

MHT CET 2020 Mathematics Answer Key PDF

Question 1 Option (B) – G_1 is more sensitive than G_2 .

Explanation: Galvanometer sensitivity is inversely proportional to the current required for a full-scale deflection. Since G_1 requires less current than G_2 for the same deflection, it is more sensitive.

Question 2 Option (C) – $\frac{\lambda_1 E_1 - \lambda_2 E_2}{\lambda_2 - \lambda_1}$

Explanation: Using Einstein's photoelectric equation, we establish two equations relating work function and wavelengths. Solving these simultaneous equations directly yields the expression for the work function.

Question 3 Option (A) – 9Ω

Explanation: From the initial balanced condition of the bridge, we find the relation between the resistances. Applying the condition with the added series resistance yields the value of the smaller resistance as 9Ω .

Question 4 Option (A) – remains the same.

Explanation: The root-mean-square velocity of gas molecules depends solely on the absolute temperature of the gas. Since the compression is isothermal, the temperature and thus the r.m.s. velocity remain constant.

Question 5 Option (B) – $4/\pi$

Explanation: The magnetic dipole moment is proportional to the area enclosed by the wire loop. For equal lengths of wire, the ratio of the circular area to the square area simplifies to $4/\pi$.

Question 6 Option (D) – be zero.

Explanation: When the frequency of the incident light is reduced to one-third of twice the threshold frequency, it falls below the threshold frequency. Hence, no photoelectric emission occurs and the current is zero.

Question 7 Option (C) – $\theta = \cot^{-1} \left(\frac{V}{c} \right)$

Explanation: According to Brewster's law, the refractive index of the medium is given by $\mu = \tan \theta$. Substituting $\mu = c/V$ and taking the cotangent inverse gives the required relationship.

Question 8 Option (A) – very high, empty.

Explanation: In insulators, the forbidden energy band gap between the valence and conduction bands is very large. This prevents any electrons from entering the conduction band, leaving it completely empty.

Question 9 Option (A) – $T/12$

Explanation: Setting the alternating e.m.f. equal to half its maximum value, we solve $\sin(\omega t) = 1/2$. This yields $\omega t = \pi/6$, which simplifies directly to $t = T/12$ using $\omega = 2\pi/T$.

Question 10 Option (C) – 3 units

Explanation: When 27 smaller droplets combine, the radius of the resulting single larger drop becomes three times the initial radius. Since excess pressure is inversely proportional to radius, it becomes 3 units.

Question 11 Option (A) – $7/8$

Explanation: Equating the frequency of the third overtone of a closed pipe ($7v/4L_c$) with that of an open pipe ($4v/2L_o$) allows us to solve for the ratio of their lengths as $7/8$.

Question 12 Option (B) – 7.91×10^{-4} rad/s

Explanation: Using the formula for effective gravity at the equator, $g' = g - \omega^2 R$, and setting $g' = 0.6g$, we solve for the angular velocity ω to get the required value.

Question 13 Option (B) – $\frac{KV}{K+1}$

Explanation: Inserting a dielectric of constant K into one capacitor increases its capacitance to KC . In a series combination, the potential difference across the other capacitor becomes $KV/(K+1)$.

Question 14 Option (D) – $13MR^2/32$

Explanation: Using the theorem of parallel axes, we subtract the moment of inertia of the removed circular portion from that of the entire disc to find the remaining moment of inertia.

Question 15 Option (A) – 22 cm

Explanation: Applying the lens maker's formula for an equi-convex lens with identical radii of curvature, we solve for R using the given focal length and refractive index of 1.55.

Question 16 Option (D) – $\max_d$

Explanation: The line-of-sight propagation range of an antenna is directly proportional to the square root of its height. Doubling the height therefore scales the propagation range by a factor of $\sqrt{2}$.

Question 17 Option (B) – $\frac{T}{V^2\rho}$

Explanation: The speed of a transverse wave is given by $V = \sqrt{T/\mu}$, where $\mu = A\rho$ is the mass per unit length. Rearranging this relation yields the cross-sectional area as $T/(V^2\rho)$.

Question 18 Option (C) – 2×10^{-2} J/T

Explanation: The net magnetic dipole moment is calculated by multiplying the uniform intensity of magnetization by the volume of the cylindrical rod, which yields approximately 2×10^{-2} J/T.

Question 19 Option (A) – $\frac{\pi m \ell}{12P}$

Explanation: The applied linear impulse determines both the linear and angular momentum of the rod. Solving for the angular velocity and setting the rotation angle to $\pi/2$ gives the required time.

Question 20 Option (C) – $E_n \propto \frac{1}{L_n^2}$

Explanation: In Bohr's atomic model, total energy is inversely proportional to n^2 , while angular momentum is directly proportional to n . Consequently, the total energy is inversely proportional to the square of angular momentum.

Question 21 Option (D) – 30°

Explanation: For an equilateral prism, the angle of the prism is 60° . Using the prism formula for the given relation of incidence and emergence angles, the angle of deviation is computed as 30° .

Question 22 Option (A) – 8 gram

Explanation: Equating the fundamental resonance frequency of the closed organ pipe to the frequency of the string's second harmonic, we find the mass of the vibrating string.

Question 23 Option (D) – which is always operated in reverse bias.

Explanation: A photodiode is a semiconductor device designed to detect light signals and is operated in reverse-bias mode to keep the dark current minimal and highly sensitive to incident light.

Question 24 Option (D) – $m_1r_1 : m_2r_2$

Explanation: Since both cars complete their circular paths in the same time period, they share the same angular velocity. The ratio of their centripetal forces is therefore determined solely by $m_1r_1 : m_2r_2$.

Question 25 Option (D) – $R\sqrt{3}$

Explanation: Using the expression for the magnetic field along the axis of a circular current-carrying loop, we equate it to one-eighth of the center field value and solve for the axial distance.

Question 26 Option (A) – $T \sin \theta$

Explanation: In a conical pendulum, the horizontal component of the tension in the string acts as the centripetal force that balances the centrifugal force in the rotating reference frame.

Question 27 Option (A) – $\frac{2}{d} \sqrt{\frac{E}{m}}$

Explanation: The rotational kinetic energy of the diatomic molecule is related to its moment of inertia and angular frequency. Solving for ω using the reduced mass of the system yields this relation.

Question 28 Option (B) – $\frac{Mg\sigma}{\pi rY}$

Explanation: Poisson's ratio relates the lateral strain to the longitudinal strain. Substituting the longitudinal strain in terms of Young's modulus and the load gives the decrease in radius.

Question 29 Option (C) – 0.9%

Explanation: The percentage error in the measurement of g is given by the sum of the percentage error in length and twice the percentage error in the time period, which equals 0.9%.

Question 30 Option (C) – stationary charge.

Explanation: A magnetic moment is generated only by moving charges or changing electric fields. Since a stationary charge creates only a static electric field, it has no associated magnetic moment.

Question 31 Option (A) – 9 cm

Explanation: The height to which water rises in a capillary tube is inversely proportional to its radius. Reducing the cross-sectional area to one-ninth scales the height up by a factor of three.

Question 32 Option (D) – 1 : 3

Explanation: In a potentiometer, the potential difference across any segment is directly proportional to its balancing length. The ratio of the potential differences is therefore equal to $0.3/0.9 = 1 : 3$.

Question 33 Option (B) – $\lambda_1 = 0.09\lambda_2$

Explanation: Calculating the wavelengths for the Balmer series limit and the longest wavelength of the Brackett series using Rydberg's formula gives the proportional relationship $\lambda_1 = 0.09\lambda_2$.

Question 34 Option (B) – $CV/2$

Explanation: The equivalent capacitance of the network is calculated to find the total charge. The charge is then distributed across the parallel components proportionally, yielding $CV/2$ for capacitor C .

Question 35 Option (B) – 45 m.

Explanation: The stopping distance of a vehicle is directly proportional to the square of its initial velocity. Since the speed increases by a factor of three, the stopping distance increases ninefold.

Question 36 Option (B) – 200 V

Explanation: The peak induced electromotive force in the secondary coil is calculated using the relation $e_0 = M\omega I_0$. Substituting the given values yields exactly 200 V.

Question 37 Option (A) – $\frac{BIL^2}{4\pi n}$

Explanation: The maximum torque on a current-carrying loop in a magnetic field is given by $\tau = nIAB$. Expressing the area in terms of the total length L and turns n yields the final formula.

Question 38 Option (C) – 21/25

Explanation: Using the degrees of freedom for rigid diatomic and monoatomic gases, we calculate their respective adiabatic indices γ_d and γ_m , finding their ratio to be 21/25.

Question 39 Option (C) – $\left[\frac{4M(g+a)}{\pi S} \right]^{1/2}$

Explanation: The maximum tension in the cable occurs during upward acceleration. Equating

this force to the product of maximum safe stress and cross-sectional area yields the minimum diameter.

Question 40 Option (D) – $mg(1 + \mu_k^2)^{1/2}$

Explanation: The net force exerted by the surface on the block is the vector sum of the normal reaction force (mg) and the kinetic friction force ($\mu_k mg$), which yields this expression.

Question 41 Option (D) – increase the length four times.

Explanation: Since the time period of a simple pendulum is directly proportional to the square root of its length, the length must be increased four times to double the time period.

Question 42 Option (C) – 36 J

Explanation: The work done is calculated as the dot product of the force vector and the displacement vector. Computing this product yields a total work of 36 J.

Question 43 Option (D) – $\frac{a_1}{b_2} = -\frac{a_2}{b_1}$

Explanation: Since the two vectors are perpendicular, their dot product must be zero. Rearranging the terms of the dot product equation directly yields the given ratio.

Question 44 Option (B) – $\frac{1}{2}\sqrt{\frac{g}{2h}}$

Explanation: The total time period of the periodic bouncing motion is twice the time taken to fall from height h . The frequency of this motion is the reciprocal of the time period.

Question 45 Option (A) – 10/11

Explanation: In a biprism experiment, equating the position of the fifth bright band to that of the sixth dark band allows us to solve for the ratio of the two wavelengths.

Question 46 Option (C) – $\frac{2\pi^2 mA^2}{T^2}$

Explanation: The total mechanical energy of a particle in simple harmonic motion is given by $E = \frac{1}{2}m\omega^2 A^2$. Substituting $\omega = 2\pi/T$ yields the correct formulation.

Question 47 Option (C) – $I/2$

Explanation: Using the intensity formula for double-slit interference, a path difference of $\lambda/4$ corresponds to a phase difference of $\pi/2$, which results in half the maximum intensity.

Question 48 Option (B) – m^2/kg

Explanation: From Newton's law of gravitation and the formula for acceleration due to gravity, the ratio G/g simplifies to units of area divided by mass, which is m^2/kg .

Question 49 Option (B) – 1

Explanation: By definition, a perfectly elastic collision involves no loss of kinetic energy, which corresponds to a coefficient of restitution equal to exactly 1.

Question 50 Option (D) – $\pi A/2$

Explanation: Equating the maximum particle velocity ($A\omega$) to four times the wave velocity ($v = n\lambda$) and simplifying the equation yields a wavelength of $\pi A/2$.

Question 51 Option (C) – $\text{Ag}_2\text{O}/\text{H}_2\text{O}, \Delta$

Explanation: Hoffmann elimination of quaternary ammonium hydroxides is carried out using moist silver oxide ($\text{Ag}_2\text{O}/\text{H}_2\text{O}$) followed by heating to yield the least substituted alkene.

Question 52 Option (D) – 67.2 L

Explanation: Based on the stoichiometry of the reaction, 3 moles of oxygen gas are produced. At standard temperature and pressure (S.T.P.), 3 moles of gas occupy a volume of $3 \times 22.4 = 67.2$ L.

Question 53 Option (C) – CH_3OH

Explanation: Methanol is more acidic than other listed alcohols because it lacks bulky electron-donating alkyl groups that destabilize the conjugate alkoxide base.

Question 54 Option (D) – $\text{Mg} < \text{Ca} < \text{Sr} < \text{Ba}$

Explanation: The reactivity of alkaline earth metals with water increases down the group as ionization energy decreases, making it easier for the metals to lose electrons.

Question 55 Option (C) – TiCl_4 along with $\text{Al}(\text{C}_2\text{H}_5)_3$

Explanation: Ziegler-Natta catalyst, which consists of titanium tetrachloride and triethylaluminum, is used for the coordination polymerization of ethene to produce high-density polythene.

Question 56 Option (B) – $-k/2.303$

Explanation: For a first-order reaction, the integrated rate equation in base-10 logarithm is $\log_{10}[A]_t = -kt/2.303 + \log_{10}[A]_0$. The slope of the plot against time is $-k/2.303$.

Question 57 Option (D) – +2

Explanation: Ammonia and water are neutral ligands, meaning the overall charge of +2 on the coordination sphere is balanced entirely by the ruthenium central metal atom.

Question 58 Option (A) – Cl^-

Explanation: According to the Hardy-Schulze rule, the precipitating power of an ion increases with its valence. The monovalent chloride ion therefore has the least precipitating power.

Question 59 Option (D) – Nylon-2-nylon-6

Explanation: Nylon-2-nylon-6 is a biodegradable polyamide containing amide linkages ($-\text{CONH}-$) rather than the ester linkages found in Dextron, PHBV, and Dacron.

Question 60 Option (D) – $\text{Ba}[\text{CuCl}_4]$

Explanation: The formula consists of a barium cation balancing a tetrachlorocuprate(II) coordination anion, which contains a copper atom in the +2 oxidation state.

Question 61 Option (C) – 1.5

Explanation: The thermal decomposition of gaseous acetaldehyde is a well-known chain reaction that experimentally follows a fractional reaction order of 1.5.

Question 62 Option (A) – P

Explanation: Salvarsan (arsphenamine) is an organoarsenic compound containing arsenic, nitrogen, and oxygen, but does not contain phosphorus.

Question 63 Option (A) – anhydrous ZnCl_2

Explanation: The reaction of primary alcohols with hydrogen chloride requires the presence of anhydrous zinc chloride as a catalyst, known as Groves' process.

Question 64 Option (C) – +5

Explanation: In chloric acid (HClO_3), setting the oxidation states of hydrogen to +1 and oxygen to -2 yields an oxidation state of +5 for the chlorine atom.

Question 65 Option (A) – Insulin

Explanation: Insulin is a globular protein that is highly soluble in water due to its folded spherical structure, unlike fibrous proteins like myosin and collagen.

Question 66 Option (D) – $\text{CH}_3 - \text{CH}(\text{OH}) - \text{CH}_3$

Explanation: Propan-1-ol converts to 1-chloropropane, which undergoes elimination to form propene. Acid-catalyzed hydration of propene yields propan-2-ol as the final product.

Question 67 Option (D) – 2-Methyl-1,3-butadiene

Explanation: Natural rubber is a polymer made up of repeating units of isoprene, whose systematic chemical name is 2-methyl-1,3-butadiene.

Question 68 Option (A) – 1° amine

Explanation: The reduction of a ketoxime using sodium and ethanol (known as Bouveault-Blanc reduction) yields a primary amine containing a $-\text{CHNH}_2$ group.

Question 69 Option (A) – Vitamin C

Explanation: Vitamin C (ascorbic acid) is an open-chain/aliphatic lactone derivative, unlike vitamins A and K which contain aromatic or complex ring systems.

Question 70 Option (C) – AB forms electrovalent bond

Explanation: The complete transfer of one or more electrons from an electropositive atom A to an electronegative atom B results in the formation of an ionic (electrovalent) bond.

Question 71 Option (D) – 5.8 kJ

Explanation: According to the first law of thermodynamics, $\Delta U = q + w$. Substituting $q = +8$ kJ and $w = -2.2$ kJ yields an internal energy change of 5.8 kJ.

Question 72 Option (C) – molecular solid

Explanation: Dry ice consists of non-polar carbon dioxide molecules held together by weak London dispersion forces in a crystalline lattice, making it a molecular solid.

Question 73 Option (B) – Argon

Explanation: In gas chromatography, inert carrier gases like argon, helium, or nitrogen are used as the mobile phase to transport the sample without reacting with it.

Question 74 Option (B) – 120°

Explanation: In a phosphorus pentachloride molecule, the three equatorial chlorine atoms lie in a single plane with bond angles of exactly 120° to minimize repulsion.

Question 75 Option (C) – 1

Explanation: In copper sulfate pentahydrate, four water molecules are coordinated to the copper cation, while the fifth water molecule is held via hydrogen bonding to the sulfate anion.

Question 76 Option (D) – Van Arkel method

Explanation: The Van Arkel method involves converting impure zirconium into volatile zirconium tetraiodide and decomposing it on a hot filament to obtain high-purity metal.

Question 77 Option (B) – $\text{Na}_{(s)}$

Explanation: Since the number of atoms in a given mass is inversely proportional to the molar mass, sodium (with the lowest molar mass of 23) contains the most atoms.

Question 78 Option (C) – Ammonium chloride

Explanation: Ammonium chloride is a highly soluble salt that completely dissociates in water, unlike semipermeable membranes such as copper ferrocyanide and cellulose derivatives.

Question 79 Option (A) – Germanium

Explanation: Zone refining is a highly effective purification technique used to obtain ultra-pure semiconductor materials like germanium and silicon.

Question 80 Option (C) – Undecane

Explanation: Undecane is a straight-chain alkane secreted by certain female cockroaches as a sex pheromone to attract male cockroaches of the same species.

Question 81 Option (B) – 0.800 V

Explanation: Using the cell potential relation $E_{\text{cell}}^\circ = E_{\text{Ag}^+/\text{Ag}}^\circ - E_{\text{Cu}^{2+}/\text{Cu}}^\circ$, we find $E_{\text{Ag}^+/\text{Ag}}^\circ = 0.463 + 0.337 = 0.800$ V.

Question 82 Option (B) – Benzaldehyde

Explanation: Benzaldehyde lacks the methyl ketone group ($-\text{COCH}_3$) or methyl carbinol group required to produce a yellow precipitate in the iodoform test.

Question 83 Option (B) – 3.87 BM

Explanation: The chromium(III) ion has three unpaired electrons. Applying the spin-only magnetic moment formula yields $\mu = \sqrt{3(3+2)} = \sqrt{15} \approx 3.87$ BM.

Question 84 Option (A) – Babbitt metal

Explanation: Babbitt metal is a tin-based alloy containing antimony and copper, commonly used as a bearing surface in heavy-duty machinery.

Question 85 Option (D) – $T^\circ = \Delta T_f + T$

Explanation: The depression of freezing point is defined as $\Delta T_f = T^\circ - T$. Rearranging this relation yields the freezing point of the pure solvent T° .

Question 86 Option (D) – +6

Explanation: In potassium dichromate ($K_2Cr_2O_7$), balancing the positive charges of potassium and the negative charges of oxygen yields an oxidation state of +6 for chromium.

Question 87 Option (A) – -231.6 kJ

Explanation: The standard Gibbs free energy change is calculated using $\Delta G^\circ = -nFE^\circ_{\text{cell}}$, which yields exactly -231.6 kJ for this two-electron reaction.

Question 88 Option (D) – $C_6H_{12}O_6$

Explanation: Calculating the empirical formula from the mass percentages yields CH_2O . Dividing the molar mass of 180 by the empirical mass of 30 gives the molecular formula.

Question 89 Option (A) – Ethyl magnesium bromide

Explanation: Ethanol reacts with hydrogen bromide to form ethyl bromide, which then reacts with magnesium metal in dry ether to form the Grignard reagent ethyl magnesium bromide.

Question 90 Option (A) – Resorcinol

Explanation: Resorcinol is a dihydric phenol containing two hydroxyl groups attached directly to a benzene ring at meta-positions (benzene-1,3-diol).

Question 91 Option (C) – Novestrol

Explanation: Novestrol (ethinylestradiol) is a synthetic estrogen derivative widely used in oral contraceptive formulations and hormone replacement therapy.

Question 92 Option (C) – 8

Explanation: A cubic interstitial site is surrounded by eight anions at the corners of a cube, which gives any cation occupying this hole a coordination number of eight.

Question 93 Option (D) – $CH_3 - CH_2 - C(=O) - CH_3$

Explanation: Alkaline hydrolysis of a gem-dihalide followed by elimination of a water molecule yields a stable carbonyl compound, represented by the ketone product.

Question 94 Option (C) – $CH_3 - CO - Cl$

Explanation: The reaction of acetyl chloride with dibenzylcadmium is a highly selective method used to synthesize benzyl methyl ketone and cadmium chloride.

Question 95 Option (D) – Dimethylamine

Explanation: The carbylamine test is highly selective for primary amines. Since dimethylamine is a secondary amine, it does not undergo this reaction.

Question 96 Option (C) – 12

Explanation: In a cubic close-packed (ccp) lattice, each sphere is in contact with twelve neighboring spheres, giving it a coordination number of twelve.

Question 97 Option (B) – 31.1°C

Explanation: Carbon dioxide gas can only be liquefied below its critical temperature of 31.1°C . Above this temperature, it remains gaseous and obeys Boyle's law.

Question 98 Option (C) – NO_2

Explanation: Nitrogen dioxide (NO_2) is a reddish-brown colored gas, unlike other common oxides of nitrogen such as nitrous oxide and nitric oxide which are colorless.

Question 99 Option (A) – $(CH_3)_3C - CH_2 - CH_2 - Cl$

Explanation: The neohexyl prefix refers to a quaternary carbon atom bonded directly to an ethyl-chloride group, corresponding to 1-chloro-3,3-dimethylbutane.

Question 100 Option (A) – -9×10^2 J

Explanation: The work done during expansion is given by $W = -P_{\text{ext}}\Delta V$. Substituting the values of external pressure and change in volume yields exactly -9×10^2 J.

Question 101 Option (A) – $1/\sqrt{2}$

Explanation: Applying the chain rule to differentiate $f(\tan x)$ with respect to $g(\sec x)$ and evaluating at $x = \pi/4$ yields a value of exactly $1/\sqrt{2}$.

Question 102 Option (A) – $53/54$

Explanation: Subtracting the probability of obtaining a sum less than five (which consists of only four outcomes) from the total probability of one yields $53/54$.

Question 103 Option (D) – 4.24%

Explanation: Using the exponential decay formula with the half-life of Radium, we calculate the remaining fraction after 100 years and find a percentage loss of 4.24%.

Question 104 Option (B) – $3e^{6y} = 2e^{9x+6} + e^6$

Explanation: Separating variables and integrating both sides of the differential equation, followed by substituting the initial boundary conditions, gives the solution.

Question 105 Option (D) – 3

Explanation: Determining the coefficients of the quadratic function from the given values allows us to evaluate $f(1) = 0$, and thus $(f \circ f)(1) = f(0) = 3$.

Question 106 Option (B) – -1

Explanation: Using the identity $\cos 2\theta = 2\cos^2 \theta - 1$ along with the direction cosines identity $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1$, we find the sum is -1.

Question 107 Option (C) – $1/\sqrt{1-x^2}$

Explanation: Substituting $x = \sin \theta$ simplifies the expression inside the arctangent to $\theta - \pi/4$. Differentiating this expression with respect to x yields $1/\sqrt{1-x^2}$.

Question 108 Option (B) – 2

Explanation: Solving the trigonometric equation leads to $\sin x = 1/2$. In the interval $[0, 2\pi]$, this equation has exactly two valid solutions, $\pi/6$ and $5\pi/6$.

Question 109 Option (B) – $a^2 + b^2$

Explanation: The sum of the squares of any two semi-conjugate diameters of an ellipse is a constant equal to the sum of the squares of its semi-axes, $a^2 + b^2$.

Question 110 Option (A) – $e^x \left(\frac{1}{1+x^2} \right) + C$

Explanation: Splitting the integrand into the form $e^x[f(x) + f'(x)]$ where $f(x) = 1/(1+x^2)$ allows us to write the integral directly as $e^x f(x) + C$.

Question 111 Option (A) – $2 \cos \theta$

Explanation: Applying the double-angle identity $1 + \cos 4\theta = 2 \cos^2 2\theta$ twice under the nested square roots simplifies the entire expression to $2 \cos \theta$.

Question 112 Option (D) – 9.6

Explanation: Using linear approximation $f(x+h) \approx f(x) + hf'(x)$ around $x = 1$ with $h = 0.1$ yields an approximate value of 9.6.

Question 113 Option (A) – -2

Explanation: Comparing the coefficients with the general equation of a pair of straight lines and equating the sum and product of slopes yields $h = -2$.

Question 114 Option (B) – $\frac{1}{5} \begin{bmatrix} 5 & -4 \\ -2 & 1 \end{bmatrix}$

Explanation: Multiplying matrix A and B to find AB , and then computing the inverse using the determinant and adjoint of the matrix, yields the option.

Question 115 Option (B) – $2 \tan y = \tan x + \tan z$

Explanation: Since the sine terms are in arithmetic progression, applying trigonometric sum-to-product formulas shows that their tangents are also in arithmetic progression.

Question 116 Option (D) – 2.2475

Explanation: The variance is calculated using the formula $\text{Var}(X) = E(X^2) - [E(X)]^2$. Substituting the expected values from the distribution yields 2.2475.

Question 117 Option (A) – 300

Explanation: According to De Morgan's laws, $n(A' \cap B') = n((A \cup B)')$. Subtracting $n(A \cup B) = 400$ from the universal set size of 700 yields exactly 300.

Question 118 Option (D) – $\frac{7^{7^{7^x}}}{(\log 7)^3} + C$

Explanation: Using substitution method with $u = 7^{7^{7^x}}$, the derivative introduces a factor of $(\ln 7)^3$, making this option the correct indefinite integral.

Question 119 Option (D) – $x = 1, y = 2$

Explanation: Evaluating the objective function at each corner point of the feasible region shows that the maximum value of $Z = 14$ is achieved at the vertex (1, 2).

Question 120 Option (D) – $11 / 3$ units

Explanation: Using the perpendicular distance formula from a point to a plane, we substitute the coordinates of the point to obtain exactly $11/3$ units.

Question 121 Option (A) – e^8

Explanation: Evaluating the limit as x approaches zero using the standard exponential limit form yields e^4/e^{-4} , which simplifies to e^8 .

Question 122 Option (A) – 1

Explanation: Using the half-angle tangent identity for the sum of angles of a triangle $A+B+C = 180^\circ$, the sum of pairwise tangents of half-angles is always equal to 1.

Question 123 Option (A) – $\cos^{-1}(4/9)$

Explanation: The angle between the two lines is calculated using the dot product of their direction ratios, which yields a cosine value of exactly $4/9$.

Question 124 Option (B) – $xe^{\tan^{-1}x} + C$

Explanation: Differentiating the product $xe^{\tan^{-1}x}$ using the product rule produces the original integrand, verifying the indefinite integral's correctness.

Question 125 Option (A) – (1, 4)

Explanation: The coordinates of the mid-point of the chord are found by projecting the center of the circle onto the intersecting line, yielding the point (1, 4).

Question 126 Option (D) – $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + 2y = 0$

Explanation: Differentiating the given function twice to eliminate the arbitrary constants A and B yields the standard second-order linear differential equation.

Question 127 Option (B) – $10 / 3$ sq. units

Explanation: Integrating the function $y = x^2 + 1$ from the boundary limit $x = 1$ to $x = 2$ yields exactly $10/3$ square units of enclosed area.

Question 128 Option (D) – $1 / 2$

Explanation: For the tangent to be parallel to the X-axis, the derivative dy/dt must be zero while $dx/dt \neq 0$. This directly yields a parameter value of $t = 1/2$.

Question 129 Option (A) – $1 / 2$

Explanation: Using the derivative of inverse functions, since $f \circ g = I$, we differentiate both sides to find that $f'(b) = 1/g'(a) = 1/2$.

Question 130 Option (C) – $1/16$

Explanation: Since the sum of all probabilities in a probability mass function must equal one, we sum the combinations and solve for k to get $1/16$.

Question 131 Option (D) – $x^2 - 2px + q^2 = 0$

Explanation: A quadratic equation is represented as $x^2 - (\text{Sum of roots})x + (\text{Product of roots}) = 0$. Substituting the AM and GM values yields this equation.

Question 132 Option (C) – -7

Explanation: Computing A^2 and equating it to the linear combination $8A + kI$ allows us to solve for the scalar constant as $k = -7$.

Question 133 Option (D) – $3e^4$

Explanation: Integrating the differential equation $f'(x)/f(x) = 2$ and using the initial condition $f(0) = 3$ yields the solution $f(x) = 3e^{2x}$, so $f(2) = 3e^4$.

Question 134 Option (B) – $\sqrt{3}(x^2 + y^2) - 4xy = 0$

Explanation: The lines trisecting the first quadrant make angles of 30° and 60° with the X-axis. Combining their equations yields the joint equation.

Question 135 Option (D) – $\pi/4$

Explanation: Using the standard definite integral identity for symmetric limits, the integral of $\sin^2 x$ from 0 to $\pi/2$ evaluates to exactly $\pi/4$.

Question 136 Option (C) – 1

Explanation: Substituting $\cos^2 x = \sin x$ into the given algebraic expression reduces it to $(\sin^2 x + \sin x)^2$, which equals exactly 1.

Question 137 Option (D) – $(\sqrt{15} + \sqrt{157})$ units

Explanation: Computing the lengths of all three sides of the triangle from the given position vectors and summing them yields the total perimeter.

Question 138 Option (D) – 0

Explanation: Since the logarithm of $(8 - x)/(8 + x)$ is an odd function, its definite integral over the symmetric interval $[-4, 4]$ is exactly zero.

Question 139 Option (D) – $x^2 + 3x = 4$

Explanation: Setting the scalar triple product of the coplanar vectors to zero yields $\lambda = -4$, which is a root of the quadratic equation $x^2 + 3x = 4$.

Question 140 Option (D) – (d)

Explanation: Constructing the truth table for statement (d) shows that it evaluates to true under all possible truth values, making it a tautology.

Question 141 Option (C) – $93/256$

Explanation: The probability of getting heads more than tails is the sum of binomial probabilities for getting 5, 6, 7, or 8 heads, which is $93/256$.

Question 142 Option (D) – 7 units

Explanation: Setting the parametric coordinates of a point along the parallel line and substituting them into the plane equation yields a distance of 7 units.

Question 143 Option (D) – 30°

Explanation: Finding the slopes of the two lines and applying the tangent formula for the angle between two lines yields $\tan \theta = 1/\sqrt{3}$, or 30° .

Question 144 Option (B) – $\pi/12$

Explanation: Completing the square in the denominator and integrating using the arctangent formula over the definite limits $[-1, 2]$ yields exactly $\pi/12$.

Question 145 Option (B) – $16 / 3$ cu. units

Explanation: The volume of a tetrahedron is given by one-sixth of the scalar triple product of its coterminal edge vectors, which evaluates to $16/3$.

Question 146 Option (D) – $\sqrt{2}r$ units, $\sqrt{2}r$ units

Explanation: For any rectangle inscribed in a circle, a square maximizes the area. The dimensions of this square are exactly $\sqrt{2}r$ by $\sqrt{2}r$.

Question 147 Option (C) – $15 / 2$

Explanation: Using the section formula, we solve for the ratio in which the point P divides the line segment, which then gives the z-coordinate as $15/2$.

Question 148 Option (C) – F T T T

Explanation: The conjunction $p \wedge q$ is true only when both are true. Its negation $\sim (p \wedge q)$ is therefore false only in that single case, giving F T T T.

Question 149 Option (B) – $\tan 2A \tan 2B \tan 2C$

Explanation: Since $2A + 2B + 2C = 360^\circ$, we apply the standard trigonometric identity for three angles summing to a multiple of 180° .

Question 150 Option (B) – $50 \left(\frac{\log 3}{\log 2} \right)$ yrs

Explanation: Using the exponential growth model, we determine the growth constant from the doubling time of 50 years to find the tripling time.