-(1.1\hat{i} + 2.5\hat{j}) \times 10^5\ N/C$

Ans C

Sol –

$$E = \frac{Q}{4\pi \in_o r^2} \hat{a}_r$$

$$E = \frac{1}{4\pi \in_o}\left\{\frac{7}{0.16}\hat{a}_y + \frac{(-5)}{0.25}\left(\frac{-0.3\hat{a}_x + 0.4\hat{a}_y}{0.5}\right)\right\}$$

$$E = 8.99\times10^9\times10^{-6}\left[\frac{7}{0.16}\hat{a}_y + \frac{5\times0.3}{0.25\times0.5}\hat{a}_x - \frac{5\times0.4}{0.25\times0.5}\hat{a}_y\right]$$

$$E = 8.99\times10^3\left\{\left[\frac{7}{0.16} - \frac{5\times0.4}{0.25\times0.5}\right]\hat{a}_y + \left[\frac{5\times0.3}{0.25\times0.5}\right]\hat{a}_x\right\}$$

$$E = \left(1.1\hat{i} + 2.5\hat{j}\right)\times10^5\ \text{N/C}$$

Q23. The terminal voltage of an ideal DC voltage source is 12 V, when connected to a 2 W resistive load. When the load is disconnected, the terminal voltage rises to 12.4 V. What are the values of source voltage, v_s, and internal resistance, R_s, of the source?

A. v_s = 10 V, R_s = 8 Ω

B. v_s = 12.4 V, R_s = 2.4 Ω

C. v_s = 12 V, R_s = 4 Ω

D. v_s = 12.4 V, R_s = 4 Ω

Ans B

Sol –

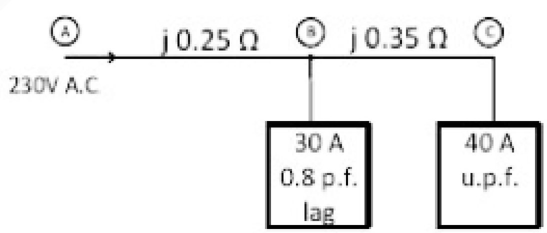
When the load is disconnected i.e. open-circuited, the terminal voltage is 12.4 V

Therefore, the source voltage is 12.4

And, when resistive load of 2 W, the terminal voltage seen is 12 V.

Therefore, internal resistance is 2.4 ohms.

Q24. A single phase AC distribution line supplies two single phase loads as shown in the figure below. The impedances of line segments A-B and B-C are j0.25 Ω and j0.35 Ω, respectively. The voltage drop from A to C is



A. 4.5 – j 30 V

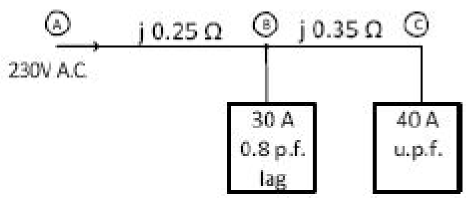
B. 30 – j 4.5 V

C. 4.5 + j 30 V

D. 30 + j 4.5 V

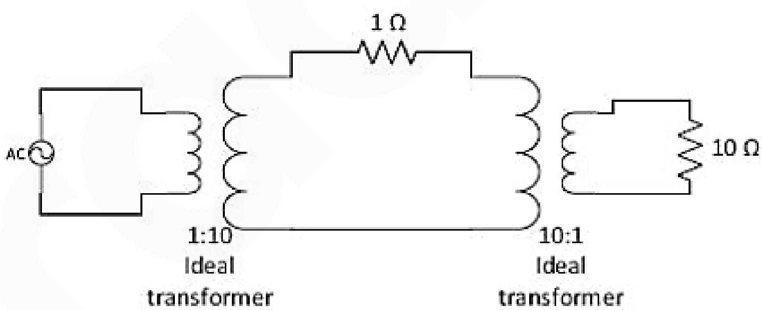
Ans C

Sol –



$$I_B = 30\angle -\cos^{-1} 0.8 = 30\angle -36.87^\circ \text{A}$$
$$I_C = 40\angle 0^\circ \text{A}$$
$$I_{AB} = I_B + I_C = 66.48\angle -15.7^\circ \text{A}$$
$$V = (66.48\angle -15.7^\circ)\cdot(0.25\angle 90^\circ) + (40\angle 0^\circ)\cdot(0.35\angle 90^\circ)$$
$$V = 30.34\angle 81.47^\circ$$
$$V = (4.5 + j30)\text{V}$$

Q25. In the circuit shown, assume that the voltage source and transformers are ideal. The AC voltage source is 10√2 sin (100πt) V. The rms value of the current flowing through the 1 Ω resistor is approximately (rounded off till first decimal place)



A. 9.1 A

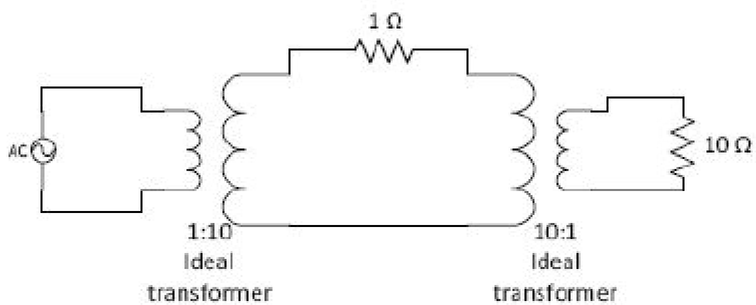
B. 0.9 A

C. 0.1 A

D. 10.0 A

Ans C

Sol –



AC voltage source is $10\sqrt{2}\sin(100\pi t)\,\mathrm{V}$

Transferring the 10 ohm resistor to primary side with the transformation ratio of 10:1

R' = 1000 ohms

Total equivalent resistance in secondary terminal of 1:10 transformer is

R" = 1000 + 1 = 1001 ohms

Now, referring the R" to primary side or at source side

R" (new) = 10.01 ohms

Then the rms value of the current flowing in the 1 ohm resistor and source rms voltage at secondary side is 100 V

$$I = \frac{100}{1001} = 0.0999 \approx 0.1\mathrm{A}$$

HINDI (1 Marks)

Q1. दिए गए विकल्पों में से कौन सा विकल्प दिए हुए शब्द का पर्यायवाची नहीं हैं?

शब्द : आँख

A. लोचन

B. चक्षु

C. चारु

D. नयन

Ans C

Sol –

चारु

Q2. दिए गए वाक्यांशों में से सर्वोचित वाक्यांश चुनकर नीचे दिए गए मुहावरे को पूरा करें ।

मुहावरा : बाल की ____________

A. खाल निकालना

B. कटाई करना

C. जड़ निकालना

D. रंगाई करना

Ans A

Sol –

बाल की खाल निकालना

Q3. मुंशी प्रेमचंद की कहानी 'ईदगाह' में हामिद अपनी दादी के लिए मेले से क्या खरीदकर लाता है?

A. चिमटा

B. बेलन

C. तवा

D. थाली

Ans A

Sol –

चिमटा

Q4. दिए गए विकल्पों में से कौन सा विकल्प नीचे लिखे शब्द का सही संधि-विग्रह है?

A. नइ + रस

B. नीर + रस

C. नि: + रस

D. निइ + रस

Ans C

Sol –

नि: + रस

Q5. दिए गए विकल्पों में से कौन सा वाक्यांश नीचे लिखे शब्द का सही अर्थ है?

शब्द : अजातशत्रु

A. जिसका कोई भी शत्रु न हो

B. जिससे जन्म से शत्रुता हो

C. जिसके बहुत से शत्रु हो

D. जन्म से शत्रुता का बोध होना

Ans A

Sol –

जिसका कोई भी शत्रु न हो

GENERAL KNOWLEDGE (1 Marks)

Q1. Nuremberg is associated with which of the following events?

A. Trials of war criminals at the end of World War II

B. The place where the leaders of the world met to deliberate on steps that should be taken to maintain peace and harmony at the end of World War I

C. Trials of war criminals at the end of World War I

D. The place where the leaders of the world met to deliberate on steps that should be taken to maintain peace and harmony at the end of World War II

Ans A

Sol –

Nuremberg is associated with trials of war criminals at the end of World War II.

Q2. Which of the following persons won the most number of Wimbledon Ladies’ Singles titles?

A. Venus Williams

B. Serena Williams

C. Martina Navratilova

D. Steffi Graf

Ans C

Sol –

Martina Navratilova won the most number of Wimbledon Ladies’ Singles title.

Q3. Which scientist received the Bharat Ratna in the same year as Sachin Tendulkar?

A. C. N. R. Rao

B. A. P. J. Abdul Kalam

C. V. Rajaraman

D. Anil Kakodkar

Ans A

Sol –

C.N.R Rao scientist received the Bharat Ratna in the same year as Sachin Tendulkar.

Q4. Who is the author of the novel “War and Peace”?
A. Alexander Pushkin
B. Leo Tolstoy
C. Mikhail Gorbachev
D. Fyodor Dostoyevsky

Ans B

Sol –

Leo Tolstoy is the author of novel “War and peace”.

Q5. In which city Humayun’s tomb is located?
A. Sasaram
B. Agra
C. New Delhi
D. Fatehpur Sikri

Ans C

Sol –

Humayun’s tomb is located in New Delhi.

Q6. Which of the following organization is most closely associated with E. Sreedharan?
A. Reserve Bank of India
B. Konkan Railway
C. Niti Aayog
D. Indian Space Research Organization

Ans B

Sol –

E. Sreedharan is associated with Konkan Railway.

Q7. Which of the following persons was the first President of Bangladesh?
A. Pervez Musharraf
B. Khalida Zia
C. Sheikh Mujibur Rahman
D. Sheikh Hasina

Ans C

Sol –

Sheikh Mujibur Rahman was the first president of Bangladesh.

Q8. Which of the following persons has not served as the Chief Minister of Uttar Pradesh?
A. N. D. Tiwari
B. Govind Ballabh Pant
C. Chandra Bhanu Gupta
D. Sarojini Naidu

Ans D

Sol –

Sarojini Naidu has never been served as the chief minister of uttar Pradesh.

Q9. Which of the following statements is true?
A. The equator passes through Prayagraj (Allahabad)
B. The equator passes through Colombo
C. All latitudes meet at the North and the South Poles
D. All longitudes meet at the North and the South Poles

Ans D

Sol –

All longitudes meet at the north and the south poles.

Q10. What is the capital of Hungary?
A. Helsinki
B. Budapest
C. Lisbon
D. Brussels

Ans B

Sol –

The capital of Hungary is Budapest.

REASONING (1 Marks)

Q1. Find the value of Z:

1 = 5

2 = 10
3 = 15
4 = 10
5 = Z

A. 20
B. 1
C. 25
D. 0

Ans B

Sol –

As 1 = 5

And 5 = Z

Therefore Z = 1

Q2. $\lim_{t\to 0}\left(\frac{\sin t}{t}\right) =$

A. undefined
B. 1
C. 0
D. -1

Ans B

Sol –

$$\lim_{t\to 0}\left(\frac{\sin t}{t}\right) = 1$$

Q3. A group of laborers promised to do a work in 15 days, but 5 of them did not turn up. If the rest of the group completes this work in 18 days, find the originally proposed number of labourers.

A. 20
B. 25
C. 30
D. 35

Ans C

Sol –

The total number of original laborers be x

$x \rightarrow 15 Days$

$(x-5) \rightarrow 18 Days$

Equating Man-Day work be constant.

$15x = 18(x-5)$

$15x = 18x - 90$

$3x = 90$

$x = 30$

Q4. Which word does not belong with others?
A. Lion
B. Tiger
C. Elephant
D. Leopard

Ans C

Sol –

Elephant does not belong to the category of Tiger Family.

Q5. Which one of the following pairs of vectors are orthogonal?
A. $[1, 2, 4]^T$ and $[-3, 0, 1]^T$
B. $[1, 2, 4]^T$ and $[-2, -1, 1]^T$
C. $[1, 2, 4]^T$ and $[-12, -1, 1]^T$
D. $[1, 2, 4]^T$ and $[5, 0, -1]^T$

Ans B

Sol –

The orthogonality means the product of two or more matrices becomes zero.

$[1,2,4]^T \ and \ [-2,-1,1]^T$

$-2-2+4=0$

Whereas others are not equal to zero.

REASONING (2 Marks)

Q1. Consider the following three systems of equations:

Case a: $x_1 + x_2 = 1$, $2x_1 - x_2 = 0$

Case b: $x_1 + x_2 = 1$, $2x_1 - 2x_2 = 2$

Case c: $x_1 + x_2 = 1$, $x_1 - x_2 = 0$

Which one of the following statements is true?

A. Case a has unique solution; case b has many solutions; case c has no solution.

B. None of the cases can be solved.

C. Case a has no solution; case b has unique solution; case c has many solutions.

D. case a has many solutions; case b has unique solution; case c has no solution.

Ans A

Sol –

$$Case(a): x_1 + x_2 = 1, 2x_1 - x_2 = 0$$
$$Case(b): x_1 + x_2 = 1, 2x_1 + 2x_2 = 2$$
$$Case(c): x_1 + x_2 = 1, x_1 + x_2 = 0$$

$$Case(a):$$
$$x_1 + x_2 = 1$$
$$2x_1 - x_2 = 0 \Rightarrow x_2 = 2x_1$$
$$x_1 + 2x_1 = 1$$
$$3x_1 = 1 \Rightarrow x_1 = \frac{1}{3}$$
$$Then,$$
$$x_2 = \frac{2}{3}$$

Case (a) has unique solution.

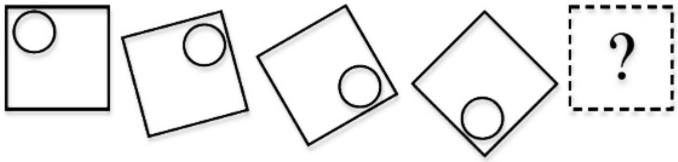
$$Case(b):$$
$$x_1 + x_2 = 1$$
$$2x_1 + 2x_2 = 2 \Rightarrow x_1 + x_2 = 1$$

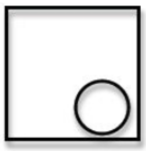
Implies that Case (b) has many solutions.

$$Case(c):$$
$$x_1 + x_2 = 1$$
$$x_1 + x_2 = 0$$

Simultaneously, both equation cannot be satisfied, therefore the system of equations has no solution.

Q2. Which of the shapes below continues the sequence?



A. 

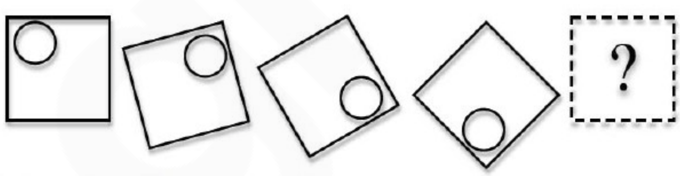
B. 

C. 

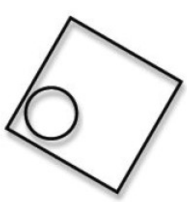
D. 

Ans D

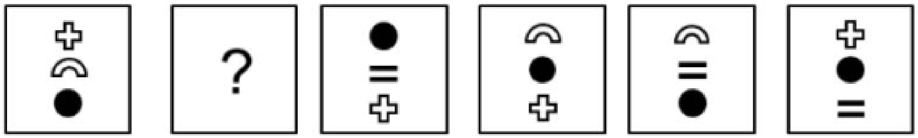
Sol –



The square is rotated to make ball move up and down, therefore the next figure will be



Q3. Which of the shapes below continues the sequence?



A. 

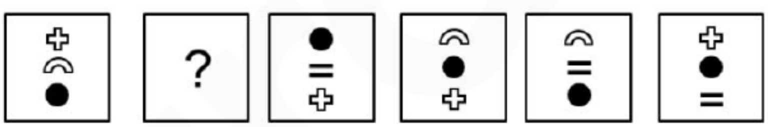
B. 

C. 

D. 

Ans A

Sol –



The inside figure is being shuffled while adding a new figure, we get

Q4. Look at the series:

1, 1, 4, 9, 25, 64, ______

What number should come next?

A. 169

B. 100

C. 144
D. 121
Ans A

Sol –

The next number is the square of the sum of two previous number.

$1,1,4,9,25,64,\_\_\_\_\_$
$5+8=13$

Next number is

$(13)^2=169$

Q5. Consider the matrix,

$$A=\begin{bmatrix} a & b \\ 0 & c \end{bmatrix}$$

Eigenvalues of the matrix are given by

A. $\lambda_1 = 0, \lambda_2 = 0$
B. $\lambda_1 = ac, \lambda_2 = 0$
C. $\lambda_1 = a, \lambda_2 = c$
D. $\lambda_1 = b, \lambda_2 = ac$

Ans C

Sol –

$$A=\begin{bmatrix} a\,b \\ 0\,c \end{bmatrix}$$

For Eigen values of the matrix,

$|A-\lambda I|=0$
$(a-\lambda)(c-\lambda)=0$
$\lambda_1 = a, \lambda_2 = c$

BEST OF LUCK FOR YOUR RESULTS