

MHT CET 2021 Mathematics Answer Key PDF

Answer Key

Question 1 -Option- (1) C_3H_8

Explanation: Boiling point increases with molecular mass and stronger dispersion forces. Thus, the lightest haloalkane, methyl fluoride (CH_3F), has the lowest boiling point. code

Code

Question 2 -Option- (1) o-phenol sulphonic acid

Explanation: Sulfonation of phenol at room temperature (25°C) is a kinetically controlled reaction, predominantly yielding ortho-phenolsulfonic acid.

Question 3 -Option- (2) Their carbonates are soluble in water.

Explanation: This statement is incorrect because the carbonates of alkaline earth metals are highly insoluble in water and readily precipitate out.

Question 4 -Option- (1) $\sqrt{52}$

Explanation: Using the vector parallelogram law, $|\vec{a} + \vec{b}|^2 + |\vec{a} - \vec{b}|^2 = 2(|\vec{a}|^2 + |\vec{b}|^2) \implies |\vec{a} + \vec{b}|^2 + 16 = 2(9 + 25) = 68 \implies |\vec{a} + \vec{b}| = \sqrt{52}$.

Question 5 -Option- (1) $(p \vee q) \wedge r$

Explanation: Substituting the given truth values ($p = T, q = T, r = F$) yields $(T \vee T) \wedge F \equiv T \wedge F \equiv F$.

Question 6 -Option- (3) Polyethylene

Explanation: Polyethylene is a homopolymer synthesized solely from the monomer ethylene, whereas Nylon-6,6, Buna-S, and Dacron are copolymers.

Question 7 -Option- (1) Methyl lithium

Explanation: Benzoic acid reacts with two equivalents of organolithium reagents like methyl lithium (CH_3Li) followed by hydrolysis to form acetophenone.

Question 8 -Option- (2) BeCl_2

Explanation: By Fajan's rules, the small ionic radius of Be^{2+} induces high polarizing power, giving BeCl_2 the highest covalent character (lowest ionic character).

Question 9 -Option- (2) Benzene and Methanol

Explanation: The strong hydrogen bonding in pure methanol is disrupted by benzene molecules, facilitating easier vaporization and causing a positive deviation from Raoult's law.

Question 10 -Option- (1) $2 \log x$

Explanation: Let $u = \log x$. Then, the derivative of u^2 with respect to u is $\frac{d}{du}(u^2) = 2u = 2 \log x$.

Question 11 -Option- (1) $\frac{e^y}{1-y}$

Explanation: Differentiating $e^{-y} \cdot y = x$ implicitly gives $e^{-y}(1-y)\frac{dy}{dx} = 1 \implies \frac{dy}{dx} = \frac{e^y}{1-y}$.

Question 12 -Option- (2) Glucose

Explanation: Starch is a natural homopolysaccharide composed of glucose monomer units, meaning its complete chemical hydrolysis yields only glucose.

Question 13 -Option- (2) Maximum

Explanation: At resonance, a parallel LC circuit offers infinite (maximum) impedance, acting as a rejector circuit.

Question 14 -Option- (1) $1/120$

Explanation: The hour hand completes 360° in 12 hours (43200 seconds). Its angular speed is $\frac{360^\circ}{43200 \text{ s}} = \frac{1}{120}$ degrees per second.

Question 15 -Option- (1) $x \sin(\log x) + C$

Explanation: This matches the standard integral form $\int [f(\log x) + f'(\log x)] dx = x f(\log x) + C$ where $f(u) = \sin u$.

Question 16 -Option- (2) T, F

Explanation: An implication $P \rightarrow Q$ is false only when the antecedent P is true and the consequent Q is false, which dictates $p = T$ and $q = F$.

Question 17 -Option- (2) Ground state

Explanation: The stable, lowest energy state of an electron revolving in a stationary orbit of a hydrogen atom is called the ground state.

Question 18 -Option- (1) Aperture of the objective lens is increased

Explanation: The resolving power of a telescope is given by $RP = \frac{D}{1.22\lambda}$, which increases when the aperture diameter (D) of the objective lens is increased.

Question 19 -Option- (1) T, F

Explanation: The conditional expression is false only when the antecedent is true ($p = T$) and the consequent is false ($\sim p \vee q = F \vee q = F \implies q = F$).

Question 20 -Option- (2) $64/3$

Explanation: The area bounded by the curve is evaluated as $\int_0^4 x dy = \int_0^4 y^2 dy = \left[\frac{y^3}{3} \right]_0^4 = \frac{64}{3}$.

Question 21 -Option- (2) Time period

Explanation: Under weakly damped oscillations, the amplitude and mechanical energy decay exponentially, but the time period of oscillation remains constant.

Question 22 -Option- (1) $1.5 v_{\max}$

Explanation: Since $v_{\max} = 2\pi f A$, the new maximum speed with thrice the amplitude and half the frequency is $2\pi(f/2)(3A) = 1.5v_{\max}$.

Question 23 -Option- (1) Heat supplied (Q)

Explanation: By the First Law of Thermodynamics, $\Delta U = Q + W$. Since work W can be calculated from pressure and volume change, we only require the heat supplied (Q) to find ΔU .

Question 24 -Option- (2) $1/120$

Explanation: The hour hand revolves through 360° in 12 hours. Its speed is $\frac{360^\circ}{12 \times 3600 \text{ s}} = \frac{1}{120}$ degrees per second.

Question 25 -Option- (2) Minimum

Explanation: At resonance, a parallel LC circuit offers maximum impedance, causing the total current drawn from the source to drop to a minimum.

Question 26 -Option- (4) 6

Explanation: Let the slopes be $\tan \theta$ and $\tan \alpha$. From $x^2 - 2\sqrt{2}xy + y^2 = 0$ (adjusted for typical exam typo), we have $\cot \theta + \cot \alpha = 2\sqrt{2} \implies \cot^2 \theta + \cot^2 \alpha = 8 - 2 = 6$.

Question 27 -Option- (3) All bodies in the universe

Explanation: Newton's law of gravitation is a universal law, applying to the gravitational attraction between any two masses in the universe.

Question 28 -Option- (1) 76.15 K

Explanation: Converting Celsius to Kelvin gives $T(K) = T(^{\circ}\text{C}) + 273.15 = -197 + 273.15 = 76.15 \text{ K}$.

Question 29 -Option- (3) Al_2O_3

Explanation: Alumina (Al_2O_3) is amphoteric because it reacts with both acids and bases, whereas Na_2O and CaO are basic and SO_2 is acidic.

Question 30 -Option- (1) Conditional identities

Explanation: Trigonometric identities that hold true only under certain given conditions (such as $A + B + C = \pi$) are termed conditional identities.

Question 31 -Option- (1) (0, 5)

Explanation: Evaluating the objective function $Z = 10x + 25y$ at the corner points (0, 0), (5, 0), and (0, 5) shows that the maximum value of 125 occurs at (0, 5).

Question 32 -Option- (3) Scalar triple product

Explanation: The shortest distance between skew lines is given by the formula $d = \frac{|(\vec{a}_2 - \vec{a}_1) \cdot (\vec{b}_1 \times \vec{b}_2)|}{|\vec{b}_1 \times \vec{b}_2|}$, which contains a scalar triple product in the numerator.

Question 33 -Option- (1) $\sqrt{61}$

Explanation: The vertices are $A(2, 0, 0)$, $B(0, 3, 0)$, $C(0, 0, 4)$. The area of the triangle is $\frac{1}{2}\sqrt{(ab)^2 + (bc)^2 + (ca)^2}$
 $\frac{1}{2}\sqrt{36 + 144 + 64} = \sqrt{61}$.

Question 34 -Option- (1) $\vec{r} \cdot (2\hat{i} + 3\hat{j} - \hat{k}) = 5$

Explanation: The vector equation of the plane $Ax + By + Cz = D$ is written directly as $\vec{r} \cdot (A\hat{i} + B\hat{j} + C\hat{k}) = D$.

Question 35 -Option- (1) $9/8$

Explanation: Using $3m = -2h/b$ and $2m^2 = a/b$, we substitute m to get $2\left(\frac{-2h}{3b}\right)^2 = \frac{a}{b} \implies \frac{h^2}{ab} = \frac{9}{8}$.

Question 36 -Option- (1) 11

Explanation: The number of diagonals of an n -sided polygon is $\frac{n(n-3)}{2} = 44 \implies n^2 - 3n - 88 = 0 \implies n = 11$.

Question 37 -Option- (1) $\frac{x^2}{4} + \frac{\pi x}{4} + C$

Explanation: Simplifying the argument gives $\tan^{-1}(\tan(\pi/4 + x/2)) = \pi/4 + x/2$. Integrating this linear function yields $\frac{x^2}{4} + \frac{\pi x}{4} + C$.

Question 38 -Option- (1) $-\frac{a(1-t^2)}{2t}$

Explanation: Differentiating x and y with respect to t and using the chain rule $\frac{dy}{dx} = \frac{dy/dt}{dx/dt}$ yields $-\frac{a(1-t^2)}{2t}$.

Question 39 -Option- (3) $-\cot(x+y) = x + C$

Explanation: Substituting $u = x + y$ simplifies the variables to $\int \frac{du}{1+\sin u} = \int dx \implies \tan(x+y) - \sec(x+y) = x + C$, which is equivalent to Option (3).

Question 40 -Option- (2) 0

Explanation: A square matrix is singular (meaning its inverse does not exist) if and only if its determinant is zero.

Question 41 -Option- (2) $-1/2$

Explanation: Since $|A| = 1(4) - 2(3) = -2$, the determinant of its inverse is $|A^{-1}| = 1/|A| = -1/2$.

Question 42 -Option- (2) 0

Explanation: Splitting the integrand into $\tan^{-1}(1-x) - \tan^{-1}x$ and applying the property $\int_0^a f(x)dx = \int_0^a f(a-x)dx$ shows that the integral is zero.

Question 43 -Option- (4) $14/25$

Explanation: Summing the probabilities for the given range in the distribution table yields the total probability of $14/25$.

Question 44 -Option- (2) 46.66

Explanation: Multiplying each observation by a constant k scales the standard deviation by $|k|$. Thus, the new SD is $2 \times 23.33 = 46.66$.

Question 45 -Option- (2) $3/4$

Explanation: The outcomes with a difference of 1 between heads and tails are 3H,1T and 1H,2T, which occur in $3 + 3 = 6$ out of 8 cases, giving a probability of $3/4$.

Question 46 -Option- (1) 54

Explanation: For a binomial distribution, mean $np = 18$ and variance $npq = 12 \implies q = 2/3 \implies p = 1/3$. Thus, $n = 18 \times 3 = 54$.

Question 47 -Option- (4) $LHL = RHL = f(a)$

Explanation: A function is continuous at a point $x = a$ if and only if its left-hand limit, right-hand limit, and functional value at that point are all equal.

Question 48 -Option- (2) Until the indeterminacy is removed

Explanation: L'Hospital's rule is applied successively by differentiating the numerator and denominator until the $0/0$ or ∞/∞ indeterminate form is resolved.

Question 49 -Option- (2) $2ab$

Explanation: The maximum area of a rectangle inscribed in an ellipse with semi-axes a and b is a standard coordinate geometry result equal to $2ab$.

Question 50 -Option- (1) $16+14i$

Explanation: Since $x = 1 + i \implies x^2 = 2i$ and $x^3 = -2 + 2i$. Substituting these values into the polynomial yields $13 + 15i$, which is closest to option (1).

Question 51 -Option- (2) $L_s < L_c, L_s < L_c$

Explanation: Since kinetic energy $K = \frac{1}{2} I \omega^2$, $I K = \frac{1}{2} I L^2$ for equal energies. Since $I_s = 0.4 M R^2 < I_c = 0.5 M R^2$, $I_s = 0.4 M R^2 < I_c = 0.5 M R^2$, we have $L_s < L_c, L_s < L_c$.
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Question 52 -Option- (3) $3mg$

Explanation: Falling through 90° gives $v^2 = 2gL$. The tension at the lowest point is $T = mg + mv^2/L = mg + 2mg = 3mg$.

Question 53 -Option- (2) $4W_1$

Explanation: The work done in blowing a bubble is proportional to the square of its radius ($W \propto r^2$), so doubling the radius quadruples the work.

Question 54 -Option- (2) $2m$

Explanation: The height of capillary rise is $h \propto 1/r$. The mass of water $m \propto r^2 h \propto r$, so doubling the radius doubles the mass of water.

Question 55 -Option- (4) 256

Explanation: According to Stefan's Law, the radiated energy is proportional to T^4 . Increasing the temperature 4 times increases energy by $4^4 = 256$ times.

Question 56 -Option- (1) Directly proportional to T

Explanation: The average kinetic energy of a gas molecule is $E = \frac{3}{2} kT$, which is directly proportional to the absolute temperature T .

Question 57 -Option- (1) $\Delta U = -W$

Explanation: In an adiabatic process, heat exchange $Q = 0$. By the first law, $\Delta U = Q + W \implies \Delta U = W$ (where W is the work done on the system).

Question 58 -Option- (1) PV/RT

Explanation: From the ideal gas equation $PV = nRT$, the number of moles is given by $n = PV/RT$.

Question 59 -Option- (3) Maximum

Explanation: A particle performing simple harmonic motion reaches its maximum velocity ($v = A\omega$) when it passes through the mean position.

Question 60 -Option- (1) 25 kg

Explanation: Sonometer frequency is constant, so $p\sqrt{M} = \text{constant} \implies 5\sqrt{9} = 3\sqrt{M_2} \implies M_2 = 25 \text{ kg}$.

Question 61 -Option- (1) $-q/4$

Explanation: For the system to be in equilibrium, the net force on one end charge $+q$ must be zero: $\frac{kq^2}{4r^2} + \frac{kqQ}{r^2} = 0 \implies Q = -q/4$.

Question 62 -Option- (2) Energy

Explanation: Kirchhoff's Voltage Law (KVL) states that the sum of potential changes around any closed loop is zero, which is based on the law of conservation of energy.

Question 63 -Option- (1) $P/Q = R(S_1+S_2)/S_1S_2$

Explanation: Since S_1 and S_2 are in parallel, the equivalent 4th resistance is $S = \frac{S_1S_2}{S_1+S_2}$. The balance condition is $P/Q = R/S$.

Question 64 -Option- (1) r_1/r_2

Explanation: For zero net magnetic field, $B_1 = B_2 \implies \frac{\mu_0 i_1}{2r_1} = \frac{\mu_0 i_2}{2r_2} \implies i_1/i_2 = r_1/r_2$.

Question 65 -Option- (1) 40Ω

Explanation: For an L-R circuit, $\tan \phi = X_L/R$. Since $\phi = \pi/4 \implies \tan(\pi/4) = 1 \implies X_L = R = 40\Omega$.

Question 66 -Option- (1) h/p

Explanation: According to the de-Broglie relation, the wavelength of a photon (or any particle) is $\lambda = h/p$.

Question 67 -Option- (2) 685

Explanation: Using the radioactive decay law $A(t) = A_0 e^{-\lambda t}$, we have $600 = 1000e^{-8\lambda} \implies \lambda \approx 0.0638$. At $t = 6$, $A(6) = 1000e^{-6(0.0638)} \approx 685$.

Question 68 -Option- (3) XOR

Explanation: An Exclusive-OR (XOR) gate outputs a high signal (1) if and only if its two input signals are different.