MHT CET 2020 Mathematics Answer Key PDF

Question 1 Option: (D) – 2
Explanation: The moment of inertia of a ring is $I = MR^2$. Since mass per unit length λ is constant, mass $M = \lambda(2\pi R) \propto R$. This gives $I \propto R^3$, hence $I_1/I_2 = (R/nR)^3 = 1/n^3 = 1/8$, which yields $n = 2$.

Question 2 Option: (A) – 4/3
Explanation: Elongation is $\Delta L = \frac{FL}{AY}$. Since mass $m = \rho AL \implies A = m/(\rho L)$, we have $\Delta L = \frac{FL^2\rho}{mY}$. For identical length, force, and material, $\Delta L \propto 1/m$, so the ratio is 4/3.

Question 3 Option: (B) – $\frac{n_1 n_2}{n_1+n_2}$
Explanation: For open organ pipes joined in series, the total length is $L = L_1 + L_2$. Since fundamental frequency is $n = v/2L \implies L = v/2n$, substituting this gives $1/n = 1/n_1 + 1/n_2 \implies n = \frac{n_1 n_2}{n_1+n_2}$.

Question 4 Option: (B) – no force.
Explanation: The magnetic field along the axis of a circular current loop is parallel to the axis. An electron projected along this axis moves parallel to the magnetic field, experiencing zero magnetic force since $\vec{F} = q(\vec{v} \times \vec{B}) = 0$.

Question 5 Option: (A) – AND
Explanation: By definition, the output of an AND logic gate is high (logic 1) if and only if all of its inputs are high.

Question 6 Option: (D) – r^2/R
Explanation: The magnetic field at the center of the outer coil is $B = \mu_0 I/2R$. The flux through the inner coil is $\phi = BA = (\mu_0 I/2R)\pi r^2$, giving mutual inductance $M = \phi/I \propto r^2/R$.

Question 7 Option: (C) – $xyz = 1$
Explanation: The given refractive indices satisfy ${}_a\mu_w \cdot {}_w\mu_g \cdot {}_g\mu_a = 1$. Substituting the variables x, y, and z yields the relation $xyz = 1$.

Question 8 Option: (D) – go on decreasing.
Explanation: The magnetic field of a short bar magnet is maximum at the axial point and decreases to half its value at the equatorial point along a circular path of the same radius.

Question 9 Option: (B) – 3
Explanation: Equal centripetal forces mean $\frac{3mv_h^2}{r/n} = \frac{mv_l^2}{r}$. Given $v_l = nv_h$, substitution leads to $3n = n^2 \implies n = 3$.

Question 10 Option: (C) – 400Ω
Explanation: Standard range conversion gives $V = I_g(G+2000)$ and $3V = I_g(G+2000+4400)$. Solving $3(G + 2000) = G + 6400$ yields $2G = 400 \implies G = 400\Omega$.

Question 11 Option: (B) – 4/7 s
Explanation: From $x = 0.25\sin(11t + 0.5)$, the angular frequency is $\omega = 11$ rad/s. The time period of the SHM is $T = 2\pi/\omega = 2(22/7)/11 = 4/7$ s.

Question 12 Option: (D) – $[L^0M^0T^1]$
Explanation: The ratio of inductance L to resistance R represents the inductive time constant of an LR circuit, which has the dimension of time.

Question 13 Option: (A) – $8\pi^2/3$
Explanation: $I_{\text{rod}} = ML^2/3$. When bent into a ring of radius R, $2\pi R = L \implies R = L/2\pi$. The moment of inertia of the ring about its diameter is $I_1 = \frac{1}{2}MR^2 = \frac{ML^2}{8\pi^2}$. The ratio I/I_1 is $8\pi^2/3$.

Question 14 Option: (B) – 7 : 5 : 2
Explanation: For a rigid diatomic gas, the molar heat capacities are $C_p = \frac{7}{2}R$ and $C_v = \frac{5}{2}R$. Thus, $\Delta Q : \Delta U : \Delta W = C_p : C_v : R = 7 : 5 : 2$.

Question 15 Option: (D) – 3/22
Explanation: By analysis of the charge distribution in the specific capacitor bridge network, the ratio of the charges on C_2 and C_1 simplifies to 3/22.

Question 16 Option: (B) – (A) (Linear with positive intercept)
Explanation: Einstein's photoelectric equation is $K.E. = h\nu - \phi$. A plot of K.E. vs frequency is a straight line with a positive threshold frequency intercept on the frequency axis.

Question 17 Option: (D) – $F^2t^2/2m$
Explanation: Under a constant force F, momentum after time t is $p = Ft$. The kinetic energy of the body is given by $K.E. = p^2/2m = F^2t^2/2m$.

Question 18 Option: (B) – 5 A
Explanation: Since the two batteries oppose each other, the net electromotive force is $E_{\text{net}} = 200\text{V} - 10\text{V} = 190\text{V}$. The current is $I = E_{\text{net}}/R = 190/38 = 5$ A.

Question 19 Option: (C) – 1 : 10
Explanation: Volume conservation yields $R = 10r$. The initial surface energy is $E_i = 1000 \times 4\pi r^2 T$ and the final is $E_f = 4\pi R^2 T = 100 \times 4\pi r^2 T$, giving a ratio of 1 : 10.

Question 20 Option: (A) – $\sqrt{2}$
Explanation: The RMS velocity is proportional to the square root of the absolute temperature. Thus, $C_2/C_1 = \sqrt{T_2/T_1} = \sqrt{600/300} = \sqrt{2}$.

Question 21 Option: (D) – real and virtual.
Explanation: In spherical mirrors, images formed on the same side of the mirror as the object are real, whereas images formed on the opposite side are virtual.

Question 22 Option: (B) – area.
Explanation: From Cauchy's formula $\mu = A + B/\lambda^2$, since refractive index μ is dimensionless, the dimension of B must equal the dimension of λ^2, which represents area.

Question 23 Option: (D) – 3 : 1
Explanation: By potentiometer principles, $E_1 + E_2 \propto 64$ and $E_1 - E_2 \propto 32$. Taking the ratio gives $\frac{E_1+E_2}{E_1-E_2} = 2 \implies E_1 = 3E_2$, so $E_1/E_2 = 3/1$.

Question 24 Option: (A) – λ^{-2}
Explanation: The power radiated from a linear antenna of length l is proportional to $(l/\lambda)^2$, which is proportional to λ^{-2}.

Question 25 Option: (D) – 1 : 8
Explanation: Excess pressure is $\Delta P = 4T/R$. Given $\Delta P_1 = 2\Delta P_2 \implies R_2 = 2R_1$. Since volume is proportional to R^3, the ratio $V_1/V_2 = (1/2)^3 = 1/8$.

Question 26 Option: (B) – 6.3×10^{-4} m
Explanation: The fringe width in water is given by $\beta = \frac{\lambda D}{\mu d}$. Substituting the values yields $\beta = \frac{6300 \times 10^{-10} \times 1.33}{1.33 \times 10^{-3}} = 6.3 \times 10^{-4}$ m.

Question 27 Option: (A) – $\cos^{-1}(-7/8)$
Explanation: Using the law of vector addition, $(R/2)^2 = R^2 + R^2 + 2R^2\cos\theta \implies R^2/4 = 2R^2(1 + \cos\theta)$, which simplifies to $\cos\theta = -7/8$.

Question 28 Option: (A) – 1 : 3
Explanation: Equating the frequencies: $2(v_1/2L_1) = 3(v_2/2L_2)$. Since $v \propto 1/r$ and $r_1 = 2r_2 \implies v_2 = 2v_1$, solving the relation yields $L_1/L_2 = 1/3$.

Question 29 Option: (D) – decreases.
Explanation: The resistance of a galvanometer coil is directly proportional to the length of the wire used, which decreases when the number of turns is reduced.

Question 30 Option: (B) – 1 : 2
Explanation: For a uniform rod of length L, the radius of gyration about the center is $k_1 = L/\sqrt{12}$ and about the end is $k_2 = L/\sqrt{3}$. The ratio is $k_1/k_2 = 1/2$.

Question 31 Option: (A) – 0.616 cm^{-1}
Explanation: Cell constant is given by the formula G^* = conductivity $\times R$. Substituting the given values: $0.0112 \times 55.0 = 0.616$ cm^{-1}.

Question 32 Option: (B) – $[Co(NH_3)_4Cl_2]Cl$
Explanation: This complex contains two different ligands (heteroleptic) and dissociates to form a complex cation $[Co(NH_3)_4Cl_2]^+$ (cationic).

Question 33 Option: (D) – 273.15°C
Explanation: According to Charles's Law, $V_1/T_1 = V_2/T_2$. To double the volume from $T_1 = 273.15$ K, we require $T_2 = 546.3$ K, which is 273.15°C.

Question 34 Option: (B) – $sp^3 - s$
Explanation: In water, the oxygen atom undergoes sp^3 hybridization. The O-H covalent bonds are formed by the overlap of sp^3 hybrid orbitals of oxygen and the $1s$ orbital of hydrogen.

Question 35 Option: (A) – phenelzine
Explanation: Phenelzine is a well-known monoamine oxidase inhibitor (MAOI) used clinically as an antidepressant acting on the central nervous system.

Question 36 Option: (A) – 60 % conc. H_2SO_4 and 373 K
Explanation: Dehydration of secondary alcohols like butan-2-ol requires moderately concentrated acid (about 60% H_2SO_4) at a temperature of 373 K.

Question 37 Option: (C) – Ce > Pm > Sm > Gd
Explanation: Due to lanthanoid contraction, there is a steady decrease in ionic radii across the lanthanoid series from Cerium to Gadolinium.

Question 38 Option: (C) – Hydroxylamine
Explanation: Glucose reacts with hydroxylamine (NH_2OH) to form glucose oxime (glucoxime), confirming the presence of a carbonyl group.

Question 39 Option: (D) – 1.0
Explanation: Isopropyl bromide is a secondary alkyl halide, which acts as the reference substrate with a relative rate set to 1.0 in standard S_N1 kinetics comparison tables.

Question 40 Option: (C) – 4-Methylpent-3-en-2-one
Explanation: Mesityl oxide has the structure $(CH_3)_2C = CHCOCH_3$, whose systematic IUPAC name is 4-methylpent-3-en-2-one.

Question 41 Option: (A) – Sodium meta aluminate
Explanation: Leaching of bauxite ore with hot concentrated sodium hydroxide solution yields soluble sodium meta aluminate.

Question 42 Option: (C) – Uuh
Explanation: The systematic IUPAC name for element 116 is Ununhexium, which is represented by the three-letter chemical symbol Uuh.

Question 43 Option: (B) – n-butylamine
Explanation: Among isomeric amines, primary amines (like n-butylamine) form stronger intermolecular hydrogen bonds than secondary and tertiary amines, leading to a higher boiling point.

Question 44 Option: (C) – sp^3
Explanation: A tetrahedral geometry around a central atom is obtained when the atom undergoes sp^3 hybridization, providing four equivalent hybrid orbitals.

Question 45 Option: (D) – Ethanamine
Explanation: Ethane undergoes nitration to form nitroethane (A). Reduction of nitroethane using lithium aluminium hydride ($LiAlH_4$) yields ethanamine (B).

Question 46 Option: (C) – 261.0
Explanation: The molar conductivity is $\Lambda_m = \lambda(Ca^{2+}) + 2\lambda(Cl^-)$. Substituting the values: $119 + 2(71) = 261.0$.

Question 47 Option: (A) – 151.98 pm
Explanation: For a body-centered cubic (BCC) lattice, the atomic radius is $r = \frac{\sqrt{3}}{4}a$. Substituting $a = 351$ pm gives $r \approx 151.98$ pm.

Question 48 Option: (A) – Melamine
Explanation: Melamine-formaldehyde polymer is highly durable and heat-resistant, making it suitable for manufacturing shatterproof dinnerware and crockeries.

Question 49 Option: (C) – m-Nitrobenzoic acid
Explanation: The carboxylic acid group ($-COOH$) is strongly deactivating and meta-directing, so nitration of benzoic acid selectively produces m-nitrobenzoic acid.

Question 50 Option: (C) – Serine
Explanation: Serine is a polar, uncharged amino acid characterized by a hydroxymethyl group ($-CH_2OH$) as its side chain (R).

Question 51 Option: (D) – 5.4×10^{-3}
Explanation: From stoichiometry, $-\frac{1}{4}\frac{d[NH_3]}{dt} = \frac{1}{6}\frac{d[H_2O]}{dt}$. Thus, the rate of water formation is $\frac{6}{4}(3.6 \times 10^{-3}) = 5.4 \times 10^{-3}$.

Question 52 Option: (C) – 24.6 atm
Explanation: Osmotic pressure is $\pi = CRT$. Substituting the values $C = 1$ M, $R = 0.082$ L atm/(mol K), and $T = 300$ K gives $\pi = 24.6$ atm.

Question 53 Option: (A) – +3
Explanation: In the complex $K_3[Cr(C_2O_4)_3]$, potassium has +1 and oxalate has −2. Therefore, $3(+1) + x + 3(-2) = 0 \implies x = +3$.

Question 54 Option: (C) – Catechol
Explanation: Catechol is benzene-1,2-diol, containing two phenolic hydroxyl groups on adjacent carbon atoms, making it a dihydric phenol.

Question 55 Option: (D) – F
Explanation: Fluorine does not possess vacant d-orbitals in its valence shell, preventing it from expanding its octet to form polyhalide ions like F_3^-.

Question 56 Option: (B) – 1 sq. units
Explanation: The area is $\int_1^e \ln x\, dx = [x \ln x - x]_1^e = (e - e) - (0 - 1) = 1$ sq. units.

Question 57 Option: (D) – 30°
Explanation: Using the angle formula $\tan\theta = \frac{2\sqrt{h^2 - ab}}{a+b}$, we get $\tan\theta = \frac{2\sqrt{12-9}}{6} = \frac{1}{\sqrt{3}} \implies \theta = 30°$.

Question 58 Option: (C) – $(14)3^{n-1}$
Explanation: The n-th term is $t_n = s_n - s_{n-1} = 7(3^n - 1) - 7(3^{n-1} - 1) = 7 \cdot 3^{n-1}(3 - 1) = 14 \cdot 3^{n-1}$.

Question 59 Option: (C) – 1/2
Explanation: Since $F(x) = \sqrt{x}/2$, the probability $P[X > 1] = 1 - F(1) = 1 - 1/2 = 1/2$.

Question 60 Option: (A) – $\log_e e$
Explanation: Let $u = x^x \implies du = x^x(1+\ln x)dx$. The integral evaluates to $x^x + c$, matching $k = 1 = \log_e e$.

Question 61 Option: (C) – 27 units
Explanation: $v = 3t^2 - 12t + 9$ and $a = 6t - 12$. Acceleration is zero at $t = 2$. At $t = 2$, displacement is $s = 8 - 24 + 18 + 25 = 27$ units.

Question 62 Option: (A) – 8.64 years
Explanation: Integrating $dP/dt = 0.08P$ yields $t = \frac{\ln 2}{0.08}$. Substituting $\ln 2 \approx 0.6912$ gives $t = 8.64$ years.

Question 63 Option: (D) – an odd function
Explanation: Finding $f(f(x))$ yields the identity function $y = x$, which is a classic example of an odd function.

Question 64 Option: (D) – -1/6
Explanation: The integral evaluates to $[\frac{5}{3}x^3 - \frac{3}{2}x^2 + kx]_0^1 = \frac{1}{6} + k = 0 \implies k = -1/6$.

Question 65 Option: (B) – $2\sqrt{x}e^x + c$
Explanation: This is of the form $\int e^x(f(x) + f'(x))dx$ where $f(x) = 2\sqrt{x}$ and $f'(x) = 1/\sqrt{x}$, yielding $2\sqrt{x}e^x + c$.

Question 66 Option: (A) – $-\sqrt{2}\cos x$
Explanation: Applying trigonometric expansion formulas: $\cos(3\pi/4 + x) - \sin(\pi/4 - x) = -\sqrt{2}\cos x$.

Question 67 Option: (B) – 0
Explanation: The integrand $\frac{2x}{1+\cos^2 x}$ is an odd function, and the integral over a symmetric interval $[-\pi, \pi]$ is zero.

Question 68 Option: (B) – $[2, 4)$
Explanation: The quadratic in $[x]$ gives $[x] = 2$ or $[x] = 3$. This corresponds to the interval $x \in [2, 4)$.

Question 69 Option: (A) – $x^4(y')^2 + xy' - y = 0$
Explanation: Elimination of the constant c from the general solution equation and its derivative yields the corresponding differential equation.

Question 70 Option: (1) – $-\sqrt{\frac{1-y^2}{1-x^2}}$
Explanation: Substituting $x = \sin\alpha$ and $y = \sin\beta$ gives $\alpha + \beta = \pi/2$. Differentiating with respect to x yields $dy/dx = -\sqrt{\frac{1-y^2}{1-x^2}}$.

Question 71 Option: (A) – 5/2
Explanation: For collinear vectors, the ratios of the corresponding components are equal: $2/4 = -q/-5 \implies q = 5/2$.

Question 72 Option: (C) – 9
Explanation: Expanding the scalar triple product in the numerator gives $9[\vec{a}\ \vec{b}\ \vec{c}]$, resulting in a ratio of 9.

Question 73 Option: (A) – $\pi/4$
Explanation: Using right triangle identities with $C = 90°$, applying the arctan sum identity simplifies the expression to $\pi/4$.

Question 74 Option: (D) – p
Explanation: Boolean simplification using distributive laws: $[p \wedge (q \vee r)] \vee [p \wedge \sim (q \vee r)] = p \wedge T = p$.

Question 75 Option: (D) – -2/3
Explanation: Since the lines are perpendicular, the dot product of their direction vectors is zero: $2(1) + 1(2) + 6(m) = 0 \implies m = -2/3$.

Question 76 Option: (A) – 16/3 cu. units
Explanation: The volume of the tetrahedron is given by $\frac{1}{6}|[\vec{AB}\ \vec{AC}\ \vec{AD}]|$, which evaluates to $32/6 = 16/3$ cubic units.

Question 77 Option: (C) – 5/13
Explanation: Since $\csc^2\theta - \cot^2\theta = 1 \implies \csc\theta - \cot\theta = 1/5$. Adding these equations gives $\csc\theta = 13/5 \implies \sin\theta = 5/13$.

Question 78 Option: (B) – 27 m, 27 m
Explanation: For a fixed perimeter, the rectangle of maximum area is a square. Thus, $x = y = 108/4 = 27$ m.

Question 79 Option: (A) – $\sqrt{19}/3$
Explanation: Transforming the equation to standard hyperbola form $\frac{(x-1)^2}{3} - \frac{(y+2)^2}{16} = 1$ gives $e = \sqrt{1 + 16/3} = \sqrt{19/3}$.

Question 80 Option: (A) – 1/4
Explanation: Simplifying, $u = \frac{1}{2}\tan^{-1}x$ and $v = 2\tan^{-1}x$. Differentiating u with respect to v gives $du/dv = 1/4$.

Question 81 Option: (B) – $\pm 1/2, 0, \sqrt{3}/2$
Explanation: In the ZOX plane, $y = 0 \implies m = 0$. Since the angle with the Z-axis is $30°$, $n = \cos 30° = \sqrt{3}/2$. Using $l^2 + m^2 + n^2 = 1$ gives $l = \pm 1/2$.

Question 82 Option: (C) – $y = 2 + 4x + e^x - \sin x$
Explanation: Integrating y'' twice and using the initial conditions $y(0) = 3$ and $y'(0) = 4$ yields the particular solution.

Question 83 Option: (B) – $x = n(\pi/3) + \pi/12$
Explanation: The general solution to $\tan 3x = 1$ is $3x = n\pi + \pi/4 \implies x = n(\pi/3) + \pi/12$.

Question 84 Option: (D) – 26
Explanation: The sum of the products of elements of any row with their corresponding cofactors equals the determinant of the matrix, which is 26.

Question 85 Option: (B) – $\pi/2 - \log 2$
Explanation: Substituting $2\tan^{-1}x$, integration by parts gives $[2x\tan^{-1}x]_0^1 - \int_0^1 \frac{2x}{1+x^2}dx = \pi/2 - \log 2$.

Question 86 Option: (D) – 8 hours
Explanation: If the population doubles in 4 hours, reaching $4N$ (two doublings) requires $2 \times 4 = 8$ hours.

Question 87 Option: (B) – $|\frac{ab}{\sqrt{a^2+b^2}}|$
Explanation: The perpendicular distance from (a, b) to $x/a + y/b - 1 = 0$ is $\frac{|a/a+b/b-1|}{\sqrt{1/a^2+1/b^2}} = \frac{ab}{\sqrt{a^2+b^2}}$.

Question 88 Option: (A) – 3
Explanation: For continuity at $x = 0$, the limit of $\frac{9^x(9^x-1)}{k^x-1}$ must equal 2, which simplifies to $\ln 9/\ln k = 2 \implies k = 3$.

Question 89 Option: (A) – $\pi/12$
Explanation: The equation simplifies to $\tan(\pi/4 - \theta) = \tan(\pi/6) \implies \theta = \pi/4 - \pi/6 = \pi/12$.

Question 90 Option: (D) – A^{-1} does not exist
Explanation: The determinant of the matrix formed by reciprocal cube roots of unity is zero, meaning the matrix is singular and its inverse does not exist.

Question 91 Option: (B) – π
Explanation: The expression evaluates to $\sin^{-1}(1/2)+\cos^{-1}(\sqrt{3}/2)+\cot^{-1}(-1/\sqrt{3}) = \pi/6+\pi/6+2\pi/3 = \pi$.

Question 92 Option: (A) – $\log|x+1| + \frac{4}{x+2} + c$
Explanation: Resolving the integrand into partial fractions yields $\frac{1}{x+1} - \frac{4}{(x+2)^2}$, which integrates to $\log|x+1| + \frac{4}{x+2} + c$.

Question 93 Option: (C) – 2
Explanation: Since the line is parallel to the plane, their directions are perpendicular: $2(3)+1(-2)+2(-m) = 0 \implies m = 2$.

Question 94 Option: (B) – 5
Explanation: S.D. $= \sqrt{npq}$. For $n = 100$, $p = 1/2$, $q = 1/2$, S.D. $= \sqrt{100 \times 1/4} = 5$.

Question 95 Option: (C) – 72
Explanation: Evaluating the objective function $Z = 3x + 5y$ at the feasible region corner points $(24, 0)$ and $(8, 4)$ yields a maximum of 72.

Question 96 Option: (D) – 17/20
Explanation: $P(A \cap B) = P(A)+P(B)-P(A \cup B) = 3/20$. Thus, $P(A' \cup B') = 1-P(A \cap B) = 17/20$.

Question 97 Option: (2) – -1/4
Explanation: The expression simplifies to $y = \tan^{-1}(\cot(x/4)) = \pi/2 - x/4$. Thus, the derivative $y' = -1/4$.

Question 98 Option: (A) – $a - b = 0$
Explanation: Calculating the probabilities gives $a = \int_0^{1/2} 1/2\, dx = 1/4$ and $b = \int_{3/2}^{2} 1/2\, dx = 1/4$. Thus, $a - b = 0$.

Question 99 Option: (C) – $y + \sin^{-1} x = c$
Explanation: Integrating the variables directly yields $y + \int \frac{1}{\sqrt{1-x^2}} dx = c \implies y + \sin^{-1} x = c$.

Question 100 Option: (A) – 9/2
Explanation: Setting up the intersection condition of the two lines and solving for k yields $k = 9/2$.

Question 101 Option: (B) – If Raju doesn't join Army, then he is not courageous.
Explanation: The contrapositive of "If P, then Q" is "If not Q, then not P".

Question 102 Option: (A) – 1, 84, 800
Explanation: $dA/dt = 2\pi r(dr/dt)$. At $t = 600$ s, $r = 4200$ cm. This yields $2 \times (22/7) \times 4200 \times 7 = 1,84,800$ cm^2/s.

Question 103 Option: (B) – 2
Explanation: Using the formula $|m_1 - m_2| = \frac{2\sqrt{h^2-ab}}{b}$, substitution of coefficients simplifies to a value of 2.

Question 104 Option: (D) – 3
Explanation: Since the two planes are parallel, their coefficients are proportional: $2/2\lambda = -5/-15 \implies \lambda = 3$.

Question 105 Option: (B) – (0,0) and 4a units
Explanation: Substituting parametric equations yields $x^2 + y^2 = (4a)^2$, representing a circle centered at the origin with radius $4a$.