MAHARASHTRA BOARD · CLASS 12 · MATHEMATICS AND STATISTICS

Maharashtra Board Class 12 Mathematics and Statistics Important Questions 2027

74 question patterns that repeated across past papers · the years show every time each was asked

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Mathematical Logic

1. Using a truth table, examine whether a statement pattern is a tautology/contradi

Asked 3× · Board 2024, Board 2026 · 2/3 marks

Using truth table, determine whether statement pattern [(p v q) ^ ~p] ^ ~q is a tautology or a contradiction or a contingency.

2. Find the dual of a given logical statement

Asked 3× · Board 2024, Board 2026 · 1/2 marks

Write the dual of p ^ t.

3. Using a truth table, verify a logical equivalence of two statement patterns

Asked 3× · Board 2022, Board 2025 · 2 marks

Using truth table, prove that ~p ^ q = (p v q) ^ ~p.

4. Determine which quantified statement over a set is not true

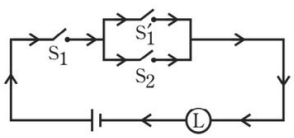
Asked 2× · Board 2025, Board 2026 · 2 marks

If A = {1, 2, 3, 4, 5} then which of the following is not true? (a) there exists x in A such that x + 3 = 8 (b) there exists x in A such that x + 2 < 9 (c) for all x in A, x + 6 >= 9 (d) for all x in A, x + 5 <= 10

5. Simplify a switching circuit to an equivalent one with minimum switches

Asked 2× · Board 2024, Board 2025 · 4 marks

Give an alternative equivalent simple circuit for the following switching circuit. (Switch S1 in series with a parallel block of switches S1' and S2', with lamp L.)

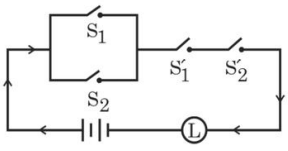


(4)

6. Express a switching circuit symbolically and construct its switching table

Asked 2× · Board 2024, Board 2025 · 3 marks

Express the following switching circuit in the symbolic form of logic. Construct the switching table and interpret it. (Parallel switches S1 and S2 in series with switches S1' and S2', with lamp L.)



(3)

Matrices

7. Find the adjoint of a given matrix

Asked 2× · Board 2025, Board 2026 · 2 marks

If A = [[2, -4], [3, 1]], then the adjoint of matrix A is ____. (a) [[1, 3], [4, -2]] (b) [[-1, 3], [-4, 1]] (c) [[-1, -3], [-4, 2]] (d) [[1, 4], [-3, 2]]

8. Verify the property A(adjA) = (adjA)A = |A|I for a given matrix

Asked 2× · Board 2023, Board 2026 · 4 marks

If A = [[1, 2], [3, 4]], prove that A.(adj A) = (adj A).A = |A|.I.

9. Find the cofactors of the elements of a given matrix

Asked 2× · Board 2022, Board 2025 · 2 marks

Find the cofactors of the elements of the matrix [[2, -3], [3, 5]].

10. Find the inverse of a matrix by elementary row transformations

Asked 2× · Board 2023, Board 2024 · 2 marks

Find the inverse of matrix A by elementary row transformations, where A = [[2, -3], [-1, 2]].

Trigonometric Functions

11. Find the general solution of a given trigonometric equation

Asked 5× · Board 2023, Board 2025, Board 2026 · 1/2/3 marks

Find the general solution of equation cos 5(theta) = 1/2.

12. Prove an identity involving inverse trigonometric functions

Asked 4× · Board 2023, Board 2024, Board 2025, Board 2026 · 3 marks

Prove that: $\sin^{-1}(3/5) + \cos^{-1}(12/13) = \sin^{-1}(56/65)$.

13. Evaluate an expression involving inverse trigonometric functions

Asked 3× · Board 2024, Board 2026 · 1/2 marks

The value of $\sin[\sin^{-1}(-1/\sqrt{2}) - 3\sin^{-1}(\sqrt{3}/2)]$ = ____. (a) -1/sqrt(2) (b) 1/sqrt(2) (c) sqrt(3)/2 (d) -sqrt(3)/2

14. Solve an equation involving inverse trigonometric functions

Asked 3× · Board 2022, Board 2024, Board 2026 · 2/3 marks

If $\tan^{-1}(2x) + \tan^{-1}(3x) = \pi/4$, then x = ____. (a) -1 (b) 1/6 (c) 1/3 (d) 3/2

15. Prove a given identity for a triangle using its properties

Asked 2× · Board 2024, Board 2026 · 2/3 marks

In triangle ABC, prove that $a(b\cos C - c\cos B) = b^2 - c^2$.

16. Find the principal solutions of a given trigonometric equation

Asked 2× · Board 2022, Board 2024 · 2 marks

The principle solutions of the equation cos(theta) = 1/2 are ____. (a) pi/6, 5pi/6 (b) pi/3, 5pi/3 (c) pi/6, 7pi/6 (d) pi/3, 2pi/3

17. Find an angle of a triangle using the cosine rule

Asked 2× · Board 2022, Board 2023 · 2 marks

In triangle ABC, if $c^2 + a^2 - b^2 = ac$, then angle B = ____. (a) pi/4 (b) pi/3 (c) pi/2 (d) pi/6

Pair of Straight Lines

18. Find the unknown constant using a relation between sum and product of slopes of
Asked 2× · Board 2024, Board 2026 · 2 marks

Find k, if the sum of the slopes of the lines represented by $x^2 + kxy - 3y^2 = 0$ is twice their product.

19. Find the unknown constant given that a line is represented by a pair-of-lines eq
Asked 2× · Board 2022, Board 2026 · 2 marks

Find the value of k, if $2x + y = 0$ is one of the lines represented by $3x^2 + kxy + 2y^2 = 0$.

20. Derive the formula for the angle between a pair of lines
Asked 2× · Board 2023, Board 2025 · 3 marks

Show that the acute angle theta between the lines represented by $ax^2 + 2hxy + by^2 = 0$ is given by $\tan(\theta) = |2\sqrt{h^2 - ab}/(a + b)|$.

21. Write the combined (joint) equation of two given lines
Asked 2× · Board 2023, Board 2024 · 1 marks

Find the combined equation of the pair of lines $2x + y = 0$ and $3x - y = 0$.

Vectors

22. Find the ratio in which a point divides a segment using position vectors
Asked 3× · Board 2023, Board 2024, Board 2026 · 2 marks

If a, b, c are the position vectors of points A, B, C respectively and $10a = 7b + 3c$ then find the ratio in which the point C divides the line segment AB.

23. Determine whether four given points are coplanar using scalar triple product
Asked 2× · Board 2024, Board 2026 · 3 marks

Are the four points A(1, 2, 1), B(2, -3, 4), C(3, 4, -5), D(2, 3, -2) coplanar? Justify your answer.

24. Express a coplanar vector as a unique linear combination of two vectors
Asked 2× · Board 2024, Board 2025 · 3/4 marks

Let a and b be non-collinear vectors. If vector r is coplanar with a and b then show that there exist unique scalars t1 and t2 such that $r = t1\ a + t2\ b$. For $r = 2i + 7j + 9k$, $a = i + 2j$, $b = j + 3k$, find t1, t2.

25. Evaluate a scalar triple product expression of unit vectors
Asked 2× · Board 2022, Board 2026 · 2 marks

If p, q, r are mutually perpendicular unit vectors and form a right handed triplet then the value of $p.(q \times r) + q.(p \times r) + r.(p \times q) =$ ____. (a) -2 (b) 0 (c) 1 (d) 3

26. Prove the section formula for internal division using vectors
Asked 2× · Board 2022, Board 2026 · 3/4 marks

If A(a) and B(b) are any two points in space and R(r) be a point on the line segment AB dividing internally in the ratio m : n then prove that $r = (m\ b + n\ a)/(m + n)$.

Line and Plane

27. Find the angle between two lines given their vector equations
Asked 3× · Board 2024, Board 2025, Board 2026 · 2 marks

Find the angle between the lines $r = (i + 2j + 3k) + \lambda(2i - j + k)$ and $r = (i + 2j + 3k) + \mu(i + 2j + k)$.

28. Find the shortest distance between two skew lines

Asked 3× · Board 2023, Board 2024, Board 2025 · 3 marks

Find the shortest distance between the lines, (x-1)/2 = (y-2)/3 = (z-3)/4 and (x-2)/3 = (y-4)/4 = (z-5)/5.

29. Find the vector equation of a plane through three given points

Asked 2× · Board 2025, Board 2026 · 3 marks

Find the vector equation of the plane passing through the points A(2, 1, 1), B(0, 2, 3) and C(4, 5, 6).

30. Find the angle between a line and a plane

Asked 2× · Board 2024, Board 2026 · 2/3 marks

The angle between the line r = (i + 2j + k) + lambda(i + j + k) and the plane r.(2i - j + k) = 8 is ____. (a) $\sin^{-1}(\sqrt{2}/3)$ (b) $\sin^{-1}(\sqrt{3}/2)$ (c) $\sin^{-1}(1/2)$ (d) $\sin^{-1}(1/\sqrt{2})$

31. Find the direction angle of a line given the other two direction angles

Asked 2× · Board 2024, Board 2025 · 2 marks

A line makes angles of measure 45 deg and 60 deg with the positive directions of the Y and Z axes respectively. Find the angle made by the line with the positive direction of the X-axis.

32. Find the distance between two parallel lines in space

Asked 2× · Board 2022, Board 2026 · 3 marks

Find the distance between parallel lines x/2 = y/-1 = z/2 and (x+1)/2 = (y-1)/-1 = (z+1)/2.

33. Find the equation of a plane given a point and its normal's direction ratios

Asked 2× · Board 2022, Board 2025 · 2 marks

Find the cartesian equation of the plane passing through the point A(-1, 2, 3), the direction ratios of whose normal are 0, 2, 5.

34. Find the vector equation of a plane through a point parallel to two vectors

Asked 2× · Board 2022, Board 2025 · 3 marks

Find the vector equation of the plane passing through the point A(-1, 2, -5) and parallel to the vectors 4i - j + 3k and i + j - k.

Linear Programming

35. Solve a linear programming problem graphically

Asked 6× · Board 2022, Board 2024, Board 2025, Board 2026 · 4 marks

Solve the linear programming problem (L.P.P.) by graphical method. Minimize z = 8x + 10y Subject to 2x + y >= 7, 2x + 3y >= 15, x >= 0, y >= 2.

Differentiation

36. Prove the parametric differentiation formula and apply it

Asked 5× · Board 2022, Board 2024, Board 2025, Board 2026 · 4 marks

If x = f(t) and y = g(t) are differentiable functions of t, so that y is differentiable function of x and dx/dt != 0 then prove that dy/dx = (dy/dt)/(dx/dt). Hence find dy/dx, if x = sin t, y = cos t.

37. Prove a second-order differential relation for a given function

Asked 3× · Board 2022, Board 2023, Board 2024 · 3/4 marks

If $y = \sin^{-1} x$, then show that: $(1 - x^2)\, d^2y/dx^2 - x\, dy/dx = 0$.

38. Differentiate an implicit function

Asked 2× · Board 2025, Board 2026 · 2 marks

Find dy/dx, if sqrt(x) + sqrt(y) = sqrt(a).

39. Find the derivative of a composite function at a given point

Asked 2× · Board 2025, Board 2026 · 2 marks

If y = sec(tan^{-1} x), then dy/dx at x = 1 is ____. (a) 1/2 (b) 1 (c) 1/sqrt(2) (d) sqrt(2)

40. Find the derivative of an implicit function at a given point

Asked 2× · Board 2023, Board 2025 · 2 marks

If y is a function of x and log(x + y) = xy then the value of dy/dx at x = 0 is ____. (a) 1 (b) -1 (c) 2 (d) 0

Applications of Derivatives

41. Find the approximate value of a function/expression using differentials

Asked 5× · Board 2023, Board 2024, Board 2026 · 2/3 marks

The approximate value of the function f(x) = x^3 - 3x + 5 at x = 1.99 is ____. (a) 6.09 (b) 6.91 (c) 7.09 (d) 7.91

42. Verify Rolle's theorem for a given function on an interval

Asked 2× · Board 2025, Board 2026 · 2/3 marks

Verify Rolle's theorem for the function f(x) = x^2 - 5x + 9, x in [1, 4].

43. Find a related rate of change in a geometric context

Asked 2× · Board 2025, Board 2026 · 2/3 marks

A stone is dropped into a quiet lake and waves in the form of circles are generated. Radius of the circular wave increases at the rate of 3 cm/sec. How fast the area enclosed is increasing when the radius is 8 cm?

44. Verify Lagrange's mean value theorem for a given function on an interval

Asked 2× · Board 2023, Board 2026 · 3/4 marks

Verify LMVT for the function f(x) = log x, on [1, e].

45. Find dimensions that maximise/minimise area/volume (optimisation word problem)

Asked 2× · Board 2022, Board 2026 · 3 marks

A wire of length 36 cm is bent to form a rectangle. Find its dimensions, if the area of the rectangle is maximum.

46. Show that a given function is increasing/decreasing on an interval

Asked 2× · Board 2022, Board 2023 · 2 marks

Show that the function f(x) = x^3 + 10x + 7, x in R is strictly increasing.

Indefinite Integration

47. Integrate a function using a suitable substitution

Asked 5× · Board 2024, Board 2025, Board 2026 · 1/2 marks

Evaluate: integral e^x(1 + x)/cos^2(x e^x) dx.

48. Integrate a product of functions using integration by parts

Asked 4× · Board 2023, Board 2024, Board 2026 · 2/3/4 marks

If f(x) = sin^{-1} x/sqrt(1 - x^2) and g(x) = e^(sin^{-1} x) then integral f(x).g(x) dx = ____. (a) e^(sin^{-1} x)(1 - sin^{-1} x) + c (b) e^(sin^{-1} x)(sin^{-1} x - 1) + c (c) e^(sin^{-1} x)(sin^{-1} x + 1) + c (d) e^(cos^{-1} x)(cos^{-1} x - 1) + c

49. Integrate a rational function using partial fractions
Asked 2× · Board 2023, Board 2026 · 4 marks

Evaluate: integral $(3x^2 + 4x - 5)/((x^2 - 1)(x + 2))$. dx.

50. Integrate a trigonometric quotient by adjusting the angle
Asked 2× · Board 2024, Board 2025 · 3 marks

Evaluate: integral sin(x + a)/cos(x - b) dx.

51. Integrate a special-form rational function (standard integral)
Asked 2× · Board 2024, Board 2025 · 1/2 marks

Evaluate: integral $1/(25 - 9x^2)$ dx.

Definite Integration

52. Evaluate a given definite integral
Asked 4× · Board 2022, Board 2024, Board 2025 · 2 marks

Evaluate: integral from 0 to -1 of e^(-x) dx.

53. Evaluate a definite integral using a suitable substitution
Asked 2× · Board 2025, Board 2026 · 2/4 marks

integral from 1 to 2 of $(1/x^2)$. e^(1/x) dx = ____. (a) sqrt(e) + 1 (b) sqrt(e) - 1 (c) sqrt(e)(sqrt(e) - 1) (d) (sqrt(e) - 1)/e

54. Prove a property of definite integrals and apply it
Asked 2× · Board 2025, Board 2026 · 4 marks

Prove that: integral from a to b of f(x) dx = integral from a to b of f(a + b - x) . dx. Hence, find integral from pi/6 to pi/3 of $\sin^2$ x . dx.

55. Evaluate a definite integral using a trigonometric identity
Asked 2× · Board 2023, Board 2024 · 2 marks

Evaluate: integral from 0 to pi/4 of sqrt(1 + sin 2x) dx.

Application of Definite Integration

56. Find the area under a curve bounded by given ordinates
Asked 3× · Board 2023, Board 2024, Board 2026 · 2 marks

Find the area bounded by curve $x^2 + y = 0$, X-axis and lines x = 1 and x = 4.

57. Find the area bounded by a line and the X-axis between given ordinates
Asked 2× · Board 2025, Board 2026 · 2 marks

The area bounded by the line y = 2x, X-axis and the lines x = -1, x = 4 is ____ sq. units. (a) 15 (b) 17 (c) 16 (d) 14

58. Find the area bounded between two curves
Asked 2× · Board 2022, Board 2025 · 4 marks

Find the area of the region lying between the parabolas $y^2 = 4x$ and $x^2 = 4y$.

Differential Equations

59. Find the order/degree of a given differential equation
Asked 5× · Board 2022, Board 2023, Board 2025, Board 2026 · 1 marks

Write the order of differential equation (d^2y/dx^2)^(5/2) = cube root of (dy/dx).

60. Solve a homogeneous differential equation

Asked 4× · Board 2024, Board 2025, Board 2026 · 3/4 marks

Solve the differential equation x dy/dx - sqrt(x^2 + y^2) = y.

61. Solve a differential equation by variable separable method

Asked 3× · Board 2022, Board 2023, Board 2026 · 2/3 marks

Solve the D.E. $3e^x$ tan y dx + (1 + e^x) sec^2 y dy = 0.

62. Solve an application of differential equations (Newton's law of cooling)

Asked 2× · Board 2025, Board 2026 · 4 marks

A body cools according to Newton's law from 100 deg C to 60 deg C in 20 minutes. The temperature of the surrounding being 20 deg C. How long will it take to cool down to 40 deg C?

63. Solve a linear differential equation

Asked 2× · Board 2024, Board 2025 · 3 marks

Solve the D.E. dy/dx + y/x = x^3 - 3.

64. Identify the solution of a variable-separable differential equation

Asked 2× · Board 2023, Board 2025 · 2 marks

The solution of the D.E. sec^2 x . tan y dx + sec^2 y . tan x dy = 0 is ____. (a) tan x . cot y = c (b) cot x - cot y = c (c) tan x . tan y = c (d) cot x - tan y = c

65. Find the particular solution of a variable-separable differential equation with

Asked 2× · Board 2023, Board 2024 · 2/3 marks

Find the particular solution of: r dr/d(theta) + cos(theta) = 5 at r = sqrt(2) and theta = 0.

66. Solve a differential equation reducible to variable separable form by substituti

Asked 2× · Board 2022, Board 2024 · 2/3 marks

Solve: 1 + dy/dx = cosec(x + y); put x + y = u.

Probability Distributions

67. Find a probability from a given probability density function

Asked 2× · Board 2025, Board 2026 · 2 marks

If the p.d.f. of a continuous r.v. X is f(x) = (x + 2)/18, for -2 < x < 4, = 0 otherwise then P(|X| < 1) = ____. (a) 1/9 (b) 2/9 (c) 1/27 (d) 2/27

68. Find the expected value and variance of a discrete random variable from an exper

Asked 2× · Board 2025, Board 2026 · 3 marks

Find E(X) and V(X), where X is the number obtained on uppermost face, when a fair die is thrown.

69. Find the unknown constant and probabilities from a discrete probability distribu

Asked 2× · Board 2024, Board 2025 · 2/3 marks

The probability distribution of X is as follows: x: 0, 1, 2, 3, 4; P[X=x]: 0.1, k, 2k, 2k, k. Find (i) k, (ii) P(X < 2), (iii) P[1 <= X < 4].

70. Find probabilities from a given probability density function

Asked 2× · Board 2023, Board 2025 · 2/3 marks

Suppose that X is waiting time in minutes for a bus and its p.d.f. is given by f(x) = 1/5, for 0 <= x <= 5, = 0 otherwise. Find the probability that: (i) waiting time is between 1 to 3 minutes. (ii) waiting time is more than 4 minutes.

Binomial Distribution

71. Find a binomial probability for a given number of successes

Asked 5× · Board 2022, Board 2023, Board 2024, Board 2025, Board 2026 · 3 marks

A pair of dice is thrown 4 times. If getting a doublet is considered as success, find the probability of two successes.

72. Find n of a binomial distribution given its mean and variance

Asked 3× · Board 2024, Board 2025, Board 2026 · 2 marks

In a Binomial Distribution, E(X) = 6, Var(X) = 4.2 then the value of n is ____. (a) 22 (b) 24 (c) 20 (d) 26

73. Find binomial probabilities for a given number of successes

Asked 2× · Board 2024, Board 2025 · 3 marks

Five cards are drawn successively with replacement from a well-shuffled deck of 52 cards. Find the probability that: (i) all the five cards are spades. (ii) none is spade.

74. Find n and p of a binomial distribution given its mean and variance

Asked 2× · Board 2022, Board 2025 · 2 marks

If X ~ B(n, p) and E(X) = 6, Var(X) = 4.2, then find n and p.

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