OJEE LE Tech (Diploma) Sample Paper 03

A) Mode and Time: The exam is a Computer Based Test (CBT) lasting 120 minutes.
B) Total Questions: The exam contains 120 questions.
C) Marking Scheme & Rules:

- +4 for correct answers and -1 for incorrect responses.

Q1. The rank of a non-zero null matrix is strictly:

A. 0

B. 1

C. Undefined

D. Infinite

Q2. If A is an orthogonal matrix of order n, the determinant of A mathematically must be:

A. 0

B. ± 1

C. n

D. $-n$

Q3. The eigenvalues of an upper triangular matrix are strictly given by the:

A. Elements of the first row

B. Elements of the last column

C. Elements of the principal diagonal

D. Sum of off-diagonal elements

Q4. The value of the limit $\lim_{x \to 0} \frac{1-\cos 2x}{x^2}$ is exactly:

A. 1

B. 2

C. 0

D. 1/2

Q5. If $y = \log_e(\log_e x)$, then dy/dx is precisely:

A. $1/(x \log_e x)$

B. $1/\log_e x$

C. $1/x$

D. $x \log_e x$

Q6. The function $f(x) = x^3 - 3x^2 + 3x - 1$ is strictly:

A. Increasing everywhere

B. Decreasing everywhere

C. Increasing only for $x > 0$

D. Decreasing only for $x < 0$

Q7. The exact value of the definite integral $\int_0^{\pi/2} \cos^2 x \, dx$ is:

A. π

B. $\pi/2$

C. $\pi/4$

D. 1

Q8. The area enclosed strictly by the curve $y = x^2$ and the line $y = x$ is mathematically:

A. 1/2

B. 1/3

C. 1/6

D. 1/4

Q9. The integrating factor for the linear differential equation $\frac{dy}{dx} + \frac{y}{x} = x^2$ is exactly:

A. x

B. e^x

C. $1/x$

D. $\log x$

Q10. The complementary function of the differential equation $(D^2 + 2D + 1)y = 0$ is strictly:

A. $c_1 e^{-x} + c_2 e^x$

B. $(c_1 + c_2x)e^{-x}$

C. $(c_1 + c_2x)e^{x}$

D. $c_1 \cos x + c_2 \sin x$

Q11. The particular integral of the differential equation $(D^2-4)y = e^{2x}$ evaluates exactly to:

A. $\frac{xe^{2x}}{4}$

B. $\frac{e^{2x}}{4}$

C. $-\frac{xe^{2x}}{4}$

D. $\frac{xe^{2x}}{2}$

Q12. If $\mathbf{a} = 2\mathbf{i} + 3\mathbf{j} - \mathbf{k}$ and $\mathbf{b} = \mathbf{i} - \mathbf{j} + 2\mathbf{k}$, the scalar dot product $\mathbf{a} \cdot \mathbf{b}$ is:

A. -3

B. -1

C. 1

D. 3

Q13. The cross product of two collinear (parallel) vectors is mathematically strictly equal to:

A. 1

B. Their dot product

C. Zero vector

D. -1

Q14. The divergence of the curl of any continuous vector field $\mathbf{F}$ $(\nabla \cdot (\nabla \times \mathbf{F}))$ is exactly:

A. $|\mathbf{F}|$

B. 1

C. 0

D. $\nabla^2\mathbf{F}$

Q15. If the complex number $z = x+iy$, the complex conjugate $\bar{z}$ geometrically represents a reflection precisely across the:

A. Real axis

B. Imaginary axis

C. Origin

D. Line $y = x$

Q16. The principal argument of the complex number $-1 - i$ strictly lies in the interval:

A. $(0, \pi/2)$

B. $(\pi/2, \pi)$

C. $(-\pi, -\pi/2)$

D. $(-\pi/2, 0)$

Q17. In a standard normal distribution, the mathematically defined mean and variance are respectively:

A. 0 and 1

B. 1 and 0

C. 0 and 0

D. 1 and 1

Q18. Two fair dice are rolled simultaneously. The probability that the sum of the numbers is exactly 7 is:

A. 1/36

B. 1/6

C. 7/36

D. 1/12

Q19. If events A and B are mutually exclusive, the strict mathematical relation for $P(A \cup B)$ is:

A. $P(A) \times P(B)$

B. $P(A) + P(B)$

C. $P(A) - P(B)$

D. $P(A)/P(B)$

Q20. The precise Laplace transform of the function $f(t) = 1$ is:

A. 1

B. s

C. $1/s$

D. $1/s^2$

Q21. The inverse Laplace transform $\mathcal{L}^{-1}\left\{\frac{s}{s^2+\omega^2}\right\}$ evaluates strictly to:

A. $\sin \omega t$

B. $\frac{1}{\omega} \sin \omega t$

C. $\frac{1}{\omega} \cos \omega t$

D. $\cos \omega t$

Q22. Using the Trapezoidal rule with exactly 1 interval, the numerical integration of $\int_0^1 x\, dx$ yields precisely:

A. 0.25

B. 0.5

C. 0.75

D. 1.0

Q23. The Newton-Raphson iterative formula for finding the roots of $f(x) = 0$ is strictly given by:

A. $x_{n+1} = x_n - f(x_n)/f'(x_n)$

B. $x_{n+1} = x_n + f(x_n)/f'(x_n)$

C. $x_{n+1} = x_n - f'(x_n)/f(x_n)$

D. $x_{n+1} = x_n + f'(x_n)/f(x_n)$

Q24. The mathematical rank of the identity matrix of order n is exactly:

A. 0

B. 1

C. n

D. n^2

Q25. A function $f(z)$ is strictly analytic at a point if its derivative exists at that point and also:

A. Nowhere else

B. Everywhere in the complex plane

C. In some neighborhood of that point

D. Only at the origin

Q26. The specific value of the integral $\oint_C \frac{1}{z-a} dz$ over a simple closed curve C enclosing $z = a$ counterclockwise is:

A. 0

B. $2\pi i$

C. πi

D. 1

Q27. The first derivative of the function $y = \tan^{-1} x$ with respect to x is:

A. $1/(1 - x^2)$

B. $1/(1 + x^2)$

C. $-1/(1 + x^2)$

D. $1/\sqrt{1 - x^2}$

Q28. The directional derivative of a scalar function ϕ is mathematically maximum precisely in the direction of its:

A. Curl

B. Divergence

C. Tangent

D. Gradient

Q29. The fundamental period of the trigonometric function $\cos(3x)$ is strictly:

A. 2π

B. $\pi/3$

C. $2\pi/3$

D. 3π

Q30. The eccentricity of an ellipse mathematically strictly satisfies the precise condition:

A. $e = 1$

B. $e > 1$

C. $e = 0$

D. $0 < e < 1$

Q31. The exact center of the sphere given by $x^2 + y^2 + z^2 - 2x + 4y - 6z = 11$ is located at:

A. $(1, -2, 3)$

B. $(-1, 2, -3)$

C. $(2, -4, 6)$

D. $(-2, 4, -6)$

Q32. The mathematical value of $\sin^{-1}(\sin \frac{2\pi}{3})$ evaluated within its principal branch is strictly:

A. $2\pi/3$

B. $\pi/3$

C. $-\pi/3$

D. $-2\pi/3$

Q33. If $y = a^x$, the second derivative d^2y/dx^2 is exactly:

A. $a^x \log_e a$

B. $a^x (\log_e a)^2$

C. $x(x-1)a^{x-2}$

D. a^x

Q34. The differential equation representing all non-vertical straight lines in a plane is exactly:

A. $dy/dx = c$

B. $d^2y/dx^2 = 0$

C. $d^2y/dx^2 = 1$

D. $dy/dx = x$

Q35. The scalar triple product [**ijk**] evaluates mathematically to exactly:

A. 0

B. 1

C. -1

D. **i**

Q36. The value of the definite integral $\int_{-1}^{1} x^3\,dx$ is exactly:

A. 0

B. 1/2

C. 2/3

D. 1

Q37. The maximum value of the function $f(x) = \sin x + \cos x$ is mathematically:

A. 1

B. 2

C. $\sqrt{2}$

D. $1/\sqrt{2}$

Q38. In a standard binomial distribution with parameters $n = 5$ and $p = 0.5$, the variance evaluates strictly to:

A. 2.5

B. 1.25

C. 5.0

D. 0.25

Q39. If the roots of the quadratic equation $x^2 - px + q = 0$ are α and β, then $\alpha^2 + \beta^2$ strictly equals:

A. $p^2 - 2q$

B. $p^2 + 2q$

C. $p^2 - q$

D. $p^2 + q$

Q40. The Maclaurin series expansion for e^x explicitly begins with the terms:

A. $x - x^2/2! + x^3/3!$

B. $1 + x + x^2/2!$

C. $1 - x + x^2/2!$

D. $1 + x^2/2! + x^4/4!$

Q41. A system of forces is mathematically termed "concurrent" if their lines of action all strictly:

A. Are parallel

B. Lie in the same plane

C. Intersect at a single common point

D. Form a closed polygon

Q42. The resultant of two forces P and Q acting at an angle θ is physically given exactly by the relation:

A. $\sqrt{P^2 + Q^2 - 2PQ\cos\theta}$

B. $\sqrt{P^2 + Q^2 + 2PQ\cos\theta}$

C. $P + Q\cos\theta$

D. $\sqrt{P^2 + Q^2 + 2PQ\sin\theta}$

Q43. According to Lami's theorem, if three coplanar forces are in static equilibrium, each force is directly proportional strictly to the:

A. Cosine of the angle between the other two

B. Sine of the angle between the other two

C. Tangent of the angle between the other two

D. Sum of the other two forces

Q44. The center of gravity of a uniform solid hemisphere of radius R from its flat base lies exactly at a distance of:

A. $3R/8$

B. $R/2$

C. $4R/3\pi$

D. $3R/4\pi$

Q45. The perpendicular axis theorem mathematically relates the moments of inertia of a plane lamina strictly as:

A. $I_z = I_x - I_y$

B. $I_z = I_x + I_y$

C. $I_x = I_y + I_z$

D. $I_z = \sqrt{I_x^2 + I_y^2}$

Q46. The limiting force of static friction (F_s) is strictly and directly proportional to the:

A. Area of contact

B. Velocity of the body

C. Normal reaction force

D. Volume of the body

Q47. When a particle is projected vertically upwards, its kinetic energy at the absolute maximum height is physically exactly:

A. Maximum

B. Zero

C. Equal to its potential energy

D. Half of its initial kinetic energy

Q48. A projectile's exact mathematical trajectory in a uniform gravitational field (ignoring air resistance) strictly traces a:

A. Circle

B. Hyperbola

C. Parabola

D. Straight line

Q49. The physical rate of change of angular velocity with respect to time is strictly defined as:

A. Linear acceleration

B. Angular momentum

C. Torque

D. Angular acceleration

Q50. If a force $\mathbf{F}$ displaces a body by a vector $\mathbf{s}$, the exact work done is mathematically defined as the:

A. Cross product $\mathbf{F} \times \mathbf{s}$

B. Dot product $\mathbf{F} \cdot \mathbf{s}$

C. Ratio $\mathbf{F}/\mathbf{s}$

D. Tensor product

Q51. The law of conservation of momentum strictly states that if no external unbalanced force acts on a system, its total momentum remains precisely:

A. Zero

B. Constant

C. Increasing

D. Decreasing

Q52. In a completely inelastic collision between two bodies, the physical quantity that strictly undergoes a severe loss is:

A. Total momentum

B. Total mass

C. Kinetic energy

D. Impulse

Q53. The mechanical advantage (MA) of an ideal, frictionless simple machine is mathematically exactly equal to its:

A. Efficiency

B. Velocity Ratio

C. Input Power

D. Load capacity

Q54. A lifting machine is officially classified strictly as "self-locking" when its operational efficiency falls strictly below:

A. 25 per cent

B. 50 per cent

C. 75 per cent

D. 100 per cent

Q55. The polar moment of inertia for a solid circular cross-section of strictly radius R is analytically precisely:

A. $\pi R^4/2$

B. $\pi R^4/4$

C. $\pi R^4/8$

D. $\pi R^4/16$

Q56. According to the principle of transmissibility, the external effect of a force on a rigid body is completely unchanged if the force is displaced strictly along its:

A. Line of action

B. Perpendicular bisector

C. Parallel offset

D. Center of gravity

Q57. The moment of a force mechanically measures its inherent physical capacity to exclusively produce:

A. Translation

B. Uniform velocity

C. Rotation

D. Deformation

Q58. A couple physically strictly consists of two forces that are completely:

A. Equal, parallel, and act in the same direction

B. Unequal, parallel, and act in opposite directions

C. Equal, collinear, and act in opposite directions

D. Equal, parallel, and act in opposite directions

Q59. The fundamental unit of physical impulse in the SI system is strictly equivalent to:

A. Newton·meter

B. Newton/second

C. Newton·second

D. Joule·second

Q60. In a simple pulley system with n movable pulleys, the ideal theoretical Velocity Ratio (VR) evaluates strictly to:

A. $2n$

B. 2^n

C. n^2

D. n

Q61. Kinematics is the specific branch of engineering mechanics that physically studies the motion of bodies strictly without considering the:

A. Time

B. Displacement

C. Forces causing the motion

D. Velocity

Q62. The physical acceleration of a particle executing uniform circular motion is always directed exactly:

A. Tangentially along the path

B. Away from the center

C. Towards the center of the circle

D. Upwards

Q63. The geometric radius of gyration (k) of an area A with moment of inertia I is explicitly mathematically given by:

A. $k = I/A$

B. $k = \sqrt{I/A}$

C. $k = \sqrt{A/I}$

D. $k = I^2/A$

Q64. The minimum effort strictly required to pull a body up a rough inclined plane occurs when the applied effort acts exactly at an angle mathematically equal to the:

A. Angle of repose

B. Angle of inclination

C. Angle of friction

D. Zero degrees

Q65. A simple truss is mathematically designated as statically determinate if the number of members m and joints j rigidly satisfy:

A. $m = 2j - 3$

B. $m > 2j - 3$

C. $m < 2j - 3$

D. $m = 3j - 2$

Q66. D'Alembert's principle explicitly introduces a hypothetical "inertia force" to completely reduce dynamic problems precisely into equivalent:

A. Kinematic problems

B. Static equilibrium problems

C. Thermodynamic problems

D. Fluid problems

Q67. When a rigid sphere rolls entirely without slipping on a flat surface, the physical friction explicitly doing the work is strictly:

A. Static friction

B. Kinetic friction

C. Rolling friction

D. Zero

Q68. If the initial velocity of a projectile is physically doubled while keeping the angle constant, its absolute maximum horizontal range becomes strictly:

A. Doubled

B. Halved

C. Four times

D. Unchanged

Q69. The exact location of the centroid of a right-angled triangle of base b and height h from its right angle is geometrically at:

A. $(b/2, h/2)$

B. $(b/3, h/3)$

C. $(b/4, h/4)$

D. $(2b/3, 2h/3)$

Q70. For a particle moving purely in a straight line, if its position $x = 3t^2 + 2t$, its physical acceleration is strictly:

A. Constant at 6

B. Linearly increasing

C. Zero

D. Constant at 3

Q71. A free-body diagram (FBD) is a simplified sketch representing an isolated body strictly alongside absolutely all the:

A. Internal forces

B. Applied active and reactive external forces

C. Velocities

D. Accelerations

Q72. The static coefficient of friction (μ_s) mathematically directly represents the exact tangent of the strictly defined:

A. Angle of inclination

B. Angle of repose

C. Angle of deviation

D. Angle of approach

Q73. In a worm and worm wheel mechanism, the theoretical velocity ratio heavily strictly depends solely on the:

A. Weight of the load

B. Length of the handle and radius of the wheel

C. Number of teeth on the wheel and threads on the worm

D. Friction present

Q74. The rotational analogue of physical mass in linear dynamics is strictly the exact physical property known as:

A. Torque

B. Angular momentum

C. Moment of inertia

D. Radius of gyration

Q75. If the sum of moments of all acting forces about a specific point is mathematically zero, the resultant of those forces strictly must:

A. Be zero

B. Pass through that specific point

C. Be infinite

D. Act tangentially

Q76. When two ideally smooth elastic spheres undergo an oblique impact, the impulsive forces exclusively strictly act exactly along the:

A. Tangent plane

B. Line of impact

C. Vertical axis

D. Horizontal axis

Q77. A flywheel precisely mathematically regulates the fluctuation of mechanical speed during a thermodynamic cycle by dynamically storing exactly:

A. Rotational kinetic energy

B. Translational kinetic energy

C. Potential energy

D. Thermal energy

Q78. In the systematic method of joints for plane trusses, we must strategically isolate and strictly begin analysis at a joint containing at most how many unknown forces?

A. 1

B. 2

C. 3

D. 4

Q79. The strict physical law stating that the total change in kinetic energy precisely equals the total mechanical work done by all forces is explicitly the:

A. Law of conservation of energy

B. Work-Energy principle

C. Impulse-Momentum theorem

D. Newton's third law

Q80. If a rigid body is heavily subjected to exactly three non-parallel coplanar forces and remains in strict equilibrium, the lines of action of these forces must definitively be:

A. Parallel

B. Collinear

C. Concurrent

D. Perpendicular

Q81. Ohm's law mathematically fails and is strictly inapplicable for electrical conduction taking place within:

A. Copper wires

B. Carbon resistors

C. Semiconductors

D. Aluminum cables

Q82. Two ideal resistors of 10 Ω and 20 Ω are perfectly connected in parallel. Their exact equivalent electrical resistance evaluates strictly to:

A. 30 Ω

B. 15 Ω

C. 6.67 Ω

D. 200 Ω

Q83. Kirchhoff's Voltage Law (KVL) is structurally grounded strictly upon the foundational physical principle of conservation of:

A. Charge

B. Energy

C. Momentum

D. Power

Q84. Thevenin's theorem seamlessly simplifies any linear DC circuit into a single strictly equivalent circuit comprising exactly one independent:

A. Voltage source in series with a resistor

B. Current source in parallel with a resistor

C. Voltage source in parallel with a resistor

D. Current source in series with a resistor

Q85. For a purely resistive AC circuit, the alternating voltage and alternating current are mathematically precisely:

A. Out of phase by 90°

B. In exact phase (0° difference)

C. Out of phase by 180°

D. Out of phase by 45°

Q86. The apparent power in an AC circuit is mathematically strictly calculated by the explicit product of the exact:

A. RMS voltage and Peak current

B. Peak voltage and Peak current

C. RMS voltage and RMS current

D. Average voltage and Average current

Q87. In a standard 3-phase star (Y) connected electrical system, the physical neutral wire reliably securely carries exactly zero current strictly when the system is absolutely:

A. Unbalanced

B. Resonant

C. Balanced

D. Overloaded

Q88. The specific material predominantly utilized for systematically laminating the heavy magnetic core of a power transformer to suppress losses is strictly:

A. Solid cast iron

B. Silicon steel

C. Pure copper

D. Aluminum

Q89. A transformer is fundamentally completely physically incapable of actively stepping up or stepping down any supplied strictly:

A. Alternating voltage

B. Alternating current

C. Direct current (DC) voltage

D. AC power

Q90. In standard DC machines, the specialized carbon brushes physically strategically slide directly over the:

A. Armature winding

B. Field winding

C. Commutator segments

D. Stator frame

Q91. The generated induced EMF in a running DC generator is mathematically exactly proportional directly to the physical operational speed and the:

A. Armature resistance

B. Magnetic flux per pole

C. Number of brushes

D. Terminal voltage

Q92. A three-phase induction motor fundamentally physically completely fails to reliably run at synchronous speed strictly because the relative slip would then precisely equal:

A. 1

B. Infinity

C. -1

D. 0

Q93. To actively effectively reverse the physical direction of rotation of a standard 3-phase induction motor, one must strategically strictly:

A. Reverse the DC supply

B. Swap any two of the three stator phase supply leads

C. Increase the supply frequency

D. Reduce the supply voltage

Q94. An ideal basic moving iron (MI) analog measuring instrument mathematically intrinsically responds to the exact:

A. Peak value

B. Average value

C. RMS value

D. Instantaneous value

Q95. In a perfectly pure intrinsic semiconductor crystal exactly at room temperature, the total number of free electrons physically generated is strictly equal to the number of:

A. Protons

B. Neutrons

C. Holes

D. Dopant atoms

Q96. A P-N junction diode electrically acts virtually as a perfect ideal closed switch specifically strictly when it is precisely:

A. Reverse biased

B. Unbiased

C. Forward biased

D. In avalanche breakdown

Q97. The full-wave bridge rectifier circuit structurally requires the strategic precise arrangement of exactly how many semiconductor diodes?

A. 1

B. 2

C. 3

D. 4

Q98. In a standard NPN bipolar junction transistor (BJT), the specific physical terminal that is intentionally the most heavily doped is strictly the:

A. Base

B. Collector

C. Emitter

D. Gate

Q99. The common-emitter (CE) BJT amplifier configuration is overwhelmingly popular structurally because it uniquely mathematically provides extremely high:

A. Current gain only

B. Voltage gain only

C. Both voltage and current gain

D. Input impedance only

Q100. Unlike a current-controlled BJT, a Field Effect Transistor (FET) is fundamentally structurally and operationally strictly a:

A. Voltage-controlled device

B. Resistance-controlled device

C. Power-controlled device

D. Frequency-controlled device

Q101. An absolutely ideal Operational Amplifier (Op-Amp) mathematically inherently boasts a strictly exact open-loop voltage gain explicitly equal to:

A. 1

B. 100

C. 0

D. Infinity

Q102. When negative feedback is actively structurally applied to a standard Op-Amp amplifier circuit, its overall operational bandwidth rigorously explicitly:

A. Decreases

B. Increases

C. Remains constant

D. Becomes zero

Q103. The specific basic digital logic gate that unequivocally exclusively outputs a logical 1 strictly when both of its inputs are precisely 1 is the:

A. OR gate

B. NOR gate

C. AND gate

D. XOR gate

Q104. In boolean algebra logic mathematics, the fundamental expression $A + \bar{A}B$ identically rigorously rigorously simplifies exactly to:

A. A

B. B

C. $A + B$

D. AB

Q105. A D-type digital flip-flop fundamentally strictly ensures that its Q output seamlessly transparently copies the precise logical state of the D input precisely strictly upon the:

A. Arrival of the next clock edge

B. Arrival of a reset signal

C. Application of power

D. Changing of the D input alone

Q106. In a balanced 3-phase electrical circuit, the exact algebraic sum of the three instantaneous phase voltages at any single millisecond strictly identically equals:

A. The peak voltage

B. The RMS voltage

C. Zero

D. Infinity

Q107. In purely inductive AC circuits, the real active power dissipation (measured in Watts) physically rigorously evaluates exactly to:

A. Maximum

B. Zero

C. Apparent power

D. Reactive power

Q108. The exact theoretical electrical condition critically mathematically necessary for resonance to strictly occur in a series RLC circuit is specifically:

A. $X_L > X_C$

B. $X_L < X_C$

C. $X_L = X_C$

D. $R = X_L$

Q109. The standard unit explicitly physically measuring the electrical quantity of Capacitance is strictly defined as the:

A. Ohm

B. Henry

C. Farad

D. Weber

Q110. The primary functional purpose of implementing a dielectric material perfectly between the metallic plates of a capacitor is heavily strictly to:

A. Decrease capacitance

B. Prevent current leakage and definitively increase capacitance

C. Generate heat

D. Act as a conductor

Q111. The physical operating principle of a standard DC motor is fundamentally rigorously based explicitly strictly upon:

A. Faraday's laws

B. Lorentz force on a current-carrying conductor

C. Lenz's law

D. Ampere's circuital law

Q112. A synchronous motor is structurally remarkably unique because, under normal stable operating conditions, it strictly essentially continuously runs exactly at:

A. Variable speed

B. Sub-synchronous speed

C. Synchronous speed

D. Super-synchronous speed

Q113. The physical phenomenon where an active electrical core retains some residual magnetism completely even after the magnetizing force is removed is strictly termed:

A. Reluctance

B. Permeability

C. Remanence (Retentivity)

D. Coercivity

Q114. To reliably accurately expand the physical measurement range of a standard analog DC ammeter, one must strategically perfectly connect a highly specific low resistance strictly in:

A. Series with the meter

B. Parallel with the meter (Shunt)

C. Series-parallel

D. Separate circuit

Q115. A standard typical standard Silicon P-N junction diode fundamentally inherently physically exhibits a strict forward-bias voltage drop at room temperature of approximately:

A. 0.3 V

B. 0.7 V

C. 1.2 V

D. 5.0 V

Q116. A Light Emitting Diode (LED) physically rigorously operates strictly by converting applied electrical energy into radiant light exactly when it is strictly:

A. Reverse biased

B. Forward biased

C. Thermally heated

D. Mechanically stressed

Q117. The decimal number exactly physically equivalent to the fundamental pure binary number 1011_2 uniquely evaluates strictly to:

A. 9

B. 10

C. 11

D. 12

Q118. The fundamental distinct combinational digital logic circuit capable of strictly simultaneously physically adding exactly three single binary bits is universally named a:

A. Half-adder

B. Full-adder

C. Multiplexer

D. Decoder

Q119. A standard generic operational amplifier structurally internally relies extensively precisely on the strict heavy incorporation of fundamental:

A. Transformer coupled stages

B. Differential amplifier stages

C. Digital logic gates

D. Relay contacts

Q120. The standard physical AC mains voltage implicitly universally safely supplied strictly for domestic single-phase electrical utility use in India is precisely standardly:

A. 110 V

B. 230 V

C. 415 V

D. 440 V

Solutions

1. C
Explanation: The determinant of A is the product of its eigenvalues: $1\times2\times(-3) = -6$. The determinant of A^{-1} is exactly $1/|A|$, yielding $-1/6$.

2. C
Explanation: According to the Rouché-Capelli theorem, if $\text{rank}(A) = \text{rank}([A|B]) < n$ (number of unknowns), the system has infinitely many solutions parameterized by free variables.

3. C
Explanation: For exactly any upper triangular, lower triangular, or purely diagonal matrix, the exact roots of the characteristic equation (eigenvalues) completely strictly lie explicitly on its principal diagonal.

4. B
Explanation: Using the exact trigonometric identity $1 - \cos 2x = 2\sin^2 x$, the limit simplifies exactly to $\lim_{x\to0} \frac{2\sin^2 x}{x^2} = 2(1)^2 = 2$.

5. A
Explanation: Applying the standard chain rule mathematically gives $dy/dx = \frac{1}{\log_e x} \cdot \frac{d}{dx}(\log_e x) = \frac{1}{\log_e x} \cdot \frac{1}{x} = \frac{1}{x \log_e x}$.

6. A
Explanation: The exact derivative $f'(x) = 3x^2 - 6x + 3 = 3(x-1)^2$. Since a mathematical perfect square is strictly non-negative, $f'(x) \geq 0$ everywhere, making the function strictly monotonically increasing.

7. C
Explanation: Applying the exact property $\int_0^a f(x)dx = \int_0^a f(a-x)dx$ yields $2I = \int_0^{\pi/2}(\cos^2 x + \sin^2 x)dx = \int_0^{\pi/2} 1dx = \pi/2$. Thus $I = \pi/4$.

8. C
Explanation: The curves precisely intersect mathematically at $x = 0$ and $x = 1$. The exact enclosed area is exactly the definite integral $\int_0^1 (x - x^2)dx = [\frac{x^2}{2} - \frac{x^3}{3}]_0^1 = \frac{1}{2} - \frac{1}{3} = 1/6$.

9. A
Explanation: The exact integrating factor is mathematically defined as strictly $e^{\int P dx}$. Here $P = 1/x$, so $IF = e^{\int (1/x)dx} = e^{\ln x} = x$.

10. B
Explanation: The exact auxiliary equation is strictly $m^2 + 2m + 1 = 0 \implies (m+1)^2 = 0$. Since the root -1 is exactly mathematically repeated, the solution is precisely $(c_1 + c_2 x)e^{-x}$.

11. A
Explanation: For exact PI of $e^{ax}/f(D)$ where exactly $f(a) = 0$, we mathematically multiply strictly by x and exactly differentiate the denominator: $x\frac{1}{2D}e^{2x} = x\frac{e^{2x}}{2(2)} = \frac{xe^{2x}}{4}$.

12. A
Explanation: The exact dot product mathematically strictly evaluates precisely

to $(2)(1) + (3)(-1) + (-1)(2) = 2 - 3 - 2 = -3$.

13. C
Explanation: The exact mathematical cross product fundamentally precisely involves explicitly the exact sine of the angle between vectors. For collinear vectors, the angle is exactly 0 or π, making strictly $\sin\theta = 0$, completely yielding the zero vector.

14. C
Explanation: A fundamental strict identity in pure vector calculus explicitly mathematically dictates that the exact divergence of the curl of absolutely any vector field is fundamentally exactly 0.

15. A
Explanation: The exact complex conjugate mathematically simply negates the imaginary part $(x - iy)$, which geometrically perfectly mirrors the exact point perfectly directly exactly across the real horizontal axis.

16. C
Explanation: The complex number $-1 - i$ strictly precisely lies exactly mathematically in the third quadrant. Its exact principal argument strictly evaluates perfectly to precisely $-3\pi/4$, explicitly residing in the strict interval $(-\pi, -\pi/2)$.

17. A
Explanation: The standard normal distribution is mathematically rigidly defined as having a strictly perfectly exact zero mean ($\mu = 0$) and a perfectly exact unit variance ($\sigma^2 = 1$).

18. B
Explanation: The mathematically strictly favorable perfectly exact combinations summing to precisely 7 are entirely (1,6), (2,5), (3,4), (4,3), (5,2), (6,1). The exact probability strictly completely evaluates to explicitly $6/36 = 1/6$.

19. B
Explanation: Mutually exclusive events fundamentally completely completely lack any strict joint intersection exactly ($P(A \cap B) = 0$). By exact addition probability rule, $P(A \cup B)$ strictly mathematically reduces completely to explicitly $P(A)+P(B)$.

20. C
Explanation: The fundamental exact rigorous definition explicitly mathematically states $\mathcal{L}\{1\} = \int_0^\infty 1 \cdot e^{-st} dt$. Exact evaluation of this perfectly mathematically yields explicitly entirely $1/s$.

21. D
Explanation: Based completely exactly on standard fundamental explicit transform tables, the exact rigorous inverse Laplace transform directly completely explicitly evaluates to precisely precisely $\cos\omega t$.

22. B
Explanation: With exactly exactly 1 strict numerical interval from 0 to 1, exactly $h = 1$. The Trapezoidal rule perfectly mathematically evaluates completely $\frac{1}{2}[f(0) + f(1)] = \frac{1}{2}[0 + 1] = 0.5$.

23. A
Explanation: The Newton-Raphson strict iterative mathematical scheme is pre-

cisely defined algebraically and geometrically entirely explicitly as exactly strictly $x_{n+1} = x_n - f(x_n)/f'(x_n)$.

24. C

Explanation: The identity matrix of order n strictly fundamentally explicitly possesses exactly precisely n mathematically non-zero linearly completely independent rows entirely, perfectly defining its strict rank exactly explicitly as precisely n.

25. C

Explanation: Strict exact mathematical completely rigorous definition of complex analyticity fully demands that the derivative explicitly physically strictly completely exists both precisely exactly at the point completely and perfectly within a strict neighborhood.

26. B

Explanation: Cauchy's exactly rigorous strictly formulated integral formula definitively perfectly mathematically explicitly precisely dictates that the exact closed contour integral evaluated around the simple pole $z = a$ completely exactly evaluates to strictly $2\pi i$.

27. B

Explanation: Using standard rigorous mathematical entirely direct fundamental differential calculus rules, the strictly exact first specific derivative of $\tan^{-1} x$ completely perfectly explicitly evaluates identically specifically exactly strictly to $1/(1 + x^2)$.

28. D

Explanation: The gradient vector explicitly physically rigorously fundamentally inherently strictly completely points strictly perfectly exactly completely in the strict direction of absolutely maximum mathematical strictly steep spatial ascent.

29. C

Explanation: The fundamental basic geometric period of the entirely pure explicit cosine mathematical function is strictly accurately 2π. Therefore, the strict period of completely exactly $\cos(kx)$ perfectly mathematically scales explicitly to exactly $2\pi/k$. Here explicitly precisely $2\pi/3$.

30. D

Explanation: A rigid strictly defining geometric completely exclusive precisely characteristic of entirely strictly all standard exact pure explicit ellipses is that their explicit mathematical completely eccentricity explicitly strictly falls tightly bounded squarely strictly within $0 < e < 1$.

31. A

Explanation: For a sphere equation exactly rigorously completely expanded precisely structurally as exclusively explicitly $x^2+y^2+z^2+2ux+2vy+2wz+d = 0$, the center is perfectly strictly precisely evaluated exactly precisely at totally completely explicitly $(-u, -v, -w)$, giving strictly explicitly specifically $(1, -2, 3)$.

32. B

Explanation: The explicit exact strict mathematical primary entirely principal branch for explicitly $\sin^{-1}$ falls completely entirely rigorously within strictly $[-\pi/2, \pi/2]$. Completely completely identically explicitly $\sin(2\pi/3) = \sin(\pi/3)$.

Hence, the completely exact explicitly strict value precisely rigorously evaluates unequivocally to explicitly $\pi/3$.

33. B
Explanation: Taking the fundamental direct strict completely explicit first pure standard exact derivative fundamentally perfectly yields precisely $dy/dx = a^x \log_e a$. Strictly explicitly differentiating perfectly directly once more explicitly exactly rigorously precisely uniquely yields exactly $a^x(\log_e a)^2$.

34. B
Explanation: The strict general completely fundamental exact explicitly explicit generic mathematical structural algebraic equation precisely strictly modeling all non-vertical lines is completely identically exactly $y = mx + c$. Fully strictly differentiating twice precisely completely identically fully yields $d^2y/dx^2 = 0$.

35. B

36. A

37. C

38. B

39. A

40. B

41. C

42. B

43. B

44. A

45. B

46. C

47. B

48. C

49. B

50. C
Explanation: The total kinetic energy of a body undergoing general plane motion (rolling) is the strict sum of its translational energy ($\frac{1}{2}Mv^2$) and its centroidal rotational energy ($\frac{1}{2}I_G\omega^2$).

51. B
Explanation: In an oblique collision between completely smooth spheres, no impulsive frictional force acts parallel to the contact plane. Thus, the velocity component strictly perpendicular to the line of impact remains completely unaltered.

52. B
Explanation: In SHM, the particle's velocity $v = \omega\sqrt{A^2 - x^2}$. This mathematical expression definitively reaches its absolute maximum precisely when the displacement x is zero, which is exactly at the central mean position.

53. B

Explanation: When elastic springs are connected in series, they share identical force but their extensions add up. Consequently, the equivalent stiffness k_{eq} is calculated identically to resistors in parallel: $1/k_{eq} = 1/k_1 + 1/k_2$.

54. B
Explanation: For a physical compound pendulum, the rigorous dynamic analysis yields an equivalent simple pendulum length of $L = I_0/mh$. Using parallel axis theorem ($I_0 = mk^2 + mh^2$), this simplifies exactly to $h + k^2/h$.

55. C
Explanation: The Coriolis fictitious acceleration ($\mathbf{a}_c = 2\vec{\omega} \times \mathbf{v}_{rel}$) is a unique dynamic effect that strictly and exclusively arises when a particle moves relative to a rapidly rotating reference frame.

56. A
Explanation: Through rigorous optimization of the mechanical advantage equation of a screw jack, the absolute maximum theoretical efficiency is mathematically determined to be precisely $\frac{1-\sin\phi}{1+\sin\phi}$.

57. D
Explanation: In structural engineering mechanics, a rigid beam that is deeply embedded or fixed at one support and entirely unsupported (free) at the opposite end is categorically defined as a cantilever beam.

58. C
Explanation: The shear force for a UDL is a linear diagonal line. Since bending moment is strictly the integral of shear force, integrating a first-degree linear function invariably produces a second-degree parabolic curve.

59. B
Explanation: The smooth wall provides exactly 1 normal reaction. The rough floor provides exactly 1 normal reaction and exactly 1 frictional force. The total number of distinct unknown reaction components is definitively 3.

60. B
Explanation: The coefficient of restitution (e) is an empirical Newtonian constant strictly defined as the exact ratio of the relative velocity of separation directly after impact to the relative velocity of approach right before impact.

61. C
Explanation: In pure rolling without slipping, the translation velocity forward is perfectly canceled by the backward tangential rotational velocity at the bottommost point. Thus, the instantaneous velocity of the contact point is strictly zero.

62. C
Explanation: A body undergoing pure uniform translation has absolutely no rotational component ($\omega = 0$). To satisfy the relation $v = r\omega$, the radial distance r to the instantaneous center must be mathematically located at infinity.

63. A
Explanation: By optimizing the complex trajectory equation for an inclined plane, the mathematical condition for absolute maximum range dictates that the projection vector must precisely bisect the angle between the vertical axis and the inclined plane.

64. C
Explanation: Newton's foundational Law of Universal Gravitation unambiguously dictates that the attractive force acts strictly inversely proportional to the square of the distance $(1/r^2)$ cleanly separating the two point masses.

65. B
Explanation: For a simply supported beam bearing a central point load W, the symmetrical support reactions are $W/2$. The maximum bending moment inevitably occurs dead center and is mathematically evaluated as strictly $(W/2) \times (L/2) = WL/4$.

66. B
Explanation: D'Alembert's principle cleverly reformulates Newton's second law $(F - ma = 0)$ by artificially introducing a reversed "inertia force" $(-ma)$, allowing complex dynamic systems to be analyzed completely using standard static equilibrium equations.

67. C
Explanation: Kinetic friction always vehemently opposes the direction of actual motion. Therefore, the mathematical dot product of friction force and displacement vectors is always $180°$, strictly resulting in cumulative negative work.

68. C
Explanation: The product of inertia is defined as the integral $\int xy\, dA$. If an area possesses an axis of geometric symmetry (say the y-axis), every positive x coordinate has an identical area with a negative x, forcing the entire integral to strictly zero.

69. C
Explanation: In pure rigid body rotation about a fixed axis, while individual linear velocities $(v = r\omega)$ strictly vary based on the radial distance r from the axis, the angular velocity ω remains unequivocally identical for absolutely all particles.

70. C
Explanation: A lifting machine is classified as reversible if it can do work in the backward direction when effort is removed. This definitively requires the efficiency to strictly exceed the 50**71. D**
Explanation: Hooke's Law strictly mandates a perfectly linear, proportional relationship between applied stress and resulting strain. This linearity breaks down precisely at a specific threshold known unequivocally as the limit of proportionality.

72. C
Explanation: Young's Modulus is defined precisely as Stress divided by Strain. Since Strain is a dimensionless geometric ratio, the modulus exclusively inherits the physical units of Stress, which are identical to Pressure (N/m^2).

73. C
Explanation: A truss is mathematically categorized as statically redundant (or over-rigid) if it physically contains strictly more structural members than the exact minimum number required by the formula $m = 2j - 3$ to maintain static stability.

74. B
Explanation: From the rotational analogue of Newton's second law $(\tau = dL/dt)$,

it rigorously follows that if the net external torque (τ) acting on a system is identically zero, the angular momentum (L) must remain strictly constant.

75. C
Explanation: The algebraic relationship is $K = p^2/2m$, meaning momentum $p = \sqrt{2mK}$. If the kinetic energy K is mathematically multiplied by 2, the momentum p is consequently strictly multiplied by exactly $\sqrt{2}$.

76. C
Explanation: For a block sliding with zero acceleration (constant velocity), the downhill gravitational force ($mg\sin\theta$) is precisely balanced by the kinetic friction ($\mu_k mg\cos\theta$). Algebraically solving yields strictly $\mu_k = \tan\theta$.

77. C
Explanation: A heavy mechanical flywheel is specifically engineered to dynamically store substantial amounts of excess mechanical energy uniquely in the physical form of rotational kinetic energy ($\frac{1}{2}I\omega^2$).

78. C
Explanation: To maintain deterministic static solvability using the three coplanar equilibrium equations ($\sum F_x = 0, \sum F_y = 0, \sum M = 0$), an exploratory section plane must sever strictly no more than exactly 3 unknown truss members.

79. C
Explanation: The friction angle ϕ is geometrically defined as the exact angle between the normal reaction and the resultant reaction force. By simple vector trigonometry, the limiting coefficient of friction μ strictly equals $\tan\phi$.

80. C
Explanation: The defining characteristic of centripetal force is that it acts strictly perpendicular (90°) to the instantaneous velocity vector. Therefore, the mechanical work done ($F \cdot d\cos 90^\circ$) is unequivocally and continuously zero.

81. C
Explanation: Thevenin's powerful network theorem systematically reduces any complex linear, bilateral DC circuit into a remarkably simple equivalent circuit strictly comprising one ideal voltage source (V_{th}) precisely in series with one resistor (R_{th}).

82. C
Explanation: The theorem fundamentally proves through calculus optimization that absolute maximum power dissipation explicitly occurs precisely when the variable load resistance R_L is matched exactly to the internal Thevenin source resistance R_{th}.

83. B
Explanation: At the precise condition of maximum power transfer ($R_L = R_{th}$), exactly half the total generated power is inherently dissipated inside the source resistance itself as useless heat, strictly capping the overall circuit efficiency at precisely 50**84. B**
Explanation: Solving the transient first-order differential equation for a series RL circuit dynamically yields an exponential term $e^{-(R/L)t}$. The exact time constant τ, where the current reaches 63.2**85. A**

Explanation: The exact half-power electrical bandwidth (Δf) of a series RLC resonant circuit is rigorously defined mathematically by the algebraic ratio of the circuit's total resistance R to its total inductance L, specifically expressed as $R/(2\pi L)$ in Hertz.

86. B
Explanation: The fundamental Quality Factor (Q) for a real, lossy inductor evaluates its energy storage efficiency and is mathematically strictly defined as the direct ratio of its reactive impedance (ωL) to its active ohmic resistance (R).

87. C
Explanation: Using the established formula $\tan\phi = \sqrt{3}(W_1 - W_2)/(W_1 + W_2)$, if exactly one wattmeter reads zero (say $W_2 = 0$), $\tan\phi = \sqrt{3}$, making the phase angle exactly $60°$. Thus, the strictly evaluated power factor $\cos 60°$ is exactly 0.5.

88. D
Explanation: In a balanced 3-phase Delta (Δ) network configuration, the line voltage perfectly equals the phase voltage, but by applying Kirchhoff's Current Law at the nodes, the line current vectorially sums to strictly $\sqrt{3}$ times the phase current.

89. C
Explanation: By differentiating the transformer efficiency equation with respect to load current and setting it to zero, it is mathematically proven that absolute maximum efficiency is achieved exactly when the variable copper losses precisely equal the constant iron losses.

90. C
Explanation: Magnetic reluctance ($S = \text{mmf}/\phi$) physically represents the direct opposition to magnetic flux. Its strict SI unit is calculated by dividing Magnetomotive Force (Ampere-turns) strictly by Magnetic Flux (Webers).

91. B
Explanation: The commutator structurally acts as a synchronized rotary mechanical switch. In a generator, it acts strictly as a full-wave rectifier converting internal AC to external DC. In a motor, it acts as an inverter converting external DC to internal AC.

92. C
Explanation: Armature reaction is the specific, unavoidable electromagnetic phenomenon where the newly created magnetic field from the current-carrying armature physically distorts and severely weakens the primary stationary field flux.

93. A
Explanation: According to fundamental electromagnetic induction laws, the strict equation governing the induced back electromotive force (E_b) in a DC machine is exactly derived as $(P\Phi ZN)/(60A)$.

94. C
Explanation: Motor speed is mathematically inversely proportional to the main field flux ($N \propto E_b/\Phi$). To strictly force the motor to rotate faster than its rated base speed, the field flux must be strategically weakened by severely reducing the field current.

95. A
Explanation: The fractional slip (s) fundamentally quantifies the crucial relative speed difference required to induce rotor current. It is rigorously defined as the strict mathematical ratio $(N_s - N_r)/N_s$, where N_s is synchronous speed and N_r is actual rotor speed.

96. B
Explanation: A PMMC instrument strictly depends on a strong, constant, unidirectional permanent magnetic field. It mechanically inherently computes the average value of current, strictly causing it to read exactly zero on symmetrical AC waveforms.

97. C
Explanation: The deflecting torque in an MI instrument mathematically acts proportional strictly to the square of the operating current ($T_d \propto I^2$). This non-linear quadratic relationship inherently results in a distinctly non-uniform, cramped initial scale.

98. C
Explanation: Doping with pentavalent impurities massively introduces excess free electrons. To maintain strict thermodynamic equilibrium, the statistical Fermi energy level is forced to physically shift dramatically upwards, resting strictly just below the conduction band.

99. B
Explanation: To actively function as a reliable voltage regulator, a Zener diode must invariably be heavily doped and strictly operated deeply inside its reverse-biased breakdown region, where voltage remains remarkably constant despite large current changes.

100. B
Explanation: By observing the polarity and magnitude of the strictly induced transverse Hall voltage inside a magnetic field, physicists can unequivocally and definitively determine both the exact density and the specific type (electrons or holes) of the majority charge carriers.

101. C
Explanation: Thermal runaway is a catastrophic positive feedback loop exclusively observed in BJTs. A slight temperature rise strictly increases minority leakage current, heavily increasing power dissipation, further spiking temperature until the transistor is completely destroyed.

102. B
Explanation: In JFET operation, the strict application of a sufficiently large reverse-biased Pinch-off voltage (V_p) to the gate fundamentally widens the depletion regions until they physically touch, completely choking the channel and strictly forcing drain current to exactly zero.

103. D
Explanation: A MOSFET features a critical, ultra-thin silicon dioxide (SiO_2) insulating layer physically separating the metallic gate strictly from the semiconductor channel. This flawless isolation guarantees an extremely high, practically infinite input impedance.

104. B
Explanation: The Slew Rate explicitly defines the absolute maximum rate at which an Op-Amp's output voltage can physically change in response to a sudden step input. It is universally standardized and reported strictly in Volts per microsecond (V/μs).

105. C
Explanation: An active Op-Amp integrator circuit mathematically performs the precise time-domain integration of the input signal. Integrating a piecewise-constant square wave strictly generates a continuous, linearly ramping triangular waveform.

106. A
Explanation: The Boolean Consensus Theorem is a crucial logic simplification rule. In the expression $AB + \bar{A}C + BC$, the term BC is mathematically completely redundant (the consensus) and can be strictly eliminated, leaving exactly $AB + \bar{A}C$.

107. C
Explanation: "Don't Care" states fundamentally represent physically impossible or completely irrelevant input combinations. They are strategically exploited in K-maps strictly as either 1s or 0s to explicitly achieve the largest possible prime implicant groupings, minimizing the logic.

108. B
Explanation: A Multiplexer (MUX) is digitally defined strictly as a many-to-one data selector. It is considered a "Universal Logic Circuit" because a properly configured MUX can effectively synthesize absolutely any combinational Boolean logic function.

109. D
Explanation: In a simple unclocked JK flip-flop, when both inputs are strictly held HIGH ($J = 1, K = 1$), the output is forced to continuously toggle. If the clock pulse is longer than the propagation delay, this results in an unpredictable, unstable "Race Around" condition.

110. C
Explanation: The fundamental modulus of any digital counter defines its maximum number of completely unique states. For an asynchronous ripple counter constructed from n cascaded flip-flops, the total modulus is exactly mathematically fixed at 2^n. Here, $2^4 = 16$.

111. D
Explanation: The absolute resolution of an ADC dictates how finely it can slice the analog input voltage. It is precisely mathematically defined as 2^n discrete quantum levels. For a 10-bit system, this equates exactly to 2^{10}, or strictly 1024 distinct levels.

112. B
Explanation: Lissajous patterns are mathematically generated by feeding two different sinusoidal signals strictly into the X and Y deflection plates of a CRO. Their exact geometric shape allows highly precise measurement of the strictly unknown frequency and phase difference.

113. B

Explanation: A diode clipper (or limiter) circuit is specifically designed to completely strictly prevent the output voltage from exceeding a predetermined voltage level, thereby cleanly "clipping off" the unwanted peaks of the applied AC waveform.

114. C
Explanation: The Early Effect uniquely occurs when a rising reverse-bias collector voltage actively extends the depletion region deeply backward into the base layer. This strictly physical phenomenon dynamically and significantly reduces the effective neutral base width.

115. C
Explanation: An SCR is a fundamental P-N-P-N thyristor device. It structurally requires exactly 4 alternating semiconductor layers precisely forming 3 distinct P-N junctions to successfully achieve its bistable, latching switching characteristics.

116. C
Explanation: While TTL often switches marginally faster, CMOS (Complementary Metal-Oxide-Semiconductor) definitively revolutionized digital ICs primarily because it draws essentially zero static current, resulting in unprecedented, extremely low static power dissipation.

117. A
Explanation: To strictly conserve limited physical IC pins, the 8085 microprocessor creatively multiplexes its lower 8 bits of the 16-bit address bus exactly with its entire 8-bit bidirectional data bus (labeled $AD_0 - AD_7$).

118. B
Explanation: Rectifier efficiency is rigorously defined as DC output power divided by AC input power. For a Half-Wave rectifier, the maximum theoretical mathematical limit is calculated precisely as $4/\pi^2$, which converts exactly to strictly 40.6**119. D**
Explanation: The Barkhausen stability criterion strictly dictates that for sustained electronic oscillations to occur spontaneously, the total closed-loop gain ($A\beta$) must be mathematically exactly equal to 1 with an absolute phase shift of precisely 0° (or 360°).

120. D
Explanation: In strict accordance with internationally recognized standard electrical safety codes (like IEC and old NEC), the hazardous, electrically "live" phase wire in domestic single-phase wiring is distinctly universally color-coded strictly as either Red or Brown.