ISC · CLASS 12 · MATHEMATICS

# ISC Class 12 Mathematics Guess Paper 2027

Time: 3 hours · Maximum marks: 80 · 39 questions

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## Section A

Compulsory. Question 1 is made up of twenty subparts of 1 mark each: seventeen multiple-choice questions (i-xvii, including statement/assertion-reason and graph-based items) and three very-short-answer questions (xviii-xx). No internal choice.

**Q1.** A cylindrical popcorn tub of radius 10 cm is being filled with popcorns at the rate of 314 $cm^3$ per minute. The level of the popcorns in the tub is increasing at the rate of: (a) 1 cm/minute (b) 0.1 cm/minute (c) 1.1 cm/minute (d) 0.5 cm/minute — 1 mark

**Q2.** The value of $\int_0^{3/2} |x| dx$ is: (a) 1/8 (b) 9/8 (c) 9/4 (d) 3/4 — 1 mark

**Q3.** `Evaluate: \int 5/sqrt(2x+7) dx` — 1 mark

**Q4.** 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 — 1 mark

**Q5.** Given two events A and B such that P(A/B) = 0.25 and P(A ∩ B) = 0.12. The value P(A' ∩ B) is: (a) 0.36 (b) 0.48 (c) 0.88 (d) 0.036 — 1 mark

**Q6.** 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 — 1 mark

**Q7.** 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 — 1 mark

**Q8.** `If \int (cot x - cosec^2 x) e^x dx = e^x f(x) + c then f(x) will be: (a) cot x + cosec x (b) cot^2 x (c) cot x (d) cosec x` — 1 mark

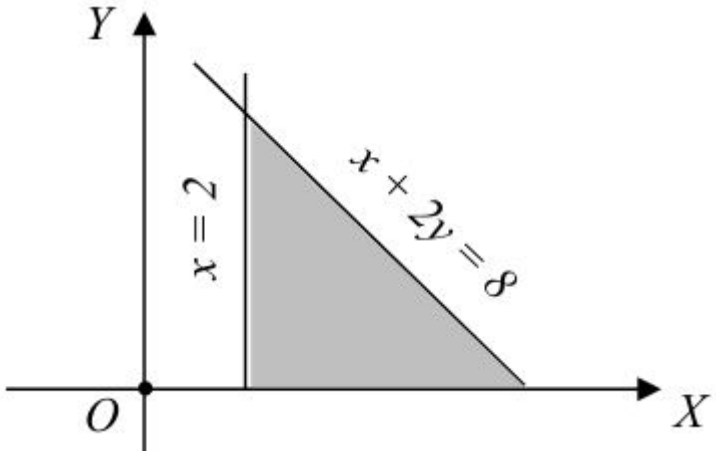
**Q9.** The interval in which the function $f(x) = 5 + 36x - 3x^2$ increases will be: (a) (-inf, 6) (b) (6, inf) (c) (-6, 6) (d) (0, -6) — 1 mark

**Q10.** If theta = $\sin^{-1} x + \cos^{-1} x - \tan^{-1} x$, x >= 0, then the smallest interval in which theta lies is: (a) pi/2 <= theta <= 3pi/4 (b) 0 < theta < pi (c) -pi/4 <= theta <= 0 (d) pi/4 <= theta <= pi/2 — 1 mark

**Q11.** Let A be the area of a triangle having vertices (x1, y1), (x2, y2) and (x3, y3). Which of the following is correct? (a) det[[x1,y1,1],[x2,y2,1],[x3,y3,1]] = +A (b) det[...] = +/-2A (c) det[...] = +/-A/2 (d) $(\det[...])^2 = A^2$ — 1 mark

**Q12.** A particle moves along the curve $6y = x^3 + 2$. At what point(s) on the curve is the y-coordinate changing 8 times as fast as the x-coordinate? (a) (2, 5/3) only (b) (4, 11) only (c) (4, 11) and (-4, -31/3) (d) (8, 86) and (-8, -85) — 1 mark

**Q13.** The expression for finding the area of the shaded region (bounded by x = 2 and x + 2y = 8) is: (a) $\int_2^8 (4 - x/2 - 2)\,dx$ (b) $\int_2^8 (x/2 + 4)\,dx$ (c) $\int_2^8 (y/2 + 4)\,dy$ (d) $\int_2^8 (4 - x/2)\,dx$ — 1 mark




**Q14.** If a = 2i + 3j - k, b = -i + 2j - 4k, c = i + j + k, then (a x b).(a x c) is: (a) 60 (b) 64 (c) 74 (d) -74 — 1 mark

**Q15.** The point of intersection of the lines (x-1)/2 = (y-2)/3 = (3-z)/(-4) and (x-1)/5 = (2-y)/(-2) = (z-3)/1 is: (a) (1, 2, -3) (b) (-1, 2, 3) (c) (1, -2, 3) (d) (1, 2, 3) — 1 mark

**Q16.** An objective function Z = ax + by is maximum at points (8, 10) and (7, 12). If a, b >= 0 and ab = 72, then the maximum value of the function is equal to: (a) 84 (b) 132 (c) 156 (d) 176 — 1 mark

**Q17.** If P(A) = m, P(B/A-bar) = 3m, P(B/A) = 6m, then what will be P(A/B)? (a) 2m/(1+m) (b) 4m/(1+m) (c) 7m/(1+m) (d) 9m/(1+m) — 1 mark

**Q18.** If a relation R on the set {a, b, c} defined by R = {(b, b)}, then classify the relation. — 1 mark

**Q19.** Solve the differential equation: dy/dx = cosec y — 1 mark

**Q20.** 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 $C^2$? — 1 mark

## Section B

Seven short-answer questions of 2 marks each (Q2-Q8), some split into 1-mark sub-parts. Internal choice is provided in three of the questions.

**Q21.** Solve the following differential equation: dx/dy = x/y + f(x/y)/f'(x/y) — 2 marks

**Q22.** Evaluate: $\int_0^5 \sqrt{x}/(\sqrt{5 - x} + \sqrt{x})\,dx$ — 2 marks

**Q23.** 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? — 2 marks

**Q24.** Evaluate: $\int x\,e^x\,dx$ — 2 marks

**Q25.** Let $f(x) = 4 - (x - 7)^3$ be an invertible function, then find $f^{-1}(x)$. — 2 marks

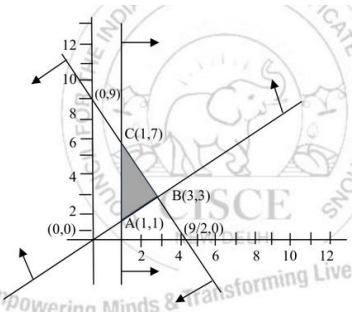
**Q26.** Find the point on the curve $y = (x - 2)^2$ at which the tangent is parallel to the chord joining the end points (2, 0) and (4, 4). 2 marks

**Q27.** If $\int x^5 \cos(x^6)\, dx = k \sin(x^6) + C$, find the value of k. 2 marks

## Section C

Seven moderately-long questions of 3 marks each (Q9-Q15), typically split into sub-parts (derivations, evaluations and reasoning). Internal choice is provided in three of the questions.

**Q28.** The feasible region determined by some constraints is the shaded region with corner points (0,0), A(1,1), (9/2,0), B(3,3) and C(1,7), with lines reaching (0,9). (i) Formulate the constraints which represent the feasible region. (ii) Hence maximise the objective function Z = x + y. (iii) What change in the constraints will make the feasible region unbounded? 3 marks




**Q29.** If $x = 3z + 1$ and $y = f(x)$, then prove that $9\, d^2y/dx^2 = d^2y/dz^2$. 3 marks

**Q30.** (i) Find the derivative of the function $f(x) = \log[(\sqrt{(1+x^2)} + x)/(\sqrt{(1+x^2)} - x)] + \tan^{-1}(2x/(1-x^2))$ with respect to x. (ii) An analyst claims that the function f(x) has a local maximum at some point x = c. Evaluate this claim using the expression for f'(x). 3 marks

**Q31.** A vector n of magnitude 8 units is inclined to x-axis at 45 degrees, y-axis at 60 degrees and at an acute angle with z-axis. A plane through the point (sqrt(2), -1, 1) is normal to n. Find the equation of the plane in vector form. 3 marks

**Q32.** If x, y, z are distinct non-zero real numbers, prove that $\Delta = \begin{vmatrix} x & x^2 & yz \\ y & y^2 & zx \\ z & z^2 & xy \end{vmatrix} = \begin{vmatrix} y^2 & z^2 & x^2 \\ y^3 & z^3 & x^3 \\ 1 & 1 & 1 \end{vmatrix}$. Hence or otherwise evaluate Delta in its simplest form if xy + yz + zx = 1. 3 marks

**Q33.** A school decorates every chair with a ribbon and every table with a cover. There are 150 chairs and 20 tables. Company A charges rupees 12 per chair ribbon and rupees 180 per table cover. Company B charges rupees 10 per chair ribbon and rupees 200 per table cover. By setting up one matrix equation that includes both companies, compare the overall prices charged by the two companies. 3 marks

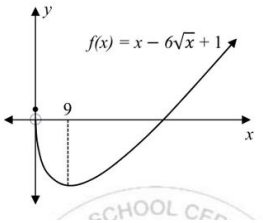
**Q34.** Let $\int_1^5 3f(x)\, dx = 12$. (i) Show that $\int_5^1 f(x)\, dx = -4$. (ii) Find the value of $\int_1^2 (x + f(x))\, dx + \int_2^5 (x + f(x))\, dx$. 3 marks

## Section D

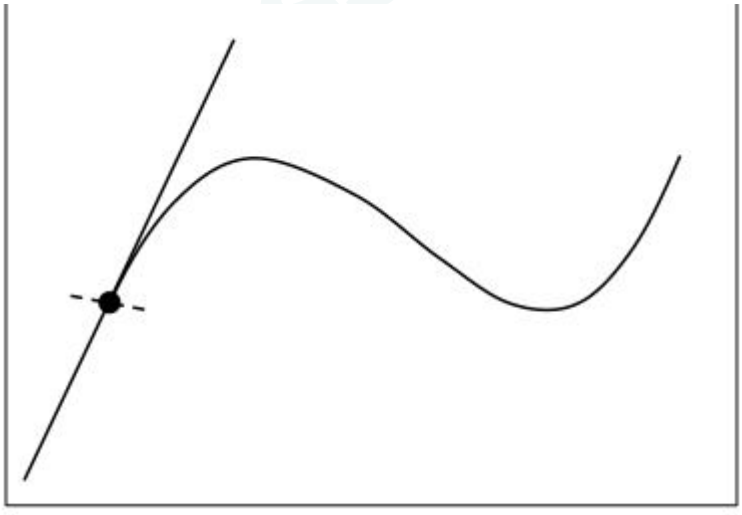
Five long-answer questions of 5 marks each (Q16-Q20), made up of multi-part application, evaluation and analysis sub-parts. Internal choice is provided in three of the questions.

**Q35.** 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. 5 marks

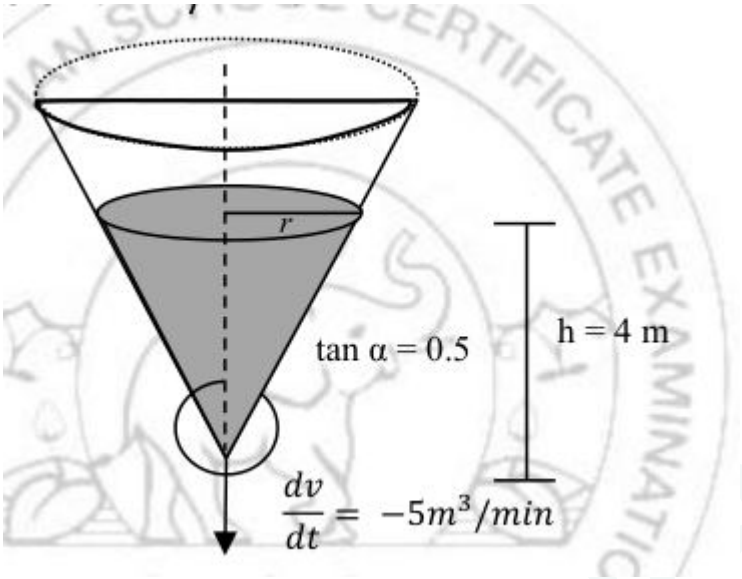
**Q36.** The graph of f(x) = x - 6 sqrt(x) + 1 is shown. (i) State the natural domain of f(x). (ii) Does f(x) have an inverse function? Explain your answer. (iii) Let g(x) = x - 6 sqrt(x) + 1, 0 <= x <= 9. Find $g^{-1}(x)$ and verify $(g \circ g^{-1})(4) = 4$. (iv) Let h(x) = x - 6 sqrt(x) + 1, x >= 9. Find $h^{-1}(x)$ and verify $(h \circ h^{-1})(16) = 16$. (v) Find the value of x such that $g^{-1}(x) = h^{-1}(x)$. 5 marks




**Q37.** A roller coaster vertical profile is $f(x) = (1/3)x^3 - 2x^2 + 3x + 5$, where x is the horizontal distance and f(x) the height (meters). (a) Identify the intervals of x where the roller coaster is climbing (increasing) and descending (decreasing). (b) A support beam is placed where the track's slope is exactly zero; find the coordinates of those points. (c) Determine the maximum and minimum heights in the interval x in [0, 4]. (d) At x = 1 a maintenance ladder must be placed perpendicular to the track (along the normal); find the equation of the maintenance ladder at x = 1. 5 marks



**Q38.** A large industrial water tank is an inverted right circular cone with semi-vertical angle $\tan^{-1}(0.5)$. Water is drained at a constant rate of 5 $m^3$/min. (a) Find the rate at which the water level is dropping when the height of the water is 4 meters. (b) Show that the wetted surface area S(h) is a strictly increasing function of the water depth h. (c) A chemical additive is added to the interior surface; if the cost is proportional to the square of the surface area ($C = K S^2$), find the depth h at which the cost is increasing most rapidly relative to time. **5 marks**




**Q39.** 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. **5 marks**

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