DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

24-0003-AB1 **TEST BOOKLET**

Time Allowed: 2 hours | **PAPER – II** | **Maximum Marks: 100**

INSTRUCTIONS TO CANDIDATES

Read the instructions carefully before answering the questions: -

1. This Test Booklet consists of **12 (twelve) pages** and has **50 (fifty) items (questions)**.
2. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS BOOKLET ***DOES NOT*** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
3. **Please note that it is the candidate's responsibility to fill in the Roll Number and other required details carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the OMR Answer Sheet liable for rejection.**
4. Do not write anything else on the OMR Answer Sheet except the required information. Before you proceed to mark in the OMR Answer Sheet, please ensure that you have filled in the required particulars as per given instructions.
5. Use **only Black Ball Point Pen** to fill the OMR Answer Sheet.
6. This Test Booklet **consist of Multiple Choice-based Questions.** The answers to these questions have to be marked in the **OMR Answer Sheet** provided to you.
7. Each item (question) **comprises of 04 (four) responses (answers).** You are required to select the response which you want to mark on the OMR Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ***ONLY ONE*** response for each item.
8. After you have completed filling in all your responses on the OMR Answer Sheet and the Answer Booklet(s) and the examination has concluded, you should hand over to the Invigilator ***only the OMR Answer Sheet and the Answer Booklet(s)***. You are permitted to take the Test Booklet with you.
9. **Penalty for wrong answers in Multiple Choice-based Questions:**
   THERE WIL BE **PENALTY** FOR WRONG ANSWERS MARKED BY A CANDIDATE.
   (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to the question will be deducted as penalty.
   (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to the question.
   (iii) If a question is left blank. i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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Choose the correct answer for the following questions: **(2x50=100)**

1. If cosec $\theta = \dfrac{p+q}{p-q}$, then cot $\left(\dfrac{\pi}{4}+\dfrac{\theta}{2}\right)$ is:

(A) $\sqrt{\dfrac{p}{q}}$ (B) $\sqrt{\dfrac{q}{p}}$ (C) $\dfrac{p}{q}$ (D) $\dfrac{q}{p}$

2. For what value of λ, the sum of the squares of the roots of the equation $x^2+(\lambda-1)x-\left(1+\dfrac{\lambda}{2}\right)=0$ is minimum?

(A) $\dfrac{3}{2}$ (B) $-\dfrac{3}{2}$ (C) $\dfrac{1}{2}$ (D) $-\dfrac{1}{2}$

3. How many words can be made out of the letters of the word INSURANCE, if all vowels come together?

(A) 8640

(B) 1440

(C) 6048

(D) 4028

4. The sum of the series $\sum_{r=1}^{n} \log\left(\dfrac{a^r}{b^{r-1}}\right)$ is:

(A) $\dfrac{n}{2}\log\left(\dfrac{a^n}{b^n}\right)$ (B) $\dfrac{n}{2}\log\left(\dfrac{a^{n+1}}{b^n}\right)$

(C) $\dfrac{n}{2}\log\left(\dfrac{a^{n+1}}{b^{n-1}}\right)$ (D) $\dfrac{n}{2}\log\left(\dfrac{a^n}{b^{n-1}}\right)$

5. The distance of the line $2x-3y=4$ from the point (1, 1), measured parallel to the line $x+y=1$ is:

(A) $\sqrt{2}$ (B) $2\sqrt{2}$ (C) $\dfrac{5\sqrt{2}}{2}$ (D) $\dfrac{1}{\sqrt{2}}$

6. The normal drawn at a point $(at_1^2,\ 2at_1)$ of the parabola $y^2 = 4ax$ meets it again in the point $(at_2^2,\ 2at_2)$. Then

(A) $t_1t_2 = -1$ (B) $t_1^2 - 2t_2 = 0$

(C) $t_1^2 + 2t_2 = 0$ (D) $t_1\ t_2 = -t_1^2 - 2$

7. The value of the $\lim_{x\to 0} x^m(\log x)^n;\ m,n \in N$ is :

(A) $\frac{m}{n}$ (B) mn (C) $m+n$ (D) 0

8. The mean deviation from the mean for the data 6, 7, 10, 12, 13, 4, 8, 20 is:

(A) 3.50

(B) 3.75

(C) 4.15

(D) 5.50

9. Let R be the relation on the set Z of integers, defined by $(a,\ b) \in R \Leftrightarrow a^2 + b^2 = 25$. Then the domain of R is:

(A) {0, 3, 4, 5} (B) {0, ±3, ±4, ±5}

(C) {0, –3, –4, –5} (D) {3, 4, 5}

10. Let R = {(*a, a*), (*b, b*), (*c, c*), (*d, d*)} be the relation defined on the set A = {*a, b, c, d*}. Then R is:

(A) an identity relation but not reflexive

(B) reflexive but not an identity relation

(C) reflexive but not a symmetric relation

(D) an equivalence relation

11. The function $f : R \to R$, defined by $f(x) = x^3 + x$, for all $x \in R$ is :

(A) one-one and onto

(B) one-one but not onto

(C) onto but not one-one

(D) neither one-one not onto

12. The function $f : R \to R$ defined by $f(x) = [x]$, for all $x \in R$ [where $[x]$ = greatest integer $\le x$] is:

(A) one-one and onto

(B) one-one but not onto

(C) onto but not one-one

(D) neither one-one nor onto

13. If $\tan^{-1} x + \cos^{-1} \frac{y}{\sqrt{1+y^2}} = \sin^{-1} \frac{3}{\sqrt{10}}$, then (x, y) is :

(A) (1, 2) and (2, 7) (B) (1, 2) and (1, 7)

(C) (1, 7) and (2, 7) (D) (1, 7) and (2, 1)

14. If $\sin^{-1}\left(x - \frac{x^2}{2} + \frac{x^3}{4} - ...\right) + \cos^{-1}\left(x^2 - \frac{x^4}{2} + \frac{x^6}{4} - ...\right) = \frac{\pi}{2}$, for $0 < |x| < \sqrt{2}$, then x equals:

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

15. If $\theta = \sin^{-1}x + \cos^{-1}x - \tan^{-1}x$, $x \ge 0$, then the smallest interval in which θ lies is:

(A) $0 \le \theta \le \pi$ (B) $\frac{\pi}{2} \le \theta \le \frac{3\pi}{4}$

(C) $\frac{\pi}{4} \le \theta \le \frac{\pi}{2}$ (D) $-\frac{\pi}{2} < \theta < \frac{\pi}{2}$

16. If A is ann × n matrix, then adj (adj A) equals:

(A) $|A|^{n-1} A$ (B) $|A|^{n-2} A$

(C) $|A|^{n+1} A$ (D) $|A|^{2n-1} A$

17. If A and B are square matrices each of order 3 such that $|A| = -1$ and $|B| = 3$, then $|3AB|$ is equal to:

(A) –9 (B) –81 (C) –27 (D) 81

18. If A and B are square matrices such that $B = -A^{-1} BA$, then $(A + B)^2$ equals :

(A) **0** (B) $A^2 - 2AB + B^2$

(C) $A^2 + 2AB + B^2$ (D) $A^2 + B^2$

19. If the matrix $\begin{bmatrix} 1 & 3 & \lambda+2 \\ 2 & 4 & 8 \\ 3 & 5 & 10 \end{bmatrix}$ is singular, then λ is equal to:

(A) –4 (B) –2 (C) 2 (D) 4

20. Let $\Delta = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$. If $A_1, B_1, C_1, A_2, ..., B_3, C_3$ denote the cofactors of $a_1, b_1, c_1, a_2, ..., b_3, c_3$ respectively, then the value of the determinant $\begin{vmatrix} A_1 & B_1 & C_1 \\ A_2 & B_2 & C_2 \\ A_3 & B_3 & C_3 \end{vmatrix}$ is :

(A) 0 (B) $\triangle$ (C) $\triangle^2$ (D) $\triangle^3$

21. If $a\lambda^4 + b\lambda^3 + c\lambda^2 + d\lambda + p = \begin{vmatrix} \lambda^2+3\lambda & \lambda-1 & \lambda+3 \\ \lambda+1 & 2-\lambda & \lambda-4 \\ \lambda-3 & \lambda+4 & 3\lambda \end{vmatrix}$, then p is equal to:

(A) 16 (B) 17 (C) 18 (D) 19

22. If n is a positive integer, then the determinant $\Delta = \begin{vmatrix} x! & (x+1)! & (x+2)! \\ (x+1)! & (x+2)! & (x+3)! \\ (x+2)! & (x+3)! & (x+4)! \end{vmatrix}$ is equal to:

(A) $x!\,(x+1)!\,(x+2)!$ (B) $2\,(x)!\,(x+1)!\,(x+2)!$

(C) $2\,(x+1)!\,(x+2)!\,(x+3)!$ (D) $(x+1)!\,(x+2)!\,(x+4)!$

23. A matrix A is such that $A^2 = 2A - I$, where I is the identity matrix. Then for $n \geq 2$, A^n is:

(A) $nA - (n-1)\,I$ (B) $nA - I$

(C) $2^{n-1}A - (n-1)\,I$ (D) $2^{n-1}A - I$

24. The value of k for which the system of linear equations $3x + ky - 2z = 0$, $x + ky + 3z = 0$, $2x + 3y - 4z = 0$ has a non-trivial solution is:

(A) $\frac{33}{2}$ (B) $-\frac{33}{2}$ (C) $\frac{11}{14}$ (D) $-\frac{11}{14}$

25. The system of linear equations $x + y + z = 6$, $x + 2y + 3z = 10$, $x + 2y + \lambda z = \mu$ has no solution for:

(A) $\lambda \neq 3,\ \mu = 10$ (B) $\lambda \neq 3,\ \mu \neq 10$

(C) $\lambda = 3,\ \mu \neq 10$ (D) $\lambda = 10,\ \mu \neq 3$

26. If $f : R \rightarrow R$ be a differentiable function and if $f(1) = 4$, then $\lim_{x \to 1} \int_4^{f(x)} \frac{2t}{x-1}\,dt$ is equal to :

(A) $f'(1)$ (B) $2f'(1)$ (C) $4f'(1)$ (D) $8f'(1)$

27. If $f(x) = |x-3|$, then f is :

(A) discontinuous at $x = 3$

(B) not differentiable at $x = 3$

(C) continuous and differentiable at x = 3

(D) continuous but not differentiable at $x = 3$

28. For the function $f(x) = \dfrac{\log_e(1+x) - \log_e(1-x)}{x}$ to be continuous at x = 0, the value of $f(0)$ must be:

(A) 2 (B) –2 (C) 0 (D) –1

29. If $f(a) = 2, f'(a) = 1, g(a) = -3, g'(a) = -1$, then

$\lim\limits_{x \to a} \dfrac{f(a)\,g(x) - f(x)\,g(a)}{x-a}$ equals:

(A) –1 (B) 1 (C) –5 (D) 6

30. Let $f(x+y) = f(x) + f(y)$ and $f(x) = x^2 g(x)$, for all $x, y \in R$, where g(x) is a continuous function. Then $f'(x)$ is equal to :

(A) 0 (B) 1 (C) $g'(0)$ (D) $g(0) + g'(x)$

31. If $f(x) = \sin x - \dfrac{x}{2}$ is an increasing function, then:

(A) $-\dfrac{\pi}{6} < x < \dfrac{\pi}{6}$ (B) $-\dfrac{\pi}{6} < x < \dfrac{\pi}{3}$

(C) $-\dfrac{\pi}{3} < x < \dfrac{\pi}{3}$ (D) $-\dfrac{\pi}{3} < x < \dfrac{\pi}{6}$

32. If the function $f(x) = \dfrac{k\sin x + 2\cos x}{\sin x + \cos x}$ is an increasing function for all values of x, then:

(A) $k < 1$ (B) $k > 1$ (C) $k < 2$ (D) $k > 2$

33. Integral $\int \frac{1}{x^2(x^4+1)^{3/4}}\,dx$ is equal to:

(A) $\frac{(x^4+1)^{1/4}}{x}+C$ (B) $-\frac{(x^4+1)^{1/4}}{x}+C$

(C) $\frac{1}{16}\frac{(x^4+1)^{1/4}}{x}+C$ (D) $-\frac{1}{16}\frac{(x^4+1)^{1/4}}{x}+C$

34. Integral $\int \frac{dx}{(2\sin x+\cos x)^2}$ is equal to:

(A) $\frac{1}{2\ (1+\tan x)}+C$ (B) $-\frac{1}{2\ (1+2\tan x)}+C$

(C) $\frac{1}{2+\cot x}+C$ (D) $-\frac{1}{2\ (1+2\cot x)}+C$

35. Integral $\int [f(x)g''(x)-f''(x)g(x)]\,dx$ is equal to:

(A) $\frac{f(x)}{g'(x)}+C$ (B) $f'(x)g(x)-f(x)g'(x)+C$

(C) $f(x)g'(x)+f'(x)g(x)+C$ (D) $f(x)g'(x)-f'(x)g(x)+C$

36. The area bounded by the curves $y=\cos x$ and $y=\sin x$ between the ordinates $x = 0$ and $x=\frac{\pi}{4}$ is:

(A) $\sqrt{2}\left(\sqrt{2}-1\right)$ (B) $\sqrt{2}\left(\sqrt{2}+1\right)$

(C) $\sqrt{2+1}$ (D) $\sqrt{2}-1$

37. The area of the region $\{(x,y): x^2+y^2 \le 1 \le x+y\}$ is:

(A) $\frac{\pi}{4}-\frac{1}{2}$ (B) $\frac{\pi}{4}+\frac{1}{2}$

(C) $\frac{\pi}{4}-\frac{3}{4}$ (D) $\frac{\pi}{4}+\frac{3}{4}$

38. The solution of the differential equation $\frac{dy}{dx} = \frac{(1+x)y}{(y-1)x}$ is:

(A) $\log xy + x + y = C$ (B) $\log xy + x - y = C$

(C) $\log\left(\frac{x}{y}\right) + x + y = C$ (D) $\log\left(\frac{x}{y}\right) + x - y = C$

39. The solution of the differential equation $\frac{dy}{dx} = \frac{e^x(\sin^2 x + \sin 2x)}{y\,(2\log y + 1)}$ is:

(A) $y^2 \log y - e^x \sin^2 x = C$ (B) $y^2 \log y + e^x \sin^2 x = C$

(C) $y^2(2\log y) - e^x \sin^2 x = C$ (D) $y^2(2\log y) - e^x \sin 2x = C$

40. The solution to the differential equation $(x^2+1)\frac{dy}{dx} + 2xy = x^2$ is :

(A) $y(x^2+1) = \frac{x^3}{3} + C$ (B) $y(x^2+1) = (x^3 - x) + C$

(C) $y = \frac{1}{3}(x^2+1)x^3 + C$ (D) $y(x^2+1) = 2x + C$

41. If $\bar{a}$ and $\bar{b}$ are unit vectors such that $\bar{a} - \bar{b}$ is also a unit vector, then the angle between $\bar{a}$ and $\bar{b}$ is:

(A) 30° (B) 45° (C) 60° (D) 90°

42. Let $\bar{a} = 2\hat{i} + \hat{k}$, $\bar{b} = \hat{i} + \hat{j} + \hat{k}$, $\bar{c} = 4\hat{i} - 3\hat{j} + 7\hat{k}$. If $\bar{d} \times \bar{b} = \bar{c} \times \bar{b}$ and $\bar{d}.\bar{a} = 0$, then the vector $\bar{d}$ is :

(A) $\hat{i} + 8\hat{j} + 2\hat{k}$ (B) $\hat{i} - 8\hat{j} + 2\hat{k}$

(C) $-\hat{i} + 8\hat{j} - 2\hat{k}$ (D) $-\hat{i} - 8\hat{j} + 2\hat{k}$

43. In the triangle ABC, if $2\,\overline{OC} = 3\,\overline{CB}$, then $2\,\overline{OA} + 3\,\overline{OB}$ equals:

(A) $-2\,\overline{OC}$ (B) $3\,\overline{OC}$ (C) $5\,\overline{OC}$ (D) $6\,\overline{OC}$

44. If $(\bar{a}\times\bar{b})+(\bar{a}.\bar{b})=144$ and $|\bar{a}|=4$, then $|\bar{b}|$ is :

(A) 3 (B) 8 (C) 9 (D) 12

45. If l_1, m_1, n_1; l_2, m_2, n_2 and l_3, m_3, n_3 are the d.c's of three mutually perpendicular lines, then the angle made by the line having d.c's$l_1 + l_2 + l_3$, $m_1 + m_2 + m_3$, $n_1 + n_2 + n_3$ with each of these lines is :

(A) 0° (B) 30° (C) 60° (D) 120°

46. The foot of the perpendicular from the point (2, –1, 5) on the line $\frac{x-11}{10}=\frac{y+2}{-4}=\frac{z+8}{-11}$ is :

(A) (1, 2, –3) (B) (1, –2, 3) (C) (1, 2, 3) (D) (–1, –2, 3)

47. A variable plane is at a constant distance p from the origin and meets the axes in points A, B and C respectively. The locus of the centroid of the triangle ABC is:

(A) $x^{-2}+y^{-2}+z^{-2}=p^{-2}$ (B) $x^{-2}+y^{-2}+z^{-2}=9p^{-2}$

(C) $x^{-2}+y^{-2}+z^{-2}=3p^{2}$ (D) $x^{-2}+y^{-2}+z^{-2}=9p^{2}$

48. A fair coin is tossed n times. If the probability that the head occurs 6 times is equal to the probability that head occurs 8 times, then n is equal to:

(A) 7 (B) 12 (C) 14 (D) 15

49. Two fair dice are thrown simultaneously. The probability of getting a multiple of 2 on one of them and a multiple of 3 on the other is:

(A) $\frac{1}{6}$ (B) $\frac{11}{36}$ (C) $\frac{13}{36}$ (D) $\frac{5}{36}$

50. Two fair dice are thrown simultaneously. The probability that the sum of the numbers appearing on both dice is a prime number is:

(A) $\frac{1}{6}$ (B) $\frac{5}{12}$ (C) $\frac{5}{36}$ (D) $\frac{19}{36}$

Field Asst

SPACE FOR ROUGH WORK