MHT CET 2020 Mathematics Answer Key PDF

Question 1 Option (D) – $r\left(\frac{\alpha\theta}{2}\right)^{\frac{1}{2}}$

Explanation: Using the kinematic relation $\theta = \frac{1}{2}\alpha t^2$, we find $t = \sqrt{\frac{2\theta}{\alpha}}$. The average velocity is the ratio of linear displacement to elapsed time, which approximates to $v_{\text{avg}} \approx \frac{r\theta}{t} = r\left(\frac{\alpha\theta}{2}\right)^{\frac{1}{2}}$ for small angular displacements.

Question 2 Option (B) – four times.

Explanation: Normal tensile stress is inversely proportional to the square of the wire radius (Stress $\propto \frac{1}{r^2}$). Since the radius of wire A is twice that of wire B ($r_A = 2r_B$), the cross-sectional area decreases fourfold, making the stress on B four times the stress on A.

Question 3 Option (D) – 4 : 3

Explanation: The resolving power of an optical instrument is inversely proportional to the wavelength of light used (R.P. $\propto \frac{1}{\lambda}$). Thus, the ratio of their relative resolving powers is expressed as $\frac{\text{R.P.}_A}{\text{R.P.}_B} = \frac{\lambda_B}{\lambda_A} = \frac{6000}{4500} = \frac{4}{3}$.

Question 4 Option (A) – $\frac{2}{\sqrt{3}}$

Explanation: Using the parallel axis theorem, the moments of inertia about the given tangent axis are $I_{\text{ring}} = 2MR^2$ and $I_{\text{disc}} = \frac{3}{2}MR^2$. The corresponding ratio of their radii of gyration simplifies to $\frac{K_{\text{ring}}}{K_{\text{disc}}} = \sqrt{\frac{2}{3/2}} = \frac{2}{\sqrt{3}}$.

Question 5 Option (C) – 4W

Explanation: The work done in blowing a spherical soap bubble is directly proportional to its total surface area ($W \propto R^2$). Doubling the radius increases the total surface area by a factor of $2^2 = 4$, making the required work done equal to $4W$.

Question 6 Option (B) – $\left[\frac{2(hc-\lambda\phi)}{m\lambda}\right]^{\frac{1}{2}}$

Explanation: According to Einstein's photoelectric equation, the maximum kinetic energy is $\frac{1}{2}mv_{\text{max}}^2 = \frac{hc}{\lambda} - \phi$. Isolating the velocity variable on the left-hand side and solving for maximum velocity yields $v_{\text{max}} = \left[\frac{2(hc-\lambda\phi)}{m\lambda}\right]^{\frac{1}{2}}$.

Question 7 Option (C) – $\frac{ML^2}{9}$

Explanation: By the parallel axis theorem, the moment of inertia is $I = I_{\text{cm}} + Md^2$. Substituting the center of mass inertia $I_{\text{cm}} = \frac{ML^2}{12}$ and the axis displacement distance $d = \frac{L}{2} - \frac{L}{3} = \frac{L}{6}$ yields $I = \frac{ML^2}{12} + \frac{ML^2}{36} = \frac{ML^2}{9}$.

Question 8 Option (A) – $\left(\frac{T_2}{T_1}\right)^2$

Explanation: Since both black bodies radiate the exact same total thermal power, Stefan's law sets the equivalence $r_1^2T_1^4 = r_2^2T_2^4$. Rearranging this equality for the ratio of the surface radii yields $\frac{r_1}{r_2} = \left(\frac{T_2}{T_1}\right)^2$.

Question 9 Option (C) – insulator.

Explanation: At absolute zero temperature ($T = 0$ K), pure silicon possesses no thermal energy to promote electrons across the forbidden band gap from the valence band to the conduction band, causing it to behave as a perfect insulator.

Question 10 Option (B) – remains unchanged.

Explanation: By Gauss's Law, the net outward electric flux through any closed Gaussian surface depends solely on the magnitude of the total net charge enclosed within it. Since the net enclosed charge remains constant, expanding the boundary leaves the flux unchanged.

Question 11 Option (D) – 6.0 A, 225 V
Explanation: For an ideal transformer, the secondary voltage scales to $V_s = V_p \left(\frac{N_s}{N_p}\right) = 150 \times 1.5 = 225$ V, while the secondary current scales inversely to match the power conservation as $I_s = I_p \left(\frac{N_p}{N_s}\right) = 9 \times \frac{2}{3} = 6.0$ A.

Question 12 Option (C) – Pr
Explanation: Praseodymium (Pr, $Z = 59$) belongs to the lanthanide series, which constitutes the first inner transition ($4f$) series of the periodic table, whereas berkelium (Bk), plutonium (Pu), and fermium (Fm) belong to the actinide series.

Question 13 Option (A) – Benzene-1,4-diol
Explanation: Hydroquinone consists of a symmetric benzene ring with two identical phenolic hydroxyl groups attached at exact opposite para positions (carbon-1 and carbon-4), giving it the systematic IUPAC name benzene-1,4-diol.

Question 14 Option (A) – Silver sol
Explanation: A silver sol is formed by the physical aggregation of a large number of individual silver atoms to form stable, intermediate colloidal-sized particles, classifying it as a classic multimolecular colloid.

Question 15 Option (A) – Liquation
Explanation: Liquation is a metallurgical refining process used for metals with low melting points, such as tin. Heating the crude metal on a sloping hearth allows the pure liquid metal to flow away, leaving infusible impurities behind.

Question 16 Option (A) – Lr (z = 103)
Explanation: Lawrencium (Lr) features a highly stable, completely filled closed $5f^{14}$ electron subshell configuration. This configuration strongly restricts its chemical oxidation behavior to the stable +3 state exclusively.

Question 17 Option (C) – 112.7 min
Explanation: Using the standard integrated first-order rate expression, $t = \frac{2.303}{k} \log\left(\frac{a}{a-x}\right)$. Substituting the rate constant and concentration parameters yields $t = \frac{2.303}{0.00813} \log(2.5) \approx 112.7$ min.

Question 18 Option (B) – residual entropy
Explanation: The small amount of entropy that remains locked within a crystalline substance even as its temperature approaches absolute zero ($T = 0$ K) due to structural alignment disorder or spatial orientation anomalies is termed residual entropy.

Question 19 Option (D) – 3-Pentanone
Explanation: Propanenitrile reacts with ethyl magnesium iodide via nucleophilic addition to form an intermediate imine complex. Subsequent acid-catalyzed hydrolysis of this addition complex yields the symmetrical ketone 3-pentanone.

Question 20 Option (B) – PVC
Explanation: Polyvinyl chloride (PVC) is widely used in the commercial manufacture of durable artificial leather (vinyl) because of its excellent water resistance, high physical toughness, and flexible properties when plasticized.

Question 21 Option (B) – $|\vec{a} \times \vec{b}|^2$
Explanation: By applying the vector triple product vector expansion identity, $(\vec{b} \times (\vec{a} \times \vec{b})) \cdot \vec{a} = (|\vec{b}|^2\vec{a} - (\vec{b} \cdot \vec{a})\vec{b}) \cdot \vec{a}$. Expanding the dot product gives $|\vec{a}|^2|\vec{b}|^2 - (\vec{a} \cdot \vec{b})^2$, which equals $|\vec{a} \times \vec{b}|^2$.

Question 22 Option (A) – e$^{-x} Explanation: Makingthesubstitution$v $= \cos y$ transforms the non-linear Bernoulli differential equation into a linear differential equation of the form $\frac{du}{dx} - u = -x$. The corresponding integrating factor is calculated as $e^{\int -1dx} = e^{-x}$.

Question 23 Option (D) – x + 2 log$(1 - 2e^{-x}) + c$
$Explanation: Rewriting the rational algebraic integrand split as e^x - 2 + 4\frac{}{e^x-2=1+\frac{4}{e^x-2}}$ allows for direct integration. Integrating these separated components term-by-term leads to the expression $x + 2\log|1 - 2e^{-x}| + c$.

Question 24 Option (B) – $\frac{25}{3}$ sq. units
Explanation: The standard bounded area enclosed between the intersecting parabolas $y^2 = 4ax$ and $x^2 = 4by$ is given by $\frac{16}{3}ab$. Substituting the parameters $a = 5/4$ and $b = 5/4$ yields $\frac{16}{3} \times \frac{5}{4} \times \frac{5}{4} = \frac{25}{3}$ square units.

Question 25 Option (C) – $\mathrm{R}^+ \cup \{0\} Explanation: The real-valued principal square root function$ f(x) $= \sqrt{x}$ yields real outputs if and only if the radicand is non-negative. This is mathematically represented by the domain interval $[0, \infty)$, or $\mathbb{R}^+ \cup \{0\}$.

Question 26 Option (C) – 36
Explanation: Evaluating the linear objective function $Z = 3x + 5y$ at the corner points of the bounded feasible region $(0, 6)$, $(2, 6)$, and $(4, 3)$ reveals that the absolute maximum value of 36 occurs at the vertex $(2, 6)$.

Question 27 Option (C) – $\frac{140}{99}$
Explanation: Let $x = 1.\overline{41}$. Multiplying by 100 aligns the repeating periods as $100x = 141.\overline{41}$. Subtracting the first equation from the second eliminates the repeating decimal part, yielding $99x = 140 \implies x = \frac{140}{99}$.

Question 28 Option (B) – 2, 3
Explanation: Cubing both sides to eliminate the fractional exponent yields the differential equation $[1 + (dy/dx)^2]^7 = 7^3(d^2y/dx^2)^3$. The highest order derivative present is second-order (order 2), which is raised to a power of 3 (degree 3).