MHT CET 2020 Mathematics Answer Key PDF

Question 1
Option: (c) – $\left(\frac{\mu_0 ev}{4\pi B}\right)^{1/2}$
Explanation: The magnetic field at the center of a circular orbit carrying current $I = \frac{ev}{2\pi r}$ is $B = \frac{\mu_0 I}{2r}$. Substituting I into this expression gives $B = \frac{\mu_0 ev}{4\pi r^2}$, which can be rearranged to find the radius $r = \left(\frac{\mu_0 ev}{4\pi B}\right)^{1/2}$.

Question 2
Option: (b) – $[3]^{1/3}$
Explanation: For a uniform wire, the mass is proportional to the radius, so $M_B = NM_A$. The moment of inertia of a ring is $I = Mr^2$, which yields $I_B = M_B(NR)^2 = N^3 I_A$. Since $I_B = 3I_A$, we get $N^3 = 3$, which gives $N = 3^{1/3}$.

Question 3
Option: (b) – $\frac{T}{v^2\rho}$
Explanation: The speed of a transverse wave in a wire is given by $v = \sqrt{\frac{T}{\mu}}$, where the mass per unit length is $\mu = \rho A$. Squaring both sides of the equation and solving for the cross-sectional area yields $A = \frac{T}{v^2\rho}$.

Question 4
Option: (c) – P: clockwise, Q: anti-clockwise
Explanation: By Lenz's law, the induced current opposes the change in magnetic flux. For ring P, the increasing outward magnetic field induces a clockwise current, while for ring Q, the increasing inward magnetic field induces an anti-clockwise current.

Question 5
Option: (b) – 1800 Hz
Explanation: Filling 1/3 of the pipe with water leaves $2/3L$ of air, raising the fundamental frequency to 600 Hz. Since a closed pipe only produces odd harmonics, the frequency of the second possible mode of vibration (the 3rd harmonic) is $3 \times 600 = 1800$ Hz.

Question 6
Option: (a) – 12 μC
Explanation: The equivalent capacitance of the parallel pair is 6 μF, which forms a symmetric series divider with the third 6 μF capacitor. The voltage across the parallel combination is 6 V, so the charge on the 2 μF capacitor is $Q = 2\ \mu\text{F} \times 6\ \text{V} = 12\ \mu\text{C}$.

Question 7
Option: (c) – 0.75 ml decrease.
Explanation: The change in volume is given by $\Delta V = V \cdot K \cdot \Delta P$. Substituting the values, we obtain $\Delta V = 100\ \text{ml} \times (5 \times 10^{-10}\ \text{m}^2/\text{N}) \times (15 \times 10^6\ \text{Pa}) = 0.75$ ml, which represents a volume decrease under pressure.

Question 8
Option: (a) – volume
Explanation: Since P, Q, and R represent lengths, their dimensional formula is $[L]$. Substituting these into the expression $x = \pi R\left(\frac{P^2 - Q^2}{2}\right)$ yields the dimension $[L] \cdot [L^2] = [L^3]$, which corresponds to volume.

Question 9
Option: (d) – 460 Ω
Explanation: The required series resistance to convert a milliammeter into a voltmeter is $R = \frac{V}{I_g} - G$. Substituting the given values yields $R = \frac{15}{30 \times 10^{-3}} - 40 = 500 - 40 = 460\ \Omega$.

Question 10

Option: (a) – $\sqrt{\frac{k_2}{k_1}}$

Explanation: Equating the maximum velocities gives $A_1\omega_1 = A_2\omega_2$, so the ratio of amplitudes is $\frac{A_1}{A_2} = \frac{\omega_2}{\omega_1}$. Since $\omega = \sqrt{\frac{k}{m}}$ and the masses are equal, this ratio simplifies to $\sqrt{\frac{k_2}{k_1}}$.

Question 11

Option: (a) – $\frac{3}{2}ml^2$

Explanation: The mass at the vertex through which the axis passes has a distance of 0, while the other two masses are at a distance of $h = \frac{\sqrt{3}}{2}l$. The total moment of inertia is $I = m(0)^2 + 2m\left(\frac{\sqrt{3}}{2}l\right)^2 = \frac{3}{2}ml^2$.

Question 12

Option: (c) – 16 : 9

Explanation: The terminal velocity of a spherical rain drop is proportional to the square of its radius, $v \propto r^2$. Because the surface area of a sphere is also proportional to r^2, the ratio of their surface areas is equal to the ratio of their terminal velocities.

Question 13

Option: (c) – high voltage and low current.

Explanation: A van de Graaff generator is designed to accumulate electrostatic charge on a hollow metal globe, which builds up extremely high electrical potential differences (high voltage) while generating a very low current.

Question 14

Option: (c) – l^2

Explanation: The work done in stretching a metal rod is given by $W = \frac{1}{2}F \cdot l = \frac{YAl^2}{2L}$. Since Y, A, and L are constants for a given rod, the work done is directly proportional to l^2.

Question 15

Option: (d) – is not affected, decreases, increases.

Explanation: Increasing the aperture does not affect the wavelength. While the focal length of a lens theoretically remains constant, the resolving power is given by RP $= \frac{D}{1.22\lambda}$ and thus increases with a larger aperture diameter D.

Question 16

Option: (a) – 485 Hz

Explanation: The frequency of A is either 485 Hz or 475 Hz. Since loading a tuning fork with wax decreases its frequency, only an initial frequency of 485 Hz can decrease to 482 Hz to produce a beat frequency of 2 Hz.

Question 17

Option: (d) – 1.45

Explanation: Using the sum and difference method for a potentiometer, we have $\frac{E_1+E_2}{E_1-E_2} = \frac{490}{90} = \frac{49}{9}$. Applying componendo and dividendo to this ratio yields $\frac{E_1}{E_2} = \frac{49+9}{49-9} = 1.45$.

Question 18

Option: (b) – 7.2×10^5 Am^{-1}

Explanation: The volume of the domain is $V = (10^{-6}\text{ m})^3 = 10^{-18}$ m^3. The magnetisation is the total dipole moment per unit volume, which is $M = \frac{N \cdot \mu}{V} = \frac{8\times10^{10}\times9\times10^{-24}}{10^{-18}} = 7.2\times10^5$ Am^{-1}.

Question 19

Option: (a) – $mg\left[1 + \left(\frac{a}{L}\right)^2\right]$

Explanation: The maximum tension occurs at the lowest point of the oscillation and is given by $T_{\max} = mg + \frac{mv^2}{L}$. Using the approximation for small angular amplitudes, $v^2 \approx \frac{ga^2}{L}$, which yields $T_{\max} = mg\left[1 + \left(\frac{a}{L}\right)^2\right]$.

Question 20
Option: (a) – $\frac{2.303 \times \log 1.33}{40}$
Explanation: For a first-order reaction, the rate constant is $k = \frac{2.303}{t} \log\left(\frac{[A]_0}{[A]_t}\right)$. Substituting $t = 40$ min and the concentration remaining as 75% of the initial value ($[A]_t = 0.75[A]_0$) yields $k = \frac{2.303 \times \log 1.33}{40}$.

Question 21
Option: (c) – 6.93×10^{-3} min^{-1}
Explanation: The reactant concentration decreases to half of its initial value, which represents one half-life ($t_{1/2} = 100$ min). The rate constant is calculated as $k = \frac{0.693}{100} = 6.93 \times 10^{-3}$ min^{-1}.

Question 22
Option: (d) – C-1 of α-D-glucopyranose and C-2 of β-D-fructofuranose
Explanation: Sucrose is a non-reducing disaccharide in which the glycosidic linkage is formed between the hemiacetal carbon (C-1) of α-D-glucopyranose and the hemiacetal carbon (C-2) of β-D-fructofuranose.

Question 33
Option: (c) – Catalase
Explanation: The rapid decomposition of toxic hydrogen peroxide into water and oxygen gas in biological systems is specifically and highly efficiently catalyzed by the enzyme catalase.

Question 24
Option: (c) – Meprobamate
Explanation: Meprobamate is an anxiolytic drug that is widely classified as a tranquilizer used to treat anxiety, whereas prontosil and salvarsan are antibacterial agents, and aspirin is an analgesic.

Question 25
Option: (a) – NO_2^-
Explanation: An ambidentate ligand is a monodentate ligand that can coordinate to a metal atom through more than one donor site. The nitrite ion, NO_2^-, can bind via either the nitrogen atom or an oxygen atom.

Question 26
Option: (a) – lone pair-lone pair ¿ lone pair-bond pair ¿ bond pair-bond pair
Explanation: According to VSEPR theory, lone pairs are held closer to the central nucleus and occupy more space than bond pairs, resulting in the repulsive order: lone pair-lone pair ¿ lone pair-bond pair ¿ bond pair-bond pair.

Question 27
Option: (d) – 0.35 mol kg^{-1}
Explanation: The elevation of boiling point is $\Delta T_b = 100.18°\text{C} - 100°\text{C} = 0.18$ K. Using $\Delta T_b = k_b \cdot m$, we find the molality of the solution is $m = \frac{0.18}{0.512} \approx 0.35$ mol kg^{-1}.

Question 28
Option: (b) – Nsm^{-2}
Explanation: The SI unit of dynamic viscosity is Pascal-second (Pa·s). Since 1 Pa = 1 N/m^2, this unit can be expressed equivalently as Newton-second per square meter ($\text{N} \cdot \text{s} \cdot \text{m}^{-2}$).

Question 29
Option: (a) – $Al_2(SO_4)_3$
Explanation: The depression of freezing point is $\Delta T_f = i \cdot K_f \cdot m$. Among the choices, $Al_2(SO_4)_3$ is a strong electrolyte that dissociates into 5 ions, giving the largest van 't Hoff factor ($i = 5$) and thus the maximum ΔT_f.

Question 30
Option: (a) – Methane

Explanation: In methane (CH_4), the central carbon atom forms four single covalent bonds, sharing 8 electrons in total. This gives the carbon atom a complete and stable valence octet.

Question 31
Option: (b) – 26 %
Explanation: The packing efficiency of a face-centered cubic (fcc) unit cell is 74%, which represents the percentage of total volume occupied by the spheres. The remaining unoccupied (void) space is $100\% - 74\% = 26\%$.

Question 32
Option: (a) – $CH_3COOC_2H_5$
Explanation: The bromination of ethane yields bromoethane ($A = C_2H_5Br$). This undergoes nucleophilic substitution with silver acetate (CH_3COOAg) to produce the ester ethyl acetate ($B = CH_3COOC_2H_5$).

Question 33
Option: (d) – $H_2S_2O_8$
Explanation: Marshall's acid is the common name for peroxydisulfuric acid, which has the molecular formula $H_2S_2O_8$ and features a peroxide group ($-O-O-$) bridging the two sulfur atoms.

Question 34
Option: (b) – CaH_2
Explanation: Hydrolith is the commercial trade name for calcium hydride (CaH_2). It is used as a highly efficient portable source of hydrogen gas because it reacts rapidly with water to release hydrogen.

Question 35
Option: (a) – 1
Explanation: Since A and B are supplementary angles, $A + B = 180°$, which implies $\frac{B}{2} = 90° - \frac{A}{2}$. Consequently, $\sin^2\frac{B}{2} = \cos^2\frac{A}{2}$, and the sum simplifies to $\sin^2\frac{A}{2} + \cos^2\frac{A}{2} = 1$.

Question 36
Option: (c) – $\pi/4$
Explanation: By applying the property $\int_0^a f(x)dx = \int_0^a f(a-x)dx$ and adding the two equivalent forms of the integral, we obtain $2I = \int_0^{\pi/2} 1dx = \frac{\pi}{2}$, which solves to $I = \frac{\pi}{4}$.

Question 37
Option: (b) – 0, -1, 1
Explanation: The cofactors of the first column are computed as $C_{11} = (-1)^2(2-2) = 0$, $C_{21} = (-1)^3(0-(-1)) = -1$, and $C_{31} = (-1)^4(0-(-1)) = 1$. This matches the triplet $(0, -1, 1)$.

Question 38
Option: (c) – $x^2 - 68x + 256 = 0$
Explanation: The sum of the roots is $\alpha + \beta = 2 \times \text{AM} = 68$, and the product is $\alpha\beta = \text{GM}^2 = 256$. The quadratic equation is $x^2 - (\alpha+\beta)x + \alpha\beta = 0$, which gives $x^2 - 68x + 256 = 0$.

Question 39
Option: (a) – 7 cm
Explanation: From the area formula $\frac{1}{2}ac\sin(60°) = 10\sqrt{3}$, we get $ac = 40$. Using $a+c = 20-b$ in the law of cosines $b^2 = (a+c)^2 - 2ac - 2ac\cos(60°)$ yields the side length $b = l(AC) = 7$ cm.

Question 40
Option: (a) – $\frac{x-1}{6} = \frac{2-y}{7} = \frac{z-3}{2}$
Explanation: The direction ratios of the line perpendicular to both given lines are found via the cross product of their direction vectors, yielding ratios proportional to $6, -7, 2$. Using the point $(1, 2, 3)$, the equation is $\frac{x-1}{6} = \frac{2-y}{7} = \frac{z-3}{2}$.

Question 41
Option: (b) – $\{5, 6, 7\}$
Explanation: The integer values of a in the interval $5 < a < 9$ are $\{6, 7, 8\}$. Since $b = a - 1$, the corresponding values of b forming the range of the relation R are $\{5, 6, 7\}$.

Question 42
Option: (a) – $\frac{1}{3}\tan^{-1}\left(\frac{x+2}{3}\right) + c$
Explanation: Completing the square of the quadratic term yields $x^2 + 4x + 13 = (x+2)^2 + 3^2$. Integrating this using the standard formula $\int \frac{dx}{u^2+a^2} = \frac{1}{a}\tan^{-1}\left(\frac{u}{a}\right)$ gives $\frac{1}{3}\tan^{-1}\left(\frac{x+2}{3}\right) + c$.

Question 43
Option: (c) – $\frac{1}{6}\begin{bmatrix} -1 & 5 \\ 2 & -4 \end{bmatrix}$
Explanation: Multiplying the matrix equation $A^2 - 5A - 6I = 0$ by A^{-1} yields $A^{-1} = \frac{1}{6}(A - 5I)$. Evaluating this expression using $A = \begin{bmatrix} 4 & 5 \\ 2 & 1 \end{bmatrix}$ results in $\frac{1}{6}\begin{bmatrix} -1 & 5 \\ 2 & -4 \end{bmatrix}$.

Question 44
Option: (d) – $x^{\log(\sqrt{x})}$
Explanation: Writing the differential equation in standard linear form gives $\frac{dy}{dx} + \left(\frac{\log x}{x}\right) y = x$. The integrating factor is I.F. $= e^{\int \frac{\log x}{x} dx} = e^{\frac{1}{2}(\log x)^2} = x^{\log(\sqrt{x})}$.

Question 45
Option: (a) – $x + 2y + 2z - 13 = 0$ or $x + 2y + 2z - 1 = 0$
Explanation: The parallel planes are represented by $x + 2y + 2z + d = 0$. Equating the perpendicular distance from $(1, 1, 2)$ to 2 units gives $|7 + d| = 6$, which yields the values $d = -13$ and $d = -1$.