

MHT CET 2024 Mathematics Answer Key PDF

Answer Key

1. **Question 1** - Correct Answer - (D) 8
Explanation: Multiplying $(A - 3I)(A - 5I) = 0$ by A^{-1} yields $A + 15A^{-1} = 8I$. Dividing by 2 gives $0.5A + 7.5A^{-1} = 4I$, matching $\alpha A + \beta A^{-1} = 4I$ where $\alpha + \beta = 8$.
2. **Question 2** - Correct Answer - (C) $k = 3$ or $k = -3$
Explanation: For two lines to be coplanar, the scalar triple product of the difference vector of points on the lines and their respective direction vectors must be zero.
3. **Question 3** - Correct Answer - (A) 833
Explanation: The variance of the first n even natural numbers is given by $\sigma^2 = \frac{n^2-1}{3}$. Substituting $n = 50$ yields $\frac{2500-1}{3} = 833$.
4. **Question 4** - Correct Answer - (D) p
Explanation: Using logical laws, the expression simplifies to $[p \wedge (q \vee r)] \vee [p \wedge \sim (q \vee r)] = p \wedge [(q \vee r) \vee \sim (q \vee r)] = p \wedge T = p$.
5. **Question 5** - Correct Answer - (D) $-\frac{1}{14}$
Explanation: Solving the functional equation gives $f(x) = \frac{8x-6/x+10}{28}$. Differentiating $y = x^2 f(x)$ and substituting $x = -1$ yields the derivative $-1/14$.
6. **Question 6** - Correct Answer - (B) $5 \times 6!$
Explanation: Total circular arrangements are $(8 - 1)! = 7!$. Subtracting arrangements where B_1 and G_1 sit adjacent, $2! \times (7 - 1)!$, gives $7! - 2(6!) = 5 \times 6!$.
7. **Question 7** - Correct Answer - (B) $\frac{6}{17}$
Explanation: Let $\theta = \csc^{-1}(5/3) = \tan^{-1}(3/4)$. Evaluating $\cot(\tan^{-1}(3/4) + \tan^{-1}(2/3)) = \cot(\tan^{-1}(17/6))$ yields $6/17$.
8. **Question 8** - Correct Answer - (D) $xe^{x+\frac{1}{x}} + c$
Explanation: Applying the product rule for differentiation shows that $d(xe^{x+1/x}) = e^{x+1/x}(1 + x - 1/x)dx$, matching the integrand.
9. **Question 9** - Correct Answer - (C) decreasing on $(0, \infty)$
Explanation: Finding the derivative $f'(x)$ of the quotient shows that $f'(x) < 0$ for all $x > 0$, confirming the function is strictly decreasing on the domain.
10. **Question 10** - Correct Answer - (D) $-\frac{8}{9}\pi^2$
Explanation: Integrating the linear differential equation yields the solution $y \sin x = 2x^2 - \frac{\pi^2}{2}$. Substituting $x = \pi/6$ gives $y(\pi/6) = -8\pi^2/9$.
11. **Question 11** - Correct Answer - (C) $\frac{1}{b^3}[a + bx - 2a \log |a + bx| - \frac{a^2}{a+bx}] + c$
Explanation: Substituting $u = a + bx$ simplifies the integral to $\frac{1}{b^3} \int (1 - 2a/u + a^2/u^2) du$, which integrates to the expression in option (C).

12. **Question 12** - Correct Answer – (C) 5
 Explanation: Projecting $\bar{a}$ on $\bar{c}$ yields $\alpha = 2$, and matching coefficients of $\bar{b} \times \bar{c}$ gives $\beta = 1$. Thus, $2\alpha + \beta = 5$.
13. **Question 13** - Correct Answer – (D) 3 : 1
 Explanation: From slope properties, $m_1 + m_2 = -2h/b$ and $m_1 m_2 = a/b$. Given $4ab = 3h^2$, we find $(m_1 - m_2)^2 = h^2/b^2$, yielding the slope ratio 3 : 1.
14. **Question 14** - Correct Answer – (D) $-1/2$
 Explanation: Equating $\sin(\cot^{-1}(x+1)) = \cos(\tan^{-1} x)$ yields $\frac{1}{\sqrt{1+(x+1)^2}} = \frac{1}{\sqrt{1+x^2}}$, which simplifies to $2x = -1 \Rightarrow x = -1/2$.
15. **Question 15** - Correct Answer – (A) $1/10$
 Explanation: The sum of probabilities $\sum P(X = x) = 1$ gives the quadratic equation $10p^2 + 9p - 1 = 0$. Since $p > 0$, the valid solution is $p = 1/10$.
16. **Question 16** - Correct Answer – (A) 0.1
 Explanation: Since $P(\text{exactly one occurs}) = P(A \cup B) - P(A \cap B)$, we have $0.4 = 0.5 - P(A \cap B)$, which gives $P(A \cap B) = 0.1$.
17. **Question 17** - Correct Answer – (D) 91
 Explanation: Expanding $(-2 - i/3)^3$ gives $\frac{-198 - 107i}{27}$, yielding $x = -198$ and $y = -107$. Thus, the value of $y - x = 91$.
18. **Question 18** - Correct Answer – (A) $x + 2y \leq 6, 5x + 3y \geq 15, x \leq 7, y \leq 6, y \geq 0$
 Explanation: The bounded shaded region in standard linear programming problems satisfies these specific constraint inequalities.
19. **Question 19** - Correct Answer – (A) $9p^2 = 4q^2$
 Explanation: Since $OR \perp OS$, the dot product of the internal division vector $\frac{3\bar{p} + 2\bar{q}}{5}$ and the external division vector $3\bar{p} - 2\bar{q}$ is zero, giving $9p^2 = 4q^2$.
20. **Question 20** - Correct Answer – (B) $1/\sqrt{3}$
 Explanation: The volume of the parallelepiped is $V = a^3 - a + 1$. Minimizing V by setting $dV/da = 3a^2 - 1 = 0$ for $a > 0$ yields $a = 1/\sqrt{3}$.
21. **Question 21** - Correct Answer – (B) 3.0009
 Explanation: Using linear approximation $f(x) \approx f(x_0) + f'(x_0)\Delta x$ with $x_0 = 1000$ and $f(x) = \log_{10} x$ gives $3 + \frac{2\log_{10} e}{1000} \approx 3.0009$.
22. **Question 22** - Correct Answer – (A) a
 Explanation: The equation of the tangent at any point (x_1, y_1) on the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$ yields axes intercepts whose sum is $(\sqrt{x_1} + \sqrt{y_1})^2 = a$.
23. **Question 23** - Correct Answer – (B) $\sqrt{3} : (2 + \sqrt{3})$
 Explanation: The angles are $120^\circ, 30^\circ, 30^\circ$. By the sine rule, the sides are proportional to $\sqrt{3} : 1 : 1$, giving the ratio $\frac{\sqrt{3}}{\sqrt{3}+2}$.
24. **Question 24** - Correct Answer – (D) is a singleton set
 Explanation: Solving $\tan^{-1}(2x) + \tan^{-1}(3x) = \pi/4$ yields $6x^2 + 5x - 1 = 0$, giving $x = 1/6$ as the only valid positive solution.
25. **Question 25** - Correct Answer – (D) $23/\sqrt{17}$
 Explanation: Substituting $(13, 32)$ into $x/c + y/3 = 1$ yields the parameters, from which the perpendicular distance between the parallel lines is computed.

26. **Question 26** - Correct Answer - (A) $-1/2$
 Explanation: The logarithmic term is odd, integrating to zero. The greatest integer function $[x]$ integrates to $-1/2$ on the interval $[-1/2, 1/2]$.
27. **Question 27** - Correct Answer - (C) 2
 Explanation: For $g(x) = f^{-1}(x)$, we have $g'(1) = 1/f'(g(1))$. Since $f(0) = 1$, we get $g(1) = 0$. Differentiating gives $f'(0) = 1/2$, so $g'(1) = 2$.
28. **Question 28** - Correct Answer - (C) $x = 2r$
 Explanation: Minimizing the combined area $A = x^2 + \pi r^2$ subject to the constraint $4x + 2\pi r = 2$ using calculus yields the relation $x = 2r$.
29. **Question 29** - Correct Answer - (B) $\frac{-\hat{i}-7\hat{j}+5\hat{k}}{5\sqrt{3}}$
 Explanation: The cross product of the direction vectors $(3, 1, 2) \times (1, 2, 3)$ gives $-\hat{i}-7\hat{j}+5\hat{k}$, which is then normalized.
30. **Question 30** - Correct Answer - (A) 88
 Explanation: Finding the midpoint of the point and its image on the line, and applying perpendicularity conditions yields $a = -56$ and $b = -32$, so $|a + b| = 88$.
31. **Question 31** - Correct Answer - (B) $23/36$
 Explanation: Summing the probabilities to 1 yields $k = 1/6$. Thus, $P(X > 2) = P(3) + P(4) + P(5) = 3k + 5k^2 = 23/36$.
32. **Question 32** - Correct Answer - (C) two
 Explanation: The coplanarity determinant simplifies to $-\lambda^6 + 3\lambda^2 + 2 = 0$. Solving for real values of λ yields $\lambda = \pm\sqrt{2}$, which are two real solutions.
33. **Question 33** - Correct Answer - (D) $2f(x)$
 Explanation: Substituting $\frac{2x}{1+x^2}$ into $f(x)$ yields $\log_e \left(\frac{1-2x/(1+x^2)}{1+2x/(1+x^2)} \right) = \log_e \left(\frac{1-x}{1+x} \right)^2 = 2f(x)$.
34. **Question 34** - Correct Answer - (A) 0
 Explanation: Since the cross product of the normal vectors of the two planes is zero, the normal vectors are parallel, which means the angle between the planes is 0.
35. **Question 35** - Correct Answer - (C) $e^{\sin \theta}(\log \sin \theta - \csc \theta) + c$
 Explanation: Using the substitution $t = \sin \theta$, the integral takes the form $\int e^t(f(t) + f'(t))dt$ where $f(t) = \log t - 1/t$.
36. **Question 36** - Correct Answer - (A) $x^2 + y^2 - 6x - 8y + 9 = 0$
 Explanation: The perpendicular distance from $(3, 4)$ to $5x + 12y - 11 = 0$ is $R = 4$. The circle equation is $(x - 3)^2 + (y - 4)^2 = 16$.
37. **Question 37** - Correct Answer - (D) $2\sqrt{2}$ units
 Explanation: The plane has normal vector $(1, 1, 0)$ and passes through $(1, -2, 1)$, which yields $x + y + 1 = 0$. The distance from $(1, 2, 2)$ is $4/\sqrt{2} = 2\sqrt{2}$.
38. **Question 38** - Correct Answer - (C) 4
 Explanation: $\frac{\sqrt{3} \cos 20^\circ - \sin 20^\circ}{\sin 20^\circ \cos 20^\circ} = \frac{2 \sin(60^\circ - 20^\circ)}{\frac{1}{2} \sin 40^\circ} = 4$.
39. **Question 39** - Correct Answer - (A) $\pi/6$
 Explanation: Applying vector triple product expansion to $\vec{a} \times (\vec{a} \times \vec{c}) + \vec{b} = 0$ and matching magnitudes yields $\vec{a} \cdot \vec{c} = \sqrt{3}$, so $\theta = \pi/6$.

40. **Question 40** - Correct Answer – (A) $1/\sqrt{3}$
 Explanation: The bounded area is given by $\frac{1}{3a^2} = 1$. Since $a > 0$, this yields $a = 1/\sqrt{3}$.
41. **Question 41** - Correct Answer – (B) $\frac{1}{3}(\tan x - \cot x)^3 + c$
 Explanation: Let $u = \tan x - \cot x$, which simplifies the integral through substitution of the trigonometric derivatives.
42. **Question 42** - Correct Answer – (B) 4
 Explanation: Maximizing $P = xy^2 = (3 - y)y^2$ with $dP/dy = 6y - 3y^2 = 0$ gives $y = 2$, which yields the maximum value $P = 4$.
43. **Question 43** - Correct Answer – (C) $x \log |y| = 2(x - 1)$
 Explanation: Integrating the differential equation yields $\log |y| = -2/x + c$. Substituting the center $(1, 1)$ gives $c = 2$, which simplifies to $x \log |y| = 2(x - 1)$.
44. **Question 44** - Correct Answer – (B) $\frac{n(n+1)(2n+1)}{6}$
 Explanation: Taking the logarithm and differentiating at $x = 0$ yields a sum of squares of integers, leading directly to the standard formula.
45. **Question 45** - Correct Answer – (D) $11/3^5$
 Explanation: Using binomial probability, the probability of getting 4 or 5 - Correct Answers is ${}^5C_4(1/3)^4(2/3) + {}^5C_5(1/3)^5 = 11/3^5$.
46. **Question 46** - Correct Answer – (A) $\frac{2 \log 10}{\log 2}$
 Explanation: The decay equation is $x = x_0(1/2)^t$. Setting $x = 0.01x_0$ yields $t = \frac{\log(100)}{\log 2} = \frac{2 \log 10}{\log 2}$.
47. **Question 47** - Correct Answer – (A) 2
 Explanation: Simplifying the limit using standard trigonometric approximations as $x \rightarrow 0$ leads directly to a value of 2.
48. **Question 48** - Correct Answer – (C) $(\sqrt{2}, 1 - \sqrt{3})$
 Explanation: Continuity at $x = 1$ and $x = \sqrt{2}$ yields two equations in a and b , which solve to give $a = \sqrt{2}$ and $b = 1 - \sqrt{3}$.
49. **Question 49** - Correct Answer – (C) T, F, T
 Explanation: For the implication $A \rightarrow B$ to be false, the antecedent $A = (p \wedge \sim q) \wedge (p \wedge r)$ must be true and the consequent $B = \sim p \vee q$ must be false. This dictates $p = T, q = F, r = T$.
50. **Question 50** - Correct Answer – (C) $7/\sqrt{3}$
 Explanation: Using cosine rule $a = \sqrt{b^2 + c^2 - 2bc \cos A} = 7$. Thus the circumradius $R = \frac{a}{2 \sin A} = \frac{7}{\sqrt{3}}$.
51. **Question 51** - Correct Answer – (C) 868 nm
 Explanation: Wavelength is the reciprocal of the wave number. $\lambda = \frac{1}{11516} \text{ cm} \approx 8.68 \times 10^{-5} \text{ cm} = 868 \text{ nm}$.
52. **Question 52** - Correct Answer – (A) $1/8$
 Explanation: The fraction remaining after n half-lives is $(1/2)^n$. For 3 half-lives, $(1/2)^3 = 1/8$.
53. **Question 53** - Correct Answer – (D) p-Benzoquinone
 Explanation: Chromic acid (CrO_3) oxidizes phenol to the conjugated diketone para-benzoquinone.

54. **Question 54** - Correct Answer – (C) 534 mm Hg
Explanation: By Raoult's law, $P_{total} = x_A P_A^\circ + x_B P_B^\circ = (0.4)(420) + (0.6)(610) = 534$ mm Hg.
55. **Question 55** - Correct Answer – (A) Copolymer
Explanation: Neoprene is a homopolymer made by the polymerization of chloroprene monomer units.
56. **Question 56** - Correct Answer – (C) Diamminedichloroplatinum(II)
Explanation: $[Pt(NH_3)_2Cl_2]$ has no net charge, making it a neutral coordination sphere complex.
57. **Question 57** - Correct Answer – (A) 2 COOH, 4 OH
Explanation: Saccharic acid (glucaric acid) contains carboxylic acid groups at both ends of a 4-carbon tetrahydroxy chain.
58. **Question 58** - Correct Answer – (C) CrO_2
Explanation: Chromium dioxide (CrO_2) is a well-known ferromagnetic transition metal oxide used in magnetic recording tapes.
59. **Question 59** - Correct Answer – (B) Glucose
Explanation: The Drath-Frost pathway uses genetically engineered microbes to convert glucose into adipic acid enzymatically.
60. **Question 60** - Correct Answer – (C) Ethoxyethane and Methoxypropane
Explanation: These two ethers have the same molecular formula ($C_4H_{10}O$) but different alkyl distribution around the oxygen atom, exhibiting metamerism.
61. **Question 61** - Correct Answer – (B) Calamine
Explanation: Calamine consists primarily of zinc carbonate ($ZnCO_3$), making it a classic zinc mineral.
62. **Question 62** - Correct Answer – (A) Po
Explanation: Ionization enthalpy decreases down a group in the periodic table, so Polonium (Po) has the lowest value in Group 16.
63. **Question 63** - Correct Answer – (C) 88.25
Explanation: Utilizing the density formula $d = \frac{z \cdot M}{N_A \cdot a^3}$ for a bcc lattice ($z = 2$) allows calculation of the molar mass.
64. **Question 64** - Correct Answer – (A) $NH_4OH + NH_4Cl$
Explanation: A basic buffer consists of a weak base (NH_4OH) and its conjugate salt containing a strong acid anion (NH_4Cl).
65. **Question 65** - Correct Answer – (D) BF_3
Explanation: Boron in BF_3 has three valence electrons, all used in bonding with fluorine, leaving no lone pairs on the central atom.
66. **Question 66** - Correct Answer – (B) 60
Explanation: Utilizing the depression of freezing point relation $\Delta T_f = K_f \cdot \frac{w \cdot 1000}{M \cdot W}$ yields $M = 60$.
67. **Question 67** - Correct Answer – (D) Coagulation by adding small electrolyte
Explanation: Lyophilic colloids are highly stable and require large amounts of electrolytes to undergo coagulation.

68. **Question 68** - Correct Answer – (C) 4.86
Explanation: Using Henderson-Hasselbalch equation, $pH = pK_a + \log \left(\frac{[salt]}{[acid]} \right) = 4.56 + \log \left(\frac{0.70}{0.35} \right) = 4.86$.
69. **Question 69** - Correct Answer – (A) But-1-ene
Explanation: Since one of the doubly bonded carbon atoms in but-1-ene holds two identical hydrogen atoms, it cannot exhibit cis-trans isomerism.
70. **Question 70** - Correct Answer – (A) $PbSO_4 + 2e \rightarrow \dots$
Explanation: During discharge of a lead storage cell, lead ions combine with sulfate ions on both electrodes to yield insoluble lead sulfate.
71. **Question 71** - Correct Answer – (D) Oxonium salts
Explanation: Ethers act as Lewis bases and react with strong concentrated acids to form stable protonated oxonium salts.
72. **Question 72** - Correct Answer – (C) 2-Iodo-3-methylbutane
Explanation: This molecule contains a chiral carbon atom bonded to four distinct groups, allowing it to exhibit optical activity.
73. **Question 73** - Correct Answer – (D) KIO_4
Explanation: In potassium periodate (KIO_4), the oxidation state of iodine is +7, which is its highest possible oxidation state.
74. **Question 74** - Correct Answer – (C) Three
Explanation: The secondary amine isomers of formula $C_4H_{11}N$ are diethylamine, methylpropylamine, and methylisopropylamine.
75. **Question 75** - Correct Answer – (D) $III > II > I$
Explanation: Allylic or tertiary halides undergo much faster $C - Cl$ bond cleavage due to the stabilization of the resulting carbocation.
76. **Question 76** - Correct Answer – (B) $R - CN \rightarrow CHO$
Explanation: The Stephen reduction converts alkyl nitriles to aldehydes using tin(II) chloride and hydrochloric acid.
77. **Question 77** - Correct Answer – (A) 2
Explanation: Nitrogen possesses two naturally occurring stable isotopes, Nitrogen-14 and Nitrogen-15.
78. **Question 78** - Correct Answer – (C) Deep blue
Explanation: Solvated electrons formed when alkali metals dissolve in liquid ammonia absorb light in the red region, imparting a deep blue color.
79. **Question 79** - Correct Answer – (B) Prop-2-enoic acid
Explanation: Acrylic acid ($CH_2 = CH - COOH$) has a three-carbon chain containing a carboxylic acid and a double bond starting at C-2.
80. **Question 80** - Correct Answer – (B) Different elements
Explanation: Isobars are atoms of different chemical elements that share the same mass number but have different atomic numbers.
81. **Question 81** - Correct Answer – (B) 20 mL
Explanation: Applying Boyle's Law ($P_1 V_1 = P_2 V_2$) yields $(1.25 \text{ atm})V_1 = (1.0 \text{ atm})(25 \text{ mL}) \Rightarrow V_1 = 20 \text{ mL}$.

82. **Question 82** - Correct Answer – (A) $\log_{10} A$
Explanation: The logarithmic Arrhenius equation is $\log_{10} k = \log_{10} A - \frac{E_a}{2.303RT}$. The intercept of the linear plot is $\log_{10} A$.
83. **Question 83** - Correct Answer – (B) Ethanal
Explanation: Ethanal is an aldehyde, which readily reduces Tollens' reagent to form a reflective silver mirror on the tube walls.
84. **Question 84** - Correct Answer – (C) Nylon-6
Explanation: Nylon-6 is synthesized via ring-opening condensation polymerization of caprolactam rather than addition polymerization.
85. **Question 85** - Correct Answer – (D) ΔU
Explanation: By the first law of thermodynamics, heat exchanged at constant volume (q_v) is directly equal to the change in internal energy (ΔU).
86. **Question 86** - Correct Answer – (C) 0.066
Explanation: The stoichiometry dictates that consumption of I^- is 1.5 times the formation rate of SO_4^{2-} . Hence, $1.5 \times 0.044 = 0.066$.
87. **Question 87** - Correct Answer – (D) Nitrito
Explanation: Nitrito (NO_2^-) is an ambidentate ligand that has two potential donor atoms (N and O) but coordinates through only one at a time.
88. **Question 88** - Correct Answer – (C) 0.1M $BaCl_2$
Explanation: Boiling point elevation depends on the van 't Hoff factor i . $BaCl_2$ dissociates into 3 ions, providing the highest effective concentration.
89. **Question 89** - Correct Answer – (B) 0.293
Explanation: Standard thermodynamic calculations for the phase change of ice at 273 K yield this entropy value.
90. **Question 90** - Correct Answer – (B) Mn and Cr
Explanation: Both elements stabilize their valence shells with half-filled d -orbitals (Mn : $[Ar]3d^5 4s^2$, Cr : $[Ar]3d^5 4s^1$).
91. **Question 91** - Correct Answer – (A) 229.5
Explanation: In a body-centered cubic unit cell, the atomic radius is given by $r = \frac{\sqrt{3}}{4}a$. Substituting $a = 530$ pm yields 229.5 pm.
92. **Question 92** - Correct Answer – (B) 0.02 M
Explanation: Using Ostwald's dilution law relations for weak acids, the molar concentration is determined directly from the dissociation constant.
93. **Question 93** - Correct Answer – (B) $CH_2 = CH - CH(OH) - CH_3$
Explanation: This compound contains a hydroxyl group attached to a sp^3 hybridized carbon adjacent to a carbon-carbon double bond.
94. **Question 94** - Correct Answer – (B) $q = \Delta U = 500, w = 0$
Explanation: Heating at constant volume implies no work is done ($w = 0$), meaning all supplied heat goes directly into increasing the internal energy.
95. **Question 95** - Correct Answer – (A) 121.4
Explanation: Standard electrolytic parameters and equations yield this conductivity value for the given dilution.

96. **Question 96** - Correct Answer – (B) $CHBr_3 > CH_2Br_2 > CH_3Br > CH_3Cl$
 Explanation: Boiling point increases with molecular mass and stronger dispersion forces, making bromoform the highest and methyl chloride the lowest.
97. **Question 97** - Correct Answer – (B) 3.5
 Explanation: On the Pauling scale, oxygen is highly electronegative and has a designated value of 3.5.
98. **Question 98** - Correct Answer – (C) N-Ethyl-N-methylpropan-2-amine
 Explanation: The longest carbon chain has three carbons (propane) with the nitrogen attached at C-2, bearing ethyl and methyl substituents.
99. **Question 99** - Correct Answer – (B) 38600 C
 Explanation: The reduction of MnO_4^- to Mn^{2+} requires 5 electrons. Charge required is $0.08 \text{ mol} \times 5 \times 96500 \text{ C/mol} = 38600 \text{ C}$.
100. **Question 100** - Correct Answer – (A) D
 Explanation: The standard one-letter abbreviation representing the acidic amino acid aspartic acid is D.
101. **Question 101** - Correct Answer – (A) $9/2 R$
 Explanation: For a diatomic gas with active vibrational modes, the degrees of freedom increase, giving a higher molar heat capacity at constant pressure.
102. **Question 102** - Correct Answer – (C) 40.5 pF
 Explanation: Using the series dielectric slab formula $C = \frac{\epsilon_0 A}{\frac{d_1}{K_1} + \frac{d_2}{K_2}}$ yields 4.5 times the initial capacitance.
103. **Question 103** - Correct Answer – (D) 0.02 mA
 Explanation: Standard transistor active bias formulas relate the collector current, base current, and β to yield this current.
104. **Question 104** - Correct Answer – (D) 88
 Explanation: Rewriting the SHM equation gives $\omega = 0.5$. Calculating the period $T = 4\pi = 88/7$, comparison yields $x = 88$.
105. **Question 105** - Correct Answer – (D) $\tan^{-1}(4)$
 Explanation: Equating $H_{max} = R$ gives $\frac{u^2 \sin^2 \theta}{2g} = \frac{u^2 \sin 2\theta}{g}$, which simplifies directly to $\tan \theta = 4$.
106. **Question 106** - Correct Answer – (A) i_a never greater than i_b
 Explanation: Circuit analysis under standard phase conditions dictates that branch current i_a remains strictly bounded by i_b .
107. **Question 107** - Correct Answer – (A) 1:2
 Explanation: Applying parallel-axis theorem to a disc and ring about their respective tangent axes yields this ratio.
108. **Question 108** - Correct Answer – (B) $3/\pi$
 Explanation: The frequencies are $f_1 = \frac{316}{2\pi}$ and $f_2 = \frac{310}{2\pi}$. The beat frequency is $f_1 - f_2 = \frac{6}{2\pi} = \frac{3}{\pi}$.
109. **Question 109** - Correct Answer – (B) 2 Ω
 Explanation: Balancing conditions of a wheatstone bridge are used to compute the required shunt resistance across the arm.

110. **Question 110** - Correct Answer – (A) $(1 - d/R)^{-1}$
 Explanation: Variation in acceleration due to gravity at depth d affects the capillary rise height inversely as $(1 - d/R)$.
111. **Question 111** - Correct Answer – (B) 40
 Explanation: Standard refraction formulas for an equilateral prism yield this angle of minimum deviation for the given incidence angle.
112. **Question 112** - Correct Answer – (A) $L/4$
 Explanation: Combining $E = \frac{1}{2}L\omega$, if E is halved and ω is doubled, the new angular momentum must be $L/4$.
113. **Question 113** - Correct Answer – (A) 1.8 km/s
 Explanation: The phase difference equation yields a wavelength of 3.6 m. Using $v = f\lambda$, we obtain 1.8 km/s.
114. **Question 114** - Correct Answer – (A) 2.5×10^{-3} J
 Explanation: The work done or energy changes in pulling the loop are calculated using Faraday's laws and mechanical power balances.
115. **Question 115** - Correct Answer – (D) λ/ϵ_0
 Explanation: Integrating the electrostatic contributions of the concentric semi-circular geometries yields the potential expression.
116. **Question 116** - Correct Answer – (C) Constant velocity bus driver
 Explanation: An inertial frame is unaccelerated, which corresponds to a reference frame moving at a constant velocity.
117. **Question 117** - Correct Answer – (D) $q^2r^2B^2/2V$
 Explanation: Using $r = \frac{mv}{qB}$ and kinetic energy $K = qV = \frac{1}{2}mv^2$ yields $m = \frac{q^2r^2B^2}{2V}$.
118. **Question 118** - Correct Answer – (C) $\sqrt{T_1^2 - T_2^2}$
 Explanation: Since $T \propto \sqrt{l}$, the difference in length $l_1 - l_2$ leads to a combined period expression of this radical form.
119. **Question 119** - Correct Answer – (C) 10 mA
 Explanation: Calculating voltage drops across R_s and R_L under Zener regulation yields the current flowing through the Zener diode.
120. **Question 120** - Correct Answer – (C) $3g/4\pi RG$
 Explanation: From $g = \frac{GM}{R^2} = \frac{G(4/3\pi R^3\rho)}{R^2}$, we solve to get the density $\rho = \frac{3g}{4\pi RG}$.
121. **Question 121** - Correct Answer – (D) decreases then increases
 Explanation: Impedance in a series LCR circuit is minimum at resonance, so it decreases as frequency approaches resonance and increases afterward.
122. **Question 122** - Correct Answer – (D) 5 Ω
 Explanation: The potential gradient along the wire dictates the required series resistance to balance the target EMF.
123. **Question 123** - Correct Answer – (D) 600 K
 Explanation: Efficiency relations of Carnot engines operating with common sink temperatures yield this source temperature.
124. **Question 124** - Correct Answer – (B) increase refractive index
 Explanation: Resolving power is proportional to the refractive index of the medium, so introducing oil immersion increases it.

125. **Question 125** - Correct Answer – (B) 3 s
 Explanation: Series versus parallel configurations of thermal conductors alter the equivalent thermal resistance, scaling the transfer time.
126. **Question 126** - Correct Answer – (D) D
 Explanation: Transient current rise curves indicate that the curve reaching maximum current slowest has the largest time constant, hence smallest inductance.
127. **Question 127** - Correct Answer – (B) $mV^2/3R$
 Explanation: Conservation of energy during expansion of the monatomic gas converts bulk kinetic energy into thermal energy.
128. **Question 128** - Correct Answer – (B) 8 cm
 Explanation: Refraction principles and apparent depth/thickness relations scale the physical path to this value.
129. **Question 129** - Correct Answer – (D) $4N_a I_a = N_b I_b$
 Explanation: Magnetic moment is given by $M = NIA = NI(\pi r^2)$. Using $r_b = 2r_a$ yields the ratio condition.
130. **Question 130** - Correct Answer – (D) 3.06 m
 Explanation: The length of a terrestrial/astronomical telescope under normal adjustment is given by the sum of focal lengths $f_o + f_e$.
131. **Question 131** - Correct Answer – (A) 2
 Explanation: Flow rate balances using the equation of continuity determine the parameter x governing efflux.
132. **Question 132** - Correct Answer – (A) first
 Explanation: Comparing standard harmonic frequencies of strings under varying boundary conditions yields this fundamental match.
133. **Question 133** - Correct Answer – (A) 500
 Explanation: Using the resonance condition $f = \frac{1}{2\pi\sqrt{LC}}$, solving for C with the given values yields approximately 500 pF.
134. **Question 134** - Correct Answer – (B) $3I_0/16$
 Explanation: Applying Malus's Law successively through the polaroids yields this fractional output intensity.
135. **Question 135** - Correct Answer – (B) p-n junction
 Explanation: Under reverse bias conditions beyond a threshold, a p-n junction exhibits sharp current shifts and cutoff features.
136. **Question 136** - Correct Answer – (D) 3:2
 Explanation: Rotational kinetic energy $K = \frac{1}{2}I\omega^2$ compared for the two geometries under specified frequencies gives this ratio.
137. **Question 137** - Correct Answer – (A) $N^2 A^2 B^2 \omega^2 / 2R$
 Explanation: Induced EMF in a rotating coil yields an average power dissipation given by the formula in option (A).
138. **Question 138** - Correct Answer – (D) 1:64
 Explanation: Standard mass and pressure relationships for spherical bubbles scaling with radius yield this cubic ratio.

139. **Question 139** - Correct Answer – (C) $10/3 \epsilon_0 F$
 Explanation: Calculating the equivalent capacitance with the inserted dielectric slab of specified thickness yields this value.
140. **Question 140** - Correct Answer – (B) $(\sqrt{3} - 1)R$
 Explanation: Setting $g_h = g/3 = g(1 + h/R)^{-2}$ yields $1 + h/R = \sqrt{3} \Rightarrow h = (\sqrt{3} - 1)R$.
141. **Question 141** - Correct Answer – (D) $(\gamma - 1)/\gamma$
 Explanation: The ratio of work done to heat supplied in an isobaric process is $\frac{W}{Q} = \frac{nR\Delta T}{nC_p\Delta T} = \frac{R}{C_p} = \frac{\gamma-1}{\gamma}$.
142. **Question 142** - Correct Answer – (D) $1/2$
 Explanation: From $K_{max} = h(f - f_0)$, we get $K_1 = hf_0$ and $K_2 = 4hf_0$. The velocity ratio is $\sqrt{K_1/K_2} = 1/2$.
143. **Question 143** - Correct Answer – (B) $2R$
 Explanation: The path radius $r = mv/qB$ scales linearly with velocity, so doubling speed doubles the radius.
144. **Question 144** - Correct Answer – (C) MgR/LB
 Explanation: Balancing the gravitational torque against the magnetic torque acting on the current loop yields this balance expression.
145. **Question 145** - Correct Answer – (A) $3/16 R$
 Explanation: Applying Stefan's law of radiation or Newton's law of cooling for the specified temperatures yields this ratio.
146. **Question 146** - Correct Answer – (B) 0.21 m
 Explanation: Relating the spatial phase difference to the wavelength of the progressive wave yields this distance.
147. **Question 147** - Correct Answer – (C) $\sqrt{K_1/K_2}$
 Explanation: Equating maximum velocities $v_{max} = A\omega$ and utilizing $\omega = \sqrt{K/m}$ yields the radical ratio.
148. **Question 148** - Correct Answer – (C) 27
 Explanation: Spectral transition wave numbers for hydrogen atoms under Rydberg formulas yield this integer ratio.
149. **Question 149** - Correct Answer – (D) $1:1$
 Explanation: Charge redistributes until potentials equalize. Identical spheres will share charge equally, giving a 1:1 ratio.
150. **Question 150** - Correct Answer – (D) $hc/(W_0 + eV)$
 Explanation: Einstein's equation $\frac{hc}{\lambda} = W_0 + eV$ solved directly for wavelength gives $\lambda = \frac{hc}{W_0 + eV}$.