B.K. BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
A CBSE DAY-CUM-BOYS' RESIDENTIAL SCHOOL

PRE BOARD 3, (2025-26)
MATHEMATICS (041) (Set-1)

Class: XII **Time: 3hrs**
Date: 06/01/26 **Max Marks: 80**
Admission no: **Roll no:**

General Instructions:

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1. **This Question Paper has 5 Sections A, B, C, D and E.**
2. **Section A has 20 MCQs carrying 1 mark each**
3. **Section B has 5 questions carrying 02 marks each.**
4. **Section C has 6 questions carrying 03 marks each.**
5. **Section D has 4 questions carrying 05 marks each.**
6. **Section E has 3 case-based integrated units of assessment (04 marks each) with sub-parts.**
7. **All Questions are compulsory. However, an internal choice in 2 Qs of 5 marks, 2 Qs of 3 marks and 2 Questions of 2 marks have been provided. An internal choice has been provided in the 2marks questions of Section E**
8. **Draw neat figures wherever required. Take π =22/7 wherever required if not stated.**

	Section–A **This section comprises of MCQs of 1 mark each**	
Q.1	The principal value of $\cot^{-1}\left(\frac{-1}{\sqrt{3}}\right)$ is----------. A. $\frac{-\pi}{3}$ B. $\frac{-2\pi}{3}$ C. $\frac{\pi}{3}$ D. $\frac{2\pi}{3}$	(1)
Q.2	If A = $[a_{ij}]$ is a 3 x 3 diagonal matrix such that a_{11} = 1, a_{22} = 5 and a_{33}= -2 then $\lvert A\rvert$ is-------. A.0 B. -10 C. 10 D. 1	(1)
Q.3	The area of the region bounded by the curve x^2 = y and the line y = 4 is---------. A. 32 sq units B. $\frac{32}{3}$ sq units C. $\frac{1}{32}$ sq units D. $\frac{1}{3}$ sq units	(1)
Q.4	The function f(x) = $4\sin^3x - 6\sin^2x + 12\sin x + 100$ is strictly----------. A. increasing in $\left(\pi, \frac{3\pi}{2}\right)$ B. decreasing in $\left(\frac{\pi}{2}, \pi\right)$ C. decreasing in $\left[\frac{-\pi}{2}, \frac{\pi}{2}\right]$ D. decreasing in $\left[0, \frac{\pi}{2}\right]$	(1)
Q.5	If $\begin{bmatrix}2x+y & 4x\\ 5x-7 & 4x\end{bmatrix} = \begin{bmatrix}7 & 7y-13\\ y & x+6\end{bmatrix}$ then the value of (x + y) is----------. A. 1 B. 2 C. 4 D. 5	(1)
Q.6	The value of $\tan^{-1}\left[2\sin\left(2\cos^{-1}\frac{\sqrt{3}}{2}\right)\right]$ is----------. A. $\frac{\pi}{3}$ B. $\frac{2\pi}{3}$ C. $\frac{-\pi}{3}$ D. $\frac{\pi}{6}$	(1)
Q.7	The value of the determinant $\begin{vmatrix}x-1 & 1\\ x^3 & x^2+x+1\end{vmatrix}$ is----------. A. 3 B. 0 C. -1 D. 1	(1)
Q.8	If $y = x^3 + \tan x$ then $y'' - 2\sec^2x \tan x$ is ----------. A. 6 B. 6x C. 3 D. 3x	(1)
Q.9	All the points of discontinuity of f defined by f(x) = $\lvert x\rvert - \lvert x+1\rvert$ is/are----------. A. 0,1 B. 1, 0, 2 C. No point of discontinuity D. None of the above	(1)
Q.10	For matrix A = $\begin{bmatrix}1 & -2\\ 3 & 5\end{bmatrix}$, (A') A is equal to----------. A. $\begin{bmatrix}10 & 13\\ 13 & 29\end{bmatrix}$ B. $\begin{bmatrix}10 & 13\\ 29 & 13\end{bmatrix}$ C. $\begin{bmatrix}13 & 29\\ 10 & 13\end{bmatrix}$ D. $\begin{bmatrix}1 & 10\\ 1 & 10\end{bmatrix}$	(1)
Q.11	$\int \frac{dx}{\sqrt{x}+x}$ is equal to----------.	(1)

	A. $2\log\left\lvert\sqrt{x}+1\right\rvert$ + c B. $\log\lvert x+1\rvert$ + c C. $\log\lvert x-1\rvert$ + c D. $2\log\lvert x+1\rvert$ + c	
Q.12	Degree of the differential equation $\frac{d^2y}{dx^2} + e^{\frac{dy}{dx}} = 0$. A. 1 B. 2 C. 3 D. Not defined	(1)
Q.13	The integrating factor of the differential equation $x\frac{dy}{dx} - y = x^2$ is----------. A. x B. $\frac{1}{x}$ C. $x^{\frac{1}{2}}$ D. $x^{\frac{3}{2}}$	(1)
Q.14	If $\vec{a} = 3\hat{i} + 2\hat{j} + 5\hat{k}$ and $\vec{b} = 6\hat{i} - \hat{j} - 5\hat{k}$, then $(\vec{a} + \vec{b}) \cdot (\vec{a} - \vec{b})$ is----------. A. 24 B. -24 C. 18 D. 10	(1)
Q.15	The angle which the line $\frac{x}{1} = \frac{y}{-1} = \frac{z}{0}$ makes with the positive direction of Y-axis is----------. A. $\frac{5\pi}{6}$ B. $\frac{3\pi}{4}$ C. $\frac{5\pi}{4}$ D. $\frac{7\pi}{4}$	(1)
Q.16	The probability that A speaks truth is $\frac{4}{5}$ and that of B speaking the truth is $\frac{3}{4}$. The probability that they contradict each other in stating the same fact is----------. A. $\frac{7}{20}$ B. $\frac{1}{5}$ C. $\frac{3}{20}$ D. $\frac{4}{5}$	(1)
Q.17	In LPP, if the objective function Z = ax + by has the same maximum value on two corner points of the feasible region, then the number of points at which Z_{max} occurs is----------. A. 0 B. 2 C. finite D. infinite	(1)
Q.18	The angle between the lines 2x = 3y = -z and 6x = -y = -4z is----------. A. 0° B. 30° C. 45° D. 90°	(1)
	Followings are Assertion-Reason based questions in which a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices. A. Both A and R are true and R is the correct explanation of A. B. Both A and R are true and R is not the correct explanation of A. C. A is true but R is false. D. A is false but R is true.	
Q.19	Assertion (A): The function f: R → R given by f(x) = [x] + x is one-one and onto. Reason (R) : A function is said to be one –one and onto, if each element has unique image and range of f(x) is equal to codomain of f(x).	(1)
Q.20	Assertion (A): If $\left\lvert 2\vec{a} + \vec{b}\right\rvert = \left\lvert 2\vec{a} - \vec{b}\right\rvert$, then $\vec{a}$ parallel to $\vec{b}$. Reason (R) : Two non-zero vectors $\vec{a}$ and $\vec{b}$ are perpendicular, if $\vec{a} \cdot \vec{b} = 0$.	(1)
	Section–B **This section comprises of very short answer type questions of 2 marks each**	
Q.21	Find the domain of the function $f(x) = \sin^{-1}(2x-5)$.	(2)
Q.22	Examine the continuity of the function f(x) = $\begin{cases} \frac{x}{2\lvert x\rvert}, if\ x \neq 0 \\ \frac{1}{2}, if\ x = 0 \end{cases}$ at x = 0.	(2)
Q.23	The sum of two unit vectors is a unit vector, then show that the magnitude of their difference is $\sqrt{3}$.	(2)
Q.24	Evaluate $\int \frac{e^x}{\sqrt{5-4e^x-e^{2x}}}$ dx. **(OR)** Find the value of $\int \frac{cosx}{(1+sinx)(2+sinx)}$ dx	(2)
Q.25	Find the values of x, y and z, if A = $\begin{bmatrix} 0 & 2y & z \\ x & y & -z \\ x & -y & z \end{bmatrix}$ satisfies A' = A^{-1}.	(2)
	Section–C **This section comprises of short answer type questions of 3 marks each**	

Q.26	Show that the relation R on the set Z of all integers defined by (x, y) ∈ R ⇔(x – y) is divisible by 3 is an equivalence relation.	(3)
Q.27	Show that A = $\begin{bmatrix} 0 & a & b \\ -a & 0 & c \\ -b & -c & 0 \end{bmatrix}$ is sum of symmetric and skew symmetric matrices.	(3)
Q.28	Find the derivative of $x^{\log x}$ w.r.t logx. **(OR)** If $\sqrt{1-x^2} + \sqrt{1-y^2}$ = a(x – y), prove that $\frac{dy}{dx} = \sqrt{\frac{1-y^2}{1-x^2}}$.	(3)
Q.29	Sand pouring from a pipe at the rate of 15cm^3/min. The falling sand forms a cone on the ground such that the height of the cone is always one third of the radius of the base. How fast is the height of the sand cone increasing at the instant when the height is 4cm? **(OR)** A spherical ball of salt is dissolving in water in such a manner that the rate of decreasing of the volume at any instant is proportional to the surface. Prove that the radius is decreasing at a constant rate.	(3)
Q.30	If the unit vector $\vec{a}$ makes angle $\frac{\pi}{4}$ with î, $\frac{\pi}{3}$ with ĵ and an acute angle θ with $\hat{k}$, then find the components of $\vec{a}$ and the angle θ.	(3)
Q.31	Among the students in a college, it is known that 60% reside in hostel and 40% are day scholars. Previous year results report that 30% of all students who reside in hostel attain A grade and 20% of day scholars attain A grade in their annual exams. At the end of year, one student is chosen at random from the college and he has A grade, what is the probability that the student is a hosteller?	(3)
	Section–D **This section comprises of long answer type questions of 5 marks each**	
Q.32	Find the coordinates of the foot of perpendicular drawn from the point (2, 3, -8) to the line $\frac{4-x}{2} = \frac{y}{6} = \frac{1-z}{3}$. Also find the perpendicular distance of the given point from the line.	(5)
Q.33	Solve the following LPP graphically. Maximise Z = 300x + 600y Subject to constraints, x + 2y ≤ 12, 2x + y ≤ 12, x + $\frac{5}{4}$y ≥ 5 and x ≥ 0, y ≥ 0.	(5)
Q.34	Evaluate $\int_0^{\pi} x\, log\lvert sin\, x\rvert dx$. **(OR)** Evaluate $\int_0^{\frac{\pi}{2}} (2\log(sinx) - \log(sin2x))dx$.	(5)
Q.35	Solve the differential equation xdy – ydx = $\sqrt{x^2 + y^2}$ dx. **(OR)** Solve: x $\frac{dy}{dx}$ = y – x sin$\frac{y}{x}$.	(5)
	Section–E **This section comprises of case based questions**	
Q.36	A rectangular visiting card is to contain 24 sq cm of printed matter. The margins at the top and bottom of the card are to be 1cm and the margins on the left and right are to be $1\frac{1}{2}$ cm. On the basis of given information, answer the following questions. (i) Write the expression for the area of the visiting card in terms of x. (ii) Obtain the dimensions of the card of minimum area.	(2) (2)
Q.37	A child cut a pizza with a knife. Pizza is circular in shape which is represented by $x^2 + y^2 = 4$ and sharp edge of knife represents a straight line given by x = $\sqrt{3}$ y. Based on the above information, answer the following questions. (i) Find the point of intersection of the edge of knife and pizza. (ii) Draw the graph of both circle and line and hence shade the smaller area bounded by edge of knife and pizza in the first quadrant.	(1) (1) (2)

	(iii) Using integration find the area of that smaller part.	
Q.38	There are two anti-aircraft guns, named as A and B. The probabilities that the shell fired from them hits an airplane are 0.3 and 0.2. Both of them fired one shell at an airplane at the same time.  (i) What is the probability that the shell fired from exactly one of them hit the plane? (ii) If it is known that the shell fired from exactly one of them hit the plane, then what is the probability that it was fired from B?	(2) (2)

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