B.K. BIRLA CENTRE FOR EDUCATION

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

TERM -1 EXAMINATION 2026-27
APPLIED MATHEMATICS (QP)

Class: XII B **Time: 3 hr**
Date: 04/09/26 **Max Marks: 80**
Admission no: **Roll no:**

General Instructions:

Read the following instructions very carefully and strictly follow them:

1. This Question paper contains 38 questions. All questions are compulsory.
2. This Question paper is divided into five Sections - A, B, C, D and E.
3. In Section A, Questions no. 1 to 18 are multiple choice questions (MCQs) and Questions no. 19 and 20 are Assertion-Reason based questions of 1 mark each.
4. In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
5. In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
6. In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
7. In Section E, Questions no. 36 to 38 are case study-based questions carrying 4 marks each.
8. There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 2 questions in Section C, 2 questions in Section D.
9. Use of calculators is not allowed.

SECTION A

1. If $100 \equiv x \pmod 7$, then the least positive value of x is:
   a) 2 b) 3 c) 6 d) 4
2. In a kilometre race, A beats B by 50 meters or 10 seconds. The time taken by A to complete the race is:
   a) 90 sec b) 120sec c) 190 sec d) 200 sec
3. The solution of $-4 < 3 + 2x \leq 11, x \in R$ is:
   a) $[-2,3]$ b) $(-7,4]$ c) $[-3,3)$ d) $(-3,3)$
4. Given that x,y and b are real numbers and $x < y, b < 0, then$
   a) $\frac{x}{y} < \frac{y}{b}$ b) $\frac{x}{b} \leq \frac{y}{b}$ c) $\frac{x}{b} > \frac{y}{b}$ d) $\frac{x}{b} \geq \frac{y}{b}$
5. If A is a square matrix such that $A^2=A$, then $(I+A)^2 - 3A$ is equal to:
   a) I b) 2A c) 3I d) A
6. Total number of possible matrices of order 2x3 with each entry 0 or 1 is:
   a) 6 b) 36 c) 32 d) 64
7. If A is a square matrix of order 3x3, then value of $|3A|$ is :
   a) $3|A|$ b) $9|A|$ c) $27|A|$ d) none of these
8. If for the matrix $A=\begin{bmatrix} \alpha & -2 \\ -2 & \alpha \end{bmatrix}$, $|A|^3 = 125$, then the value of α is :
   a) ± 3 b) -3 c) ± 1 d) 1
9. If $\begin{vmatrix} 2 & 3 & 2 \\ x & x & x \\ 4 & 9 & 1 \end{vmatrix} + 3 = 0$, then the value of x is:

a) -1 b) 0 c) 1 d) 3

10. If $(x^2+y^2)^2 = xy$, then $\frac{dy}{dx}$ *is*:

a) $\frac{y+4x(x^2+y^2)}{4y(x^2+y^2)-x}$ b) $\frac{y-4x(x^2+y^2)}{x+y(x^2+y^2)}$ c) $\frac{y-4x(x^2+y^2)}{4y(x^2+y^2)-x}$ d) $\frac{4y(x^2+y^2)-x}{y-4x(x^2+y^2)}$

11. The function $y= x^2e^{-x}$ is decreasing in the interval;

a) (0,2) b) $(2,\infty)$ c) $(-\infty, 0)$ d) $(-\infty, 0) \cup (2, \infty)$

12. The maximum value $[x(x-1)+1]^{1/3}$, $0 \leq x \leq 1$ is;

a) 0 b) ½ c) 1 d) $(1/3)^{1/3}$

13. Find the primitive of $x+\frac{1}{x^2}$.

a) $x^2+\log x+c$ b) $x^2/2 +\log x+c$ c) $x/2 +\log x+c$ d) $x/2 -\log x+c$

14. Find the value of $\int \log_x x^7 dx$:

a) 7 b) 7x c) 7x+c d) $7x^2+c$

15. If the supply function is p =4+x, then the producers surplus when 12 units are sold is:

a) 72 b) 64 c) 46 d) 76

16. The order and the degree of the differential equation $\left(\frac{d^4y}{dx^4}\right)^2 = \left[1+\left(\frac{dy}{dx}\right)^2\right]^3$

a) ord 4 deg 2 b) ord1deg 6 c) ord 2 deg 3 d) ord 3 deg 2

17. The number of arbitrary constants in the general solution of a differential equation of fourth order are:

a) 0 b) 2 c) 3 d) 4

18. If the sides of an equilateral triangle are increasing at the rate of 4cm/sec, then the rate at which the area increases when side is cm is:

a) $10 cm^2/sec$ b) $\sqrt{3}\ cm^2/sec$ c) $10\sqrt{3}\ cm^2/sec$ d) $\frac{10}{3} cm^2/sec$

Assertion and Reasoning questions: In the following two questions, 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.*

19. **Assertion:** If x is real, then the minimum value of $x^2-6x+11$ is 2
Reason: If f"(x) >0 at critical point, then the value of the function at critical point will be the minimum value of the function.

20. **Assertion:** If the marginal revenue function of a commodity is $MR= 5+2x+3x^2$, then the corresponding demand function is $p= 5+x+x^2$.
Reason: $R=\int MR dx + k$, where R is the revenue function.

SECTION B

21. In what ratio must a grocer mix two varieties of rice costing Rs. 150 and Rs. 200 per kg respectively so as to get a mixture worth Rs. 165 per kg.

22. Find a matrix X such that 2A+B+X=0 where

$A= \begin{bmatrix} -1 & 2 \\ 3 & 4 \end{bmatrix}$, $B= \begin{bmatrix} 3 & -2 \\ 1 & 5 \end{bmatrix}$.

OR

Find X and Y, if $2x+3Y=\begin{bmatrix}2 & 3\\ 4 & 0\end{bmatrix}$ and $3X+2Y=\begin{bmatrix}3 & 6\\ 0 & -1\end{bmatrix}$.

23. Differentiate x^x w.r.t xlogx.

24. $Evaluate\ \int_0^4(\sqrt{x}-2x+x^2)\,dx$.

OR

Find the value of: $\int_0^a \frac{x}{\sqrt{a^2+x^2}}\,dx$.

25. Form a differential equation of the family of curves represented by $y=ax+bx^2$, where a and b are arbitrary constants.

SECTION C

26. A tank is filled by three pipes with uniform flow. The first two pipes operating simultaneously fill the tank in the same time during which the tank is filled by the third pipe alone. The second pipe fills the tank 5 hours faster than the first pipe and 4 hours slower than the third pipe. Find the time required by the first pipe alone to fill the tank.

27. Solve the following in equation: $\frac{3(x-2)}{5} \geq \frac{5(2-x)}{3}$.

28. Prove that $\begin{vmatrix}1 & x+y & x^2+y^2\\ 1 & y+z & y^2+z^2\\ 1 & z+x & z^2+x^2\end{vmatrix}$=(x-y)(y-z)(z-x)

OR

Find the area of triangle hose vertices are (a, 0), (0, b) and (x, y). Hence find the condition that the points are collinear.

29. Find the intervals in which the function $f(x) = (x+2)\,e^{-x}$ is strictly increasing or strictly decreasing.

30. Find the consumers surplus and producers surplus under pure competition for demand function $P_d = \frac{8}{x+1} - 2$ and supply function $P_s = ½(x+3)$, where p is price and x is the quantity.

OR

The marginal revenue function of a commodity is given by $MR= 9-2x+4x^2$. Find the total revenue function and the corresponding demand function.

31. Solve the following differential equation : $y(1-x^2)\frac{dy}{dx} + x(1-y^2) = 0$

SECTION D

32. Solve the system of equations by Cramer's rule:
6x+y-3z=5 , x+3y-2z=5 , 2x+y+4z=8.

OR

If $A=\begin{bmatrix}1 & -1 & 1\\ 2 & 1 & -3\\ 1 & 1 & 1\end{bmatrix}$, then find A^{-1} and hence find the system of equation:
x+2y+z=4, -x+y+z=0, x-3y+z=2

33. A firm produces x units of output per week at a total cost of

Rs($\frac{x^3}{3} - x^2 + 5x + 3$). Find the output levels at which the marginal cost and average variable cost attain their respective minima.

34. Determine the consumers surplus and the producer surplus, given the demand function D(x) = 25-5x+$\frac{x^2}{4}$. And supply function S(x) = 5x+$\frac{x^2}{4}$.

OR

A tyre manufacturer estimates that x thousand radial tyres will be purchased i.e., demanded by wholesaler's when price p=D(x) = 90-$\frac{x^2}{10}$ thousand rupees per tyre and the same number of tyres will be supplied when the price is p=S(x)= $\frac{1}{5}x^2 + x + 50$ thousand rupees per tyre. (i) Find the equilibrium price and the quantity supplied and demanded at that price. (ii) Determine the consumers and producer surplus at the equilibrium price.

35. Find the differential equation of all circles in the first quadrant which touch the co-ordinate axes.

SECTION E

36. Rajat decides to buy a few essential commodities such as masks (say x0, hand sanitizers (say y) and disposables (say z) to be distributed among the poor people living in slum clusters in order to prevent them from Corona- Virus. He decided to purchase a total of 600 such commodities. The sum of 3 times the number of masks, 2 times the number of sanitizers and the number of gloves is 1000, and the sum of 4 time the numbers of mask, all the sanitizers and 3 times the number of gloves is 1500.



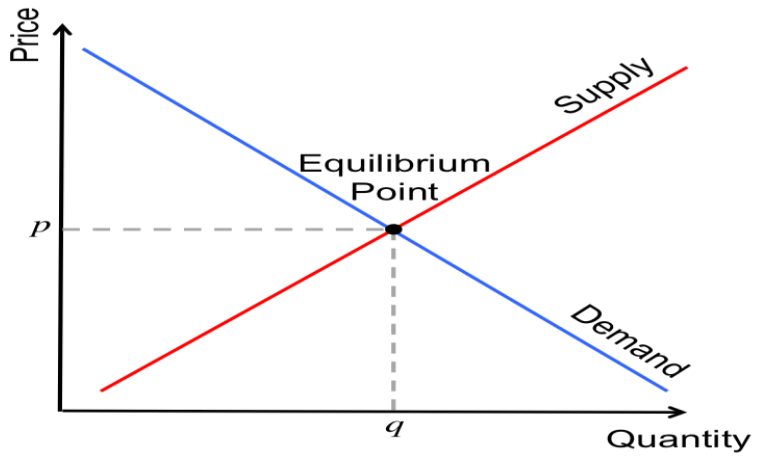

Based on the above information, answer the following:

i) Represent the above information as the system of equation.

ii) If A is the matrix of coefficients, find adj A.

iii) Find the values of x,y and z satisfying the given condition.

37. The demand and supply curve of a mobile phone manufacturing company are linear as shown in the following figure.



The company sold 25 units every month when the price of a phone was Rs. 20000 per unit and 125 units every month when the price was reduced to Rs. 15000 per unit. When the price was Rs. 25000 per unit, 180 phones were available per month for sale and when the price was reduced to Rs.15000 per unit, so 80 phone remained for sale.

Based on the above information, answer the following

i) Find the demand function D(x).
ii) Find the supply function S(x).
iii) Find the consumer surplus.

38. A teacher introduced the concept of order and degree of a differential equation to the students, which are defined below:
    a) Order: The order of a differential equation is the order of the highest order derivative which occurs in it.
    b) Degree: The degree of a differential equation is the degree of the highest order derivative which occurs in it, after the derivatives have been made free from radicals and fractions.

    On the basis of above information answer the following questions:

    i) Write the order and degree of the differential equation
    $x(\frac{d^2y}{dx^2})^3 + y(\frac{dy}{dx})^4 + x^3 = 0$

    ii) Find the sum of order and degree of differential equation $\sqrt{1-y^2}\,dx + y\sqrt{1-x^2}\,dy = 0$

****** BEST OF LUCK*****