



**BK BIRLA CENTRE FOR EDUCATION**  
SARALA BIRLA GROUP OF SCHOOLS  
SENIOR SECONDARY CO-ED DAY CUM BOYS' RESIDENTIAL SCHOOL



**PRE BOARD-1, (2024-25)**

**APPLIED MATHEMATICS (241)**

Class: XII Commerce  
Date: 22/11/24  
Admission Number: \_\_\_\_\_

Duration: 3 Hour  
Max. Marks: 80  
Roll number: \_\_\_\_\_

General Instructions:

1. This Question paper contains - five sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2. Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer (VSA)-type questions of 2 marks each.
4. Section C has 6 Short Answer (SA)-type questions of 3 marks each.
5. Section D has 4 Long Answer (LA)-type questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment of 4 marks each with sub parts.

**Section –A (Multiple Choice Questions)**

Each question carries 1 mark

- 1 The speed of a boat in still water is 15 km/hr and the rate of current is 3km/hr. The distance travelled by boat downstream in 12 minutes is:  
a) 1.2km                      b) 1.8km                      c) 2.4km                      d) 3.6km
- 2 The solution set of  $6 \leq -3(2x - 4) < 12, x \in R$  is:  
a) (0,1]                      b) [1,0)                      c) (0,1)                      d) [0,1]
- 3 The number of all possible matrices of order  $3 \times 3$  with each entry 0 or 1 is  
a) 18                      b) 27                      c) 81                      d) 512
- 4 If  $A = \begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}$  and  $A^2 - xA = I_2$ , then the value of x is:  
a) 4                      b) 2                      c) -2                      d) -4
- 5 If  $A^2 - A + I = 0$ , then  $A^{-1}$  is equal to  
a)  $A+I$                       b)  $A-I$                       c)  $A+2I$                       d)  $I-A$
- 6 For what value of k inverse does not exist for the matrix  $\begin{bmatrix} 1 & 2 \\ k & 6 \end{bmatrix}$   
a) 0                      b) 3                      c) 6                      d) 2
- 7 Derivative of  $a^{2x+3}$  w.r.t.x is  
a)  $2a^{2x+3}$                       b)  $2a^{2x+3} \log a$                       c)  $a^{2x+3} \log a$                       d)  $a^{2x+3}$
- 8 If  $x = at^2, y = 2at$ , then  $\frac{d^2y}{dx^2}$   
a)  $-\frac{1}{2at^3}$                       b)  $-\frac{1}{2at^2}$                       c)  $\frac{1}{t^2}$                       d)  $-\frac{2a}{t}$
- 9 The point on the curve  $y = 6x - x^2$  where the tangent is parallel to the line  $4x - 2y - 1 = 0$  is  
a) (2,8)                      b) (8,2)                      c) (6,1)                      d) (4,2)
- 10  $\int \frac{(\log x)^5}{x} dx$  is equal to

- 11 If  $\int_0^{40} \frac{dx}{2x+1} = \log k$ , then the value of k is  
 a)  $\frac{\log x^6}{6} + c$       b)  $\frac{(\log x)^6}{6} + c$       c)  $\frac{(\log x)^6}{3x^2} + c$       d) none of these
- 12 If the marginal cost function of a product is given by  $MC = 10 - 4x + 3x^2$  and fixed cost is Rs. 500, the cost function is  
 a)  $10x - 2x^2 + x^3$       b)  $500 + 10x - 2x^2 + x^3$       c)  $-4 + 6x$       d)  $500 + 10x - 8x^2 + 9x^3$
- 13 If the demand function of a commodity is  $p = 20 - 2x - x^2$  and the market demand is 3 units, then the consumers surplus is  
 a) 27      b) 38      c) 42      d) 47
- 14 Integrating factor of the differential equation  $(1-x^2) \frac{dy}{dx} - xy = 1$  is  
 a)  $-x$       b)  $\frac{x}{1+x^2}$       c)  $\sqrt{1-x^2}$       d)  $\frac{1}{2} \log(1-x^2)$
- 15 The order and degree of the differential equation  $\left(\frac{dy}{dx}\right)^5 + 3xy \left(\frac{d^3y}{dx^3}\right)^2 + y^2 \left(\frac{d^2y}{dx^2}\right)^3 = 0$ .  
 a) 2,3      b) 3,2      c) 3,5      d) 1,5
- 16 A dice is thrown twice, the probability of occurring of at least once is  
 a)  $\frac{11}{36}$       b)  $\frac{7}{12}$       c)  $\frac{35}{36}$       d) none of these
- 17 For a binomial variate X, if  $n=4$  and  $P(X=0) = \frac{16}{81}$ , then  $P(X=4)$  is  
 a)  $\frac{1}{3}$       b)  $\frac{1}{27}$       c)  $\frac{1}{81}$       d)  $\frac{1}{16}$
- 18 A fire in a factory delaying production for some time is  
 a) Long termed trend      b) Cyclic trend      c) Seasonal trend      d) Irregular trend

**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 (A): A simple random sample consists of five observations 2, 4, 6, 8, 10. The point estimate of population standard deviation is  $\sqrt{10}$ .  
 Reason (R): Sample standard deviation of n observations,  $S = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n}}$
- 20 Assertion (A): If the nominal rate of interest is 12.5% and the inflation is 2%, then the Effective rate of interest is 10.5%.

Reason (R): If the interest is calculated only at the end of an year, the effective rate of interest is same as the nominal rate of interest.

**Section –B**

**[This section comprises of very short answer type questions (VSA) of 2 marks each]**

- 21 Find the remainder when  $5^{61}$  is divided by 7.
- 22 Solve the following inequality for real x:  $3(2-x) \geq 2(1-x)$ .

**OR**

A man wants to cut three lengths from a single piece of cardboard of length 91cm. The second length is to be 3cm longer than the shortest and the third length is to be twice as long as the shortest. What are the possible lengths for the shortest board if the third piece is to be at least 5 cm longer than the second?

- 23 The total cost and the total revenue of a company that produces and sells x-units of a particular product are respectively  $C(x) = 5x+350$  and  $R(x) = 50x-x^2$ . Find the break even values.

24 Evaluate:  $\int \frac{x^2}{x^2-4x+3} dx$

**OR**

*Evaluate:*  $\int_2^4 |x - 3| dx$

- 25 What is the mean of the numbers obtained on throwing a die having written 1 on three faces, 2 on two faces and 5 on one face?

**Section – C**

**[This section comprises of short answer type questions (SA) of 3 marks each]**

26 If  $x^y = y^x$ , Prove that  $\frac{dy}{dx} = \frac{y(x \log y - y)}{x(y \log x - x)}$ .

27 *Evaluate*  $\int \frac{x^3}{x^4+3x^2+2} dx$ .

**OR**

*Evaluate*  $\int \left(x - \frac{1}{x}\right)^3 dx$ .

- 28 Solve the following differential equation:  $x^2(y+1) dx + y^2(x-1) dy = 0$ .
- 29 Find the probability distribution of the number of tails in the simultaneous tosses of three coins.

**OR**

If the probability that an individual suffers a bad reaction from injection of a given serum is 0.001, determine the probability that out of 2000 individuals (i) exactly 3, (ii) more than 2 individuals will suffer from a bad reaction. (Use  $e^{-2} = 0.1353$ ).

- 30 The average heart rate of Indians is 72 beats per minute. To lower their heart rate, a group of 25 people participated in an aerobics exercise programme. The group was tested after to see if the group had significantly slowed their heart rate. The average heart rate of the group was 69 beats/minute with a standard deviation of 6.5. Was the aerobic program effective in lowering rate? (Given  $\alpha = 0.05$ ,  $t_\alpha = 1.711$ )
- 31 Diwakar invested Rs. 20000 in a mutual fund in year 2010. The value of mutual fund increased to Rs. 32000 in year 2015. Calculate the compound annual growth rate.

#### Section –D

**[This section comprises of long answer type questions (LA) of 5 marks each]**

- 32 The marginal cost of production of  $x$  units of a commodity is  $30+2x$ . It is known that fixed cost are Rs. 120. Find the total cost of producing 100 units, the cost of increasing output from 100 to 200 units.
- 33 Fit a straight line trend by the methods of least squares and tabulate the trend values from the following Data:

Year	1995	1996	1997	1998	1999	2000	2001	2002
Sales(Rs.Crore)	6.7	5.3	4.3	6.1	5.6	7.9	5.8	6.1

- 34 A person wishes to purchase a house for Rs. 4500000 with a down payment of Rs. 500000 and balance in EMI for 25 years. If bank charges 6% per annum compounded monthly calculate the EMI. (Given  $(1.005)^{300} = 4.4650$ ).

#### OR

What sum of money is needed to invest now, so as to get Rs. 5000 at the beginning of every month forever, if the money is worth 6% per annum compounded monthly?

- 35 Find graphically, the maximum value of  $Z = 2x + 5y$ , subject to constraint  $2x + 4y \leq 8$ ,  
 $3x + y \leq 6$ ,  $x + y \leq 4$ ,  $x \geq 0$ ,  $y \geq 0$ .

#### OR

A mill owner buys two types of machines A and B for his mill. Machine A occupies 1000sq. m of area and requires 12 men to operate, while machine B occupies 1200sq. m area and requires 8 men to operate it. The owner has 7600 sq. m of area available and 72 men to operate machines. If machine A produces 50 units and machine B produces 40 units daily, how many machines of each type should he buy to maximise the daily output? Use linear programming to find the solution.

#### Section –E

**[This section comprises of 3 case- study/passage based questions of 4 marks each with sub parts. The all three case study questions have three sub parts (i), (ii), (iii) of marks 1, 1, 2 respectively.]**

36 Consider the differential equation of the form  $\frac{dy}{dx} + Py = Q$

Where P and Q are constants or functions of x. It is known as linear differential equation in y. To solve this type of differential equation, we calculate integrating factor (I.F) =  $e^{\int P dx}$  and solution is given by  $y \times (I.F.) = \int Qx(I.F.)dx + c$ .

Question:  $x\frac{dy}{dx} - y - 2x^3 = 0$ , Based on this information, answer the following questions:

- (A) Find the values of P and Q in given question.
- (B) Find the I.F. of the given differential equation.
- (C) Find the solution of the given differential equation.

37 Three shopkeepers Salim, Vijay and Venkat are using polythene bags, handmade bags (prepared by prisoners) and newspaper's envelope as carry bags. It is found that the shopkeepers Salim, Vijay and Venket are using (20, 30, 40), (30, 40, 20), (40, 20, 30) polythene bags, handmade bags and newspaper's envelops respectively. The shopkeepers Salim, Vijay and Venket spent Rs. 250, Rs. 270 and Rs. 200 on these carry bags respectively.

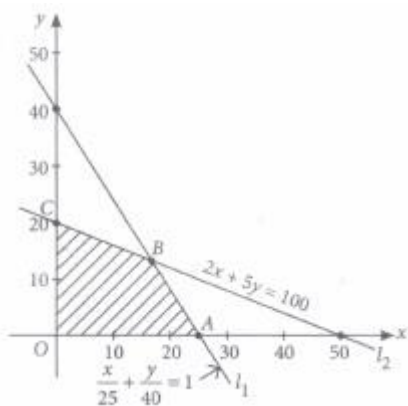


Using the concept of matrices and determinants, answer the following questions:

- (A) What is the cost one polythene bag?
- (B) What is the cost of one handmade bag?
- (C) What is the cost one newspaper envelope?

38 Deepa rides her car at 25 km/hr, She has to spend Rs. 2 per km on diesel and if she rides it at a faster speed of 40 km/hr, the diesel cost increases to Rs. 5 per km. She has Rs. 100 to spend on diesel. Let she travels x kms with speed 25 km/hr and y kms with speed 40 km/hr. The feasible region for the LPP is shown below:

Based on the above information, answer the following questions



- (i) What is the point of intersection of line  $l_1$  and  $l_2$ ?
- (ii) What are the corner points of the feasible region shown in above graph?
- (iii) If  $Z = x + y$  be the objective function and  $\max Z = 30$ . What is the maximum value occurs at corner point?

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