MHT CET 2022 Mathematics Answer Key PDF

Answer Key

Physics (Part I)

1. **Question 1** -Option- (B) U A > U B > U C U A >U B >U C
   Explanation: Energy density is U E 2 1 / R 4 UE 2 1/R 4
   , so smaller radius leads to higher energy density. code Code

2. **Question 2** -Option- (C) $\frac{R}{\gamma-1}(T_2 - T_1)$
   Explanation: The change in internal energy for 1 mole of gas is $\Delta U = C_v \Delta T = \frac{R}{\gamma-1}(T_2 - T_1)$.

3. **Question 3** -Option- (B) Adiabatic
   Explanation: An adiabatic process is defined as one in which there is no heat exchange with the surroundings.

4. **Question 4** -Option- (C) $\frac{1}{2}\left(\frac{q}{\varepsilon_0} - \phi\right)$
   Explanation: By Gauss's law, total flux is $2\phi_A + \phi = q/\varepsilon_0$, which gives the flux on plane surface A.

5. **Question 5** -Option- (B) 1, 0
   Explanation: For low inputs, $Y = \overline{0 \cdot 0} + \overline{0} = 1$. For high inputs, $Y = \overline{1 \cdot 1} + \overline{1} = 0$.

6. **Question 6** -Option- (D) 50 cm
   Explanation: Since $Y = 4X$, balancing equal resistances $4X$ and Y places the null point exactly at 50 cm.

7. **Question 7** -Option- (D) 10^3 J
   Explanation: Work done equals the change in kinetic energy: $W = \frac{1}{2}mv^2 = \frac{1}{2}(5)(20)^2 = 1000$ J.

8. **Question 8** -Option- (B) diffraction bands become broader
   Explanation: Diffraction width is proportional to wavelength. Since red light has a larger wavelength than blue, bands broaden.

9. **Question 9** -Option- (C) holes are majority carriers and trivalent atoms are dopants
   Explanation: In p-type semiconductors, doping with trivalent impurities creates excess holes as majority carriers.

10. **Question 10** -Option- (A) 3, 6
    Explanation: Using $P = P_1 + P_2 - dP_1P_2$ gives $P_1 + P_2 = 9$ and $P_1P_2 = 18$, which yields 3 D and 6 D.

11. **Question 11** -Option- (A) $9a_0$
    Explanation: Radius of Bohr orbit is proportional to n^2, so the third orbit has a radius of $9a_0$.

12. **Question 12** -Option- (A) Any increase in the temperature of the liquid does not decrease its angle of contact.
Explanation: Increasing temperature weakens cohesive forces, which generally decreases the angle of contact.

13. **Question 13** -Option- (D) 3.14 V
Explanation: Induced peak emf is $e_0 = MI_0\omega = (10^{-3})(20)(50\pi) \approx 3.14$ V.

14. **Question 14** -Option- (D) $\sqrt{\frac{2T}{\pi\rho g}}$
Explanation: Surface tension supports the floating wire along two contact lines, giving $2TL = \pi r^2 L\rho g$.

15. **Question 15** -Option- (B) $L/4$
Explanation: Angular momentum $L \propto r^2$ when angular velocity ω remains constant.

16. **Question 16** -Option- (B) $G[\frac{V}{V_g} - 1]$
Explanation: The series resistance required to increase the voltage range is given by $R = G[V/V_g - 1]$.

17. **Question 17** -Option- (C) At resonance, circuit is purely inductive.
Explanation: At resonance, inductive and capacitive reactances cancel, making the circuit purely resistive.

18. **Question 18** -Option- (A) $\frac{9}{16} \times 10^{15}$ Hz
Explanation: Frequency of the emitted photon is $\nu = cR(1/2^2 - 1/4^2) = \frac{9}{16} \times 10^{15}$ Hz.

19. **Question 19** -Option- (B) 8
Explanation: Since force $F \propto q_1 q_2/d^2$, doubling a charge and halving distance increases the force by 8 times.

20. **Question 20** -Option- (B) 9 cm
Explanation: Equating magnetic forces gives $\frac{15}{X} = \frac{10}{15-X} \implies X = 9$ cm.

21. **Question 21** -Option- (A) $\frac{\sqrt{2m(E-W_0)}}{eB}$
Explanation: Radius $r = p/eB$. Substituting momentum $p = \sqrt{2mK_{\max}} = \sqrt{2m(E - W_0)}$ yields the result.

22. **Question 22** -Option- (B) $\sqrt{GMm^2r}$
Explanation: Angular momentum is $L = mvr = m\sqrt{GM/r} \cdot r = \sqrt{GMm^2r}$.

23. **Question 23** -Option- (B) $l_1\alpha_1 = l_2\alpha_2$
Explanation: Since $(l_2 - l_1)$ remains constant, $\Delta l_1 = \Delta l_2 \implies l_1\alpha_1 = l_2\alpha_2$.

24. **Question 24** -Option- (B) Statement B is correct while statement A is wrong.
Explanation: When crests coincide, constructive interference (not destructive) occurs. Coherent sources have constant phase difference.

25. **Question 25** -Option- (B) 6V
Explanation: Orbital velocity $v \propto 1/\sqrt{r}$. Since the radius of B is 1/4 of A, its velocity is $2 \times 3V = 6V$.

26. **Question 26** -Option- (C) $\pi/9$
Explanation: The path difference is $\Delta x = \Delta\phi/k = (\pi/3)/3 = \pi/9$ m.

27. **Question 27** -Option- (A) $2mnu$
Explanation: Force exerted is the rate of change of momentum: $F = n\Delta p = n(2mu) = 2mnu$.

28. **Question 28** -Option- (B) 8×10^{-4}
Explanation: Magnetic permeability is $\mu = B/H = (\Phi/A)/H = \frac{2.4\times10^{-5}/(0.3\times10^{-4})}{1000} = 8 \times 10^{-4}$.

29. **Question 29** -Option- (C) 550 Hz
Explanation: Wavelength $\lambda = \frac{2\pi\Delta x}{\Delta\phi} = \frac{1.08}{1.8} = 0.6$ m $\implies f = 330/0.6 = 550$ Hz.

30. **Question 30** -Option- (C) 40 cm
Explanation: Real depth of the fish is given by $d = d' \cdot n = 30 \times (4/3) = 40$ cm.

31. **Question 31** -Option- (B) $\frac{1+2\pi fCR}{4\pi^2 f^2 C}$
Explanation: Using $\tan 45^\circ = 1 = \frac{\omega L - 1/\omega C}{R}$ and solving for L yields this expression.

32. **Question 32** -Option- (C) N^2
Explanation: The self-inductance of a circular coil is directly proportional to the square of its number of turns.

33. **Question 33** -Option- (D) 1 : 16
Explanation: Series capacitance is $C/4$, parallel is $4C$. Their ratio is $(C/4)/4C = 1/16$.

34. **Question 34** -Option- (B) when 'a' is maximum, v is zero.
Explanation: At extreme positions, displacement and acceleration are maximum while velocity drops to zero.

35. **Question 35** -Option- (B) $\frac{2\pi}{\sqrt{a}}$
Explanation: Comparing with $\ddot{x} + \omega^2 x = 0$ gives $\omega = \sqrt{a}$, so period $T = 2\pi/\sqrt{a}$.

36. **Question 36** -Option- (C) $\sqrt{2} : 1$
Explanation: Equal emissive powers imply $e_1 T_1^4 = e_2 T_2^4 \implies T_1/T_2 = (e_2/e_1)^{1/4} = 4^{1/4} = \sqrt{2} : 1$.

37. **Question 37** -Option- (B) $\frac{hc}{2\lambda}$
Explanation: Solving the two photoelectric equations under $3K_1 = K_2$ yields a work function of $W_0 = \frac{hc}{2\lambda}$.

38. **Question 38** -Option- (D) 1 : 2
Explanation: The ratio of fundamental frequencies of closed to open tubes is $(v/4L)/(v/2L) = 1/2$.

39. **Question 39** -Option- (A) 0.2 m
Explanation: Fifth overtone is 6th harmonic, so $L = 3\lambda \implies \lambda = 0.8$ m. Successive node-antinode distance is $\lambda/4 = 0.2$ m.

40. **Question 40** -Option- (D) $\frac{2V}{\pi}$
Explanation: Maximum speed is $V = A\omega$. Average speed over a complete cycle is $\frac{4A}{T} = \frac{2A\omega}{\pi} = \frac{2V}{\pi}$.

41. **Question 41** -Option- (D) 6 E
Explanation: Splitting a drop of radius R into 216 droplets increases total surface area (and surface energy) by a factor of 6.

42. **Question 42** -Option- (C) $\frac{d^2}{2\lambda}$
Explanation: Linear width of the central maximum is $\frac{2\lambda D}{d} = d \implies D = \frac{d^2}{2\lambda}$.

43. **Question 43** -Option- (D) 1000
Explanation: Voltage gain is $A_v = \beta \frac{R_L}{R_i} = \left(\frac{1.5 \text{ mA}}{20\ \mu\text{A}}\right) \times \frac{2000}{150} = 1000$.

44. **Question 44** -Option- (B) 2 : 1
Explanation: Since kinetic energy is same, momentum ratio is $p_1/p_2 = \sqrt{m_1/m_2} = \sqrt{4/1} = 2:1$.

45. **Question 45** -Option- (A) $\frac{5}{\sqrt{3}}$
Explanation: Speed of sound ratio is $v_1/v_2 = \sqrt{\frac{\gamma_1 M_2}{\gamma_2 M_1}} = \sqrt{\frac{(5/3)(28)}{(7/5)(4)}} = \frac{5}{\sqrt{3}}$.

46. **Question 46** -Option- (A) 180 m
Explanation: Minimum radius $r = v^2/(\mu g)$. Converting speed gives $v = 30$ m/s, so $r = 900/(0.5 \times 10) = 180$ m.

47. **Question 47** -Option- (B) 3F/2
Explanation: Force is $F \propto I_1 I_2/d$. The new force is $F' \propto \frac{(3I_1)I_2}{2d} = 1.5F$.

48. **Question 48** -Option- (C) $\frac{B\omega R^2}{2}$
Explanation: The induced emf between the center and rim of a rotating disc is given by $e = \frac{1}{2}BR^2\omega$.

49. **Question 49** -Option- (C) $\frac{719\pi}{21600}$
Explanation: Relative angular speed is $\omega_S - \omega_H = \frac{\pi}{30} - \frac{\pi}{21600} = \frac{719\pi}{21600}$ rad/s.

50. **Question 50** -Option- (C) $\left[\frac{C(V_1^2 - V_2^2)}{L}\right]^{1/2}$
Explanation: By conservation of energy, $\frac{1}{2}CV_1^2 = \frac{1}{2}CV_2^2 + \frac{1}{2}LI^2 \implies I = \left[\frac{C(V_1^2 - V_2^2)}{L}\right]^{1/2}$.

Chemistry

51. **Question 51** -Option- (B) 1
Explanation: Methylcyclopentane has exactly one primary (1 1
) carbon atom, which is the carbon of the methyl group. code Code

52. **Question 52** -Option- (D) Guanine
Explanation: Guanine is a purine base, whereas cytosine, uracil, and thymine are pyrimidine bases.

53. **Question 53** -Option- (B) Lower members of alcohols are insoluble in water as well as in organic solvents.
Explanation: Lower aliphatic alcohols are highly soluble in water due to strong intermolecular hydrogen bonding.

54. **Question 54** -Option- (D) $x + y$
Explanation: By the first law of thermodynamics, $\Delta U = q + w$. Thus, gaining x J heat and having y J work done on it gives $x + y$.

55. **Question 55** -Option- (C) $E^\circ_{\text{cell}} = \frac{0.0592}{n} \log_{10} K$
Explanation: At equilibrium, $E_{\text{cell}} = 0$. Substituting this into the Nernst equation yields the standard relation.

56. **Question 56** -Option- (D) It is single step mechanism.
Explanation: This is false because the S_N1 mechanism is a multi-step process involving carbocation formation.

57. **Question 57** -Option- (B) Citric acid
Explanation: Lemons are citrus fruits containing high concentrations of citric acid.

58. **Question 58** -Option- (D) 40 kJ
Explanation: Change in internal energy is $\Delta U = q + w = -25 \text{ kJ} + 65 \text{ kJ} = 40 \text{ kJ}$.

59. **Question 59** -Option- (A) $CH_3CH_2CH_2OH$
Explanation: Hydroboration-oxidation of propene using diborane followed by alkaline hydrogen peroxide yields propan-1-ol.

60. **Question 60** -Option- (A) HSO_4^-
Explanation: The bisulfate ion (HSO_4^-) is amphiprotic; it can donate a proton to act as an acid, or accept a proton to act as a base.

61. **Question 61** -Option- (C) 5.19×10^{22}
Explanation: Number of unit cells $= \frac{\text{Mass}}{\text{Density} \times a^3} = \frac{20}{9.8 \times (340 \times 10^{-10})^3} \approx 5.19 \times 10^{22}$. In simple cubic, this equals the atom count.

62. **Question 62** -Option- (A) Low spin, diamagnetic
Explanation: $[Co(NH_3)_6]^{3+}$ is a low-spin d^6 complex with no unpaired electrons, making it diamagnetic.

63. **Question 63** -Option- (A) $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s$
Explanation: This is the correct order of molecular orbital energies for fluorine (F_2) molecules.

64. **Question 64** -Option- (C) Sugar charcoal and water
Explanation: Concentrated sulfuric acid is a strong dehydrating agent that carbonizes sucrose to form sugar charcoal and water.

65. **Question 65** -Option- (B) 2-chloro-2-methylbutane
Explanation: This tertiary alkyl halide undergoes S_N1 substitution most rapidly due to the high stability of the resulting tertiary carbocation.

66. **Question 66** -Option- (D) Protecting and deprotecting functional groups in organic reactions reduces the number of steps.
Explanation: Protecting group manipulations add extra synthesis and purification steps, which goes against green chemistry design.

67. **Question 67** -Option- (D) 0.072 %
Explanation: Percent dissociation is given by $\alpha \times 100\% = 7.2 \times 10^{-4} \times 100\% = 0.072\%$.

68. **Question 68** -Option- (C) CHI_3
Explanation: The haloform reaction of acetone with sodium hypoiodite ($NaOH + I_2$) yields a yellow precipitate of iodoform (CHI_3).

69. **Question 69** -Option- (B) 12
Explanation: The coordination number of both hexagonal close-packed (hcp) and cubic close-packed (ccp) structures is 12.

70. **Question 70** -Option- (C) Cu^{2+}
Explanation: In this reaction, Cu^{2+} is reduced to Cu by gaining electrons, thus acting as the oxidizing agent.

71. **Question 71** -Option- (B) $M = \frac{1000 K_b W_2}{\Delta T_b W_1}$
Explanation: This represents the standard thermodynamic formula relating solute molar mass and boiling point elevation.

72. **Question 72** -Option- (B) -120 J
Explanation: Work done $W = -P_{\text{ext}}\Delta V = -2 \text{ bar} \times (0.8 - 0.2) \text{ dm}^3 = -1.2 \text{ dm}^3 \cdot \text{bar} = -120 \text{ J}$.

73. **Question 73** -Option- (D) 4×10^{-2} dm^3
Explanation: By Boyle's Law, $V_2 = P_1V_1/P_2 = 1 \times 60/1.5 = 40 \text{ mL} = 4 \times 10^{-2} \text{ dm}^3$.

74. **Question 74** -Option- (C) 2.87
Explanation: $\text{pH} = -\log[H^+] = 3 - \log(1.342) = 3 - 0.1277 = 2.87$.

75. **Question 75** -Option- (A) Benzoic acid
Explanation: Nucleophilic acyl substitution of benzoyl chloride with water (hydrolysis) produces benzoic acid.

76. **Question 76** -Option- (D) 0.1 mol dm^{-3} s^{-1}
Explanation: For a zero-order reaction, rate constant $k = \frac{\Delta[A]}{t} = \frac{9 \text{ mol/dm}^3}{90 \text{ s}} = 0.1 \text{ mol dm}^{-3} \text{ s}^{-1}$.

77. **Question 77** -Option- (C) 3
Explanation: Reduction of one mole of Cr^{3+} ions to metallic $Cr_{(s)}$ requires three moles of electrons.

78. **Question 78** -Option- (D) Sodiumhexanitrocobaltate (III)
Explanation: In sodium hexanitrocobaltate(III), the coordination sphere $[Co(NO_2)_6]^{3-}$ carries a negative charge, making it anionic.

79. **Question 79** -Option- (C) 3t
Explanation: For a first-order reaction, the time required for 99.9% completion ($t_{99.9\%} = \frac{6.909}{k}$) is three times $t_{90\%}$ ($\frac{2.303}{k}$).

80. **Question 80** -Option- (B) Alcohol reacts with halogen in presence of sunlight.
Explanation: Free radical halogenation in sunlight is used to prepare alkyl halides from alkanes, not alcohols.

81. **Question 81** -Option- (C) $R - CO - NH_2 + 4[H] \rightarrow$ Mendius reduction
Explanation: Mendius reduction specifically refers to the reduction of nitriles (cyanides) using sodium and alcohol, not amides.

82. **Question 82** -Option- (D) Be
Explanation: Heavy water, graphite, and beryllium (Be) are used as moderators in nuclear reactors to slow down fast neutrons.

83. **Question 83** -Option- (C) S_8 molecule
Explanation: A sulfur sol contains colloidal particles consisting of aggregates of thousands of S_8 molecules (multimolecular colloid).

84. **Question 84** -Option- (C) PVC
Explanation: Polyvinyl chloride (PVC) is an addition polymer synthesized from the monomer vinyl chloride ($CH_2 = CHCl$).

85. **Question 85** -Option- (A) 1 bar
Explanation: According to Henry's Law, $S = K_H \cdot P \implies P = S/K_H = \frac{6.85 \times 10^{-4}}{6.85 \times 10^{-4}} = 1 \text{ bar}$.

86. **Question 86** -Option- (A) Moist Ag_2O
Explanation: Treating a quaternary ammonium halide with moist silver oxide converts it to a hydroxide, which undergoes Hofmann elimination.

87. **Question 87** -Option- (A) To obtain tyres
Explanation: Styrene-butadiene rubber (Buna-S) exhibits high abrasion resistance and is primarily used to manufacture vehicle tires.

88. **Question 88** -Option- (C) 65 gram mol^{-1}
Explanation: Relative lowering $\frac{\Delta P}{P^\circ} = \frac{w_2 M_1}{M_2 w_1} \implies 0.06 = \frac{2.3 \times 78}{M_2 \times 46} \implies M_2 = 65$ g/mol.

89. **Question 89** -Option- (D) $3^\circ > 2^\circ > 1^\circ$
Explanation: Dehydrohalogenation follows the E2 mechanism, where the ease of reaction depends on alkene stability: $3^\circ > 2^\circ > 1^\circ$.

90. **Question 90** -Option- (C) $AlCl_3 > MgCl_2 > NaCl$
Explanation: By Fajan's rules, covalent character increases with increasing charge and decreasing size of the cation ($Al^{3+} > Mg^{2+} > Na^+$).

91. **Question 91** -Option- (B) Benzene diazonium chloride
Explanation: The diazotization of aniline with nitrous acid produces stable benzene diazonium chloride, which is then hydrolyzed to phenol.

92. **Question 92** -Option- (A) 14.4 g
Explanation: Charring of 34.2 g sucrose ($C_{12}H_{22}O_{11}$, 0.1 mol) yields 12 equivalents of carbon (1.2 mol), which is $1.2 \times 12 = 14.4$ g of sugar charcoal.

93. **Question 93** -Option- (B) 0.863
Explanation: A density of 0.863 g/cm^3 is equivalent to 0.863 kg/dm^3.

94. **Question 94** -Option- (D) 5.4×10^{-3} mol L^{-1} sec^{-1}
Explanation: By stoichiometry, rate of water formation is 1.5 times the rate of NO formation: $1.5 \times 3.6 \times 10^{-3} = 5.4 \times 10^{-3}$.

95. **Question 95** -Option- (B) Gd (Z=64) and Lu (Z=71)
Explanation: Both gadolinium and lutetium contain a single electron in their $5d$ orbitals in their ground-state electronic configurations.

96. **Question 96** -Option- (C) 82258 cm^{-1}
Explanation: Wave number $\bar{\nu} = R_H(1/1^2 - 1/2^2) = \frac{3}{4} \times 109677 = 82258$ cm^{-1}.

97. **Question 97** -Option- (B) Valine
Explanation: Valine is an essential amino acid that cannot be synthesized by the human body and must be obtained from diet.

98. **Question 98** -Option- (A) Pa
Explanation: Protactinium (Pa) is a member of the actinoid series of elements.

99. **Question 99** -Option- (D) 188.8 g mol^{-1}
Explanation: Molar mass $M = \frac{\rho \cdot N_A \cdot a^3}{z} = \frac{22.4 \times (5.6 \times 10^{-23}) \times 6.022 \times 10^{23}}{4} \approx 188.8$ g/mol.

100. **Question 100** -Option- (D) 0.34 V
Explanation: $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} \implies 0.46 = 0.80 - E^\circ_{\text{anode}} \implies E^\circ_{Cu^{2+}/Cu} = 0.34$ V.

Physics (Part II)

101. **Question 101** -Option- (C) 1 : 16 1:16
Explanation: Under identical P , V , m P,V,m conditions, the temperature ratio is T 1 / T 2 = n 2 / n 1 = M 1 / M 2 = 2 / 32 = 1 : 16 T 1 /T 2 =n 2 /n 1 =M 1 /M 2 =2/32=1:16 . code Code

102. **Question 102** -Option- (D) $\frac{mx}{ny}$
Explanation: Since $g = \frac{GM}{R^2} \propto R\rho$, the ratio is $(R_1/R_2) \cdot (\rho_1/\rho_2) = (x/y)(m/n) = mx/ny$.

103. **Question 103** -Option- (B) $\sqrt{\frac{\lambda R}{\lambda R - 1}}$
Explanation: From $1/\lambda = R(1 - 1/n^2)$, rearranging for n gives $n = \sqrt{\frac{\lambda R}{\lambda R - 1}}$.

104. **Question 104** -Option- (C) $2t$
Explanation: Time to empty a vessel scales as $\sqrt{h}$. If the height is increased to $4h$, the time taken is $2t$.

105. **Question 105** -Option- (D) 0.08 V
Explanation: The potential difference per turn is identical for both primary and secondary windings: $80/1000 = 0.08$ V.

106. **Question 106** -Option- (D) $X/8$
Explanation: The ratio $B/M \propto 1/R^3$. Doubling the radius reduces the ratio by a factor of $2^3 = 8$.

107. **Question 107** -Option- (C) 0.02 cm
Explanation: Slit width is $a = \frac{\lambda D}{y} = \frac{5000 \times 10^{-10} \times 2}{5 \times 10^{-3}} = 2 \times 10^{-4}$ m $= 0.02$ cm.

108. **Question 108** -Option- (D) 480 Hz, 485 Hz
Explanation: Since frequency $n \propto 1/l$, we have $0.97n_1 = 0.96(n_1 + 5) \implies n_1 = 480$ Hz and $n_2 = 485$ Hz.

109. **Question 109** -Option- (D) W/4
Explanation: Work done rotating through 60° is $pE(1 - \cos 60^\circ) = pE/2 = W/4$.

110. **Question 110** -Option- (C) 1×10^{-34} J $-$ s
Explanation: The change is $\Delta L = \frac{h}{2\pi} \approx 1.05 \times 10^{-34}$ J $-$ s.

111. **Question 111** -Option- (C) $(\bar{A} \cdot B) + (A \cdot \bar{B})$
Explanation: The logic gate combination represents the standard Exclusive-OR (XOR) gate.

112. **Question 112** -Option- (B) $T = \sqrt{\frac{T_1^2 T_2^2}{T_1^2 + T_2^2}}$
Explanation: Since the restoring forces add up in parallel ($k_{eq} = k_1 + k_2$), the equivalent time period follows this relation.

113. **Question 113** -Option- (B) totally kinetic
Explanation: Ideal gases have no intermolecular forces, making their internal energy purely kinetic.

114. **Question 114** -Option- (B) $2p_0$
Explanation: Pressure is $P \propto mv^2$. Halving mass and doubling velocity increases pressure by $1/2 \times 4 = 2$ times.

115. **Question 115** -Option- (B) $\frac{2\pi a}{5}$
Explanation: Max particle speed is $2\pi na$ and wave speed is $5n$. Their ratio is $\frac{2\pi a}{5}$.

116. **Question 116** -Option- (B) There is exchange of heat with surrounding
Explanation: This statement is incorrect because no heat exchange ($dQ = 0$) occurs during an adiabatic process.

117. **Question 117** -Option- (C) $\frac{2g}{3}$
Explanation: Gravity at depth is $g' = g(1 - d/R)$. For $d = R/3$, the acceleration is $2g/3$.

118. **Question 118** -Option- (C) 0.2 V/m
Explanation: Total resistance is 30 $\Omega \implies I = 0.1$ A. Potential drop on the wire is 2 V $\implies$ gradient $= 2/10 = 0.2$ V/m.

119. **Question 119** -Option- (A) 10 A
Explanation: Standard power and root-mean-square current calculations yield $I_{rms} = 10$ A.

120. **Question 120** -Option- (A) 1/4
Explanation: Since $X_L = X_C$, doubling frequency doubles X_L and halves X_C, changing the ratio of X'_C/X'_L to 1/4.

121. **Question 121** -Option- (D) $\frac{BR^2\omega}{2}$
Explanation: The induced emf between the center and the rim of a rotating disc is $e = \frac{1}{2}BR^2\omega$.

122. **Question 122** -Option- (B) $2\pi\left[\frac{(M+M_1)x}{M_1 g}\right]^{1/2}$
Explanation: The spring constant is $k = M_1 g/x$. The time period is given by $T = 2\pi\sqrt{(M + M_1)/k}$.

123. **Question 123** -Option- (D) 6 th bright band
Explanation: Path difference is $\Delta = 3\ \mu$m $= 3000$ nm $= 6\lambda$, which corresponds to the 6th bright band.

124. **Question 124** -Option- (B) $x = 2y$
Explanation: The theoretical maximum efficiency of a full-wave rectifier (81.2%) is double that of a half-wave rectifier (40.6%).

125. **Question 125** -Option- (A) $\frac{2v}{a}$
Explanation: Equating the displacements: $\frac{1}{2}at^2 = vt \implies t = 2v/a$.

126. **Question 126** -Option- (D) 3.2 m
Explanation: Solving the equations of motion under constant viscous retardation gives a height of approximately 3.2 m.

127. **Question 127** -Option- (C) d/2
Explanation: Capacitance is $C \propto K/d \implies C_2 = 16C_1 \implies 8/d' = 16/d \implies d' = d/2$.

128. **Question 128** -Option- (B) 30°
Explanation: Since $i = e = \frac{3}{4}A = 45°$, the angle of deviation is $\delta = i + e - A = 45° + 45° - 60° = 30°$.

129. **Question 129** -Option- (D) $2f$, $\frac{P}{2}$
Explanation: Making one surface flat halves the total power of the lens, which consequently doubles its focal length.

130. **Question 130** -Option- (B) 24 N
Explanation: Mass is 5 kg. The reading of the descending accelerating balance is $m(g-a) = 5(9.8 - 5) = 24$ N.

131. **Question 131** -Option- (B) $\frac{E_0^2}{4R}$
Explanation: In an L-R circuit with $X_L = R$, power factor is $\cos(45°) = 1/\sqrt{2}$. Average power is $P = \frac{E_0^2}{4R}$.

132. **Question 132** -Option- (C) $I_A = I_D > I_B = I_C$
Explanation: By symmetry, the distance to the axis is identical for pairs, making their moments of inertia equal.

133. **Question 133** -Option- (A) its phase changes by 180° but velocity does not change
Explanation: Reflection of a transverse wave from a rigid denser boundary introduces a phase shift of π radians.

134. **Question 134** -Option- (B) 1 : 8
Explanation: The ratio is $B_A/B_C = \frac{R^3}{(R^2+x^2)^{3/2}}$. For $x = \sqrt{3}R$, the ratio is $1/2^3 = 1/8$.

135. **Question 135** -Option- (D) Zero
Explanation: The work done in moving a charge along any path in a conservative electrostatic field is zero.

136. **Question 136** -Option- (B) Intensity of bright fringe decreases and that of dark fringe increases.
Explanation: Reducing the intensity of one slit lowers the interference contrast, causing dark fringes to brighten and bright fringes to dim.

137. **Question 137** -Option- (A) soft ferromagnetic substance soft iron.
Explanation: Highly permeable soft iron channels external magnetic lines around the interior, shielding the instrument.

138. **Question 138** -Option- (B) 2 C
Explanation: Symmetrical reduction of the capacitive bridge network yields an equivalent capacitance of 2 C.

139. **Question 139** -Option- (D) $(4)^{1/3}W$
Explanation: Work scales with area: $W \propto A \propto V^{2/3}$. Thus, $W' = 2^{2/3}W = 4^{1/3}W$.

140. **Question 140** -Option- (B) Heating a room by heater
Explanation: Space heaters warm rooms primarily by setting up thermal convection currents in the air.

141. **Question 141** -Option- (B) $\frac{K(n+1)}{n}$
Explanation: Spring constant is inversely proportional to length. Since $l_1 = \frac{n}{n+1}l$, we get $K_1 = \frac{n+1}{n}K$.

142. **Question 142** -Option- (C) 3 : 4
Explanation: Equating overtones: $\frac{3v}{4L_c} = \frac{v}{L_o} \implies L_c/L_o = 3/4$.

143. **Question 143** -Option- (C) $40\pi\mu$ V
Explanation: Since $B = \mu_0 H = 4\pi \times 10^{-4}$ T, the induced emf is $e = Bvl = (4\pi \times 10^{-4}) \times 1 \times 0.1 = 40\pi\mu$ V.

144. **Question 144** -Option- (A) diffraction as well as photoelectric effect
Explanation: Wave nature is exhibited by diffraction, whereas particle nature is exhibited by the photoelectric effect.

145. **Question 145** -Option- (D) 20 kJ
Explanation: Efficiency $\eta = 1 - 300/500 = 0.4$. The work done by the engine is $W = \eta Q_1 = 0.4 \times 50$ kJ $= 20$ kJ.

146. **Question 146** -Option- (A) Decreases
Explanation: Doping introduces additional charge carriers, which significantly reduces the electrical resistivity.

147. **Question 147** -Option- (B) $\frac{u^2\cos^2\theta}{g}$
Explanation: At maximum height, velocity is $u\cos\theta$ and acts horizontally. Centripetal acceleration is $g \implies g = v^2/R \implies R = \frac{u^2\cos^2\theta}{g}$.

148. **Question 148** -Option- (B) 4λ
Explanation: Photoelectric equations yield a work function of $W_0 = 1.6$ eV, which gives a threshold wavelength of 4λ.

149. **Question 149** -Option- (C) $\sqrt{\frac{3g}{l}}$
Explanation: Conservation of energy gives $mg(l/2) = \frac{1}{2}I\omega^2 = \frac{1}{6}ml^2\omega^2 \implies \omega = \sqrt{\frac{3g}{l}}$.

150. **Question 150** -Option- (B) G/24
Explanation: Since $I_g = 0.04I$, the shunt resistance is $S = \frac{I_g}{I-I_g}G = \frac{0.04}{0.96}G = G/24$.