ISC · CLASS 12 · MATHEMATICS

ISC Class 12 Mathematics Important Questions 2027

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

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Relations and Functions

1. relations: classify a given relation by its properties

Asked 3× · Sample 2024, Sample 2025, Sample 2026 · 1 marks

If a relation R on the set {a, b, c} defined by R = {(b, b)}, then classify the relation.

2. relations: classify a given relation as reflexive/symmetric/transitive

Asked 2× · Board 2024, Sample 2027 · 1 marks

A relation R is defined on Z as aRb if and only if $a^2 - 7ab + 6b^2 = 0$. Then R is: (a) reflexive and symmetric (b) transitive but not reflexive (c) symmetric but not reflexive (d) reflexive but not symmetric

3. functions: find the inverse of a given invertible function

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

Let $f(x) = 4 - (x - 7)^3$ be an invertible function, then find $f^{-1}(x)$.

4. relations: write smallest equivalence relation on a set

Asked 2× · Board 2025, Sample 2023 · 1 marks

Write the smallest equivalence relation from the set A to A, where A = {1, 2, 3}.

5. functions: prove a given function is bijective (one-one and onto)

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

If f: R -> R is defined by f(x) = (2x-7)/4, show that f(x) is one-one and onto.

Inverse Trigonometric Functions

6. inverse trig: solve an equation using inverse-trig identities

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

Solve: $\sin^{-1}(x) + \sin^{-1}(1 - x) = \cos^{-1} x$.

7. inverse trig: evaluate expression using principal values

Asked 2× · Board 2024, Sample 2023 · 1 marks

The value of $\text{cosec}(\sin^{-1}(-1/2)) - \sec(\cos^{-1}(-1/2))$ is equal to: (a) -4 (b) 0 (c) -1 (d) 4

Matrices

8. matrices: find entry making a matrix symmetric/skew-symmetric

Asked 2× · Board 2023, Board 2025 · 1 marks

For what value of x, is A = [[0, 1, -2], [-1, 0, 3], [x, -3, 0]] a skew symmetric matrix?

Determinants

9. matrices: solve system of equations using inverse (matrix method)

Asked 6× · Board 2024, Board 2026, Sample 2024, Sample 2025, Sample 2026, Sample 2027 · 4/5/6 marks

A ball is thrown vertically downwards from the top of a cliff, tracked from when first thrown until it hits the ground. The height above the ground after t seconds is $S(t) = at^2 + bt + c$, where a, b, c are real constants and S is in meters. After 1 second the ball is 285 m above the ground; after 2 seconds its height is 260 m; after 4 seconds it is 180 m. Set up and solve a matrix equation to find the height of the cliff.

10. determinants: determinant of the cofactor/adjoint matrix

Asked 2× · Sample 2025, Sample 2026 · 1 marks

The value of the determinant of a matrix A of order 3 is 3. If C is the matrix of cofactors of the matrix A, then what is the value of determinant of C^2?

11. determinants: evaluate/prove using row-column properties without expansion

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

Find the value of the determinant given below, without expanding it at any stage. | beta gamma, 1, alpha(beta + gamma) ; gamma alpha, 1, beta(gamma + alpha) ; alpha beta, 1, gamma(alpha + beta) |

Continuity, Differentiability and Differentiation

12. differentiation: prove a second-order differential relation for a given function

Asked 7× · Board 2023, Board 2024, Board 2025, Board 2026, Sample 2023, Sample 2025, Sample 2026 · 4 marks

If $y = x^3 \log(1/x)$, then prove that $x\, d^2y/dx^2 - 2\, dy/dx + 3x^2 = 0$.

13. continuity: find constant making a piecewise function continuous at a point

Asked 2× · Board 2023, Board 2024 · 1/2 marks

Determine the value of k for which the following function is continuous at x = 3. f(x) = { ((x+3)^2 - 36)/(x-3), x != 3 ; k, x = 3 }

Applications of Derivatives

14. application of derivatives: related rates word problem

Asked 5× · Board 2023, Board 2024, Board 2025, Board 2026, Sample 2025 · 1/2/4 marks

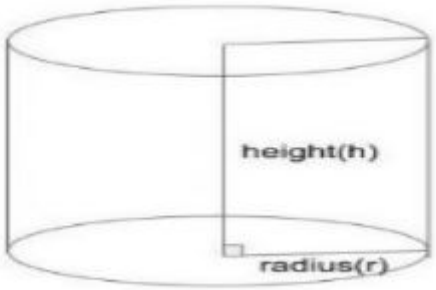
The surface of a spherical balloon is increasing at the rate of 4 cm^2/sec. Find the rate of change of volume when its radius is 12 cm.

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15. application of derivatives: maxima-minima optimization word problem

Asked 2× · Sample 2025, Sample 2026 · 6 marks

A person manufactured a water tank as a closed right circular cylinder of volume 539/2 cubic units with height h and radius r. (a) Express h in terms of radius r and given volume. (b) Express the total surface area S of the closed cylinder tank in terms of radius r. (c) If the total surface area of the tank is minimum, prove that radius r = 7/2 units. (d) Find the height of the tank.



16. application of derivatives: point where tangent is parallel to a chord/line

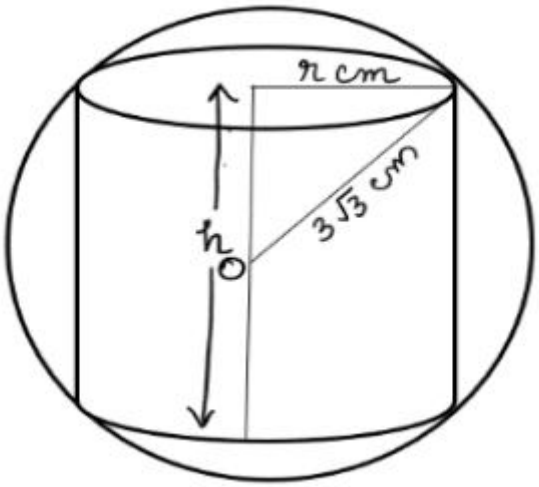
Asked 2× · Board 2024, Sample 2026 · 2 marks

Find the point on the curve $y = (x - 2)^2$ at which the tangent is parallel to the chord joining the end points (2, 0) and (4, 4).

17. application of derivatives: maxima-minima optimization word problem

Asked 2× · Sample 2023, Sample 2024 · 6 marks

A paper weight manufacturer designs a paper weight as a cylinder inscribed in a sphere and wants the volume of the cylinder to be maximum. The radius of the sphere is 3 sqrt(3) cm. Find the maximum volume of the cylinder.



18. application of derivatives: point where tangent is parallel to an axis

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

Find the point on the curve $y = 2x^2 - 6x - 4$ at which the tangent is parallel to the x-axis.

19. application of derivatives: find interval where function is increasing/decreasing

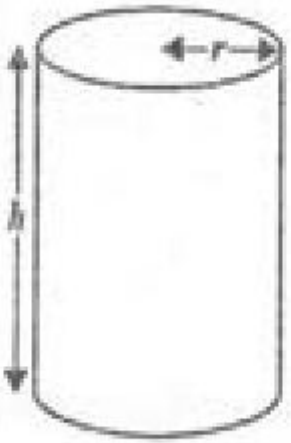
Asked 2× · Board 2023, Sample 2025 · 1/2 marks

Find the interval in which the function $f(x) = x^2 e^{-x}$ is strictly increasing or decreasing.

20. application of derivatives: maxima-minima optimization word problem

Asked 2× · Board 2024, Sample 2024 · 6 marks

Sumit bought a closed cylindrical dustbin of radius r cm and height h cm with volume 20pi cm^3. (a) Express h in terms of r using the volume. (b) Prove the total surface area is 2pi r^2 + 40pi/r. (c) Cost of painting base and top is rupees 2 per cm^2 and curved side is rupees 25 per cm^2; find the total cost in terms of r. (d) Calculate the minimum cost for painting the dustbin.



Integrals

21. definite integral: evaluate using king/property of definite integrals

Asked 6× · Board 2024, Board 2025, Board 2026, Sample 2023, Sample 2026 · 2/6 marks

Using properties of definite integral, calculate the value of: $\int_0^{pi/2} \sin^2 x / (1 + \sin x \cos x)\, dx$

22. definite integral of a modulus/absolute-value function

Asked 5× · Board 2023, Board 2024, Board 2026, Sample 2023, Sample 2024 · 1/2/4 marks

The value of $\int_0^{3/2} |x|\, dx$ is: (a) 1/8 (b) 9/8 (c) 9/4 (d) 3/4

23. evaluate the indefinite integral by substitution

Asked 4× · Board 2023, Board 2025, Sample 2024 · 1/2/4 marks

Evaluate: $\int 5/\sqrt{(2x+7)}\, dx$

24. evaluate the indefinite integral using partial fractions

Asked 3× · Board 2023, Board 2025, Sample 2026 · 6 marks

Evaluate: $\int (x^2 + x + 1)/((x + 2)(x^2 + 1))\, dx$

25. evaluate the indefinite integral by parts

Asked 3× · Board 2024, Board 2025, Sample 2024 · 2/4 marks

Evaluate: $\int (\log x)^2\, dx$

26. evaluate the indefinite integral using trigonometric simplification

Asked 2× · Sample 2023, Sample 2025 · 4 marks

Evaluate: $\int \sqrt{(\sec(x/2) - 1)}\, dx$

27. integrals: find constant given result of an integral by substitution

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

If $\int x^5 \cos(x^6)\, dx = k \sin(x^6) + C$, find the value of k.

28. integrals: apply the $e^x[f(x)+f'(x)]$ rule

Asked 2× · Board 2024, Sample 2025 · 1/2 marks

Evaluate: $\int e^x \operatorname{cosec} x (1 - \cot x)\, dx$

29. evaluate the indefinite integral by substitution and partial fractions

Asked 2× · Board 2023, Sample 2025 · 2/6 marks

Evaluate: $\int (2x^3 - 1)/(x^4 + x)\, dx$

30. evaluate the indefinite integral of a trigonometric rational function

Asked 2× · Board 2025, Board 2026 · 4/6 marks

Evaluate: $\int \sin x\, dx / (\cos x (1 - \sin x))$

Differential Equations

31. solve the differential equation (homogeneous)

Asked 7× · Board 2023, Board 2024, Board 2025, Board 2026, Sample 2025, Sample 2026, Sample 2027 · 2/4/6 marks

Solve the following differential equation: dx/dy = x/y + f(x/y)/f'(x/y)

32. solve the differential equation (linear)

Asked 3× · Sample 2023, Sample 2024, Sample 2026 · 4/6 marks

Solve the following differential equation: $(1 + x^2)\, dy/dx + 2xy = 4x^2$

33. solve the differential equation (variable-separable)

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

Show that the general solution of the differential equation dy/dx = y cot 2x is log y = (1/2) log|sin 2x| + C.

34. solve the differential equation (linear)

Asked 3× · Board 2023, Board 2025, Board 2026 · 4/6 marks

Find the particular solution for the following differential equation: $\sqrt{1 - y^2}\, dx = (\sin^{-1} y - x)\, dy$, given that y(0) = 0

Vectors

35. vectors: evaluate statements on parallelogram sides and diagonals

Asked 2× · Sample 2025, Sample 2026 · 1 marks

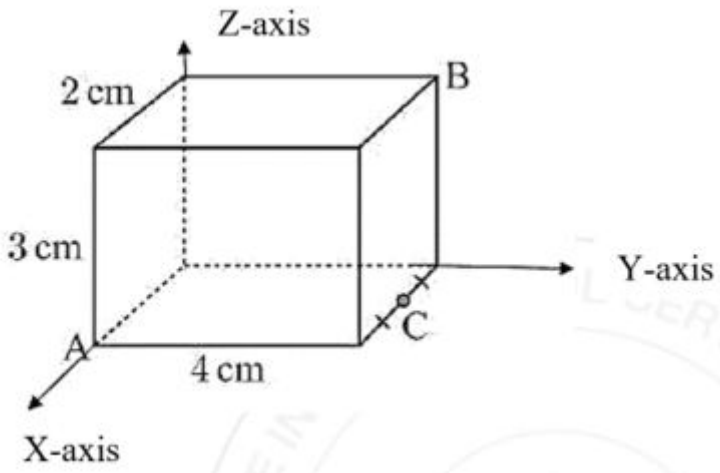
Statement 1: If a and b represent two adjacent sides of a parallelogram then the diagonals are represented by a + b and a - b. Statement 2: If a and b represent two diagonals of a parallelogram then the adjacent sides are represented by 2(a + b) and 2(a - b). Which is correct? (a) Statement 1 is true and Statement 2 is false. (b) Statement 2 is true and Statement 1 is false. (c) Both the statements are true. (d) Both the statements are false.

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36. vectors: dot product of two vectors from a figure

Asked 2× · Sample 2025, Sample 2026 · 1 marks

Shown is a cuboid (with sides 2 cm, 3 cm, 4 cm). Find BA . BC.



37. vectors: find values for which angle between vectors is obtuse

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

What are the values of x for which the angle between the vectors $2x^2$ i + 3x j + k and i - 2j + x^2 k is obtuse?

38. vectors: scalar projection of one vector on another

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

The projection of i + 2j - 3k on 2i - j + k is: (a) sqrt(3)/sqrt(2) (b) -sqrt(3)/sqrt(2) (c) -3/2 (d) -sqrt(3)/2

39. vectors: find a vector of given magnitude parallel to a given vector

Asked 2× · Board 2024, Sample 2023 · 1 marks

Find a vector of magnitude 20 units parallel to the vector 2i + 5j + 4k.

40. vectors: find angle from relation between dot and cross products

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

If a and b are two non-zero vectors such that |a x b| = a . b, find the angle between a and b.

Three-dimensional Geometry

41. 3D geometry: value from direction cosines identity

Asked 2× · Sample 2025, Sample 2026 · 1 marks

If the direction cosines of a line are <1/c, 1/c, 1/c> then: (a) c > 0 (b) 0 < c < 1 (c) c = +/-sqrt(3) (d) c > 2

42. 3D geometry: equation of plane containing a line and a point

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

Find the equation of the plane containing the line x/(-2) = (y-1)/3 = (1-z)/1 and the point (-1, 0, 2).

Linear Programming

43. linear programming: formulate and solve LPP (maximize profit)

Asked 3× · Board 2024, Board 2026, Sample 2024 · 4 marks

Raunak sells sewing machines in a rural market with total capital of rupees 5,760 and a godown storing a maximum of 20 machines. Electronic sewing machine costs him rupees 360; manually operated costs him rupees 240. Profit is rupees 22 on an electronic machine and rupees 18 on a manually operated one. Using Linear Programming, find the number of sewing machines of each type Raunak should sell to maximise his profit.

44. linear programming: solve LPP graphically and analyse optimal solutions

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

A linear programming problem is given by Z = px + qy where p, q > 0 subject to the constraints x + y <= 60, 5x + y <= 100, x >= 0 and y >= 0. (a) Solve graphically to find the corner points of the feasible region. (b) If Z = px + qy is maximum at (0, 60) and (10, 50), find the relation of p and q. Also mention the number of optimal solution(s) in this case.

45. linear programming: solve LPP graphically (maximize)

Asked 2× · Board 2023, Sample 2024 · 4 marks

Maximise Z = 4x - 3y, subject to the constraints 2x + y <= 20, 3x - 2y >= 16, x <= 9, y >= 1. Also, find Z's maximum value.

Probability

46. probability: total probability / Bayes theorem

Asked 6× · Board 2023, Board 2024, Board 2025, Sample 2023, Sample 2026, Sample 2027 · 4/5/6 marks

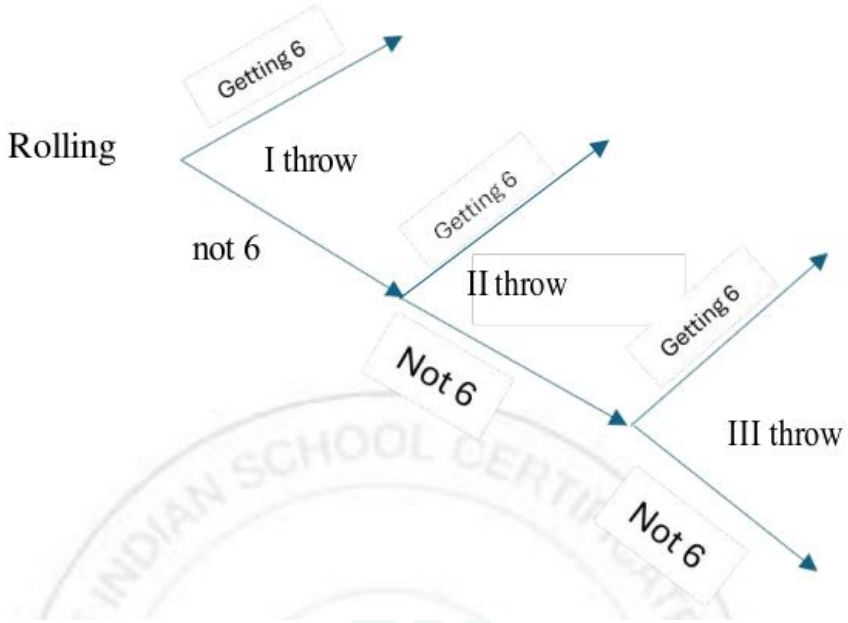
In a large organisation, only 1 out of every 1,500 emails contains a harmful attachment. An automated filter correctly marks a harmful email as dangerous 97% of the time and correctly marks a safe email as safe 97% of the time. (a) Find the probability that the email is safe. (b) Find the probability that given the email is harmful the filter marks it safe. (c) One email has been flagged as dangerous by the system. Find the probability that this email is actually safe.

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47. probability: construct probability distribution of a random variable and find mean

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

Kiran plays a game of throwing a fair die 3 times but quits as and when she gets a six. Kiran gets +1 point for a six and -1 for any other number. (i) If X denotes the random variable 'points earned', what are the possible values X can take? (ii) Find the probability distribution of X. (iii) Find the expected value of the points she gets.



48. probability: probability of an ordered selection using combinations

Asked 2× · Sample 2025, Sample 2026 · 1 marks

Five numbers x1, x2, x3, x4, x5 are randomly selected from 1, 2, 3, ..., 18 and arranged in increasing order such that $x1 < x2 < x3 < x4 < x5$. What is the probability that $x2 = 7$ and $x4 = 11$? (a) 26/51 (b) 3/104 (c) 1/68 (d) 1/34

49. probability: compute joint probability with complement using conditional

Asked 2× · Sample 2025, Sample 2026 · 1 marks

Given two events A and B such that $P(A/B) = 0.25$ and $P(A \cap B) = 0.12$. The value $P(A' \cap B)$ is: (a) 0.36 (b) 0.48 (c) 0.88 (d) 0.036

50. probability: sequential testing without replacement

Asked 2× · Sample 2025, Sample 2026 · 1 marks

There are three machines and 2 of them are faulty. They are tested one by one in a random order till both the faulty machines are identified. What is the probability that only two tests are needed to identify the faulty machines?

51. probability: total probability / Bayes theorem

Asked 2× · Board 2026, Sample 2025 · 4/6 marks

A gardener plants saplings on a day when rain is not predicted. Forecast: probability of rain today is 0.4; if it rains today, probability of raining tomorrow is 0.8; if it does not rain today, probability it will rain tomorrow is 0.7. (i) What is the probability that he will not plant the saplings tomorrow? (ii) Find the probability that he will plant them tomorrow. (iii) Given that he does not plant them tomorrow, what is the probability that he did not plant them today? (iv) What is the probability that he can plant saplings on both the days?