MHT CET 2019 Mathematics Answer Key PDF

Question 1 Option: (b) – 1/3
Explanation: Using the binomial distribution formulas for mean and variance, we have $np = 18$ and $npq = 12$, which gives $q = 2/3$. Since $p + q = 1$, the value of p is $1 - 2/3 = 1/3$.

Question 2 Option: (c) – 9/2
Explanation: For two lines to intersect, the vectors formed by their directions and the line joining their given points must be coplanar. Setting their determinant to zero and solving for λ yields $\lambda = 9/2$.

Question 3 Option: (d) – $y = e^x$
Explanation: Rewriting the differential equation gives $dy/dx = e^x$, which integrates to $y = e^x + c$. Substituting the initial conditions $x = 0$ and $y = 1$ yields $c = 0$, so the particular solution is $y = e^x$.

Question 4 Option: (d) – ± 8
Explanation: For $f(x)$ to be continuous at $x = 0$, the limit $\lim_{x\to 0} f(x)$ must equal $f(0) = 16$. Evaluating this limit gives $k^2/4 = 16 \implies k^2 = 64$, which yields $k = \pm 8$.

Question 5 Option: (b) – $x = ye^x$
Explanation: Dividing both sides of the differential equation by xy yields $dx/x - dy/y = dx$. Integrating both sides gives $\log(x/y) = x + c$, which simplifies to the general solution $x = ye^x$ when the arbitrary constant is zero.

Question 6 Option: (a) – 72
Explanation: By plotting the constraints of the feasible region, we obtain the corner points $(0, 0)$, $(3, 3)$, and $(12, 0)$. Evaluating the objective function $z = 6x + 8y$ at these vertices shows that the maximum value is 72 at $(12, 0)$.

Question 7 Option: (a) – 20
Explanation: The given summation simplifies to the quadratic equation $n^2 + 2n = 440$, which can be rearranged to $(n + 22)(n - 20) = 0$. Since n must be positive, we find $n = 20$.

Question 8 Option: (c) – $(p \to q) \vee (r \leftrightarrow s)$
Explanation: Substituting the truth values of p, q as True and r, s as False into the logical expression $(p \to q) \vee (r \leftrightarrow s)$ yields $(T \to T) \vee (F \leftrightarrow F) \equiv T \vee T \equiv T$.

Question 9 Option: (b) – $3p(1 + 2p)$
Explanation: Using the relation $E(X^2) = \mathrm{Var}(X) + [E(X)]^2$, we substitute $\mathrm{Var}(X) = 3pq$ and $E(X) = 3p$ to get $3pq + 9p^2$. Replacing $q = 1 - p$ simplifies this expression to $3p(1 + 2p)$.

Question 10 Option: (c) – 0
Explanation: For values of x immediately to the right of 1, the greatest integer function is constant at $f(x) = 1$. The right-hand derivative $f'(1^+)$ is the derivative of this constant function, which is 0.

Question 11 Option: (c) – $3\pi/2$
Explanation: For two lines $ax^2 + 2hxy + by^2 = 0$ to be perpendicular, $a + b = 0 \implies \sin^2\theta + 2\sin\theta + 1 = 0$. This factors to $(\sin\theta + 1)^2 = 0 \implies \sin\theta = -1$, which gives the solution $\theta = 3\pi/2$ in $[0, 2\pi]$.

Question 12 Option: (b) – $\{2, 5\}$
Explanation: The set $A = \{2, 3, 5, 7, 11\}$ and $B = \{1, 2, 5, 10\}$. The intersection $A \cap B$ represents the elements common to both sets, which are $\{2, 5\}$.

Question 13 Option: (b) – $abc/4R$
Explanation: From the standard formulas for a triangle, the area of $\triangle ABC$ is given by $\Delta = \frac{abc}{4R}$, where a, b, c are the side lengths and R is the circumradius.

Question 14 Option: (b) – $(2, 3\pi/4)$
Explanation: The radial distance is $r = \sqrt{(-\sqrt{2})^2 + (\sqrt{2})^2} = 2$. Since the point lies in the second quadrant, the angle is $\theta = \pi - \tan^{-1}(1) = 3\pi/4$, giving the polar coordinates $(2, 3\pi/4)$.

Question 15 Option: (a) – 6
Explanation: Using the substitution $t = \sin x + \cos x$, we get $dt = (\cos x - \sin x)dx$ and $8 - \sin 2x = 9 - t^2$. Integrating $\int \frac{dt}{9-t^2}$ yields $\frac{1}{6} \log |\frac{3+t}{3-t}| + c$, which gives $p = 6$.

Question 16 Option: (a) – $2A$
Explanation: Expanding the given matrix equation gives $A^2 - I = 0 \implies A^2 = I$. Multiplying both sides by A^{-1} yields $A = A^{-1}$, which means that $A + A^{-1} = A + A = 2A$.

Question 17 Option: (d) – $x - 2y + 2z = 0$, $x - 2y + 2z - 6 = 0$
Explanation: Let the parallel plane be $x - 2y + 2z + k = 0$. Setting the perpendicular distance from $(1, 2, 3)$ to 1 gives $|k + 3|/3 = 1 \implies k = 0$ or $k = -6$, yielding the two equations.

Question 18 Option: (b) – 13
Explanation: The slope of the perpendicular line is $m = -2$. The equation of the line passing through $A(6, 1)$ with this slope is $2x + y = 13$, which gives a y-intercept of 13 at $x = 0$.

Question 19 Option: (a) – 3
Explanation: In any triangle, $\tan A + \tan B + \tan C = \tan A \tan B \tan C$. Substituting the given sum of 6 and product of 2 yields $6 = 2 \tan C \implies \tan C = 3$.

Question 20 Option: (a) – 0
Explanation: For a right angle at Q, the dot product of the vectors $\vec{QP} = (5, 10, 15)$ and $\vec{QR} = (5, -10, \lambda + 5)$ must be zero. Solving $25 - 100 + 15(\lambda + 5) = 0$ yields $\lambda = 0$.

Question 21 Option: (b) – Unbounded solution
Explanation: Plotting the constraints reveals that the feasible region is unbounded and extends infinitely in the positive direction of both axes. Thus, the objective function $z = 4x_1 + 2x_2$ has no finite maximum value.

Question 22 Option: (a) – increasing in $(-\infty, -1) \cup (1, \infty)$ and decreasing in $(-1, 1)$
Explanation: The derivative $f'(x) = 3(x-1)(x+1)$. Solving $f'(x) > 0$ gives $(-\infty, -1) \cup (1, \infty)$ for increasing intervals, and solving $f'(x) < 0$ gives $(-1, 1)$ for the decreasing interval.

Question 23 Option: (b) – 6
Explanation: Expressing y in terms of x gives $y = x^3$, which has a second derivative of $\frac{d^2y}{dx^2} = 6x$. Since $x = \sin(\pi/2) = 1$ at $\theta = \pi/2$, the value of the second derivative is 6.

Question 24 Option: (a) – 20 square units
Explanation: The lines decompose to the coordinate axes $x = 0, y = 0$ and the lines $x = 4, y = -5$. This bounds a rectangle in the fourth quadrant of dimensions 4×5, giving an area of 20 square units.

Question 125 Option: (b) – 53/54
Explanation: The only sums less than 5 are 3 (1 way) and 4 (3 ways). Subtracting these 4 unfavorable outcomes from the total of 216 possibilities gives a probability of $212/216 = 53/54$.

Question 26 Option: (d) – 9
Explanation: Equating the composite functions gives $3(4x + k) + 6 = 4(3x + 6) + k$. Simplifying this linear equation in k yields $2k = 18 \implies k = 9$.

Question 27 Option: (c) – 2/3
Explanation: From the infinite G.P. sum formula, $a = 9(1 - r)$. Substituting this into the sum of the first two terms $a(1 + r) = 5$ yields $9(1 - r^2) = 5 \implies r^2 = 4/9 \implies r = 2/3$.

Question 28 Option: (a) – $\exists n \in \mathbb{N}$, such that $n + 7 \leq 6$
Explanation: The negation of a universal quantifier $\forall$ is the existential quantifier $\exists$, and the negation of the inequality $>$ is $\leq$. This directly gives the statement in option (a).

Question 29 Option: (b) – -9/7
Explanation: Since the vectors are collinear, their components are proportional: $x/1 = -3/y = 7/-z$. Solving for y and z in terms of x and substituting into the expression yields $-9/7$.

Question 30 Option: (a) – -3/2
Explanation: Using the trigonometric identity for $\tan(A+B)$, the integrand simplifies to $\tan 2x - \tan(x+a) - \tan(x-a)$. Integrating this gives $p = 1/2, q = -1, andr = -1$, whose sum is $-3/2$.

Question 31 Option: (a) – 3.96
Explanation: Using linear approximation $f(a+h) \approx f(a) + hf'(a)$ with $a = 3$ and $h = -0.01$ for $f(x) = (x-1)^2$ yields $4 + (-0.01)(4) = 3.96$.

Question 32 Option: (b) – 56 units
Explanation: The particle reverses direction when $v = dx/dt = 27 - 3t^2 = 0 \implies t = 3$. Evaluating the position at this instant gives $x(3) = 2 + 27(3) - 3^3 = 56$ units.

Question 33 Option: (d) – $\vec{v} \cdot (\vec{u} \times \vec{w})$
Explanation: The scalar triple product $\vec{w} \cdot (\vec{u} \times \vec{v}) = [\vec{w}\ \vec{u}\ \vec{v}]$, which is cyclic. Option (d) represents $[\vec{v}\ \vec{u}\ \vec{w}] = -[\vec{w}\ \vec{u}\ \vec{v}]$, making it the incorrect match.

Question 34 Option: (b) – $\frac{\sqrt{5}-1}{4}$
Explanation: By using the multiple-angle trigonometric formula for $\sin(5\theta) = 0$ with $\theta = 18°$, we derive the standard value of $\sin 18° = \frac{\sqrt{5}-1}{4}$.

Question 35 Option: (b) – $4x - 2y - 5z = 45$
Explanation: The normal vector to the plane is $\vec{n} = (4, -2, -5)$. The equation of the plane passing through the point $(4, -2, -5)$ is $4(x-4) - 2(y+2) - 5(z+5) = 0 \implies 4x - 2y - 5z = 45$.

Question 36 Option: (d) – $\tan^{-1}\left(\frac{x^2-1}{x}\right) + c$
Explanation: Dividing the numerator and denominator by x^2 and substituting $t = x - 1/x$ transforms the integral to $\int \frac{dt}{t^2+1} = \tan^{-1}(t) + c = \tan^{-1}((x^2-1)/x) + c$.

Question 37 Option: (c) – 0
Explanation: Taking logarithms on both sides gives $y = \frac{x}{1+\log x}$. Differentiating with respect to x and substituting $x = 1$ yields a derivative value of 0.

Question 38 Option: (d) – 4 I
Explanation: Using the property $A(\text{adj } A) = |A|I$, we calculate the determinant of A as $(1+2i)(1-2i) - i(-i) = 1 + 4 - 1 = 4$, yielding the resulting matrix $4I$.

Question 39 Option: (c) – $(p \vee q) \wedge \sim q$
Explanation: A statement is a contingency if its truth value depends on the inputs. Applying truth table verification shows that $(p \vee q) \wedge \sim q$ is neither a tautology nor a contradiction.

Question 40 Option: (b) – $(b-a)/2$
Explanation: Applying the integration property $\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$ and adding the two integrals simplifies the integrand to 1, yielding the standard result $(b-a)/2$.

Question 41 Option: (a) – $x^2 + y^2 - 6x - 4y + 4 = 0$
Explanation: The concentric circle has the same center $(3, 2)$. Since it touches the Y-axis, its radius must be 3, giving the equation $(x-3)^2 + (y-2)^2 = 9 \implies x^2 + y^2 - 6x - 4y + 4 = 0$.

Question 42 Option: (b) – 1/42
Explanation: Using the property $\int_0^a f(x)dx = \int_0^a f(a-x)dx$ transforms the integral to $\int_0^1 (1-x)x^5 dx = [x^6/6 - x^7/7]_0^1 = 1/6 - 1/7 = 1/42$.

Question 43 Option: (c) – 0
Explanation: Using $\sin^{-1} x + \cos^{-1} x = \pi/2$ allows us to rewrite the equation as $4(\pi/2) + 2\cos^{-1} x = 3\pi \implies \cos^{-1} x = \pi/2 \implies x = 0$.

Question 44 Option: (d) – πa
Explanation: Substituting $x = a\sin^2\theta$ converts the integral to $2a\int_0^{\pi/2}\cos^2\theta d\theta = \pi a/2$. Equating this to $K/2$ directly yields $K = \pi a$.

Question 45 Option: (c) – a
Explanation: Applying the sine rule $b = k\sin B$ and $c = k\sin C$ simplifies the numerator to $k(\sin^2 B - \sin^2 C) = k\sin(B+C)\sin(B-C)$. This reduces the expression to $k\sin A = a$.

Question 46 Option: (a) – $\theta = \theta_0 + ae^{-kt}$
Explanation: Separating variables gives $\frac{d\theta}{\theta-\theta_0} = -kdt$. Integrating both sides yields $\log(\theta - \theta_0) = -kt + c'$, which simplifies to $\theta = \theta_0 + ae^{-kt}$.