BK BIRLA CENTRE FOR EDUCATION

SARALA BIRLA GROUP OF SCHOOLS
SENIOR SECONDARY CO-ED DAY CUM BOYS' RESIDENTIAL SCHOOL

PRE-BOARD EXAMINATION – 3 (2024-25)

APPLIED MATHEMATICS (241)

Class : XII Commerce — Duration: 3 Hrs.
Date : 10-01-2025 — Max. Marks: 80
Adm no: _____ — Roll number: ____

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 2 marks each.
4 Section C has 6 questions carrying 3 marks each.
5 Section D has 4 questions carrying 5 marks each
6 Section E has 3 case based integrated units of assessment (04 marks each) with subparts of the values 1, 1 and 2 marks each respectively.
7 All questions are compulsory. However, an internal choice in 2 Qs of 5 marks, 2Qs of 3 marks and 2 Qs of 2 marks has been provided. An internal choice has been provided in the 2 marks questions of Section E.
8 Draw neat figures wherever required. Take $\pi = \frac{22}{7}$ wherever required if not stated.

SECTION – A

1 What is the least value of 'x' that satisfies $x \equiv 17\ (mod\ 4)$ when $18 < x \leq 25$?
(A) 17 (B) 21 (C) 25 (D) Not defined

2 If $a = 31, m = 5$ and $a \equiv b\ (mod\ m)$ is true then value of 'b'
(A) 21 (B) 31 (C) 16 (D) All of these

3 In an examination out of 1000 students, 70% boys and 80% girls are passed. If total pass percentage 76%, then the number of girls is
(A) 500 (B) 600 (C) 700 (D) 800

4 Pipe A can fill a tank in 12 minutes whereas Pipe B can fill the tank in 18 minutes. If both the tanks are open then the time taken to fill the tank is
(A) 5 minutes (B) 6.4 minutes (C) 7.2 minutes (D) 8.5 $minutes$

5 Evaluate:

$$\int \frac{x+3}{x+5}\, dx$$

(A) $x + \log|x-5|$ (B) $x - 2\log|x+5|$
(C) $x - 2\log|x-3|$ (D) $x - 2\log|x+3|$

6 Find $\frac{d^2y}{dx^2}\ if\ y = x$
(A) 1 (B) 0 (C) x (D) -1

7 Find the value of k from the following table:

X	0	1	2	3	4
P(X)	0.1	k	2k	2k	k

(A) 1 (B) 0 (C) 0.15 (D) 1.5

8 If a die is thrown 6 times and getting even number is success then calculate probability of getting exactly 2 success.

(A) $\frac{15}{32}$ (B) $\frac{15}{64}$ (C) $\frac{3}{64}$ (D) $\frac{10}{23}$

9 Find the mean and variance from the binomial distribution $B\left(4, \frac{1}{3}\right)$

(A) $4, \frac{1}{3}$ (B) $16, \frac{1}{9}$ (C) $\frac{4}{3}, \frac{8}{3}$ (D) $\frac{4}{3}, \frac{8}{9}$

10 A set of observations recorded at an equal interval of time is called

(A) $Array\ data$ (B) $data$
(C) $Geometric\ series$ (D) $Time\ series\ data$

11 How many components does a Time series data have?

(A) 0 (B) 1 (C) 3 (D) 6

12 A marketing company is going to promote its number of departmental stores by campaigning. Then what is Null hypothesis?

(A) $Mean\ (\mu_a) before\ campaign = Mean\ (\mu_b)\ after\ campaign$
(B) $Mean\ (\mu_a) before\ campaign = 0$
(C) $Mean\ (\mu_a)\ before\ campaign > Mean\ (\mu_b)\ after\ campaign$
(D) $Mean\ (\mu_b)\ after\ campaign = 0$

13 The best fitted trend line is one for which sum of squares of residuals or errors is

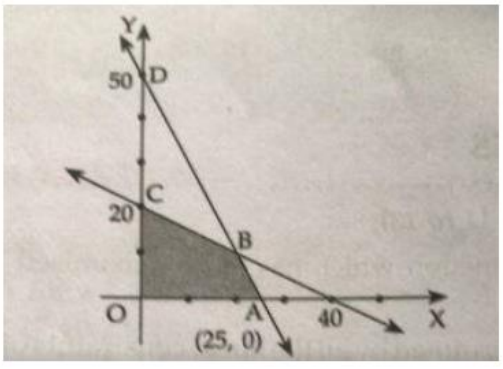
(A) positive (B) negative (C) minimum (D) maximum

14 Calculate present value of a sequence of payment Rs.60 made at the end of each 6 months and continuing forever, if money is worth 4% compounded semi-annually.

(A) $Rs.3000$ (B) $Rs.1000$ (C) $Rs.300$ (D) $Rs.360$

15 In the given figure what is the LPP shaded region known as?

(A) Feasible region
(B) feasible solution
(C) Optimal region
(D) objective region



16 A machine costing Rs.40000 is expected to have a useful life of 4 years and a final scrap value of Rs.8000. Find the annual depreciation charge using the straight line method:

(A) 8000 (B) 10000 (C) 5000 (D) 4000

17 A sample of 50 bulbs is taken at random. Out of 50 we found 15 bulbs are Bajaj, 17 are of Surya and 18 are of Crompton. What is the point estimate of population proportion of Surya?

(A) 0.3 (B) 0.34 (C) 0.36 (D) 0.4

18 Rs.100 shares of a company are selling at Rs.80. If the company is paying a dividend of 12%, then the rate of return is

(A) 10% (B) 12% (C) 15% (D) 18%

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): Sale of woollen clothes goes up in winter and sale of cold drinks goes up during summer season.
Reason (R): Seasonal variations mean the variations occurring within parts of a year.

20 The total revenue received from the sale of x units of a product is given by $R(x) = 3x^2 + 36x + 5$ in rupees.
Assertion (A): The marginal revenue when $x = 5$ is 66
Reason (R): Marginal revenue is the rate of change of total revenue with respect to the number of items sold at an instance.

SECTION – B

21 The following data are from a random sample: $5, 8, 10, 7, 10, 14$.

(i) what is the point estimate of the population mean?

(ii) what is the point estimate of the population standard deviation?

22 A manufacturing company makes two models A and B of a product. Each piece of Model A requires 9 labour hours for fabricating and 1 labour hour for finishing. Each piece of Model B requires 12 labour hours for fabricating and 3 labour hours for finishing. For fabricating and finishing, the maximum labour hours available are 180 and 30 respectively. The company makes a profit of Rs.8000 on each piece of Model A and Rs.12000 on each piece of Model B. How many pieces of Model A and Model B should be manufactured per week to realise a maximum profit? Formulate the linear programming problem to maximise the manufacturer profit?

23 Find the area of the triangle whose vertices are (3, 8), (-4, 2) and (5, 1).

OR

Find the inverse of a matrix $A = \begin{bmatrix} 2 & -2 \\ 4 & 3 \end{bmatrix}$ if it exists.

24 In a 500 metre race, A defeats B by 60 metres (or) 12 seconds. What is the time taken by A to complete the race?

OR

A pump can fill a tank with water in 2 hours. Because of a leak in the tank, it takes $2\frac{1}{3}$ hours to fill the tank. In how much time will the leak will completely empty the tank?

25 At what rate of interest will the present value of Perpetuity of Rs.500 at the end of every 6 months be Rs.10000?

SECTION – C

26 Mr. Ramesh wishes to purchase a new house, costing Rs.4500000 with a down payment of Rs.500000 and balance in EMI for 25 years. If the bank charges 6% per annum compounded monthly (reducing balance method) calculate the EMI. [Use $(1.005)^{300} = 4.4650$]

27 Evaluate:

$$\int \frac{2x+1}{(x+1)(x-2)}\,dx$$

OR

Integrate:

$$\int \frac{3x-2}{(x+1)(x-2)^2}\,dx$$

28 Ram has setup a sinking fund so that he can accumulate Rs.1000000 in 10 years for his children's higher education. How much should he deposit every six months if interest is 5% per annum compounded semi-annually? [Use $(1.025)^{20} = 1.6386$]

29 Integrate:

$$\int_1^4 |x-5|\,dx$$

OR

The demand function for a commodity is given by $p = 100 - 8x$. Find the consumer's surplus at equilibrium price $p_0 = 4$.

30 The cost of 4 kg onion, 3 kg wheat and 2 kg rice is 60. The cost of 2 kg onion, 4 kg wheat and 6 kg rice is 90. The cost of 6 kg onion, 2 kg wheat and 3 kg rice is 70. Find the cost of each item per kg. by matrix method.

31 Find the second derivative of $x^3 \log x$

SECTION – D

32 An open tank with the square bottom to contain 400 cubic cm of liquid is to be constructed. Find the dimensions of the tank so that the surface area of the tank is minimum.

OR

Find a point on the curve $y^2 = 2x$ which is nearest to the point (1, 4).

33 If the level of education among adults in a certain region is normally distributed with mean 8 and Standard deviation 5. What is the probability that in a sample of 100 adults, you will find an average level of education (i) between 10 and 14 years (ii) more than 14 years?

OR

It is known that 3% of plastic buckets manufactured in a factory are defective. Using the Poisson distribution on a sample of 100 buckets, find the probability of: (i) zero defective bucket (ii) at most one defective bucket. [Use: $e^{-3} = 0.049$]

34 Maximise $Z = 22x + 44y$ subject to the constraints

$$x + y \geq 3; 3x + 8y \leq 24; x - y \geq 0 \; and \; x, y \geq 0$$

OR

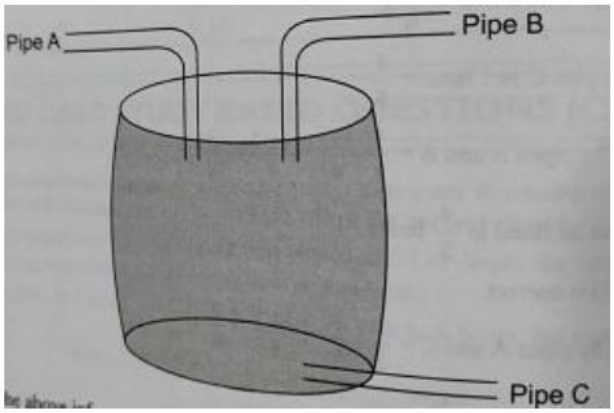
Solve the following Linear Programing Problem using corner point method. Minimise $Z = 18x + 10y$ subject to the constraints

$$4x + y \geq 20; 2x + 3y \geq 30; x \geq 0 \; and \; y \geq 0$$

35 The sum of three numbers is 20. If we multiply the first number by 2 and add the second number to the result and subtract the third number, we get 23. By adding second and third numbers to three times the first number, we get 46. Represent the above problem algebraically and use Cramer's rule to find the numbers from these equations.

SECTION – E

36 A pipe is connected to a tank or cistern. It is used to fill or empty the cistern. The amount of work done by a pipe is a part of the tank filled or emptied in unit time. Three pipes A, B and C are connected to a tank. A and B fill the tank in 6 and 8 hours respectively when operated independently. Pipe C empties the full tank in 12 hours when opened alone.



Based on the above information, answer the following questions:

36a If both pipes A and B are opened together, then the tank can be filled in

36b If pipe A and C are opened together, then the tank can be filled in

36c If pipe B and C are opened together, then the tank can be filled in

OR

If all the three pipes are opened together, then the tank can be filled in

37 Let X denote the number of hours you study during a randomly selected school day. The probability that X can take the value x, has the following form, where k is some constant.

$$P(X = x) = \begin{cases} 0.1, & if \; x = 0 \\ kx, & if \; x = 1 \; and \; x = 2 \\ k(5 - x), & if \; x = 3 \; and \; x = 4 \\ 0, & otherwise \end{cases}$$

Based on the above information, answer the following questions:

37a Calculate the value of k.

37b Calculate the probability P (Studies for three hours).

37c what is the probability when you study exactly two hours.

OR

Compute the probability when you study at least for two hours.

38 The following data shows the percentage of rural, urban and suburban Indians who have a high speed internet connection at home.

Year	Rural	Urban	Suburban
2001	3	9	9
2002	6	18	17
2003	9	21	23
2004	16	29	29
2005	24	38	40

Based on the above information, answer the following questions:

38a what is the forecast for the year 2006 for Urban group using trend equation

$$y_t = 23 + 6.9x$$

38b what is the forecast for the year 2006 for Rural group using trend equation

$$y_t = 11.6 + 5.2x$$

38c Find the straight line trend by the method of least squares for the Rural Indians.

OR

Find the straight line trend by the method of least squares for the Urban Indians.