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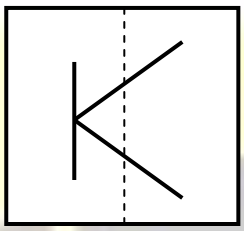
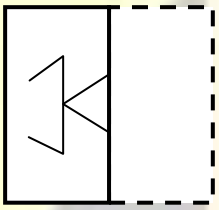
GENERAL APTITUDE

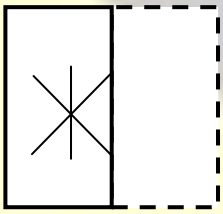
Q. No. 1 - 5 Carry One Mark Each

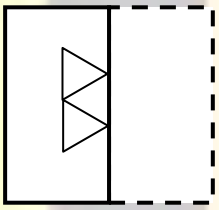
1.

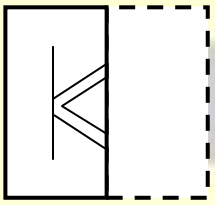


A transparent square sheet show above is folded along the dotted line. The folded sheet will look like

(A) 

(B) 

(C) 

(D) 

Answer: (C) Click here to watch video explanation

2. The people _____ were at the demonstration were from all sections of society.

(A) whose (B) which (C) whom (D) who

Answer: (D) Click here to watch video explanation

3. Oasis is to sand as island is to _____.

Which one of the following options maintains a similar logical relation in the above sentence?

(A) Water (B) Mountain (C) Land (D) Stone

Answer: (A) Click here to watch video explanation

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4. For a regular polygon having 10 sides, the interior angle between the sides of the polygon, in degrees, is:

(A) 396 (B) 144 (C) 216 (D) 324

Answer: (B) Click here to watch video explanation

5. Which one of the following numbers is exactly divisible by $\left(11^{13}+1\right)$?

(A) $11^{52}-1$ (B) $11^{39}-1$ (C) $11^{33}+1$ (D) $11^{26}+1$

Answer: (A) Click here to watch video explanation

Q. No. 6 - 10 Carry Two Marks Each

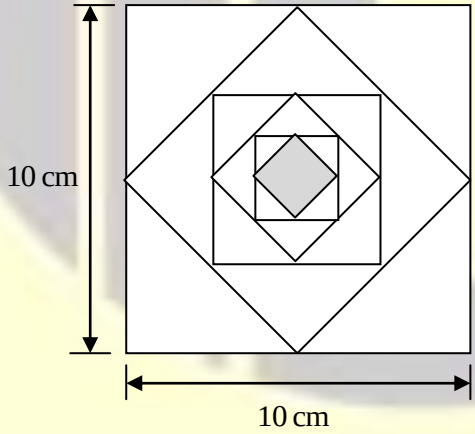
6. Let X be a continuous random variable denoting the temperature measured. The range of temperature is [0, 100] degree Celsius and let the probability density function of X be f(x) = 0.01 for $0 \le X \le 100$.

The mean of X is _____.

(A) 25.0 (B) 5.0 (C) 50.0 (D) 2.5

Answer: (C) Click here to watch video explanation

7.



In the figure shown above, each inside square is formed by joining the midpoints of the sides of the next larger square. The area of the smallest square (shaded) as shown, in cm^2 is:

(A) 6.25 (B) 3.125 (C) 1.5625 (D) 12.50

Answer: (B) Click here to watch video explanation

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8. The important of sleep is often overlooked by students when they are preparing for exams. Research has consistently shown that sleep deprivation greatly reduces the ability to recall the material learnt. Hence, cutting down on sleep to study longer hours can be counterproductive.

Which one of the following statements is the CORRECT inference from the above passage?

(A) To do well in exam, adequate sleep must be part of the preparation

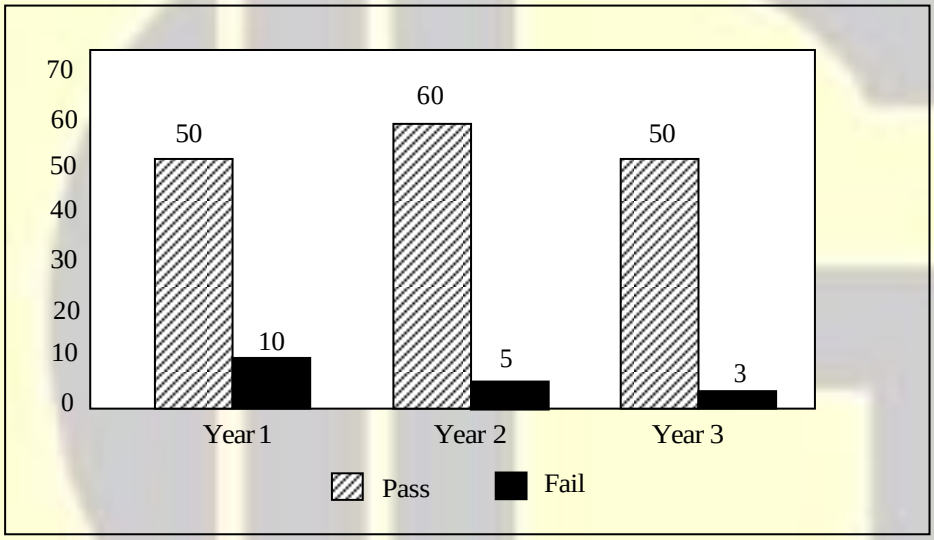
(B) Students are efficient and are not wrong in thinking that sleep is a waste of time

(C) If a student is extremely well prepared for an exam, he needs little or no sleep

(D) Sleeping well alone is enough to prepare for an exam. Studying has lesser benefit

Answer: (A) Click here to watch video explanation

9.



The number of students passing or failing in an exam for a particular subject is presented in the bar chart above. Students who pass the exam cannot appear for the exam again. Students who fail the exam in the first attempt must appear for the exam in the following year. Students always pass the exam in their second attempt.

The number of students who took the exam for the first time in the year 2 and the year 3 respectively, are_____.

(A) 65 and 53 (B) 55 and 53 (C) 60 and 50 (D) 55 and 48

Answer: (D) Click here to watch video explanation

10. Seven cars P, Q, R, S, T, U and V are parked in a row not necessarily in that order. The cars T and U should be parked next to each other. The cars S and V also should be parked next to each other, whereas P and Q cannot be parked next to each other. Q and S must be parked next to each other. R isparked to the immediate right of V. T is parked to the left of U.

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Based on the above statements, the only INCORRECT option given below is:

(A) There are two cars parked in between Q and V

(B) Q and R are not parked together

(C) V is the only car parked in between S and R

(D) Car P is parked at the extreme end

Answer: (A) Click here to watch video explanation

ELECTRICAL ENGINEERING

Q. No. 1 to 25 Carry One Mark Each

1. Let p and q be real numbers such that $p^2 + q^2 = 1$. The eigen values of the matrix $\begin{bmatrix} p & q \\ q & -p \end{bmatrix}$ are

(A) j and –j (B) 1 and 1 (C) 1 and –1 (D) pq and –pq

Answer: (C) Click here to watch video explanation

2. Let $p(z) = z^3 + (1+j)z^2 + (2+j)z + 3$, where Z is a complex number. Which one of the following is true?

(A) All the roots cannot be real

(B) conjugate {p(z)} = p(conjugate {z}) for all z

(C) The sum of the roots of p(z) = 0 is a real number

(D) The complex roots of the equation p(z) = 0 come in conjugate pairs

Answer: (A) Click here to watch video explanation

3. Two single-cover power cables have total conductor resistances of 0.7 Ω and 0.5 Ω, respectively, and their insulation resistance (between core and sheath) are 600 MΩ and 900 MΩ respectively. When the two cables are joined in series, the ratio of insulation resistance to conductor resistance is _____ $\times 10^6$.

Answer: (300) Click here to watch video explanation

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4. Two generators have cost functions F_1 and F_2. Their incremental-cost characteristics are

$$\frac{dF_1}{dP_1} = 40 + 0.2P_1$$
$$\frac{dF_2}{dP_2} = 32 + 0.4P_2$$

They need to deliver a combined load of 260 MW. Ignoring the network losses, for economic operation, the generations P_1 and P_2 (in MW) are

(A) $P_1 = P_2 = 130$ (B) $P_1 = 160, P_2 = 100$

(C) $P_1 = 140, P_2 = 120$ (D) $P_1 = 120, P_2 = 140$

Answer: (B) Click here to watch video explanation

5. Which one of the following vector functions represents a magnetic field $\vec{B}$?

($\hat{x}$, $\hat{y}$ and $\hat{z}$ are unit vectors along x-axis, y-axis and z-axis respectively)

(A) $10x\hat{x} + 20y\hat{y} - 30z\hat{z}$ (B) $10y\hat{x} + 20x\hat{y} - 10z\hat{z}$

(C) $10x\hat{x} - 30z\hat{y} + 20y\hat{z}$ (D) $10z\hat{x} + 20y\hat{y} - 30x\hat{z}$

Answer: (A) Click here to watch video explanation

6. Two discrete-time linear time-invariant systems with impulse responses $h_1[n] = \delta[n-1] + \delta[n+1]$ and $h_2[n] = \delta[n] + \delta[n-1]$ are connected in cascade, where $\delta[n]$ is the Kronecker delta. The impulse response of the cascaded system is

(A) $\delta[n]\delta[n-1] + \delta[n-2]\delta[n+1]$ (B) $\delta[n-2] + \delta[n+1]$

(C) $\delta[n-2] + \delta[n-1] + \delta[n] + \delta[n+1]$ (D) $\delta[n-1]\delta[n] + \delta[n+1]\delta[n-1]$

Answer: (C) Click here to watch video explanation

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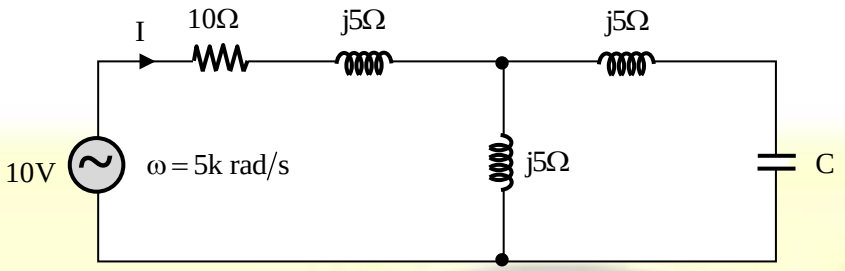
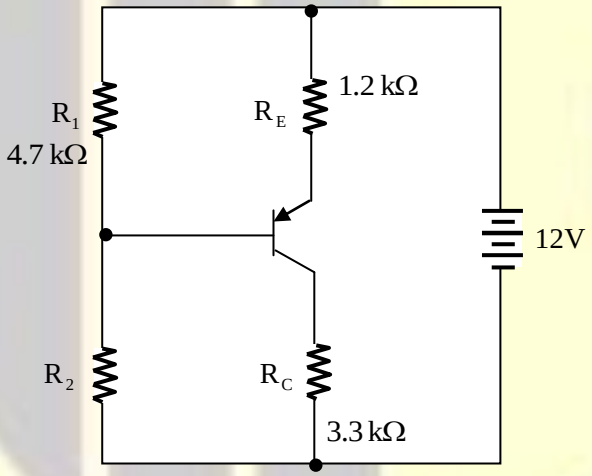
7. In the given circuit, the value of capacitor C that makes current I = 0 is _____ μF.



Answer: (20) Click here to watch video explanation

8. In the BJT circuit shown, beta of the PNP transistor is 100. Assume $V_{BE} = -0.7V$. The voltage across R_C will be 5V when R_2 is _____ kΩ. (Round of to 2 decimal places).



9. Suppose the circles $x^3 + y^2 = 1$ and $(x-1)^2 + (y-1)^2 = r^2$ intersect each other orthogonally at the point (u, v). The u + v = _____,

Answer: (17.53) Click here to watch video explanation

10. A 16-bit synchronous binary up-counter is clocked with a frequency f_{CLK}. The two most significant bits are OR-ed together to form an output Y. Measurement show that Y is periodic, and the duration for which Y remains high in each period is 24ms. The clock frequency f_{CLK} is _____ MHz.

(Round off to 2 decimal places).

Answer: (C) Click here to watch video explanation

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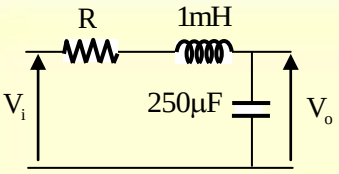
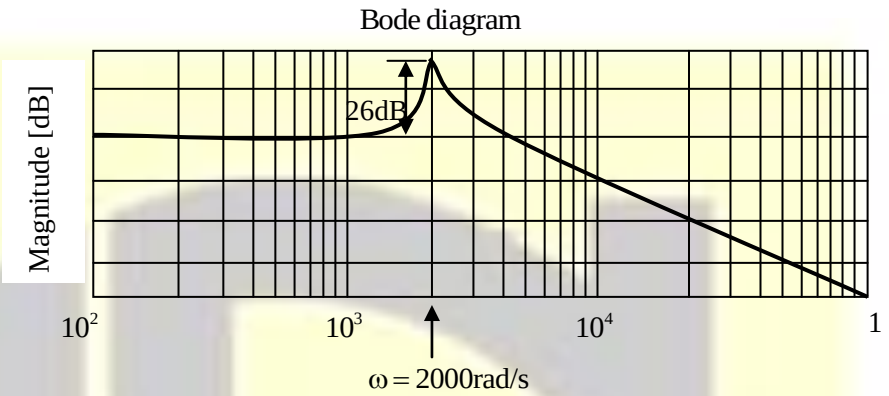
11. The bode magnitude plot for the transfer function $\frac{V_o(s)}{V_i(s)}$ of the circuit is as shown.

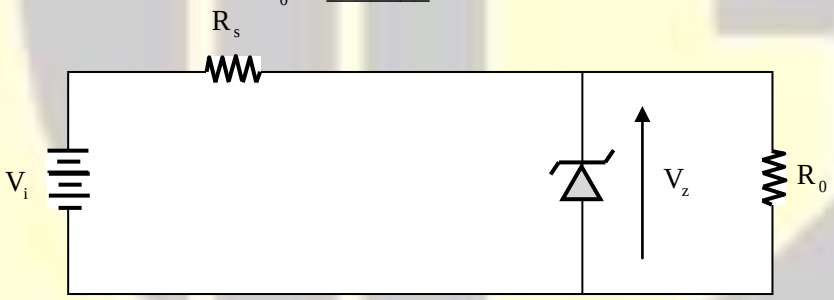
The value of R is _____ Ω. (Round off to 2 decimal places).





Answer: (0.1) Click here to watch video explanation

12. In the circuit shown, a 5V Zener diode is used to regulate the voltage across load R_0. The input is an unregulated DC voltage with a minimum value of 6V and a maximum value of 8V. The value of R_S is $6\,\Omega$. . The zener diode has a maximum rated power dissipation of 2.5 W. Assuming the zener diode to be ideal, the minimum value of R_0 is _____ Ω.



Answer: (10) Click here to watch video explanation

13. A signal generator having a source resistance of $50\,\Omega$ is set to generate a 1 kHz sinewave. Open circuit terminal voltage is 10V peak-to-peak. Connecting a capacitor across the terminals reduces the voltage to 8V peak-to-peak. The value of this capacitor is _____ μF. (Round off to 2 decimal places).

Answer: (C) Click here to watch video explanation

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14. Consider the table given:

Constructional feature	Machine type	Mitigation
(P) Damper bars	**(S)** Induction motor	**(X)** Hunting
(Q) Skewed rotor slots	**(T)** Transformer	**(Y)** Magnetic locking
(R) Compensating winding	**(U)** Synchronous machine	**(Z)** Armature reaction
	(V) DC machine	

The correct combination that relates the constructional feature, machine type and mitigation is

(A) P-V-X, Q-U-Z, R-T-Y
(B) P-T-Y, Q-V-Z, R-S-X
(C) P-U-X, Q-V-Y, R-T-Z
(D) P-U-X, Q-S-Y, R-V-Z

Answer: (D) Click here to watch video explanation

15. Inductance is measured by

(A) Schering bridge
(B) Kelvin bridge
(C) Wien bridge
(D) Maxwell bridge

Answer: (D) Click here to watch video explanation

16. An alternator with internal voltage of $I\angle\delta_1$ p.u and synchronous reactance of 0.4 p.u is connected by a transmission line of reactance 0.1 p.u to a synchronous motor having synchronous reactance 0.35 p.u and internal voltage of $0.85\angle\delta_2$ p.u. If the real power supplied by the alternator is 0.866 p.u, then $(\delta_1 - \delta_2)$ is _____ degrees. (Round off to 2 decimal places.)

(Machines are of non-salient type. Neglect resistances).

Answer: (60) Click here to watch video explanation

17. If the input x(t) and output y(t) of a system are related as $y(t) = \max(0, x(t))$, then the system is

(A) non-linear and time-invariant
(B) linear and time-invariant
(C) non-linear and time-variant
(D) linear and time-variant

Answer: (A) Click here to watch video explanation

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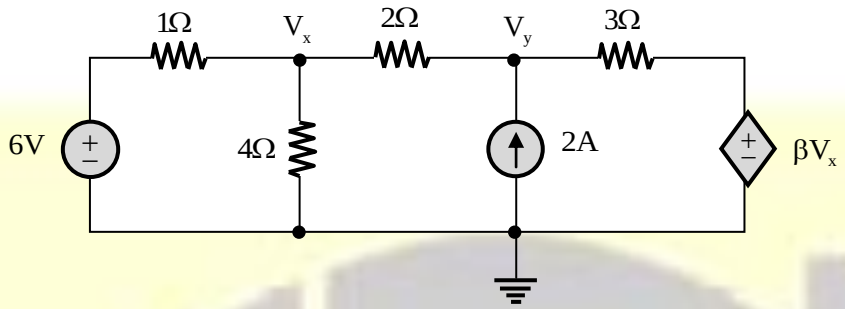
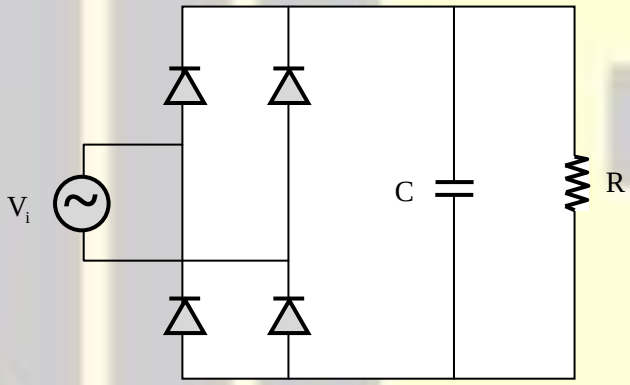
18. In the given circuit, for voltage V_y to be zero, the value of β should be (Round off to 2 decimal places).



Answer: (–3.25) Click here to watch video explanation

19. In the circuit shown, the input V_i is a sinusoidal AC voltage having and RMS value of $230V \pm 20\%$. The worst-case peak-inverse voltage seen across any diode is _____V. (Round off to 2 decimal places).



Answer: (390.32) Click here to watch video explanation

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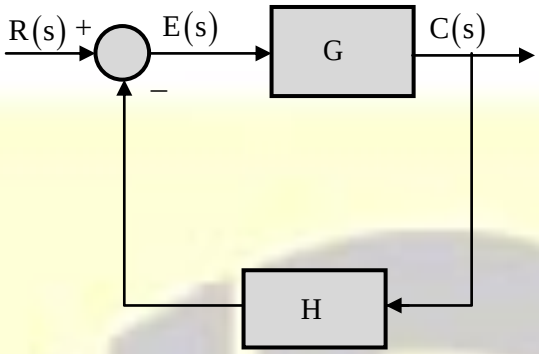
20. For the closed-loop system shown, the transfer function $\frac{E(s)}{R(s)}$ is



(A) $\frac{GH}{1+GH}$ (B) $\frac{G}{1+GH}$ (C) $\frac{1}{1+G}$ (D) $\frac{1}{1+GH}$

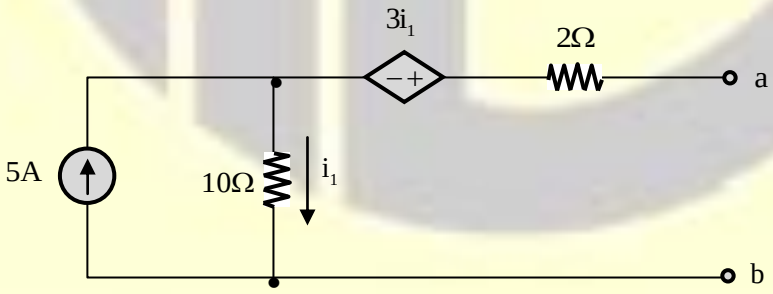
Answer: (D) Click here to watch video explanation

21. Let $f(x)$ be a real-valued function such that $f'(x_0)=0$ for some $x_0 \in (0,1)$, and $f''(x)>0$ for all $x \in (0,1)$. The $f(x)$ has

(A) no local minimum in (0, 1)
(B) one local maximum in (0, 1)
(C) exactly one local minimum in (0, 1)
(D) two distinct local minima in (0, 1)

Answer: (C) Click here to watch video explanation

22. For the network shown, the equivalent Thevenin voltage and Thevenin impedance as seen terminals 'ab' is



(A) 65 V in series with 15 Ω (B) 35V in series with 2 Ω
(C) 10 V in series with 12 Ω (D) 50V in series with 2 Ω

Answer: (A) Click here to watch video explanation

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23. Consider a power system consisting of N number of buses. Buses in this power system are categorized into slack bus, PV buses and PQ buses for load flow study. The number of PQ buses is N_L. The balanced Newton-Raphson method is used to carry out load flow study in polar form. H, S, M and R are sub-matrices of the Jacobian matrix J as shown below.

$$\begin{bmatrix}\Delta P\\ \Delta Q\end{bmatrix} = J\begin{bmatrix}\Delta\delta\\ \Delta V\end{bmatrix} \text{ where } J = \begin{bmatrix}H & S\\ M & R\end{bmatrix}$$

The dimension of the sub-matrix M is

(A) $N_L \times (N-1+N_L)$ (B) $(N-1)\times(N-1+N_L)$

(C) $N_L \times (N-1)$ (D) $(N-1)\times(N-1-N_L)$

Answer: (C) Click here to watch video explanation

24. The power input to a 500V, 50 Hz, 6-pole, 3-phae induction motor running at 975 RPM is 40 kW. The total stator losses are 1 kW. If the total friction and windage losses are 2.025 kW, then the efficiency is _____%.

Answer: (90) Click here to watch video explanation

25. A 1 μC point charge is held at the origin of a Cartesian coordinate system. If a second point charge of 10 μC is moved from (0, 10, 0) to (5, 5, 5) and subsequently to (5, 0, 0), then the total work done is _____ mJ. (Round off to 2 decimal places).

Take $\frac{1}{4\pi\varepsilon_o} = 9\times10^9$ in SI units. All coordinates are in meters.

Answer: (9) Click here to watch video explanation

Q. No. 26 - 55 Carry Two Marks Each

26. A counter is constructed with three D flip-flops. The input-output pairs are named $(D_0, Q_0), (D_1, Q_1)$ and (D_2, Q_2) where the subscript 0 denotes the least significant bit. The output sequence is desired to be the Gray-code sequence 000, 001, 011, 010, 110, 111, 101 and 100 repeating periodically. Note that the bits are listed in the $Q_2Q_1Q_0$ format. The combinational logic expression for D_1 is

(A) $Q_2Q_0 + Q_1\bar{Q}_0$ (B) $Q_2Q_1Q_0$ (C) $Q_2Q_1 + \bar{Q}_2\bar{Q}_1$ (D) $\bar{Q}_2Q_0 + Q_1\bar{Q}_0$

Answer: (D) Click here to watch video explanation

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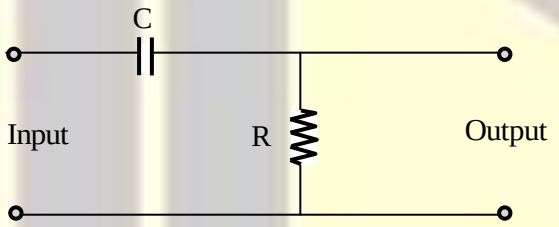
27. In a single-phase transformer, the total iron loss is 2500 W at nominal voltage of 440V and frequency 50Hz. The total iron loss is 850W at 220V and 25 Hz. Then, at nominal voltage and frequency, the hysteresis loss and eddy current loss respectively are

(A) 900 W and 1600 W (B) 250 W and 600 W

(C) 1600 W and 900 W (D) 600 W and 250 W

Answer: (A) Click here to watch video explanation

28. A 100 Hz square wave, switching between 0V and 5V, is applied to a CR high-pass filter circuit as shown. The output voltage waveform across the resistor is 6.2V peak-to-peak. If the resistance R is 820 Ω, then the value C is _____ μF. (Rounded off to 2 decimal places).



Answer: (12.43) Click here to watch video explanation

29. Let f(t) be an even function, i.e., $f(-t)=f(t)$ for all t. Let the Fourier transform of f(t) be defined as $F(\omega)=\int_{-\infty}^{\infty} f(t)e^{-j\omega t}dt$. Suppose $\frac{dF(\omega)}{d\omega}=-\omega F(\omega)$ for all ω, and $F(0)=1$. Then

(A) $f(0)>1$ (B) $f(0)=0$ (C) $f(0)<1$ (D) $f(0)=1$

Answer: (C) Click here to watch video explanation

30. Suppose I_A, I_B and I_C are a set of unbalanced current phasors in a three-phase system. The phase-B zero-sequence current $I_{B0}=0.1\angle 0°$ p.u. If phase-A current $I_A=1.1\angle 0°$ p.u and phase-C current $I_C=(1\angle 120°+0.1)$ p.u. then I_B in p.uis

(A) $1\angle -120°+0.1\angle 0°$ (B) $1\angle -240°+0.1\angle 0°$

(C) $1.1\angle 240°-0.1\angle 0°$ (D) $1.1\angle -120°+0.1\angle 0°$

Answer: (A) Click here to watch video explanation

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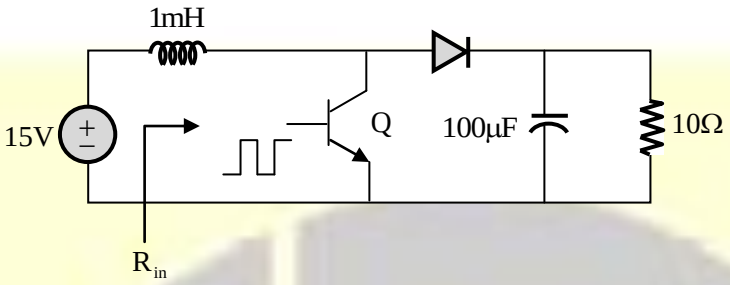
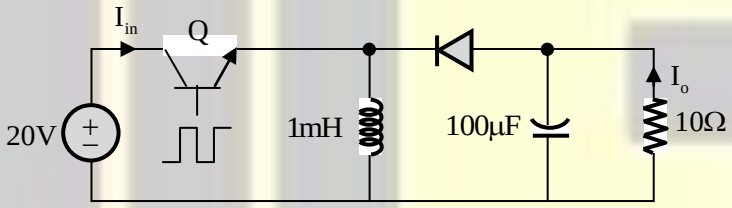
31. Consider the boost converter shown. Switch Q is operating at 25 kHz with a duty cycle of 0.6. Assume the diode and switch to be ideal. Under steady-state condition, the average resistance R_{in} as seen by the source is _____Ω (Round off to 2 decimal places).



Answer: (1.6) Click here to watch video explanation

32. Consider the buck-boost converter shown. Switch Q is operating at 25 kHz and 0.75 duty-cycle. Assume diode and switch to be ideal. Under steady-state condition, the average current flowing through the inductor is _____A.



Answer: (24) Click here to watch video explanation

33. Let A be a 10 × 10 matrix such that A^5 is a null matrix, and let I be the 10 × 10 identity matrix. The determinant of A + I is _____.

Answer: (1) Click here to watch video explanation

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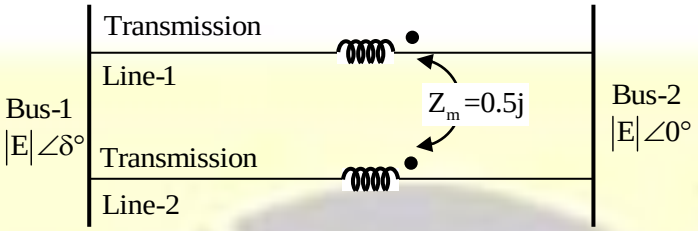
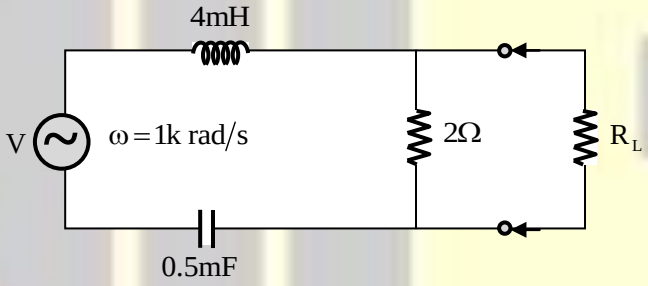
34. In the figure shown, self-impedance of the two transmission lines are 1.5j p.u each, and $Z_m = 0.5j$ p.u is the mutual impedance. Bus voltage shown in the figure are in p.u. Given that $\delta > 0$, the maximum steady-state real power that can be transferred in p.u from Bus-1 to Bus-2 is



(A) $2|E||V|$ (B) $\frac{3|E||V|}{2}$ (C) $|E||V|$ (D) $\frac{|E||V|}{2}$

Answer: (C) Click here to watch video explanation

35. In the given circuit, for maximum power to be delivered to R_L, its value should be _____ Ω. (Round off to 2 decimal places).



Answer: (1.414) Click here to watch video explanation

36. Suppose the probability that a coin toss shown "head" is p, where $0 < p < 1$. The coin is tossed repeatedly until the first "head" appears. The expected number of tosses required is

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

Answer: (C) Click here to watch video explanation

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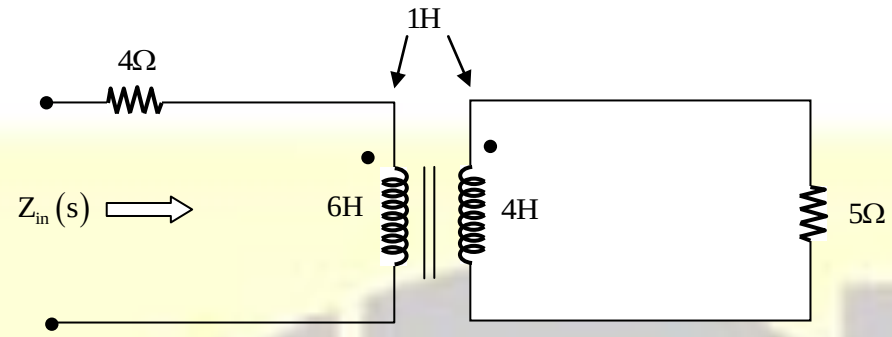
37. The input impedance, $Z_{in}(s)$, for the network shown is



(A) $6s+4$

(B) $7s+4$

(C) $\dfrac{25s^2+46s+20}{4s+5}$

(D) $\dfrac{23s^2+46s+20}{4s+5}$

Answer: (D) **Click here to watch video explanation**

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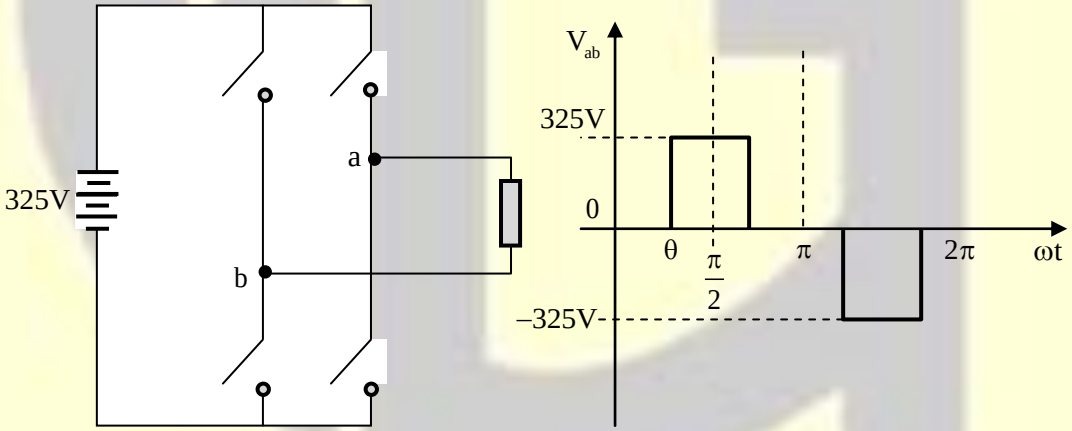
38. A single-phase full-bridge inverter fed by a 325 V DC produces a symmetric quasi-square waveform across 'ab' as shown.



To achieve a modulation index of 0.8, the angle θ expressed in degrees should be _____ (Round off to 2 decimal places).

(Modulation index is defined as the ratio of the peak of the fundamental component of V_{ab} to the applied DC value).

Answer: (51.07) **Click here to watch video explanation**

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39. Consider a continuous-time signal $x(t)$ defined by $x(t)=0$ for $|t|>1$, and $x(t)=1-|t|$ for $|t|\le 1$. Let the Fourier transform of x(t) defined as $X(\omega)=\int_{-\infty}^{\infty} x(t)e^{-j\omega t}dt$.. The maximum magnitude of $X(\omega)$ is _____.

Answer: (1) Click here to watch video explanation

40. One coulomb of point charge moving with a uniform velocity $10\,\hat{X}$ m/s enters the region $x\ge 0$ having a magnetic flux density $\vec{B}=(10y\hat{x}+10x\hat{y}+10\hat{z})$T. The magnitude for force on the charge at $x=0^{+}$ is _____ N. ($\hat{x}$, $\hat{y}$ and $\hat{z}$ are unit vectors along x-axis and z-axis, respectively).

Answer: (100) Click here to watch video explanation

41. The causal signal with z-transform $z^2(z-a)^{-2}$ is (u[n] is the unit step signal)

(A) $a^{2n}u[n]$ (B) $n^{-1}a^{n}u[n]$ (C) $n^{2}a^{n}u[n]$ (D) $(n+1)a^{n}u[n]$

Answer: (D) Click here to watch video explanation

42. A belt-driven DC shunt generator running at 300 RPM delivers 100 kW to 200V DC grid. It continues to run as a motor when the belt breaks, taking 10 kW from the DC grid. The armature resistance is $0.025\,\Omega$, field resistance is $50\,\Omega$, and brush drop is 2V. Ignoring armature reaction, the speed of the motor is _____RPM. (Round off to 2 decimal places).

Answer: (275.18) Click here to watch video explanation

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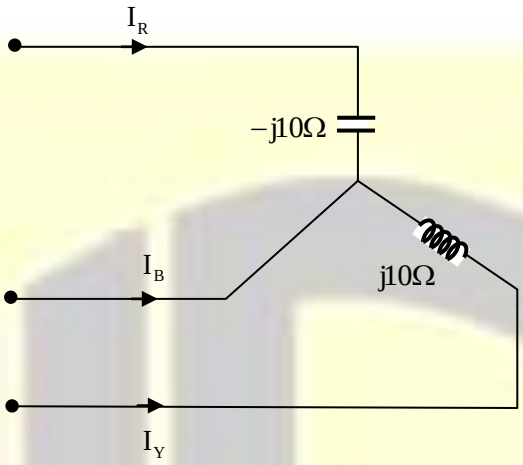
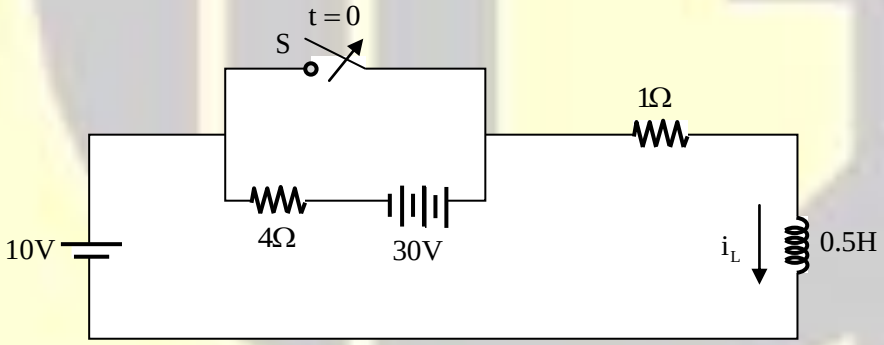
43. A three-phase balanced voltage is applied to the load shown. The phase sequence is RYB. The ratio $\frac{|I_B|}{|I_R|}$ is _____.



Answer: (1) Click here to watch video explanation

44. In the circuit, switch 'S' is in the closed position for a very long time. If the switch is opened at time t = 0, then $i_L(t)$ in amperes, for $t \geq 0$ is



(A) $8e^{-10}$ (B) 10 (C) $10\left(1-e^{-2t}\right)$ (D) $8+2e^{-10t}$

Answer: (D) Click here to watch video explanation

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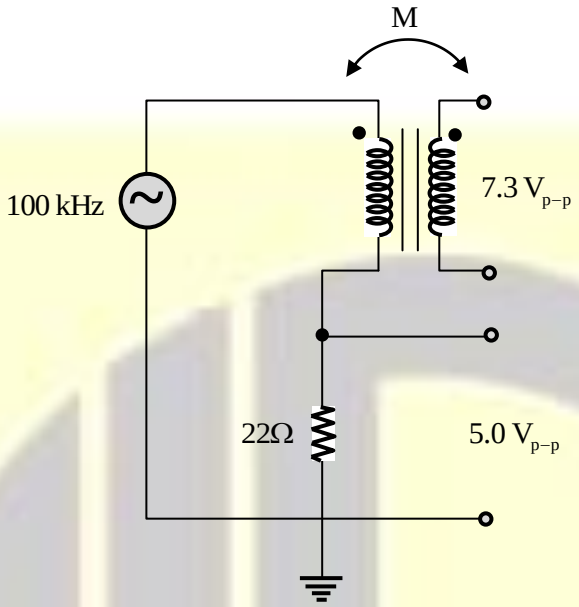
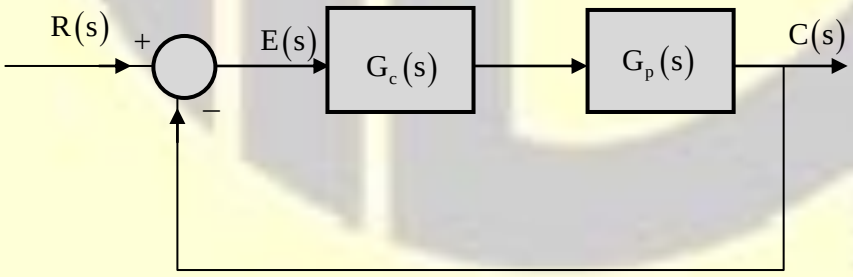
45. An air core radio-frequency transformer as shown has a primary winding and a secondary winding. The mutual inductance M between the windings of the transformer is _____ μH. (Round off to 2 decimal places).



Answer: (51.1) Click here to watch video explanation

46. Consider a closed-loop system as shown. $G_p(s)=\frac{14.4}{s(1+0.1s)}$ is the plant transfer function and $G_c(s)=1$ is the compensator. For a unit-step input, the output response has damped oscillations. The damped natural frequency is _____rad/s. (Round off to 2 decimal places).



Answer: (10.90) Click here to watch video explanation

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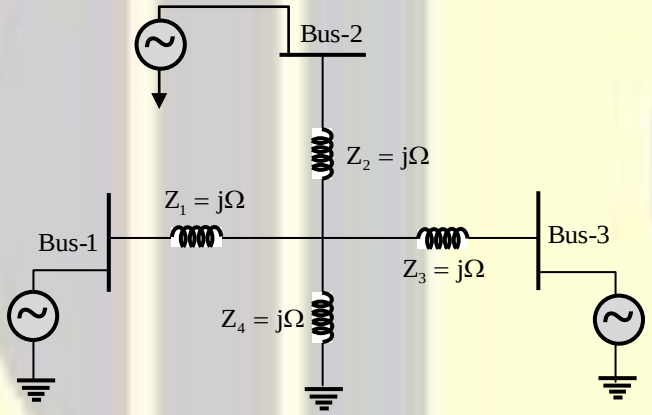
47. An 8-pole, 50 Hz, three-phase, slip-ring induction motor has an effective rotor resistance of 0.08 Ω per phase. Its speed at maximum torque is 650 RPM. The additional resistance per phase that must be inserted in the rotor to achieve maximum torque at start is _____Ω. (Round off to 2 decimal places). Neglect magnetizing current and stator leakage impedance. Consider equivalent circuit parameters referred to stator.

Answer: (0.52) Click here to watch video explanation

48. Consider a large parallel plate capacitor., The gap d between the two plates is filled entirely with dielectric slab of relative permittivity 5. The plates are initially charged to a potential different of V volts and then disconnected from the source. If the dielectric slab is pulled out completely, then the ratio of the new electric field E_2 in the gap to the original electric field E_1 is _____.

Answer: (5) Click here to watch video explanation

49. A 3-Bus network is shown. Consider generators as ideal voltage sources. If rows 1, 2 and 3 of the Y_{Bus} matrix correspond to Bus 1, 2 and 3, respectively then Y_{Bus} of the network is



(A) $\begin{bmatrix} -4j & 2j & 2j \\ 2j & -4j & 2j \\ 2j & 2j & -4j \end{bmatrix}$

(B) $\begin{bmatrix} -\frac{1}{2}j & \frac{1}{4}j & \frac{1}{4}j \\ \frac{1}{4}j & -\frac{1}{2}j & \frac{1}{4}j \\ \frac{1}{4}j & \frac{1}{4}j & -\frac{1}{2}j \end{bmatrix}$

(C) $\begin{bmatrix} -4j & j & j \\ j & -4j & j \\ j & j & -4j \end{bmatrix}$

(D) $\begin{bmatrix} -\frac{3}{4}j & \frac{1}{4}j & \frac{1}{4}j \\ \frac{1}{4}j & -\frac{3}{4}j & \frac{1}{4}j \\ \frac{1}{4}j & \frac{1}{4}j & -\frac{3}{4}j \end{bmatrix}$

Answer: (D) Click here to watch video explanation

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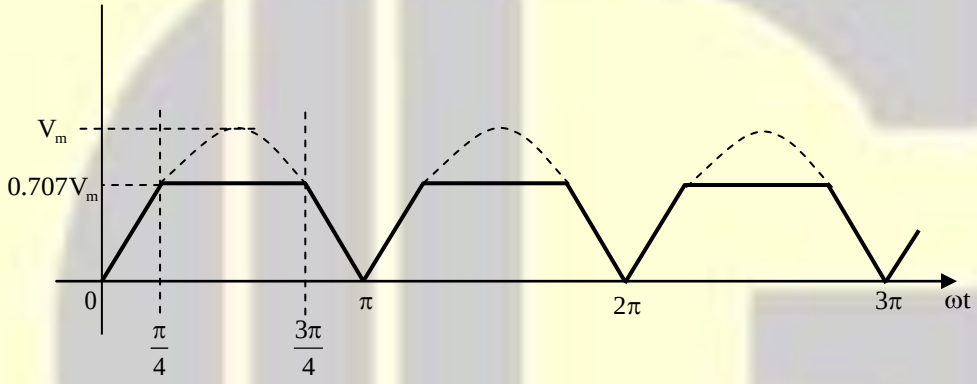
50. The state space representation of a first-order system is given as

$$\dot{x} = -x + u$$
$$y = x$$

Where, x is the state variable, u is the control input and y is the controlled output. Let u = –Kx be the control law, where K is the controller gain. To place closed-loop pole at –2, the value of K is _____.

Answer: (1) Click here to watch video explanation

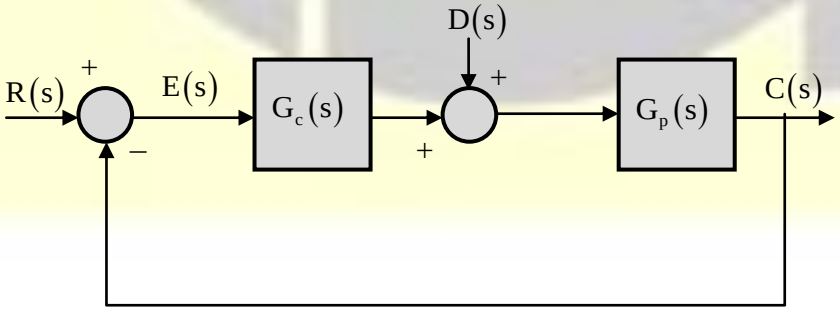
51. The waveform shown in solid line is obtained by clipping a full-wave rectified sinusoid (shown dashed). The ratio of the RMS value of the full-wave rectified waveform to the RMS value of the clipped waveform is _____(Round off to 2 decimal places).



Answer: (1.21) Click here to watch video explanation

52. In the given figure, plant $G_p(s) = \dfrac{2.2}{(1+0.1s)(1+0.4s)(1+1.2s)}$ and compensator $G_c(s) = K\left(\dfrac{1+T_1 s}{1+T_2 s}\right)$.

The external disturbance input is D(s). It is desired that when the disturbance is a unit step, the steady-error should not exceed 0.1 unit. The minimum value of K is _____. (Round off to 2 decimal places).



Answer: (9.54) Click here to watch video explanation

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53. In the open interval (0, 1), the polynomial $p(x) = x^4 - 4x^3 + 2$ has

(A) two real roots (B) three real roots

(C) one real root (D) no real roots

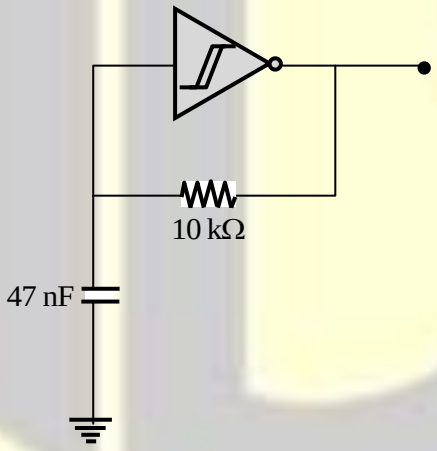
Answer: (C) Click here to watch video explanation

54. Let $(-1-j), (3-j), (3+j)$ and $(-1+j)$ be the vertices of a rectangle C in the complex plane. Assuming that C is traversed in counter-clockwise direction, the value of the contour integral $\oint_C \frac{dz}{z^2(z-4)}$ is

(A) 0 (B) $\frac{-j\pi}{8}$ (C) $\frac{j\pi}{16}$ (D) $\frac{j\pi}{2}$

Answer: (B) Click here to watch video explanation

55. A CMOS Schmitt-trigger inverter has a low output level of 0V and a high output level of 5V. It has input thresholds of 1.6V and 2.4V.



The input capacitance and output resistance of the Schmitt-trigger are negligible. The frequency of the oscillator shown is _____Hz.

(Round off to 2 decimal places).

Answer: (3166.20) Click here to watch video explanation

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