MHT CET 2023 Mathematics Answer Key PDF

Answer Key

Mathematics

Question 1 -Option- (C) 3
Explanation: Separating variables gives d (x / y) = d y x / y = y 2 d(x/y)=dyx/y=y2 . Solving for x = 3 x=3 with y > 0 y>0 yields y = 3 y=3 . code Code

Question 2 -Option- (B) π
Explanation: Simplifying gives $y = e^x \cos x$, whose derivative $m = e^x(\cos x - \sin x)$ reaches its minimum when $dm/dx = -2e^x \sin x = 0 \implies x = \pi$.

Question 3 -Option- (A) -2
Explanation: Setting the coplanarity determinant of the given vectors to zero directly yields $pqr - (p + q + r) = -2$.

Question 4 -Option- (D) $\cos^{-1}\left(\frac{25}{\sqrt{59}\sqrt{35}}\right)$
Explanation: The normal vectors to the faces are $\vec{n}_1 = (-1, -7, 3)$ and $\vec{n}_2 = (1, -5, -3)$, giving $\cos\theta = \frac{|\vec{n}_1 \cdot \vec{n}_2|}{|\vec{n}_1||\vec{n}_2|} = \frac{25}{\sqrt{59}\sqrt{35}}$.

Question 5 -Option- (A) 1/4
Explanation: Total outcomes are 36. Sums that are prime (2, 3, 5, 7, 13) occur in exactly 9 pairs, yielding a probability of $9/36 = 1/4$.

Question 6 -Option- (D) $-\infty < x < 1$
Explanation: For real values of y, $2^y = 2 - 2^x > 0 \implies 2^x < 2 \implies x < 1$.

Question 7 -Option- (D) -5
Explanation: Given unit orthogonal vectors $\vec{a}$ and $\vec{b}$, the expression reduces to $(2\vec{a} - \vec{b}) \cdot (\vec{b} - 2\vec{a}) = -|2\vec{a} - \vec{b}|^2 = -5$.

Question 8 -Option- (C) 1
Explanation: Taking the logarithm of y and differentiating with respect to x yields $y'(0) = 1(1 + 1 + 1 - 1 - 1) = 1$ at $x = 0$.

Question 9 -Option- (C) 11
Explanation: The ratio is given by ${}^{n-2}C_3 / {}^{n-2}C_5 = 2/3 \implies (n - 5)(n - 6) = 30$, which solves to $n = 11$.

Question 10 -Option- (D) $\log(2 + \sqrt{5})$
Explanation: Substituting $u = \log(t + \sqrt{1 + t^2})$ transforms the integral to $\int u du \implies g(t) = \log(t + \sqrt{1 + t^2})$. Evaluating at $t = 2$ gives the answer.

Question 11 -Option- (B) $\begin{bmatrix} \cos 2x & -\sin 2x \\ \sin 2x & \cos 2x \end{bmatrix}$
Explanation: Calculating the transpose and inverse matrices of A and multiplying them yields the standard rotation matrix.

Question 12 -Option- (C) $\sqrt{155}$
Explanation: Solving $\vec{r} \times \bar{a} = \bar{b}$ alongside $\bar{r} \cdot \bar{c} = 3$ gives $|\vec{r}|^2 = 155 \implies |\vec{r}| = \sqrt{155}$.

Question 13 -Option- (A) $3x^2 + 8xy - 3y^2 - 20x - 10y + 25 = 0$
Explanation: Finding the lines of slope 3 and $-1/3$ passing through $Q(2, 1)$ and multiplying their equations yields this combined equation.

Question 14 -Option- (A) $a = 3, b = -1$
Explanation: Using $a + b = 2$ and $\int_0^4 y dx = 8 \implies \frac{16}{3}a + 8b = 8$ yields the parameters.

Question 15 -Option- (C) 36
Explanation: The normal to the plane is $\vec{n} = (1, 1, 1)$, giving $x + y + z = 6$. The volume of the tetrahedron is $\frac{1}{6}(6 \times 6 \times 6) = 36$.

Question 16 -Option- (B) $(p \wedge r) \to p \vee r$
Explanation: Since q and r are false, the antecedent $p \wedge r$ is false, making the implication always true (a tautology).

Question 17 -Option- (B) $(\sim p \vee q) \wedge (p \vee \sim q)$
Explanation: Negating the contrapositive of $P \to Q$ yields $\sim Q \wedge P$, which translates directly to the expression in option (B).

Question 18 -Option- (B) 17/6
Explanation: Expanding $\tan(\tan^{-1}(3/4) + \tan^{-1}(2/3))$ using the addition formula yields 17/6.

Question 19 -Option- (D) $\frac{4n^2-1}{12}$
Explanation: The variance of the first N natural numbers is $\frac{N^2-1}{12}$. Substituting $N = 2n$ yields the answer.

Question 20 -Option- (A) $e^x \left(\frac{1}{(x-1)^2}\right) + c$
Explanation: Splitting the integrand into $\frac{1}{(x-1)^2} - \frac{2}{(x-1)^3}$ matches the standard form $e^x(f(x) + f'(x))$.

Question 21 -Option- (A) $3\pi/4$
Explanation: Expanding $\bar{a} \times (\bar{b} \times \bar{c})$ yields $(\bar{a} \cdot \bar{c})\bar{b} - (\bar{a} \cdot \bar{b})\bar{c} = \frac{1}{\sqrt{2}}\bar{b} + \frac{1}{\sqrt{2}}\bar{c}$, giving $\cos\theta = \bar{a} \cdot \bar{b} = -1/\sqrt{2}$.

Question 22 -Option- (A) $2\log|x + \sin(x/2)| + c$
Explanation: Substituting $u = x + \sin(x/2)$ simplifies the integral to $\int \frac{2du}{u} = 2\log|u| + c$.

Question 23 -Option- (B) 51/35
Explanation: Solving for sides yields $a = 7k, b = 6k, c = 5k$. Summing the cosines of the angles using the law of cosines gives 51/35.

Question 24 -Option- (B) 1
Explanation: Substituting $(1, 1)$ gives $a + b = -1$. Differentiating and setting the slope $y' = 2$ gives $a + 2b = -3 \implies 3a + b = 1$.

Question 25 -Option- (B) 0
Explanation: Equating the conjugate real and imaginary parts yields $x = y = -1/3$, making the fraction zero.

Question 26 -Option- (B) -1
Explanation: Expanding $(\tan^{-1} x)^2 + (\cot^{-1} x)^2 = \frac{5\pi^2}{8}$ yields $\tan^{-1} x = -\pi/4 \implies x = -1$.

Question 27 -Option- (B) $\log(x/y) = \frac{1}{xy} + k$
Explanation: Using the integrating factor $1/(2x^2y^2)$ simplifies the equation, yielding the solution in option (B).

Question 28 -Option- (B) $3^{7/6} - 3^{5/6}$
Explanation: Substituting $t = \tan x$ simplifies the integral to $\int_{3^{-1/2}}^{3^{1/2}} t^{-4/3} dt$, which evaluates to option (B).

Question 29 -Option- (C) 3
Explanation: Multiplying by the conjugate of the numerator and applying standard limits yields the value 3.

Question 30 -Option- (B) $(2,0),\ (-2,0)$
Explanation: Equating the derivative $y' = 1 + 4/x^2$ to the chord slope 2 yields $x = \pm 2$, corresponding to these points.

Question 31 -Option- (B) -2
Explanation: Differentiating $f(x)$ successively yields parameters $A = -5$, $B = 2$, and $C = 6$, giving $f(2) = -2$.

Question 32 -Option- (A) $\frac{m_0}{h} \log 2$
Explanation: The initial decay rate of the sample is given by λm_0, where the decay constant is $\lambda = \frac{\log 2}{h}$.

Question 33 -Option- (D) $x^2 + y^2 + 2ax + 2py - (b^2 + q^2) = 0$
Explanation: The circle with diameter AB is given by $(x - x_1)(x - x_2) + (y - y_1)(y - y_2) = 0$. Substituting roots simplifies to option (D).

Question 34 -Option- (A) $\left(-\frac{3}{2}, \frac{1}{2}, 1\right)$
Explanation: Side lengths are $a = 2, b = 3, c = 3$. Using the incentre coordinates formula gives $(-3/2, 1/2, 1)$.

Question 35 -Option- (C) $\cos^{-1}\left(\frac{7}{5\sqrt{10}}\right)$
Explanation: The angle between direction vectors $(-1, 0, 2)$ and $(3, 4, 5)$ is found using the dot product formula.

Question 36 -Option- (C) 0.83
Explanation: $E \cup F = \{1, 2, 3, 4, 5, 7\}$. Summing the probabilities of these outcomes yields 0.83.

Question 37 -Option- (D) 105
Explanation: Evaluating the objective function $z = 10x + 25y$ at the corner points of the feasible region yields a maximum of 105.

Question 38 -Option- (A) $(3, 5, 9)$
Explanation: Projecting $(1, 2, 3)$ onto the line and finding the orthogonality condition yields $\lambda = -1$, giving the coordinates.

Question 39 -Option- (C) $\frac{1}{16\pi}$ cm/sec
Explanation: Utilizing the volume of a spherical cap $V = \pi h^2(R - h/3)$, differentiating at $h = 120$ cm yields the rate.

Question 40 -Option- (B) $\pi/6, \pi/3$
Explanation: Factoring gives $\sin 3x(2\cos 2x - 1) = 0$, which yields the solutions in the interval $(0, \pi/2)$.

Question 41 -Option- (B) $-x$
Explanation: Substituting algebraic parameters and resolving the trigonometric forms yields $\sin 4x = -x$.

Question 42 -Option- (D) 0.2
Explanation: Mean plus variance is $5p + 5pq = 5p(2 - p) = 1.8 \implies 25p^2 - 50p + 9 = 0 \implies p = 0.2$.

Question 43 -Option- (C) $\frac{1}{2} \log \left|\frac{e^{2x} - e^x + 1}{e^{2x} + e^x + 1}\right| + C$
Explanation: Substituting $t = e^x$ and simplifying the difference $J - I$ leads to the integration of $\frac{1 - 1/t^2}{t^2 + 1 + 1/t^2}$.

Question 44 -Option- (A) $\pi/4$
Explanation: The principal value is given by $\sin^{-1}(\sin(3\pi/4)) = \sin^{-1}(\sin(\pi/4)) = \pi/4$.

Question 45 -Option- (B) $-1/2$
Explanation: Differentiating $\tan(y/2) = \sqrt{\frac{1-t}{1+t}}$ and evaluating at $t = 1/2$ gives $-1/2$.

Question 46 -Option- (B) $F(x) = 4x^3 - 3x^4$
Explanation: Integrating the p.d.f. $f(x) = 12x^2 - 12x^3$ on the interval $[0, x]$ yields the cumulative distribution function.

Question 47 -Option- (B) -10
Explanation: Continuity at $x = 0$ yields $a = 4$, and at $x = 1$ yields $b = -6$. Thus, $2a + 3b = -10$.

Question 48 -Option- (C) $-7/2, -7/9$
Explanation: The line parallel to the median PS is $2x + 9y + 7 = 0$, whose axes intercepts are $-7/2$ and $-7/9$.

Question 49 -Option- (C) $11, -6$
Explanation: Applying $f(1) = f(3)$ and setting $f'(2 + 1/\sqrt{3}) = 0$ yields the values of a and b respectively.

Question 50 -Option- (C) 13 units
Explanation: The line and plane intersect at $P(5, 3, 14)$. The distance of $(1, 6, 2)$ from this point is 13 units.

Chemistry

Question 51 -Option- (D) 3.34
Explanation: The pH value is calculated as $\log\ 10\ [\ H\ +\ ]\ =\ \log\ 10\ (\ 4.62\ \times\ 10\ \ 4\ )\ =\ 3.34$ $\log\ 10\ \ [H\ +\ ]{=}\log\ 10\ \ (4.62{\times}10\ 4\ ){=}3.34$. code Code

Question 52 -Option- (B) But-2-en-2-ol
Explanation: In vinylic alcohols, the hydroxyl group is directly bonded to a sp^2 hybridized carbon of a double bond.

Question 53 -Option- (A) $C_6H_5 - CH_2 - X$
Explanation: In benzylic halides, the halogen atom is attached to a sp^3 hybridized carbon adjacent to an aromatic ring.

Question 54 -Option- (C) Benzophenone
Explanation: Symmetrical (simple) ketones have identical alkyl or aryl groups attached on either side of the carbonyl group.

Question 55 -Option- (D) $\alpha - 1, 4$
Explanation: Maltose is a disaccharide consisting of two α-D-glucose units joined by an α-1,4-glycosidic linkage.

Question 56 -Option- (C) Nano-sized Cu and Pd clusters have very less hardness than bulk metal.
Explanation: This statement is incorrect because nanomaterials generally exhibit significantly higher hardness and strength than their bulk counterparts.

Question 57 -Option- (B) $H_2N(CH_2)_2NH_2$
Explanation: Ethylenediamine is a didentate (bidentate) ligand containing two nitrogen donor atoms.

Question 58 -Option- (A) Zero kJ
Explanation: For the free and isothermal expansion of an ideal gas, both the internal energy change and enthalpy change are zero.

Question 59 -Option- (B) 2-iodo-4,5-dimethylhept-3-ene
Explanation: Applying IUPAC nomenclature rules for numbering and naming substituents yields this name.

Question 60 -Option- (C) C_5H_{12}
Explanation: Pentane (C_5H_{12}) is the smallest alkane that exhibits exactly three structural isomers.

Question 61 -Option- (D) 2.5
Explanation: N_2^+ has 13 electrons, and its molecular orbital configuration yields a bond order of 2.5.

Question 62 -Option- (B) Sr
Explanation: Strontium (Sr) belongs to Group 2 of the periodic table, making it an alkaline earth metal.

Question 63 -Option- (C) 2.6 m
Explanation: Using $\Delta T_b = K_b \cdot m$, the molality of the solution is calculated as $m = 7.15/2.75 = 2.6$ m.

Question 64 -Option- (D) It's unit is independent of order of reaction.
Explanation: This statement is incorrect because the unit of the rate constant depends on the overall order of the reaction.

Question 65 -Option- (D) $CH_3CH_2NH_2$
Explanation: Nucleophilic substitution yields CH_3CN (A), which undergoes reduction with sodium and ethanol to give ethylamine (B).

Question 66 -Option- (B) 194.85 pm
Explanation: For a bcc unit cell, the atomic radius is $r = \frac{\sqrt{3}}{4}a$. For $a = 450$ pm, $r = 194.85$ pm.

Question 67 -Option- (D) IUPAC name of this compound is 2-hydroxypentane-3-one.
Explanation: Applying functional group priority rules, the carbonyl group has higher priority, making this the correct IUPAC name.

Question 68 -Option- (A) $CuCl_2$
Explanation: Copper(II) chloride is a salt of a weak base and a strong acid, which undergoes hydrolysis to form an acidic solution.

Question 69 -Option- (A) Boiling point and heat capacity
Explanation: Boiling point is an intensive property (independent of mass), whereas heat capacity is an extensive property (dependent on mass).

Question 70 -Option- (B) Fluoromethane
Explanation: Fluoromethane has the lowest molecular mass and weakest van der Waals forces, giving it the lowest boiling point.

Question 71 -Option- (D) The crystal shape of polymorphic substances is identical to each other.
Explanation: This is incorrect because polymorphs are defined by having different crystal structures and shapes.

Question 72 -Option- (A) $2\lambda^0_{A+++} + 3\lambda^0_{B--}$
Explanation: By Kohlrausch's law, the molar conductivity of an A_2B_3 electrolyte is the sum of its individual ionic conductivities.

Question 73 -Option- (A) Radio waves
Explanation: Radio waves have the longest wavelength and lowest frequency, and thus possess the lowest energy.

Question 74 -Option- (B) Low density polythene
Explanation: Low density polythene (LDPE) is synthesized under high pressure, resulting in highly branched polymer chains.

Question 75 -Option- (B) Rate increases by factor 4
Explanation: Since the reaction is first-order with respect to both reactants, doubling both concentrations increases the rate by $2 \times 2 = 4$.

Question 76 -Option- (A) 4.8 mol^{-2} dm^6 s^{-1}
Explanation: Substituting the rates and concentrations gives $0.24 = k(0.5)^2(0.2) \implies k = 4.8$.

Question 77 -Option- (A) 121.3 Ω^{-1} cm^2 mol^{-1}
Explanation: Molar conductivity $\Lambda_m = \frac{1000\kappa}{M} = \frac{1000 \times 6.065 \times 10^{-4}}{0.005} = 121.3$.

Question 78 -Option- (D) Raffinose
Explanation: Raffinose is a trisaccharide, whereas sucrose, maltose, and lactose are disaccharides.

Question 79 -Option- (B) Ne > Ar > Cl > S
Explanation: Noble gases have extremely stable closed-shell configurations, resulting in the highest ionization enthalpies.

Question 80 -Option- (D) Na_2SO_4
Explanation: The dissolution of sodium sulfatedecahydrate above 32.4°C is exothermic, showing an inverse solubility-temperature relation.

Question 81 -Option- (A) Zn > Fe > Cr > Sc
Explanation: First ionization enthalpy values generally increase across the 3d transition series due to increasing nuclear charge.

Question 82 -Option- (A) Methane and water
Explanation: Methanation of carbon monoxide ($CO + 3H_2 \rightarrow CH_4 + H_2O$) occurs when synthesis gas is heated with a nickel catalyst.

Question 83 -Option- (A) 0.637 V
Explanation: The standard cell potential is $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = -0.126 - (-0.763) = 0.637$ V.

Question 84 -Option- (C) O
Explanation: Oxygen is a highly electronegative non-metal and exhibits a strong tendency to gain electrons (undergo reduction).

Question 85 -Option- (B) 4.8 g
Explanation: Moles of $H_2 = 4.48/22.4 = 0.2$ mol. This requires 0.2 mol of Mg, equivalent to $0.2 \times 24 = 4.8$ g.

Question 86 -Option- (C) 0.45 and 0.55
Explanation: Total pressure is 10 bar. Mole fraction of A is $4.5/10 = 0.45$, and that of B is $5.5/10 = 0.55$.

Question 87 -Option- (C) Benzaldehyde
Explanation: The chromyl chloride oxidation of toluene in CS_2 followed by acid hydrolysis (Etard reaction) yields benzaldehyde.

Question 88 -Option- (C) Propan-2-ol
Explanation: The addition of a Grignard reagent to formaldehyde (methanal) always yields a primary alcohol.

Question 89 -Option- (B) 10
Explanation: Each d-block transition series contains exactly 10 elements, corresponding to the filling of the d-subshell.

Question 90 -Option- (C) C
Explanation: The Wolff-Kishner reduction involves heating a carbonyl compound with hydrazine and a strong base.

Question 91 -Option- (A) 15354.8 cm^{-1}
Explanation: The wave number is calculated using the Rydberg formula: $\bar{\nu} = 109677 \times (1/2^2 - 1/3^2) \approx 15354.8$ cm^{-1}.

Question 92 -Option- (B) 4.5×10^{-2} M
Explanation: Using $K_a = c\alpha^2$, the concentration is $c = \frac{1.8 \times 10^{-5}}{(0.02)^2} = 4.5 \times 10^{-2}$ M.

Question 93 -Option- (B) -90 J
Explanation: Work done $w = -P\Delta V = -10^5 \times 3 \times 10^{-3} = -300$ J. Then, $\Delta U = q + w = 210 - 300 = -90$ J.

Question 94 -Option- (B) C_7H_9N
Explanation: para-Toluidine is an aromatic amine with the formula $CH_3 - C_6H_4 - NH_2$, giving C_7H_9N.

Question 95 -Option- (C) 3.00
Explanation: From $\Delta T_f = i \cdot K_f \cdot m$, the van't Hoff factor is $i = \frac{0.056}{1.86 \times 0.01} = 3.00$.

Question 96 -Option- (A) At
Explanation: Astatine (At) is a halogen (Group 17), whereas oxygen, sulfur, selenium, tellurium, and polonium are chalcogens.

Question 97 -Option- (D) 2-ethyl-5-methylcyclopentanol
Explanation: Applying IUPAC numbering starting from the hydroxyl group gives this systematic name.

Question 98 -Option- (C) Phenol and formaldehyde
Explanation: Novolac is a linear condensation polymer synthesized from phenol and formaldehyde monomers under acidic conditions.

Question 99 -Option- (A) 6.00×10^{-21} cm^3
Explanation: The volume is $V = \frac{z \cdot M}{\rho \cdot N_A}$. Substituting $z = 4$ (for fcc) and the given values yields 6.00×10^{-21} cm^3.

Question 100 -Option- (A) $[Co(NH_3)_6]^{3+}$
Explanation: Homoleptic complexes contain only one type of ligand coordinated to the central metal atom.

Physics

Question 101 -Option- (D) 16 : 1
Explanation: Since T M molar TM molar
under equal P , V , m P,V,m conditions, the temperature ratio is M (O 2) / M (H 2) = 16 : 1 M(O 2)/M(H 2)=16:1 . code Code

Question 102 -Option- (D) mx/ny
Explanation: Acceleration due to gravity is $g \propto R\rho$. Hence, the ratio is $(R_1/R_2) \cdot (\rho_1/\rho_2) = mx/ny$.

Question 103 -Option- (B) $\sqrt{\frac{\lambda R}{\lambda R - 1}}$
Explanation: Using $1/\lambda = R(1 - 1/n^2)$ and rearranging for the quantum number n yields the expression in option (B).

Question 104 -Option- (C) $2t$
Explanation: The time to empty the vessel scales as $\sqrt{h}$. If height is increased by 4 times, the time is doubled.

Question 105 -Option- (D) 0.08 V
Explanation: The potential difference per turn is identical in both coils: $V/N = 80/1000 = 0.08$ V.

Question 106 -Option- (D) $X/8$
Explanation: The ratio is $B/M = \frac{\mu_0}{2\pi R^3} \propto 1/R^3$. Doubling the radius decreases this ratio to $X/8$.

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.

Question 108 -Option- (D) 480 Hz, 485 Hz
Explanation: Frequency $n \propto 1/l \implies 0.97n_1 = 0.96(n_1 + 5) \implies n_1 = 480$ Hz.

Question 109 -Option- (D) $W/4$
Explanation: $W_{180} = 2pE = W \implies pE = W/2$. The work done for 60° is $W_{60} = pE(1 - \cos 60°) = pE/2 = W/4$.

Question 110 -Option- (C) 1×10^{-34} J · s
Explanation: The change is $\Delta L = \frac{5h}{2\pi} - \frac{4h}{2\pi} = \frac{h}{2\pi} \approx 1.05 \times 10^{-34}$ J · s.

Question 111 -Option- (C) $(\bar{A} \cdot B) + (A \cdot \bar{B})$
Explanation: The logical gates in the diagram combine to form an XOR configuration.

Question 112 -Option- (D) $T = \sqrt{T_1^2 + T_2^2}$
Explanation: Since the restoring forces add up, the equivalent time period of oscillation is $T = \sqrt{T_1^2 + T_2^2}$.

Question 113 -Option- (B) totally kinetic
Explanation: For a monoatomic ideal gas, intermolecular potential energy is zero, so its internal energy is purely kinetic.

Question 114 -Option- (B) $2p_0$
Explanation: Pressure $P \propto mv^2$. Halving the mass and doubling the velocity increases the pressure by a factor of 2.

Question 115 -Option- (B) $\frac{2\pi a}{5}$
Explanation: Max particle velocity $v_p = 2\pi na$ and wave velocity $v = 5n$, giving a ratio of $\frac{2\pi a}{5}$.

Question 116 -Option- (B) There is exchange of heat with surrounding
Explanation: In an adiabatic process, the system is thermally insulated, so no heat exchange with the surroundings occurs.

Question 117 -Option- (C) $2g/3$
Explanation: Acceleration due to gravity at depth is $g' = g(1 - d/R)$. For $d = R/3$, $g' = 2g/3$.

Question 118 -Option- (C) 0.2 V/m
Explanation: Total resistance is 30 Ω $\implies$ $I = 0.1$ A. Potential gradient $= \frac{I \cdot R_{\text{wire}}}{L} = \frac{2}{10} = 0.2$ V/m.

Question 119 -Option- (A) 10 A
Explanation: Using the power relations and root-mean-square values yields an rms current of 10 A.

Question 120 -Option- (A) 1/4
Explanation: Under resonance, $X_L = X_C$. Doubling the frequency doubles X_L and halves X_C, so the ratio becomes 1/4.

Question 121 -Option- (D) $\frac{BR^2\omega}{2}$
Explanation: The induced electromotive force in a rotating metal disc in a perpendicular magnetic field is $e = \frac{1}{2}BR^2\omega$.

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 of the combined mass is $T = 2\pi\sqrt{\frac{M+M_1}{k}}$.

Question 123 -Option- (D) 6th bright band
Explanation: Path difference is 3000 nm. Since $\Delta = n\lambda \implies 3000 = n(500) \implies n = 6$ (6th bright band).

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

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

Question 126 -Option- (D) 3.2 m
Explanation: Solving the equations of motion for the ball dropped into the viscous fluid gives a fluid height of approximately 3.2 m.

Question 127 -Option- (C) d/2
Explanation: Since $C \propto K/d$, we have $C_2 = 16C_1 \implies 8/d' = 16/d \implies d' = d/2$.

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

Question 129 -Option- (D) $2f,\ P/2$
Explanation: Making one surface flat reduces the power of the lens to half ($P' = P/2$), thereby doubling the focal length ($f' = 2f$).

Question 130 -Option- (B) 24 N
Explanation: Mass $m = 49/9.8 = 5$ kg. The reading of the descending accelerating balance is $m(g - a) = 5(9.8 - 5) = 24$ N.

Question 131 -Option- (B) $\frac{E_0^2}{4R}$
Explanation: For $X_L = R$, the power is $P = V_{rms}I_{rms}\cos\phi = \frac{E_0}{\sqrt{2}}\frac{E_0}{Z\sqrt{2}}\frac{R}{Z} = \frac{E_0^2}{4R}$.

Question 132 -Option- (C) $I_A = I_D > I_B = I_C$
Explanation: By symmetry of placement and the perpendicular axis theorem, the moments of inertia follow this inequality.

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

Question 134 -Option- (B) 1 : 8
Explanation: Magnetic field on the axis is $B_A = \frac{\mu_0 IR^2}{2(R^2+x^2)^{3/2}}$. At $x = \sqrt{3}R$, this simplifies to $B_A = B_C/8$.

Question 135 -Option- (D) Zero
Explanation: The work done in moving a charge along any path within a conservative electrostatic field depends only on endpoints.

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

Question 137 -Option- (A) soft ferromagnetic substance soft iron.
Explanation: Soft iron has high magnetic permeability, which channels and diverts external magnetic field lines around the shielded region.

Question 138 -Option- (B) 2 C
Explanation: The equivalent capacitance of the network is calculated to be 2 C.

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

Question 140 -Option- (B) Heating a room by heater
Explanation: Heating a room involves the circulation of warm air currents, which is a process of convection.

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 $K_1 = \frac{n+1}{n}K$.

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

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.

Question 144 -Option- (A) diffraction as well as photoelectric effect
Explanation: Diffraction exhibits the wave nature of light, while the photoelectric effect demonstrates its particle nature.

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.

Question 146 -Option- (A) Decreases
Explanation: Doping introduces additional free charge carriers (electrons or holes), significantly reducing electrical resistivity.

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

Question 148 -Option- (B) 4λ
Explanation: Solving Einstein's equation for the two wavelengths gives $W_0 = 1.6$ eV, yielding a threshold wavelength of 4λ.

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

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