GATE Electrical Engineering

Sample Paper – 10

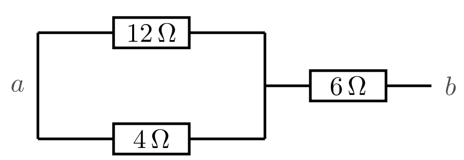
Duration: 128 Minutes **Maximum Marks: 72**

Instructions

- This paper contains **46 questions** covering the core **Electrical Engineering** subject of the GATE paper conducted by the IITs and IISc (General Aptitude and Engineering Mathematics are provided as separate papers).
- **Q1–Q20 carry 1 mark each** and **Q21–Q46 carry 2 marks each**, for a total of **72 marks**.
- Each question carries **negative marking of one-third of its allotted marks**: a wrong 1-mark question costs **0.33** and a wrong 2-mark question costs **0.67**. Unattempted questions carry no penalty.
- Every question here is a single-correct **MCQ**. The real GATE paper also has Multiple Select (MSQ) and Numerical Answer Type (NAT) questions, and **those carry no negative marking**.
- Attempt this paper in one timed sitting of about **128 minutes**, the share this core subject earns at GATE's overall pace of 180 minutes for 65 questions. Unless stated otherwise take $\varepsilon_0 = 8.854 \times 10^{-12}$ F/m, $\mu_0 = 4\pi \times 10^{-7}$ H/m and $c = 3 \times 10^8$ m/s.

Electric Circuits

Q1. To find the Thevenin equivalent seen at terminals a–b of the network shown, all independent sources are deactivated. The resulting Thevenin resistance R_{th} (a $12\ \Omega$ in parallel with $4\ \Omega$, then in series with $6\ \Omega$) is: **[1 mark]**



(A) $9\ \Omega$

(B) $18\ \Omega$

(C) $3\ \Omega$

(D) $22\ \Omega$

Q2. A source network consists of a 12 V ideal voltage source in series with a $4\ \Omega$ resistor. When the output terminals are short-circuited, the Norton (short-circuit) current I_N delivered by the network is: **[1 mark]**

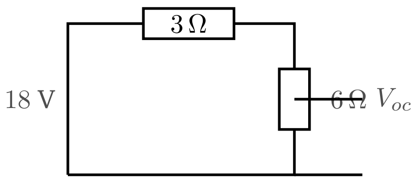
(A) 6 A

(B) 48 A

(C) 3 A

(D) 0.33 A

Q3. For the network shown, the open-circuit (Thevenin) voltage V_{oc} at terminals a–b is the voltage that the 18 V source produces across the $6\ \Omega$ resistor through the $3\ \Omega$–$6\ \Omega$ divider. This V_{oc} is: **[1 mark]**



(A) 6 V

(B) 12 V

(C) 18 V

(D) 9 V

Q4. A source is reduced to its Norton equivalent with short-circuit current $I_N = 4$ A and Norton resistance $R_N = 5\ \Omega$. When a matched load is connected for maximum power transfer, the power delivered to the load, $P_{\max} = \frac{1}{4} I_N^2 R_N$, is: **[1 mark]**

(A) 40 W

(B) 20 W

(C) 10 W

(D) 80 W

Q5. A capacitor $C = 250\ \mu$F sees a Thevenin resistance $R_{th} = 4\ \Omega$ looking back into the rest of the circuit. The time constant of the natural response, $\tau = R_{th}C$, is: **[1 mark]**

(A) 4 ms

(B) 0.25 ms

(C) 1 ms

(D) 2 ms

Q6. By the superposition theorem, the branch current in a $5\ \Omega$ resistor is found one source at a time. The 20 V source acting alone produces 2 A (downward) in that branch, and the 10 V source acting alone produces 1 A (downward). The total branch current is: **[1 mark]**

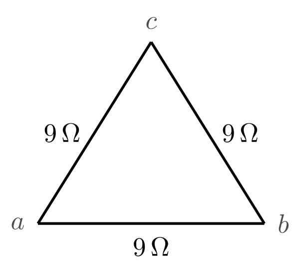
(A) 1 A

(B) 2 A

(C) 5 A

(D) 3 A

Q7. The three equal resistors of $9\ \Omega$ each form the balanced delta network shown. When converted to an equivalent star (wye), each star-arm resistance, $R_Y = \frac{R_\Delta}{3}$, is: **[1 mark]**



(A) $9\ \Omega$

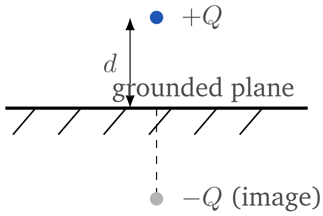
(B) $27\ \Omega$

(C) $3\ \Omega$

(D) $6\ \Omega$

Electromagnetic Fields

Q8. A point charge $Q = 10$ nC is held at a distance $d = 3$ cm above an infinite grounded conducting plane, as shown. By the method of images the plane is replaced by an image charge $-Q$ at depth d, so the attractive force is $F = \dfrac{1}{4\pi\varepsilon_0} \cdot \dfrac{Q^2}{(2d)^2}$ (take $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$). Its magnitude is: **[1 mark]**



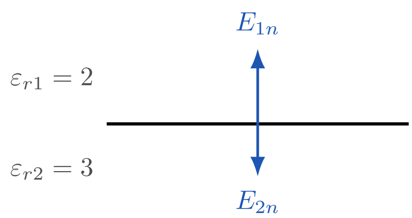
(A) 2.5×10^{-4} N

(B) 1.0×10^{-3} N

(C) 2.5×10^{-3} N

(D) 1.0×10^{-4} N

Q9. At a charge-free boundary between two dielectrics the normal component of the electric flux density is continuous, $\varepsilon_1 E_{1n} = \varepsilon_2 E_{2n}$. With $\varepsilon_{r1} = 2$, $\varepsilon_{r2} = 3$ and $E_{1n} = 6$ V/m in region 1 (see figure), the normal field E_{2n} in region 2 is: **[1 mark]**



(A) 6 V/m

(B) 4 V/m

(C) 9 V/m

(D) 2 V/m

Q10. In the parallel-plate region the potential satisfies Laplace's equation, giving a uniform field. If $V = 0$ at one plate and $V = 100$ V at the other, and the plate separation is $d = 5$ mm, the magnitude of the electric field $E = V/d$ is: **[1 mark]**

(A) 5 kV/m

(B) 10 kV/m

(C) 20 kV/m

(D) 50 kV/m

Q11. A point charge $+Q$ is placed a distance d in front of an infinite grounded conducting plane. To satisfy the boundary condition of zero potential on the plane, the method of images replaces the plane by a single image charge of: **[1 mark]**

(A) $+Q$ at distance d behind the plane

(B) $-Q$ at distance $2d$ behind the plane

(C) $+Q$ at distance $2d$ behind the plane

(D) $-Q$ at distance d behind the plane

Signals and Systems

Q12. A continuous-time system has the transfer function $H(s) = \dfrac{s+1}{s^2+3s+2}$. The minimum number of state variables needed for a state-variable (state-space) description of this system equals the order of the denominator, which is: **[1 mark]**

(A) 1

(B) 2

(C) 3

(D) 4

Q13. A second-order system has the state matrix $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$. The eigenvalues of A (the roots of $\det(sI - A) = 0$), which are the natural modes of the system, are: **[1 mark]**

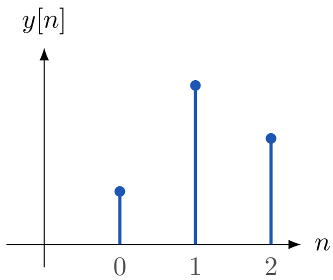
(A) $-1,\ -2$

(B) $+1,\ +2$

(C) $-2,\ -3$

(D) $0,\ -3$

Q14. The finite sequences $x[n] = \{1,\ 2\}$ (for $n = 0, 1$) and $h[n] = \{1,\ 1\}$ (for $n = 0, 1$) are linearly convolved to give $y[n]$, sketched below. The value of $y[1]$ is: **[1 mark]**



(A) 2

(B) 3

(C) 1

(D) 4

Q15. A continuous-time signal is strictly band-limited to a maximum frequency of 4 kHz. According to the sampling theorem, the minimum sampling rate (Nyquist rate) required to avoid aliasing is: **[1 mark]**

(A) 2 kHz

(B) 4 kHz

(C) 8 kHz

(D) 16 kHz

Q16. A discrete-time LTI system has transfer function $H(z) = \dfrac{1}{1 - 0.5\,z^{-1}}$. Its d.c. gain, obtained by evaluating $H(z)$ at $z = 1$, is: **[1 mark]**

(A) 1

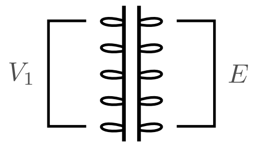
(B) 0.5

(C) 4

(D) 2

Electrical Machines

Q17. A single-phase transformer has $N = 100$ primary turns and operates at $f = 50$ Hz with a peak core flux $\Phi_m = 0.02$ Wb, as indicated. Its induced primary e.m.f., from $E = 4.44\, f\, N\, \Phi_m$, is: **[1 mark]**



$f = 50$ Hz, $N = 100$

(A) 444 V

(B) 222 V

(C) 888 V

(D) 111 V

Q18. Two single-phase transformers with the same per-unit impedance are operated in parallel and share a total load of 240 kVA in proportion to their kVA ratings. Their ratings are 100 kVA and 200 kVA. The load carried by the 200 kVA transformer is: **[1 mark]**

(A) 80 kVA

(B) 120 kVA

(C) 160 kVA

(D) 240 kVA

Q19. For two single-phase transformers to operate satisfactorily in parallel, the essential conditions to be met are: **[1 mark]**

(A) the same kVA rating

(B) the same core material

(C) the same primary current

(D) the same voltage ratio and the same polarity

Q20. A single-phase transformer delivers an output of 8 kW at unity power factor. Its iron loss is 400 W and its full-load copper loss is 400 W. The full-load efficiency, $\eta = \dfrac{P_{out}}{P_{out} + P_{loss}}$, is nearest to: **[1 mark]**

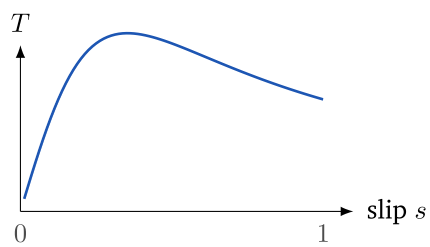
(A) 90.9%

(B) 95.0%

(C) 80.0%

(D) 98.0%

Q21. A 6-pole, 50 Hz three-phase induction motor runs with a per-unit slip of $s = 0.05$. Its torque–slip characteristic is sketched below. The rotor speed, $N = N_s(1 - s)$ with $N_s = \dfrac{120f}{P}$, is: **[2 marks]**



(A) 1000 rpm

(B) 950 rpm

(C) 900 rpm

(D) 1500 rpm

Q22. A d.c. shunt motor is supplied at $V = 250$ V and draws an armature current $I_a = 40$ A. The armature resistance is $R_a = 0.25\ \Omega$. The back e.m.f. $E_b = V - I_aR_a$ is: **[2 marks]**

(A) 250 V

(B) 240 V

(C) 260 V

(D) 10 V

Q23. An 8-pole, 50 Hz three-phase synchronous machine runs at synchronous speed. Its synchronous speed, $N_s = \frac{120f}{P}$, is: **[2 marks]**

(A) 1000 rpm

(B) 500 rpm

(C) 750 rpm

(D) 3000 rpm

Power Systems

Q24. A distribution feeder supplies a total energy of 4800 kWh over a day, and its maximum demand during the day is 400 kW. The load factor, defined as the ratio of average load to maximum demand, is: **[2 marks]**

(A) 0.2

(B) 0.8

(C) 1.0

(D) 0.5

Q25. A consumer has a total connected load of 500 kW, but the maximum demand actually drawn is only 300 kW. The demand factor, defined as maximum demand divided by connected load, is: **[2 marks]**

(A) 0.5

(B) 0.6

(C) 0.8

(D) 1.2

Q26. Three consumers on a distribution transformer have individual maximum demands of 40 kW, 30 kW and 30 kW, while the maximum demand measured at the transformer is 80 kW. The diversity factor, defined as the sum of individual maximum demands divided by the coincident (system) maximum demand, is: **[2 marks]**

(A) 0.8

(B) 1.0

(C) 0.5

(D) 1.25

Q27. In per-unit analysis a base of 100 MVA and 33 kV is selected. The base impedance, $Z_{base} = \dfrac{(kV_{base})^2}{MVA_{base}}$, is: **[2 marks]**

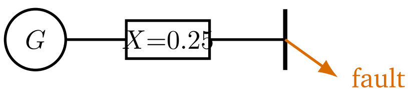
(A) $1.089\ \Omega$

(B) $10.89\ \Omega$

(C) $108.9\ \Omega$

(D) $33\ \Omega$

Q28. A generator is connected to a bus through a reactance of $X = 0.25$ pu on a 100 MVA base, as shown in the single-line diagram. For a three-phase symmetrical fault at the bus, the fault level $\text{MVA}_{fault} = \dfrac{\text{MVA}_{base}}{X_{pu}}$ is: **[2 marks]**



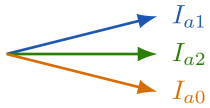
(A) 100 MVA

(B) 25 MVA

(C) 200 MVA

(D) 400 MVA

Q29. A single-line-to-ground fault occurs on an unloaded generator with sequence reactances $Z_1 = Z_2 = Z_0 = 0.15$ pu and pre-fault e.m.f. $E = 1.0$ pu. The three sequence networks carry equal currents (see phasor sketch), and the fault current is $I_f = \dfrac{3E}{Z_1 + Z_2 + Z_0}$, which equals: **[2 marks]**



equal sequence currents (SLG fault)

(A) 6.67 pu

(B) 3.33 pu

(C) 20 pu

(D) 2 pu

Q30. A lossless overhead line has series inductance $L = 1.6$ mH/km and shunt capacitance $C = 0.01$ μF/km. Its surge (characteristic) impedance $Z_c = \sqrt{L/C}$ is: **[2 marks]**

(A) 100 Ω

(B) 200 Ω

(C) 400 Ω

(D) 800 Ω

Control Systems

Q31. A standard second-order system has the characteristic equation $s^2 + 8s + 64 = 0$. Comparing with $s^2 + 2\zeta\omega_n s + \omega_n^2 = 0$, the damping ratio ζ is: **[2 marks]**

(A) 0.25

(B) 0.5

(C) 1

(D) 0.6

Q32. The characteristic equation of a closed-loop system is $s^3+4s^2+5s+2 = 0$. Using the Routh–Hurwitz criterion, the number of closed-loop poles lying in the right half of the s-plane is: **[2 marks]**

(A) 0

(B) 1

(C) 2

(D) 3

Q33. From the Bode plot of a unity-feedback loop, the phase angle at the gain-crossover frequency (where the open-loop gain is 0 dB) is found to be $-135°$. The phase margin, PM $= 180° + \angle G(j\omega_{gc})$, is: **[2 marks]**

(A) $45°$

(B) $90°$

(C) $135°$

(D) $0°$

Q34. A type-1 unity-feedback system has open-loop transfer function $G(s) = \dfrac{20}{s(s+4)}$. For a unit-ramp input the steady-state error is $e_{ss} = 1/K_v$, where $K_v = \lim_{s\to 0} sG(s)$. This steady-state error is: **[2 marks]**

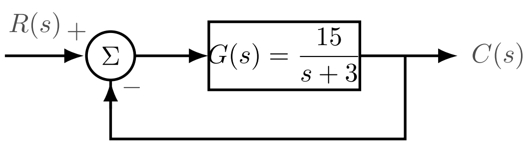
(A) 0

(B) 1

(C) 0.2

(D) 0.05

Q35. For the unity-feedback control system shown, the forward-path transfer function is $G(s) = \dfrac{15}{s+3}$. The d.c. gain of the closed-loop transfer function $\dfrac{C(s)}{R(s)} = \dfrac{G(s)}{1+G(s)}$ (its value at $s = 0$) is nearest to: **[2 marks]**



(A) 5

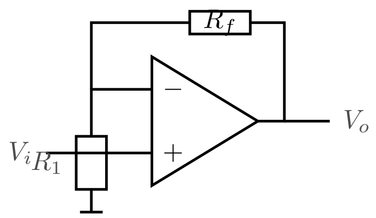
(B) 1

(C) 0.833

(D) 0.5

Analog, Digital and Measurements

Q36. For the ideal-op-amp non-inverting amplifier shown, $R_1 = 10$ kΩ and $R_f = 90$ kΩ. The closed-loop voltage gain $V_o/V_i = 1 + R_f/R_1$ is: **[2 marks]**



(A) 9

(B) 0.1

(C) 8

(D) 10

Q37. The unsigned binary number $(11010)_2$ has the decimal (base-10) value: **[2 marks]**

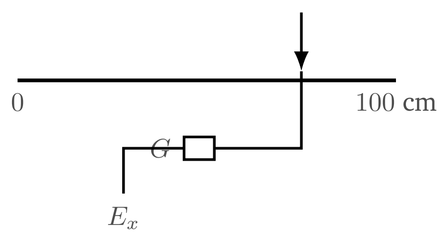
(A) 11

(B) 22

(C) 26

(D) 44

Q38. A slide-wire potentiometer is set so that its working current makes the wire drop 2 mV per cm. An unknown e.m.f. is balanced (null on the galvanometer) at a length of 75 cm, as shown. The unknown e.m.f. $E_x = (2 \text{ mV/cm}) \times (75 \text{ cm})$ is: **[2 marks]**



(A) 0.15 V

(B) 0.075 V

(C) 1.5 V

(D) 37.5 mV

Q39. The hexadecimal number $(2\text{C})_{16}$ has the decimal (base-10) value: **[2 marks]**

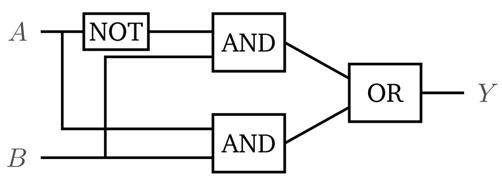
(A) 16

(B) 26

(C) 32

(D) 44

Q40. The gate network shown realizes the Boolean output $Y = \bar{A}B + AB$. Applying the distributive law and $\bar{A} + A = 1$, the simplified expression is: **[2 marks]**



(A) A

(B) B

(C) AB

(D) $A + B$

Q41. Among the common bipolar and MOS logic families used in digital ICs, the family that offers the highest switching speed (lowest propagation delay), because its transistors do not saturate, is: **[2 marks]**

(A) TTL

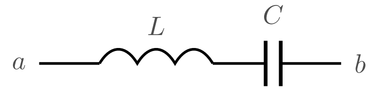
(B) ECL

(C) CMOS

(D) DTL

Power Electronics

Q42. A series resonant converter uses the resonant tank shown with $L = 10\ \mu$H and $C = 0.1\ \mu$F. The resonant frequency $f_0 = \dfrac{1}{2\pi\sqrt{LC}}$ is nearest to: **[2 marks]**



(A) 1.59 kHz

(B) 15.9 kHz

(C) 1.59 MHz

(D) 159 kHz

Q43. A single-phase full-bridge inverter operating in square-wave mode has a d.c.-link voltage $V_{dc} = 100$ V, so its output alternates between $+V_{dc}$ and $-V_{dc}$. The RMS value of this square-wave output voltage is: **[2 marks]**

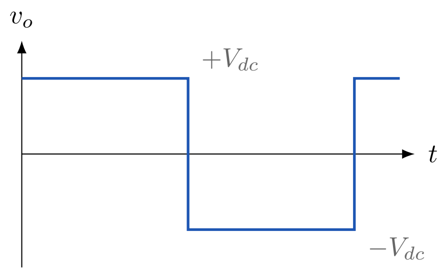
(A) 100 V

(B) 70.7 V

(C) 63.66 V

(D) 90 V

Q44. A single-phase full-bridge square-wave inverter has a d.c.-link voltage $V_{dc} = 200$ V, giving the output waveform shown. The peak (amplitude) of the fundamental component, $V_{1,\text{peak}} = \dfrac{4V_{dc}}{\pi}$, is nearest to: **[2 marks]**



(A) 200 V

(B) 127.3 V

(C) 180 V

(D) 254.6 V

Q45. A boost (step-up) d.c.–d.c. converter operates from an input $V_s = 48$ V with a duty ratio $D = 0.6$. Its output voltage $V_o = \dfrac{V_s}{1-D}$ is: **[2 marks]**

(A) 120 V

(B) 80 V

(C) 48 V

(D) 76.8 V

Q46. A single-phase fully controlled bridge feeds a highly inductive load from a supply of peak voltage $V_m = 100$ V and is fired at $\alpha = 120°$, so it operates in the line-commutated inverting mode. The average output voltage $V_{dc} = \dfrac{2V_m}{\pi}\cos\alpha$ is: **[2 marks]**

(A) $+31.83$ V

(B) $+63.66$ V

(C) 0 V

(D) -31.83 V

Detailed Solutions

Q1.

Solution

Concept – Thevenin resistance: With every independent source deactivated (voltage sources shorted, current sources opened), the Thevenin resistance is the pure resistance seen at the terminals.

Step 1 – combine the $12\ \Omega$ and $4\ \Omega$ in parallel: $R_p = \dfrac{12 \times 4}{12 + 4}$

Step 2 – form the product and the sum: $12 \times 4 = 48$

$12 + 4 = 16$

Step 3 – divide: $R_p = \dfrac{48}{16} = 3\ \Omega$

Step 4 – add the series $6\ \Omega$: $R_{th} = R_p + 6 = 3 + 6$

$R_{th} = 9\ \Omega$

Final Answer: $R_{th} = 9\ \Omega \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept – Norton (short-circuit) current: The Norton current is the current that flows when the output terminals are shorted; the full source voltage then appears across the series resistance.

Step 1 – short the terminals: The 12 V source drives the current through the $4\ \Omega$ resistor only.

Step 2 – apply Ohm's law: $I_N = \dfrac{V}{R} = \dfrac{12}{4}$

Step 3 – evaluate: $I_N = 3$ A

Final Answer: $I_N = 3\text{ A} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept – Thevenin (open-circuit) voltage by voltage division: With the output terminals open, no current is drawn from the divider, so the open-circuit voltage is simply the divider output across the $6\ \Omega$ resistor.

Step 1 – add the two series resistances: $3 + 6 = 9\ \Omega$

Step 2 – form the divider ratio for the $6\ \Omega$ resistor: $\dfrac{6}{3+6} = \dfrac{6}{9}$

Step 3 – multiply by the source voltage: $V_{oc} = 18 \times \dfrac{6}{9}$

Step 4 – evaluate: $V_{oc} = 18 \times \dfrac{2}{3} = 12\ \text{V}$

Final Answer: $V_{oc} = 12\ \text{V} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept – maximum power transfer from a Norton source: When the load matches the Norton resistance, the source current splits equally, and the load power is $P_{\max} = \dfrac{1}{4} I_N^2 R_N$.

Step 1 – square the Norton current: $I_N^2 = 4^2 = 16$

Step 2 – multiply by the Norton resistance: $I_N^2 R_N = 16 \times 5 = 80$

Step 3 – take one-quarter: $P_{\max} = \dfrac{80}{4}$

$P_{\max} = 20\ \text{W}$

Why the other options are wrong:

- C, 10 W: uses $\frac{1}{8}$ instead of $\frac{1}{4}$.
- D, 80 W: forgets to divide by 4 (that is the total source power at match).

Final Answer: $P_{\max} = 20\ \text{W} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept – time constant with a Thevenin resistance: A capacitor discharging through the rest of the circuit sees the Thevenin resistance at its terminals, and $\tau = R_{th}C$.

Step 1 – list the data in base units: $R_{th} = 4\ \Omega$

$C = 250\ \mu\text{F} = 250 \times 10^{-6}$ F

Step 2 – multiply: $\tau = 4 \times (250 \times 10^{-6})$

Step 3 – evaluate: $\tau = 1000 \times 10^{-6} = 1 \times 10^{-3}$ s

$\tau = 1$ ms

Final Answer: $\tau = 1$ ms $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept – superposition theorem: In a linear circuit the response due to several sources equals the algebraic sum of the responses due to each source acting alone.

Step 1 – response of the 20 V source alone: $I_1 = 2$ A (downward)

Step 2 – response of the 10 V source alone: $I_2 = 1$ A (downward)

Step 3 – add algebraically (both in the same direction): $I = I_1 + I_2 = 2 + 1$

$I = 3$ A

Final Answer: $I = 3$ A $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q6

Q7.

Solution

Concept – balanced delta-to-star conversion: For a balanced delta of three equal resistors R_Δ, each arm of the equivalent star is $R_Y = \dfrac{R_\Delta}{3}$.

Step 1 – list the delta resistance: $R_\Delta = 9\ \Omega$

Step 2 – divide by three: $R_Y = \dfrac{9}{3}$

$R_Y = 3\ \Omega$

Step 3 – sanity check: The star arm should be smaller than the delta branch, and

$3 < 9$, so the result is consistent.

Final Answer: $R_Y = 3\,\Omega \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept – method of images for a grounded plane: The grounded plane is replaced by an image charge $-Q$ at the mirror position, so the charge is attracted by a force $F = \dfrac{1}{4\pi\varepsilon_0} \cdot \dfrac{Q^2}{(2d)^2}$.

Step 1 – list the data in base units: $Q = 10\text{ nC} = 1 \times 10^{-8}\text{ C}$

$d = 3\text{ cm} = 0.03\text{ m}$, so $2d = 0.06\text{ m}$

Step 2 – square the charge: $Q^2 = (1 \times 10^{-8})^2 = 1 \times 10^{-16}$

Step 3 – square the separation: $(2d)^2 = (0.06)^2 = 3.6 \times 10^{-3}$

Step 4 – assemble the force: $F = \dfrac{(9 \times 10^9) \times (1 \times 10^{-16})}{3.6 \times 10^{-3}}$

Step 5 – evaluate the numerator: $(9 \times 10^9) \times (1 \times 10^{-16}) = 9 \times 10^{-7}$

Step 6 – divide: $F = \dfrac{9 \times 10^{-7}}{3.6 \times 10^{-3}} = 2.5 \times 10^{-4}\text{ N}$

Final Answer: $F = 2.5 \times 10^{-4}\text{ N} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept – normal boundary condition on D: With no free surface charge, the normal component of the flux density is continuous, $\varepsilon_1 E_{1n} = \varepsilon_2 E_{2n}$, so $E_{2n} = \dfrac{\varepsilon_{r1}}{\varepsilon_{r2}} E_{1n}$.

Step 1 – list the data: $\varepsilon_{r1} = 2$, $\varepsilon_{r2} = 3$, $E_{1n} = 6\text{ V/m}$.

Step 2 – form the permittivity ratio: $\dfrac{\varepsilon_{r1}}{\varepsilon_{r2}} = \dfrac{2}{3}$

Step 3 – multiply by E_{1n}: $E_{2n} = \dfrac{2}{3} \times 6$

Step 4 – evaluate: $E_{2n} = 4\text{ V/m}$

Final Answer: $E_{2n} = 4\text{ V/m} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept – uniform field from Laplace's equation: Between parallel plates the potential varies linearly, so the field magnitude is $E = V/d$.

Step 1 – list the data in base units: $V = 100$ V

$d = 5$ mm $= 5 \times 10^{-3}$ m

Step 2 – divide: $E = \dfrac{100}{5 \times 10^{-3}}$

Step 3 – evaluate: $E = 20000$ V/m $= 20$ kV/m

Final Answer: $E = 20$ kV/m $\Rightarrow \boxed{\text{C}}$

$\boxed{\text{Answer: (C)}}$ Go Back to Q10

Q11.

Solution

Concept – image charge for a grounded plane: The unique image that forces the plane to be an equipotential at zero volts is a single charge of equal magnitude and opposite sign, located at the mirror position.

Step 1 – magnitude and sign of the image: The image must be $-Q$ so that the plane potential is zero everywhere.

Step 2 – position of the image: It sits at distance d on the far side of the plane, symmetric to the real charge.

Step 3 – state the result: Image $= -Q$ at distance d behind the plane.

Why the other options are wrong:

- A, $+Q$: same sign would not make the plane an equipotential at zero.
- B and C, distance $2d$: the mirror image lies at d, not $2d$, behind the plane.

Final Answer: $-Q$ at distance d behind the plane $\Rightarrow \boxed{\text{D}}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q11

Q12.

Solution

Concept – state variables and system order: The minimum number of state variables equals the order of the system, which is the degree of the denominator polynomial of a proper transfer function.

Step 1 – identify the denominator: $D(s) = s^2 + 3s + 2$

Step 2 – read its degree: The highest power of s is 2.

Step 3 – state the number of state variables: Number of state variables $= 2$.

Final Answer: 2 state variables $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q12

Q13.

Solution

Concept – eigenvalues of the state matrix: The natural modes (poles) are the eigenvalues of A, found from $\det(sI - A) = 0$.

Step 1 – form $sI - A$: $sI - A = \begin{bmatrix} s & -1 \\ 2 & s+3 \end{bmatrix}$

Step 2 – take the determinant: $\det(sI - A) = s(s+3) - (-1)(2)$

Step 3 – expand: $= s^2 + 3s + 2$

Step 4 – factor the characteristic polynomial: $s^2 + 3s + 2 = (s+1)(s+2)$

Step 5 – read the roots: $s = -1$ and $s = -2$

Final Answer: eigenvalues $= -1,\ -2 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept – linear convolution of two length-2 sequences: $y[n] = \sum_k x[k]\,h[n-k]$; the result has length $2 + 2 - 1 = 3$.

Step 1 – compute $y[0]$: $y[0] = x[0]h[0] = 1 \times 1 = 1$

Step 2 – compute $y[1]$: $y[1] = x[0]h[1] + x[1]h[0]$

Step 3 – substitute the values: $y[1] = (1)(1) + (2)(1)$

Step 4 – evaluate: $y[1] = 1 + 2 = 3$

Step 5 – (check) compute $y[2]$: $y[2] = x[1]h[1] = 2 \times 1 = 2$, matching the sketch $\{1, 3, 2\}$.

Final Answer: $y[1] = 3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept – sampling theorem: To reconstruct a signal band-limited to f_m, the sampling rate must be at least twice the highest frequency, $f_s \geq 2f_m$.

Step 1 – list the maximum frequency: $f_m = 4$ kHz

Step 2 – apply the Nyquist rate: $f_s = 2f_m = 2 \times 4$

Step 3 – evaluate: $f_s = 8$ kHz

Final Answer: $f_s = 8$ kHz $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept – d.c. gain of a discrete-time system: The d.c. (zero-frequency) gain is the transfer function evaluated at $z = 1$.

Step 1 – substitute $z = 1$: $H(1) = \dfrac{1}{1 - 0.5 \times (1)^{-1}}$

Step 2 – simplify the denominator: $1 - 0.5 = 0.5$

Step 3 – divide: $H(1) = \dfrac{1}{0.5}$

$H(1) = 2$

Final Answer: d.c. gain $= 2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept – transformer e.m.f. equation: The r.m.s. induced e.m.f. of a winding is $E = 4.44\, f\, N\, \Phi_m$.

Step 1 – list the data: $f = 50$ Hz, $N = 100$, $\Phi_m = 0.02$ Wb.

Step 2 – multiply f and N: $f\,N = 50 \times 100 = 5000$

Step 3 – multiply by the flux: $f\,N\,\Phi_m = 5000 \times 0.02 = 100$

Step 4 – multiply by 4.44**:** $E = 4.44 \times 100$

$E = 444$ V

Final Answer: $E = 444 \text{ V} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept – load sharing in parallel transformers: When two transformers have equal per-unit impedance, they share the load in direct proportion to their kVA ratings.

Step 1 – form the total rating: $100 + 200 = 300$ kVA

Step 2 – form the share of the 200 **kVA unit:** $\dfrac{200}{300}$

Step 3 – multiply by the total load: $S_2 = 240 \times \dfrac{200}{300}$

Step 4 – evaluate: $S_2 = 240 \times \dfrac{2}{3} = 160$ kVA

Final Answer: $S_2 = 160 \text{ kVA} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept – conditions for parallel operation: Single-phase transformers must produce equal secondary voltages of the same phase and connect with matched polarity, otherwise circulating currents flow even at no load.

Step 1 – voltage ratio requirement: Equal turns (voltage) ratios keep the open-circuit secondary voltages equal, so no circulating current flows at no load.

Step 2 – polarity requirement: The polarities must match so the secondaries aid correctly around the loop.

Step 3 – select the option that states both: Same voltage ratio and same polarity.

Why the other options are wrong:

- A, same kVA rating: not required; unequal ratings share load by their ratings.
- B and C: core material and identical primary current are not conditions for paralleling.

Final Answer: same voltage ratio and polarity $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q19

Q20.

Solution

Concept – transformer efficiency: $\eta = \dfrac{P_{out}}{P_{out} + P_{loss}}$, where the total loss is the sum of iron and copper losses.

Step 1 – add the losses: $P_{loss} = 400 + 400 = 800$ W $= 0.8$ kW

Step 2 – form the denominator: $P_{out} + P_{loss} = 8 + 0.8 = 8.8$ kW

Step 3 – divide: $\eta = \dfrac{8}{8.8}$

Step 4 – evaluate: $\eta = 0.909 = 90.9\%$

Final Answer: $\eta = 90.9\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q20

Q21.

Solution

Concept – rotor speed of an induction motor: The synchronous speed is $N_s = \dfrac{120f}{P}$ and the rotor runs slower by the slip, $N = N_s(1 - s)$.

Step 1 – compute the synchronous speed: $N_s = \dfrac{120 \times 50}{6}$

Step 2 – evaluate: $N_s = \dfrac{6000}{6} = 1000$ rpm

Step 3 – apply the slip: $N = 1000 \times (1 - 0.05)$

Step 4 – evaluate: $N = 1000 \times 0.95 = 950$ rpm

Final Answer: $N = 950$ rpm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept – back e.m.f. of a d.c. motor: The back e.m.f. is the supply voltage less the armature resistive drop, $E_b = V - I_a R_a$.

Step 1 – compute the armature drop: $I_a R_a = 40 \times 0.25 = 10$ V

Step 2 – subtract from the supply: $E_b = 250 - 10$

Step 3 – evaluate: $E_b = 240$ V

Final Answer: $E_b = 240 \text{ V} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept – synchronous speed: The speed of the rotating field is $N_s = \dfrac{120f}{P}$.

Step 1 – list the data: $f = 50$ Hz, $P = 8$ poles.

Step 2 – form the numerator: $120 \times 50 = 6000$

Step 3 – divide by the pole number: $N_s = \dfrac{6000}{8}$

Step 4 – evaluate: $N_s = 750$ rpm

Final Answer: $N_s = 750 \text{ rpm} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept – load factor: Load factor is the average load over the maximum demand; the average load is the energy divided by the time.

Step 1 – compute the average load: $P_{avg} = \dfrac{4800 \text{ kWh}}{24 \text{ h}} = 200$ kW

Step 2 – form the load-factor ratio: $\text{LF} = \dfrac{P_{avg}}{P_{max}} = \dfrac{200}{400}$

Step 3 – evaluate: $\text{LF} = 0.5$

Final Answer: load factor $= 0.5 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept – demand factor: Demand factor is the ratio of the maximum demand actually drawn to the total connected load.

Step 1 – list the data: Maximum demand $= 300$ kW, connected load $= 500$ kW.

Step 2 – form the ratio: $\text{DF} = \dfrac{300}{500}$

Step 3 – evaluate: $\text{DF} = 0.6$

Step 4 – sanity check: A demand factor is at most 1; $0.6 < 1$, so the result is consistent.

Final Answer: demand factor $= 0.6 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q25

Q26.

Solution

Concept – diversity factor: Diversity factor is the sum of the individual maximum demands divided by the coincident (simultaneous) system maximum demand; it is always at least 1.

Step 1 – add the individual maxima: $40 + 30 + 30 = 100$ kW

Step 2 – form the ratio with the system maximum: $\text{DiF} = \dfrac{100}{80}$

Step 3 – evaluate: $\text{DiF} = 1.25$

Final Answer: diversity factor $= 1.25 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q26

Q27.

Solution

Concept – base impedance in per unit: $Z_{base} = \dfrac{(kV_{base})^2}{MVA_{base}}$ when voltage is in kV and power in MVA.

Step 1 – square the base voltage: $(33)^2 = 1089$

Step 2 – divide by the base MVA: $Z_{base} = \dfrac{1089}{100}$

Step 3 – evaluate: $Z_{base} = 10.89\ \Omega$

Final Answer: $Z_{base} = 10.89\ \Omega \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept – symmetrical fault level: The three-phase fault MVA at a bus is the base MVA divided by the per-unit reactance up to the fault, $\text{MVA}_{fault} = \dfrac{\text{MVA}_{base}}{X_{pu}}$.

Step 1 – list the data: $\text{MVA}_{base} = 100$, $X_{pu} = 0.25$.

Step 2 – divide: $\text{MVA}_{fault} = \dfrac{100}{0.25}$

Step 3 – evaluate: $\text{MVA}_{fault} = 400$ MVA

Final Answer: $\text{MVA}_{fault} = 400 \text{ MVA} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept – single-line-to-ground fault current: For an SLG fault the three sequence networks are in series, giving $I_f = \dfrac{3E}{Z_1 + Z_2 + Z_0}$.

Step 1 – add the sequence reactances: $Z_1 + Z_2 + Z_0 = 0.15 + 0.15 + 0.15 = 0.45$ pu

Step 2 – form the numerator: $3E = 3 \times 1.0 = 3$

Step 3 – divide: $I_f = \dfrac{3}{0.45}$

Step 4 – evaluate: $I_f = 6.67$ pu

Final Answer: $I_f = 6.67 \text{ pu} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept – surge (characteristic) impedance: For a lossless line $Z_c = \sqrt{L/C}$, using the per-unit-length inductance and capacitance.

Step 1 – list the data in base units: $L = 1.6 \text{ mH/km} = 1.6 \times 10^{-3}$ H/km

$C = 0.01\ \mu\text{F/km} = 1 \times 10^{-8}$ F/km

Step 2 – form the ratio L/C: $\dfrac{L}{C} = \dfrac{1.6 \times 10^{-3}}{1 \times 10^{-8}} = 1.6 \times 10^{5}$

Step 3 – take the square root: $Z_c = \sqrt{1.6 \times 10^{5}}$

Step 4 – evaluate: $Z_c = 400\ \Omega$

Final Answer: $Z_c = 400\ \Omega \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q30

Q31.

Solution

Concept – damping ratio of a second-order system: Compare $s^2 + 8s + 64$ with $s^2 + 2\zeta\omega_n s + \omega_n^2$.

Step 1 – find ω_n from the constant term: $\omega_n^2 = 64 \Rightarrow \omega_n = 8$ rad/s

Step 2 – match the middle coefficient: $2\zeta\omega_n = 8$

Step 3 – substitute $\omega_n = 8$: $2\zeta \times 8 = 8$

Step 4 – solve for ζ: $16\zeta = 8 \Rightarrow \zeta = 0.5$

Final Answer: $\zeta = 0.5 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q31

Q32.

Solution

Concept – Routh–Hurwitz criterion: The number of right-half-plane poles equals the number of sign changes in the first column of the Routh array.

Step 1 – write the first two rows: $s^3 : \ 1 \quad 5$

$s^2 : \ 4 \quad 2$

Step 2 – compute the s^1 row: $b_1 = \dfrac{(4)(5) - (1)(2)}{4} = \dfrac{20 - 2}{4} = \dfrac{18}{4} = 4.5$

Step 3 – compute the s^0 row: $c_1 = 2$

Step 4 – inspect the first column: $1,\ 4,\ 4.5,\ 2$ are all positive.

Step 5 – count sign changes: There are no sign changes, so no poles lie in the right half-plane.

Final Answer: 0 RHP poles $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q32

Q33.

Solution

Concept – phase margin from the Bode plot: The phase margin is $180°$ added to the open-loop phase at the gain-crossover frequency.

Step 1 – list the crossover phase: $\angle G(j\omega_{gc}) = -135°$

Step 2 – apply the definition: $\text{PM} = 180° + (-135°)$

Step 3 – evaluate: $\text{PM} = 45°$

Step 4 – interpret: A positive phase margin of $45°$ indicates a comfortably stable design.

Final Answer: $\text{PM} = 45° \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept – steady-state error to a ramp (type-1 system): For a unit-ramp input the error is $e_{ss} = 1/K_v$, where the velocity error constant is $K_v = \lim_{s\to 0} sG(s)$.

Step 1 – form $sG(s)$: $sG(s) = \dfrac{20s}{s(s+4)} = \dfrac{20}{s+4}$

Step 2 – take the limit as $s \to 0$: $K_v = \dfrac{20}{0+4} = 5$

Step 3 – compute the steady-state error: $e_{ss} = \dfrac{1}{K_v} = \dfrac{1}{5}$

Step 4 – evaluate: $e_{ss} = 0.2$

Final Answer: $e_{ss} = 0.2 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q34

Q35.

Solution

Concept – d.c. gain of a closed-loop system: Evaluate the closed-loop transfer function $\dfrac{G(s)}{1+G(s)}$ at $s = 0$.

Step 1 – evaluate the forward path at $s = 0$: $G(0) = \dfrac{15}{0+3} = 5$

Step 2 – form the closed-loop d.c. gain: $\dfrac{G(0)}{1+G(0)} = \dfrac{5}{1+5}$

Step 3 – evaluate: $= \frac{5}{6} = 0.833$

Final Answer: closed-loop d.c. gain $= 0.833 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept – non-inverting op-amp gain: For an ideal non-inverting amplifier the closed-loop gain is $A_v = 1 + \frac{R_f}{R_1}$.

Step 1 – form the resistance ratio: $\frac{R_f}{R_1} = \frac{90\ \text{k}\Omega}{10\ \text{k}\Omega} = 9$

Step 2 – add one: $A_v = 1 + 9$

Step 3 – evaluate: $A_v = 10$

Why the other options are wrong:

- A, 9: this is R_f/R_1 alone, forgetting the "1+".
- B, 0.1: inverts the ratio.

Final Answer: $A_v = 10 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept – binary-to-decimal conversion: Weight each bit by its power of two and add.

Step 1 – write the bit weights (from MSB): $1{\cdot}2^4 \quad 1{\cdot}2^3 \quad 0{\cdot}2^2 \quad 1{\cdot}2^1 \quad 0{\cdot}2^0$

Step 2 – evaluate each nonzero term: $2^4 = 16$, $2^3 = 8$, $2^1 = 2$

Step 3 – add the contributions: $16 + 8 + 0 + 2 + 0$

Step 4 – evaluate: $= 26$

Final Answer: $(11010)_2 = 26 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q37

Q38.

Solution

Concept – potentiometer measurement: At balance no current flows through the galvanometer, so the unknown e.m.f. equals the voltage drop along the balanced length, $E_x = (\text{drop per cm}) \times (\text{balance length})$.

Step 1 – list the data: Drop $= 2$ mV/cm, balance length $= 75$ cm.

Step 2 – multiply: $E_x = 2 \text{ mV/cm} \times 75 \text{ cm}$

Step 3 – evaluate in millivolts: $E_x = 150 \text{ mV}$

Step 4 – convert to volts: $E_x = 0.15 \text{ V}$

Final Answer: $E_x = 0.15 \text{ V} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept – hexadecimal-to-decimal conversion: Weight each hex digit by its power of sixteen, using C $= 12$.

Step 1 – identify the digits: Digit "2" at position 16^1; digit "C" ($= 12$) at position 16^0.

Step 2 – evaluate the high digit: $2 \times 16 = 32$

Step 3 – evaluate the low digit: $12 \times 1 = 12$

Step 4 – add: $32 + 12 = 44$

Final Answer: $(2\text{C})_{16} = 44 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q39

Q40.

Solution

Concept – Boolean simplification: Factor the common variable and use $\bar{A} + A = 1$.

Step 1 – write the expression: $Y = \bar{A}B + AB$

Step 2 – factor out B: $Y = B(\bar{A} + A)$

Step 3 – apply the complement law: $\bar{A} + A = 1$

Step 4 – simplify: $Y = B \times 1 = B$

Final Answer: $Y = B \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

Q41.

Solution

Concept – speed of logic families: Emitter-coupled logic (ECL) keeps its transistors in the active region and never lets them saturate, so there is no storage-time delay; this makes it the fastest of the common families.

Step 1 – compare the families: TTL and DTL saturate their transistors, incurring storage delay; CMOS is low-power but slower at comparable technology nodes.

Step 2 – identify the non-saturating family: ECL uses a differential current-steering pair that avoids saturation.

Step 3 – conclude: ECL has the lowest propagation delay (highest speed).

Final Answer: ECL $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q41

Q42.

Solution

Concept – resonant frequency of an LC tank: $f_0 = \dfrac{1}{2\pi\sqrt{LC}}$.

Step 1 – list the data in base units: $L = 10\ \mu\text{H} = 1 \times 10^{-5}\ \text{H}$

$C = 0.1\ \mu\text{F} = 1 \times 10^{-7}\ \text{F}$

Step 2 – form the product LC: $LC = (1 \times 10^{-5})(1 \times 10^{-7}) = 1 \times 10^{-12}$

Step 3 – take the square root: $\sqrt{LC} = 1 \times 10^{-6}$

Step 4 – form the denominator: $2\pi\sqrt{LC} = 2\pi \times 10^{-6} = 6.283 \times 10^{-6}$

Step 5 – divide: $f_0 = \dfrac{1}{6.283 \times 10^{-6}} \approx 1.59 \times 10^5\ \text{Hz}$

Step 6 – express in kHz: $f_0 \approx 159\ \text{kHz}$

Final Answer: $f_0 \approx 159\ \text{kHz} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q42

Q43.

Solution

Concept – RMS of a square wave: A symmetric square wave swinging between $+V_{dc}$ and $-V_{dc}$ has a magnitude of V_{dc} at every instant, so its RMS value equals V_{dc}.

Step 1 – square the instantaneous value: $v_o^2 = V_{dc}^2$ for the whole period.

Step 2 – take the mean of the square: $\overline{v_o^2} = V_{dc}^2$

Step 3 – take the square root: $V_{rms} = \sqrt{V_{dc}^2} = V_{dc}$

Step 4 – substitute the value: $V_{rms} = 100$ V

Why the other options are wrong:

- B, 70.7 V: that is the RMS of a sinusoid of peak 100 V, not a square wave.
- C, 63.66 V: that is $2V_m/\pi$, an average-rectifier value.

Final Answer: $V_{rms} = 100\text{ V} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q43

Q44.

Solution

Concept – fundamental of a square-wave inverter: The Fourier series of a square wave of amplitude V_{dc} has a fundamental of peak value $\dfrac{4V_{dc}}{\pi}$.

Step 1 – list the data: $V_{dc} = 200$ V, $\pi = 3.1416$.

Step 2 – form the numerator: $4V_{dc} = 4 \times 200 = 800$

Step 3 – divide by π: $V_{1,\text{peak}} = \dfrac{800}{3.1416}$

Step 4 – evaluate: $V_{1,\text{peak}} \approx 254.6$ V

Final Answer: $V_{1,\text{peak}} \approx 254.6\text{ V} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q44

Q45.

Solution

Concept – boost converter transfer ratio: For a boost converter in continuous conduction, $V_o = \dfrac{V_s}{1-D}$.

Step 1 – form the denominator: $1 - D = 1 - 0.6 = 0.4$

Step 2 – divide the input by it: $V_o = \dfrac{48}{0.4}$

Step 3 – evaluate: $V_o = 120$ V

Step 4 – sanity check: A boost converter steps up, and $120 > 48$, so the result is consistent.

Final Answer: $V_o = 120 \text{ V} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q45

Q46.

Solution

Concept – controlled bridge in the inverting mode: For a single-phase fully controlled bridge feeding a highly inductive load, $V_{dc} = \dfrac{2V_m}{\pi}\cos\alpha$; for $\alpha > 90^\circ$ the output average voltage goes negative (inverter operation).

Step 1 – evaluate the uncontrolled part: $\dfrac{2V_m}{\pi} = \dfrac{2 \times 100}{3.1416} = 63.66$ V

Step 2 – evaluate the cosine of the firing angle: $\cos 120^\circ = -0.5$

Step 3 – multiply: $V_{dc} = 63.66 \times (-0.5)$

Step 4 – evaluate: $V_{dc} = -31.83$ V

Why the other options are wrong:

- A, $+31.83$ V: drops the negative sign of $\cos 120^\circ$.
- C, 0 V: would require $\alpha = 90^\circ$.

Final Answer: $V_{dc} = -31.83 \text{ V} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q46

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	C	3	B	4	B	5	C
6	D	7	C	8	A	9	B	10	C
11	D	12	B	13	A	14	B	15	C
16	D	17	A	18	C	19	D	20	A
21	B	22	B	23	C	24	D	25	B
26	D	27	B	28	D	29	A	30	C
31	B	32	A	33	A	34	C	35	C
36	D	37	C	38	A	39	D	40	B
41	B	42	D	43	A	44	D	45	A
46	D								