MHT-CET 2021 Question Paper

20th September 2021

1. The logical expression $p \wedge (\sim p \vee \sim q) \wedge q \equiv$
(A) $p \vee q$ (B) T
(C) F (D) $p \wedge q$

2. If $x = a\cos\theta$ and $y = b\sin\theta$, then $\left[\frac{d^2y}{dx^2}\right]_{\theta=\frac{\pi}{4}} =$
(A) $-2\sqrt{2}\left(\frac{b}{a^2}\right)$ (B) $\sqrt{2}\left(\frac{a^2}{b}\right)$
(C) $2\sqrt{2}\left(\frac{b}{a^2}\right)$ (D) $2\left(\frac{a^2}{b}\right)$

3. The parametric equations of a line passing through the points A(3, 4, –7) and B(1, –1, 6) are
(A) $x = 1+3\lambda$, $y = -1+4\lambda$, $z = 6-7\lambda$
(B) $x = 3+\lambda$, $y = -1+4\lambda$, $z = -7+6\lambda$
(C) $x = 3-2\lambda$, $y = 4-5\lambda$, $z = -7+13\lambda$
(D) $x = -2+3\lambda$, $y = -5+4\lambda$, $z = 13-7\lambda$

4. If $X \sim B(4, p)$ and $P(X = 0) = \frac{16}{81}$, then $P(X = 4) =$
(A) $\frac{1}{27}$ (B) $\frac{1}{16}$ (C) $\frac{1}{81}$ (D) $\frac{1}{8}$

5. If $\int \frac{1+x^2}{1+x^4}\,dx = \frac{1}{\sqrt{2}}\tan^{-1}\left[\frac{f(x)}{\sqrt{2}}\right] + c$, then $f(x) =$
(A) $x - \frac{1}{x}$ (B) $x + \frac{2}{x}$
(C) $x - \frac{1}{x^2}$ (D) $x + \frac{1}{x^2}$

6. The value of $(1 + i)^5 (1 - i)^7$ is
(A) –64i (B) 64 (C) 64i (D) –64

7. The value of sin18° is
(A) $\frac{4}{\sqrt{5}+1}$ (B) $\frac{4}{\sqrt{5}-1}$
(C) $\frac{\sqrt{5}+1}{4}$ (D) $\frac{\sqrt{5}-1}{4}$

8. Rajesh has just bought a VCR from Maharashtra Electronics. Maharashtra Electronics offers after sales service contract for ₹1000.00 for the next five years. Considering the experience of VCR users, the following distribution of maintainance expenses for the next five years is formed.

Expenses	0	500	1000	1500	2000	2500	3000
Probability	0.35	0.25	0.15	0.10	0.08	0.05	0.02

The expected value of maintainance cost is
(A) ₹ 800/- (B) ₹ 700/-
(C) ₹ 770/- (D) ₹ 900/-

9. If $x \in \left(0, \frac{\pi}{2}\right)$ and x satisfies the equation $\sin x \cos x = \frac{1}{4}$, then the values of x are
(A) $\frac{\pi}{12}, \frac{5\pi}{12}$ (B) $\frac{\pi}{8}, \frac{3\pi}{8}$
(C) $\frac{\pi}{8}, \frac{\pi}{4}$ (D) $\frac{\pi}{6}, \frac{\pi}{12}$

10. The joint equation of the pair of lines through the origin and making an equilateral triangle with the line $x = 3$ is
(A) $\sqrt{3}x^2 - 2xy + y^2 = 0$
(B) $3x^2 - y^2 = 0$
(C) $x^2 + 2xy - \sqrt{3}y^2 = 0$
(D) $x^2 - 3y^2 = 0$

11. The slope of the line through the origin which makes an angle of 30° with the positive direction of y-axis measured anticlockwise is
(A) $\frac{-1}{\sqrt{3}}$ (B) $\frac{\sqrt{3}}{2}$
(C) $-\sqrt{3}$ (D) $\frac{-2}{\sqrt{3}}$

12. The Area of the region bounded by the parabola $x^2 = y$ and the line $y = x$ is
(A) $\frac{1}{2}$ sq. units (B) $\frac{1}{6}$ sq. units
(C) $\frac{1}{3}$ sq. units (D) $\frac{5}{6}$ sq. units

13. If $h(x) = \sqrt{4f(x) + 3g(x)}$, $f(1) = 4$, $g(1) = 3$, $f'(1) = 3$, $g'(1) = 4$, then $h'(1) =$
(A) $\frac{-5}{12}$ (B) $\frac{-12}{7}$
(C) $\frac{5}{12}$ (D) $\frac{12}{5}$

14. If $A = \begin{bmatrix} 3 & 2 & 4 \\ 1 & 2 & 1 \\ 3 & 2 & 6 \end{bmatrix}$ and A_{ij} are cofactors of the elements a_{ij} of A, then $a_{11}A_{11} + a_{12}A_{12} + a_{13}A_{13}$ is equal to
(A) 4 (B) 8
(C) 6 (D) 0

15. An ice ball melts at the rate which is proportional to the amount of ice at that instant. Half the quantity of ice melts in 20 minutes. x_0 is the initial quantity of ice. If after 40 minutes the amount of ice left is Kx_0, then K =

(A) $\frac{1}{2}$ (B) $\frac{1}{8}$ (C) $\frac{1}{4}$ (D) $\frac{1}{3}$

16. A random variable X has the following probability distribution.

X = x	0	1	2	3	4	5	6	7
P [X = x]	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2 + k$

Then F(4) =

(A) $\frac{3}{10}$ (B) $\frac{1}{10}$

(C) $\frac{7}{10}$ (D) $\frac{4}{5}$

17. If $(2\hat{i}+6\hat{j}+27\hat{k})\times(\hat{i}+\lambda\hat{j}+\mu\hat{k})=\bar{O}$, then λ and μ are respectively

(A) $\frac{17}{2}, 3$ (B) $\frac{27}{2}, 3$

(C) $3, \frac{27}{2}$ (D) $3, \frac{17}{2}$

18. $\lim_{x\to\infty}\left(\sqrt{x^2+5x-7}-x\right)=$

(A) 5 (B) 6

(C) $\frac{7}{2}$ (D) $\frac{5}{2}$

19. With usual notations if the angles of a triangle are in the ratio 1 : 2 : 3, then their corresponding sides are in the ratio

(A) $1:\sqrt{3}:3$ (B) $1:\sqrt{3}:2$

(C) 1 : 2 : 3 (D) $\sqrt{2}:\sqrt{3}:3$

20. $\int \tan^{-1}(\sec x + \tan x)\, dx =$

(A) $\frac{\pi x}{2}+\frac{x^2}{2}+c$ (B) $\frac{\pi x}{4}+\frac{x^2}{4}+c$

(C) $\sin x + x + c$ (D) $\sin x \cos x + c$

21. The equation of the tangent to the curve $y = 4xe^x$ at $\left(-1, \frac{-4}{e}\right)$ is

(A) $x = -1$ (B) $x - \frac{e}{4}y = 0$

(C) $y = \frac{-4}{e}$ (D) $6x - \frac{e}{4}y = -5$

22. Two dice are rolled simultaneously. The probability that the sum of the two numbers on the dice is a prime number, is

(A) $\frac{7}{12}$ (B) $\frac{5}{12}$ (C) $\frac{7}{11}$ (D) $\frac{5}{11}$

23. If the acute angle beween the lines given by $ax^2 + 2hxy + by^2 = 0$ is $\frac{\pi}{4}$, then $4h^2 =$

(A) $a^2 + 6ab + b^2$ (B) $a^2 + 4ab + b^2$

(C) (a – 2b) (2a + b) (D) (a + 2b) (a + 3b)

24. All the letters of the word 'ABRACADABRA' are arranged in different possible ways. Then the number of such arrangements in which the vowels are together is

(A) 1220 (B) 1240

(C) 1260 (D) 1200

25. If $y = \log \tan\left(\frac{x}{2}\right) + \sin^{-1}(\cos x)$, then $\frac{dy}{dx} =$

(A) $\sin x + 1$ (B) x

(C) $\operatorname{cosec} x - 1$ (D) $\operatorname{cosec} x$

26. If $\bar{a}, \bar{b}, \bar{c}$ are three vectors which are perpendicular to $\bar{b}+\bar{c}, \bar{c}+\bar{a}$ and $\bar{a}+\bar{b}$ respectively, such that $|\bar{a}| = 2, |\bar{b}| = 3, |\bar{c}| = 4$, then $|\bar{a}+\bar{b}+\bar{c}| =$

(A) 29 (B) $\sqrt{29}$

(C) 3 (D) 9

27. If $\int_0^{\frac{\pi}{2}} \frac{dx}{5+4\sin x} = A\tan^{-1}B$, then A + B =

(A) $\frac{1}{3}$ (B) $\frac{2}{3}$

(C) 1 (D) 2

28. If inverse of $\begin{bmatrix} 1 & 2 & x \\ 4 & -1 & 7 \\ 2 & 4 & -6 \end{bmatrix}$ does not exist, then x =

(A) –3 (B) 3

(C) 2 (D) 0

29. The general solution of the differential equation $\frac{dy}{dx} = \frac{x+y+1}{x+y-1}$ is given by

(A) $y = x + \log(x + y) + c$

(B) $x - y = \log(x + y) + c$

(C) $x + y = \log(x + y) + c$

(D) $y = x \log(x + y) + c$

30. $\int_0^{\frac{\pi}{4}} \log(1+\tan x)\, dx =$

(A) $\frac{\pi}{16}\log 2$ (B) $\frac{\pi}{8}\log 2$

(C) $\frac{\pi}{4}\log 2$ (D) $\pi \log 2$

31. A differential equation for the temperature 'T' of a hot body as a function of time, when it is placed in a bath which is held at a constant temperature of 32° F, is given by (where k is a constant of proportionality)

(A) $\frac{dT}{dt} = kT + 32$ (B) $\frac{dT}{dt} = 32kT$

(C) $\frac{dT}{dt} = kT - 32$ (D) $\frac{dT}{dt} = -k(T - 32)$

32. The negation of a statement '$x \in A \cap B \rightarrow (x \in A \text{ and } x \in B)$' is

(A) $x \in A \cap B \rightarrow (x \in A \text{ or } x \in B)$

(B) $x \in A \cap B \text{ or} (x \in A \text{ and } x \in B)$

(C) $x \in A \cap B \text{ and } (x \notin A \text{ or } x \notin B)$

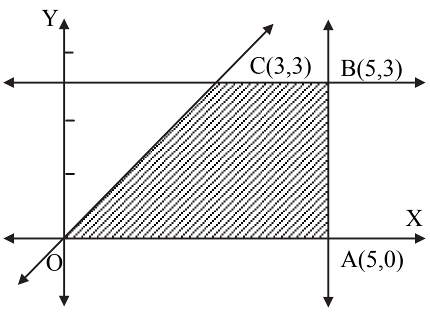
(D) $x \notin A \cap B \text{ and } (x \in A \text{ and } x \in B)$

33. The cartesian equation of the plane passing through the point (0, 7, –7) and containing the line $\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$ is

(A) $x + 2y + z = 7$ (B) $2x + y + z = 0$

(C) $2x + y - z = 14$ (D) $x + y + z = 0$

34. The shaded part of the given figure indicates the feasible region.



Then the constraints are

(A) $x, y \geq 0; x + y \geq 0; x \geq 5; y \leq 3$

(B) $x, y \geq 0; x - y \geq 0; x \leq 5; y \geq 3$

(C) $x, y \geq 0; x - y \geq 0; x \leq 5; y \leq 3$

(D) $x, y \geq 0; x - y \leq 0; x \leq 5; y \leq 3$

35. If the volume of a tetrahedron whose coterminus edges are $\bar{a} + \bar{b}, \bar{b} + \bar{c}, \bar{c} + \bar{a}$ is 24 cubic units, then the volume of parallelopiped whose coterminus edges are $\bar{a}, \bar{b}, \bar{c}$ is

(A) 72 cubic units (B) 144 cubic units

(C) 48 cubic units (D) 10 cubic units

36. If f(x) = $\lfloor x \rfloor$, for $x \in (-1, 2)$, then f is discontinuous at (where $\lfloor x \rfloor$ represents floor function)

(A) $x = 0, 1$ (B) $x = -1, 0, 1$

(C) $x = 2$ (D) $x = -1, 0, 1, 2$

37. If 1 is added to first 10 natural numbers, then variance of the numbers so obtained is

(A) 6·5 (B) 3·87

(C) 2·87 (D) 8·25

38. The general solution of the differential equation $x + y\frac{dy}{dx} = \sec(x^2 + y^2)$ is

(A) $\sin(x^2 + y^2) = 2x + c$

(B) $\sin(x^2 + y^2) + 2x = c$

(C) $\sin(x^2 + y^2) + x = c$

(D) $\cos(x^2 + y^2) = 2x + c$

39. A particle is moving on a straight line. The distance S travelled in time t is given by $S = at^2 + bt + 6$. If the particle comes to rest after 4 seconds at a distance of 16m. from the starting point, then the acceleration of the particle is

(A) $\frac{-3}{4} m/sec^2$ (B) $\frac{-5}{4} m/sec^2$

(C) $-1\ m/sec^2$ (D) $\frac{-1}{2} m/sec^2$

40. If the lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$ and $\frac{x-3}{1} = \frac{y-k}{2} = \frac{z}{1}$ intersect, then the value of k is

(A) $\frac{9}{2}$ (B) $\frac{-2}{9}$ (C) $\frac{-3}{2}$ (D) $\frac{3}{2}$

41. The differential equation of all circles which pass through the origin and whose centres lie on Y-axis is

(A) $(x^2 - y^2)\frac{dy}{dx} - 2xy = 0$

(B) $(x^2 - y^2)\frac{dy}{dx} + 2xy = 0$

(C) $(x^2 + y^2)\frac{dy}{dx} + 2xy = 0$

(D) $(x^2 + y^2)\frac{dy}{dx} - 2xy = 0$

42. If $\bar{e}_1, \bar{e}_2$ and $\bar{e}_1 + \bar{e}_2$ are unit vectors, then the angle between $\bar{e}_1$ and $\bar{e}_2$ is

(A) 135° (B) 120°

(C) 90° (D) 150°

43. If the line $\frac{x+1}{2} = \frac{y-m}{3} = \frac{z-4}{6}$ lies in the plane $3x - 14y + 6z + 49 = 0$, then the value of m is

(A) 2 (B) –5 (C) 5 (D) 3

44. If $A(\alpha) = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$, then $[A^2(\alpha)]^{-1} =$

(A) $A(\alpha)$ (B) $A(-2\alpha)$

(C) $A(2\alpha)$ (D) $A^2(\alpha)$

45. $\int \frac{x+\sin x}{1+\cos x}\,dx =$

(A) $x\tan\left(\frac{x}{2}\right)+c$ (B) $\cot\left(\frac{x}{2}\right)+c$

(C) $\log(1+\cos x)+c$ (D) $\log(x+\sin x)+c$

46. A wire of length 20 units is divided into two parts such that the product of one part and cube of the other part is maximum, then product of these parts is

(A) 15 units (B) 5 units
(C) 70 units (D) 75 units

47. The angle between a line with direction ratio 2, 2, 1 and a line joining (3, 1, 4) and (7, 2, 12) is

(A) $\cos^{-1}\left(\frac{1}{3}\right)$ (B) $\cos^{-1}\left(\frac{2}{3}\right)$

(C) $\cos^{-1}\left(\frac{\sqrt{2}}{3}\right)$ (D) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$

48. If the lines $3x - 4y + 4 = 0$ and $6x - 8y - 7 = 0$ are tangents to a circle, then the radius of the circle is

(A) $\frac{7}{4}$ units (B) $\frac{1}{4}$ units

(C) $\frac{3}{4}$ units (D) $\frac{4}{3}$ units

49. The domain of the function $f(x)=\frac{1}{\sqrt{x+|x|}}$ is

(A) $(-\infty, \infty)$ (B) $(2, 5)$
(C) $(0, \infty)$ (D) $(-\infty, 0)$

50. If $4\sin^{-1}x + 6\cos^{-1}x = 3\pi$, where $-1 \le x \le 1$, then $x =$

(A) 0 (B) $\frac{1}{\sqrt{2}}$ (C) $\frac{1}{2}$ (D) $\frac{-1}{2}$