



B.K. BIRLA CENTRE FOR EDUCATION

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



PRE BOARD 1 (2025-26) APPLIED MATHEMATICS (241)

Class: XII
Date: 07-11-25
Admission no:

Time: 3hrs
Max Marks: 80
Roll no:

General Instructions:

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 $\pi = 22/7$ wherever required if not stated.

SECTION A

1. In what ratio must tea at ₹ 60/kg be mixed with tea at ₹ 80/kg so that the mixture costs ₹ 70/kg? 1m
(a) 1:1 (b) 2:3 (c) 3:2 (d) none of these
2. If $x \equiv 2 \pmod{7}$, then $x^2 \equiv ? \pmod{7}$. 1m
(a) 2 (b) 4 (c) 1 (d) 3
(a) 4 (b) 2 (c) 1 (d) none of these
3. If $-2x > 6$, then x is: 1m
(a) $x > -3$ (b) $x < -3$ (c) $x = -3$ (d) none of these
4. The order of matrix $A = [a_{ij}]$ where $a_{ij} = 3i - 2j$ for $1 \leq i \leq 2, 1 \leq j \leq 3$ is 1m
(a) 2×2 (b) 2×3 (c) 3×2 (d) none of these
5. The sum of a matrix and its transpose is always 1m
(a) Symmetric matrix (b) Skew-symmetric matrix (c) Diagonal matrix (d) none of these
6. The determinant of a scalar multiple of a matrix kA (where A is an $n \times n$ matrix) is 1m
(a) $k \det(A)$ (b) $k^n \det(A)$ (c) $n k \det(A)$ (d) none of these
7. If A is a square matrix and $|A| = 0$, then A is 1m
(a) Invertible (b) Singular (c) Orthogonal (d) none of these
8. If A is a 3×3 matrix and $\det(A) = 5$, then $\det(A^{-1}) = ?$ 1m
(a) 5 (b) $1/5$ (c) -5 (d) none of these
9. If $y = \log x$, then $\frac{dy}{dx} = ?$ 1m
(a) $\frac{1}{x}$ (b) x (c) $\log x$ (d) none of these
10. If $\frac{d}{dx} F(x) = 6x^2$, then $F(x) = ?$ 1m

- (a) $2x^3 + C$ (b) $3x^2 + C$ (c) $x^3 + C$ (d) none of these

11 The order of the differential equation 1m

$$\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^3 + y = 0$$

is:

(a) 2 (b) 3 (c) 4 (d) none of these 1m

12 For a binomial distribution $B(n, p)$, the mean is 1m

- (a) $np(1 - p)$ (b) np^2 (c) np (d) none of these

13 Poisson distribution is a limiting case of binomial distribution when 1m

- (a) n is small, p is large (b) n is large, p is small (c) n is small, p is small (d) none of these

14 The feasible region of an LPP is always: 1m

- (a) A straight line (b) A convex polygon or unbounded region (c) A circle (d) none of these

15 A subset of a population selected for analysis is called: 1m

- (a) Parameter (b) Sample (c) Variable (d) none of these

16 The standard deviation of the sampling distribution of the sample mean is called: 1m

- (a) Standard deviation (b) Standard error (c) Variance (d) none of these

17 The components of time series are: 1m

- (a) Trend, seasonal, cyclical, irregular (b) Mean, median, mode, range (c) Profit, loss, cost, revenue (d) none of these

18 If a perpetuity pays ₹ 2,000 every year and the rate of interest is 8% p.a., its present value is: 1m

- (a) ₹ 16,000 (b) ₹ 20,000 (c) ₹ 25,000 (d) none of these

19 Assertion (A): The present value of a perpetuity decreases when the rate of interest increases. 1m

Reason (R): Present value of a perpetuity is inversely proportional to the rate of interest.

(a) Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true but Reason (R) is not a correct explanation of Assertion (A).

(c) Assertion (A) is true and Reason (R) is false.

(d) Assertion (A) is false and Reason (R) is true.

20 Assertion (A): In a sinking fund, the total amount accumulated at the end of the period depends on the rate of interest and time. 1m

Reason (R): Sinking fund amount is calculated using the formula $A = R \times \frac{(1+i)^n - 1}{i}$.

(a) Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true but Reason (R) is not a correct explanation of Assertion (A).

(c) Assertion (A) is true and Reason (R) is false.

(d) Assertion (A) is false and Reason (R) is true.

SECTION B

21 A boat goes 12 km downstream in 3 hours and 18 km upstream in 6 hours. Find the speed of the boat in still water. 2m

Or

In what ratio must coffee costing ₹ 200 per kg be mixed with coffee costing ₹ 280 per kg so that the mixture may be worth ₹ 240 per kg?

- 22 Four bad eggs are mixed with ten good ones. If three eggs are drawn one after another without replacement, find the probability distribution of the number of bad eggs drawn. 2m
- Or
- A fair die is thrown once. Let X denote the number obtained. Find the mean and variance of X .
- 23 The probability of a man hitting a target in a single shot is $\frac{1}{4}$. How many times must he fire so that the probability of hitting the target at least once is greater than $\frac{2}{3}$? 2m
- 24 A machine is purchased for ₹ 30,000. Its scrap value after 13 years is estimated to be ₹ 4,000. Find the annual depreciation using the straight-line method. 2m
- 25 A start-up company invested ₹ 3,00,000 in shares for 5 years. The value of this investment was ₹ 3,50,000 at the end of the second year, ₹ 3,80,000 at the end of the third year, and on maturity, the final value stood at ₹ 4,50,000. Calculate the Compound Annual Growth Rate (CAGR) on the investment. 2m
- [Given that $(1.5)^5 = 1.084$]

SECTION C

- 26 Two pipes A and B can fill a cistern in 12 hours and 15 hours, respectively. A third pipe C can empty the cistern in 20 hours. All three pipes are opened together. 3m
- (a) Find the time in which the cistern will be filled.
- (b) If pipe C is closed after 4 hours, find how much more time will be required to fill the cistern.
- 27 In a 200 m race, A can run 200 m in 25 seconds, and B in 28 seconds. 3m
- (a) By what distance does A beat B?
- (b) By what time does A beat B?
- 28 Show that the local maximum value of $x + 1/x$ is less than local minimum value. 3m

Or

$$\text{Solve } x(x-1)(x-2)(x-3) > 0$$

- 29 Solve the differential equation: 3m
- $$\frac{dy}{dx} = e^{x+y} + x^2 e^y$$

Or

Verify that

$$y = x^2 + 2x + 3$$

is a solution of

$$\frac{d^2 y}{dx^2} = 2.$$

- 30 A company produces two types of biscuits, A and B. 3m
 Each packet of A requires 4 kg of flour and 2 kg of sugar.
 Each packet of B requires 2 kg of flour and 4 kg of sugar.
 The company has 40 kg of flour and 48 kg of sugar available per day.
 If the profit per packet of A and B is ₹ 6 and ₹ 8 respectively,
 formulate an LPP to maximize profit.

- 31 A company establishes a sinking fund to repay a debt of ₹ 2,50,000 due in 4 years. 3m
 Annual contributions are made at the end of each year. Find the amount of each annual
 deposit if the rate of interest is 18% per annum compounded annually.

SECTION D

- 32 Solve by matrix method: 5m
 $2x + y + z = 10, 3x + 2y + 3z = 18, x + 4y + 2z = 12$

- 33 The fixed cost of producing an item is ₹ 6500 and the variable cost per item is ₹ 12.50. 5m
 Find:
 (i) The cost function.
 (ii) The total cost of producing 75 items.
 (iii) The average cost of producing 400 items.
 Also, draw a suitable graph showing Fixed Cost (TFC), Variable Cost (TVC) and Total
 Cost (TC).

Or

A firm has a fixed cost of ₹ 10,000 and the variable cost per item is ₹ 18.

Find:

- (i) The cost function
 (ii) The total cost of producing 150 items
 (iii) The average cost of producing 400 items
- 34 The production of cement (in tonnes) by a firm during 9 years is given below: 5m

Year	1	2	3	4	5	6	7	8	9
Production(tonnes)	4	5	5	6	7	8	9	8	10

Calculate the trend values for the above series using the 3-yearly moving average
 method.

- 35 Madhu exchanged her old car valued at ₹ 1,50,000 for a new car priced at ₹ 6,50,000. She 5m
 paid ₹ x as down payment and agreed to pay the balance in 20 equal monthly instalments
 of ₹ 21,000 each. The rate of interest charged is 9% per annum, compounded monthly.
 Find the value of x, given that $(1.0075)^{-20} = 0.86118985$.

Or

Mr. Arjun retires and opts for a pension plan that promises to pay him ₹ 40,000 per year
 for life. The company wants to set aside a lump sum now to cover this perpetuity. The
 prevailing interest rate is 8% per annum.

(i) Write the formula for the present value of a perpetuity, stating the meaning of each
 term.

(ii) Calculate the amount the company must invest now if the interest rate is 8% per
 annum.

Now suppose the company's investment rate falls to 6% per annum.

(iii) Calculate the new amount that must be invested to provide the same annual payment of ₹ 40,000 forever.

or

Find the percentage increase in the required investment when the rate of interest decreases from 8% to 6%.

SECTION E

- 36 A digital safe uses a 4-digit PIN where each digit follows modulo 10 arithmetic (i.e., after 9, it goes back to 0). 4m

For example, adding 7 to 6 gives $(7 + 6)(\text{mod}10) = 3$.

The original PIN is 5836. The safe's system performs the following operations each time it's accessed:

- Add 7 to the first digit,
- Add 8 to the second digit,
- Add 9 to the third digit,
- Add 6 to the fourth digit, all under modulo 10.

Answer the following:

(i) Find the new PIN after the first access.

(ii) Find the PIN after the second access (apply the same operation again).

(iii) How many accesses will return the PIN to its original form?

Or

(iii) If the third digit after 5 accesses becomes 5, verify the result using modular arithmetic.

- 37 The total profit function of a company is given by 4m

$$P(x) = -5x^2 + 125x + 37500$$

where x represents the number of units produced.

Based on the above information, answer the following:

(i) What will be the production when the profit is maximum?

(ii) What will be the maximum profit?

Or

When the production is 2 units, what will be the profit of the company?

(iii) Find the interval in which the profit function is strictly increasing.

- 38 An urn contains 25 balls, 10 marked X and 15 marked Y. A ball is drawn at random, its mark noted, and then it is replaced. Six balls are drawn in this way. Find: 4m

(i) Probability that all six bear mark X.

(ii) Probability that not more than 2 balls bear mark Y.

(iii) Probability that the number of balls with X and Y marks are equal.

Or

(iii) Probability that at least one ball bears mark Y.

*****Best of luck*****