S.R. Study Material

S R SAMPLE PAPER 2

Class 12 - Applied Mathematics

Time Allowed: 3 hours **Maximum Marks: 80**

General Instructions:

1. This question paper contains five sections A, B, C, D and E. Each section is compulsory.
2. Section - A carries 20 marks weightage, Section - B carries 10 marks weightage, Section - C carries 18 marks weightage, Section - D carries 20 marks weightage and Section - E carries 3 case-based with total weightage of 12 marks.
3. **Section – A:** It comprises of 20 MCQs of 1 mark each.
4. **Section – B:** It comprises of 5 VSA type questions of 2 marks each.
5. **Section – C:** It comprises of 6 SA type of questions of 3 marks each.
6. **Section – D:** It comprises of 4 LA type of questions of 5 marks each.
7. **Section – E:** It has 3 case studies. Each case study comprises of 3 case-based questions, where 2 VSA type questions are of 1 mark each and 1 SA type question is of 2 marks. Internal choice is provided in 2 marks question in each case-study.
8. Internal choice is provided in 2 questions in Section - B, 2 questions in Section – C, 2 questions in Section - D. You have to attempt only one of the alternatives in all such questions.

Section A

1. If a, b, c are all distinct, an $\begin{vmatrix} a & a^2 & 1+a^3 \\ b & b^2 & 1+b^3 \\ c & c^2 & 1+c^3 \end{vmatrix}$ = 0, then the value of abc is **[1]**

a) 3 b) 0

c) -3 d) -1

2. An observed set of the population that has been selected for analysis is called **[1]**

a) a forecast b) a sample

c) a process d) a parameter

3. Assume that the year-end revenues of a business over a three period, are mentioned in the following table: **[1]**

Year-End	31-12-2018	31-12-2021
Year-End Revenue	9,000	13,000

Calculate the CAGR of revenues over, three-years period spanning the "end" of 2018 to the **end** of 2021. Given that

$\left(\frac{13}{9}\right)^{\frac{1}{3}}$ = 1.13

a) 13%

b) None of these

c) 15%

d) 14%

4. Let X_1 and X_2 are optimal solutions of an LPP, then **[1]**

a) $X = \lambda X_1 + (1 + \lambda) X_2, 0 \leq \lambda \leq 1$ give an optimal solution

b) $X = \lambda X_1 + (1 + \lambda) X_2, \lambda \in R$ gives an optimal solution

c) $X = \lambda X_1 + (1 - \lambda) X_2, \lambda \in R$ is also an optimal solution

d) $X = \lambda X_1 + (1 - \lambda) X_2, 0 \leq \lambda \leq 1$ gives an optimal solution

5. If $\begin{vmatrix} 3x & 4 \\ 5 & x \end{vmatrix} = \begin{vmatrix} 4 & -3 \\ 5 & -2 \end{vmatrix}$, then x = **[1]**

a) 6 or -6

b) 3 or -3

c) -3 only

d) 3 only

6. A random variable 'X' has the following probability distribution: **[1]**

X	0	1	2	3	4	5	6	7
P(X)	k	k	2k	3k	k^2	$2k^2$	$7k^2$	2k

The value of k is

a) -1

b) 1

c) $-\frac{1}{10}$

d) $\frac{1}{10}$

7. For the following probability distribution: **[1]**

X	1	2	3	4
P(X)	$\frac{1}{10}$	$\frac{1}{5}$	$\frac{3}{10}$	$\frac{2}{5}$

The value of $E(X^2)$ is:

a) 3

b) 5

c) 10

d) 7

8. The number of arbitrary constants in the general solution of differential equation of fourth order is: **[1]**

a) 0

b) 4

c) 2

d) 3

9. In a game, A can give B 25 points, A can give C 40 points and B can give C 20 points. How many points make the game? **[1]**

a) 80

b) 150

c) 120

d) 100

10. If $\begin{vmatrix} 2 & 3 & 2 \\ \mathrm{x} & \mathrm{x} & \mathrm{x} \\ 4 & 9 & 1 \end{vmatrix} + 3 = 0$, then the value of x is: **[1]**

a) 1

b) 3

c) 0

d) -1

11. How much water must be added to 60 litres of milk at $1\frac{1}{2}$ litres for ₹ 20 so as to have mixture worth ₹ $10\frac{2}{3}$ a **[1]**

litre?

a) 20 litres

b) 5 litres

c) 15 litres

d) 10 litres

12. If |x + 2| $\leq$ 9, then **[1]**

a) x $\in$ [-11, 7]

b) $x \in (-\infty, -7) \cup [11, \infty)$

c) x $\in$ (-7, 11)

d) $x \in (-\infty, -7) \cup (11, \infty)$

13. The speed of a boat in still water is 10 km/hr. It is can travel 26 km downstream and 14 km upstream in the same time, the speed of the stream, in km/hr, is **[1]**

a) 2

b) 3

c) 4

d) $\frac{5}{2}$

14. Linear programming of linear functions deals with: **[1]**

a) Minimizing

b) Optimizing

c) Maximizing

d) None of these

15. In an L.P.P. if the objective function Z = ax + by has same maximum value on two corner points of the feasible region, then the number of points at which the maximum value of Z occurs is **[1]**

a) 0

b) finite

c) infinite

d) 2

16. A simple random sample consists of four observations 1, 3, 5, 7. What is the point estimate of population standard deviation? **[1]**

a) 3.1

b) 2.3

c) 2.87

d) 2.58

17. $\int \frac{x^3}{\sqrt{1+x^2}} dx$ = a(1 + x^2)$^{3/2}$ + $b\sqrt{1+x^2}$ + C, then **[1]**

a) $a = \frac{1}{3}$, b = -1

b) $a = -\frac{1}{3}$, b = -1

c) $a = -\frac{1}{3}$, b = 1

d) $a = \frac{1}{3}$, b = 1

18. Moving average method is used for measurement of trend when: **[1]**

a) Trend is curvilinear

b) Trend is linear

c) None of these

d) Trend is non-linear

19. For the matrices A' = $\begin{bmatrix} 3 & 4 \\ -1 & 2 \\ 0 & 1 \end{bmatrix}$ and B = $\begin{bmatrix} -1 & 2 & 1 \\ 1 & 2 & 3 \end{bmatrix}$, consider the following statements. **[1]**

Assertion (A): (A + B)' = A' - B'

Reason (R): (A - B)' = A' - B'

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

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

20. **Assertion (A):** $y = \frac{e^x + e^{-x}}{2}$ is an increasing function on [0, ∞). **[1]**

Reason (R): $y = \frac{e^x - e^{-x}}{2}$ is an increasing function on (-∞, ∞).

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

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

Section B

21. State the two normal equations used in fitting a straight line. **[2]**

22. Abhay bought a mobile phone for ₹ 30,000. The mobile phone is estimated to have a scrap value of ₹ 3,000 after a span of 3 years. Using the linear depreciation method, find the book value of the mobile phone at the end of 2 years. **[2]**

OR

A couple wishes to purchase a house for ₹10,00,000 with a down payment of ₹2,00,000. If they can amortize the balance at 9% per annum compounded monthly for 25 years, what is their monthly payment? What is the total interest paid? Given $a_{\overline{300}/0.0075}$ = 119.1616

23. Evaluate: $\int\limits_1^2 \frac{1}{x(1+x^2)}$ dx **[2]**

24. Evaluate $\Delta = \begin{vmatrix} 2 & -1 & 3 \\ 4 & 1 & 2 \\ 1 & -1 & 5 \end{vmatrix}$ by using Sarrus diagram. **[2]**

OR

Write the minors and cofactors of each element of the first column of the given matrix and hence evaluate the determinant: $A = \begin{bmatrix} -1 & 4 \\ 2 & 3 \end{bmatrix}$

25. Find the equivalence class of 3 (mod 5). **[2]**

Section C

26. Solve the differential equation: x log x$\frac{dy}{dx}$ + y = $\frac{2}{x}$ log x **[3]**

OR

The rate at which radioactive substances decay is known to be proportional to the number of such nuclei that are present at the time in a given sample. If 100 grams of a radioactive substance is present 1 year after the substance was produced and 75 grams is present 2 years after the substance was produced, how much radioactive substance was produced?

27. A bond has issued with the face (Par) value of ₹ 1,000 at 10% coupon for three years The required rate of return is 8%. What is the value of the bond if the coupon amount is payable on half-yearly basis? Given $(1.04)^{-6}$ = 0.79031 **[3]**

28. A company has approximated the marginal cost and marginal revenue functions for one of its products by MC = 81 - 16x + x^2 and MR = 20x - $2x^2$ respectively. Determine the profit-maximizing output and the total profit at the optimal output, assuming fixed cost as zero. **[3]**

29. The probability that a bulb produced by a factory will fuse after 150 days of use is 0.05. Find the probability that out of 5 such bulbs **[3]**

i. none

ii. not more than one

iii. more than one

iv. at least one will fuse after 150 days of use.

OR

From a lot of 10 items containing 3 defectives, a sample of 4 items is drawn at random. Let the random variable X denote the number of defective items in the sample. If the sample is drawn randomly, find:

i. the probability distribution of X
ii. $P(X \leq 1)$
iii. $P(X < 1)$
iv. $P(0 < X < 2)$

30. Following table shows the data on energy consumption and expenditure at Badarpur Thermal Power Station in Delhi region. Construct an aggregative price index for the energy expenditure in year 2015 using Marshall-Edgeworth's index number. **[3]**

Sector	**Quantity (Weights)**		**Unit price (₹/kWh)**	
	Year 1987	Year 2015	Year 1987	Year 2015
Commercial	5416	6015	1.97	10.92
Residential	15293	20262	2.32	6.16
Industrial	21287	17832	0.79	5.13
Agriculture	9473	8804	2.25	8.10

31. A random sample of 10 boys had the following I.Q's: 70, 120, 110, 101, 88, 83, 95, 98, 107, 100. Do these data support the assumption of a population mean I.Q. of 100? Find a reasonable range in which most of the mean I.Q. values of samples of 10 boys lie. (Given to (0.05) = 2.262) **[3]**

Section D

32. A company produces soft drinks that has a contract which requires that a minimum of 80 units of chemical A and 60 units of chemical B to go into each bottle of the drink. The chemicals are available in a prepared mix from two different suppliers. Supplier S has a mix of 4 units of A and 2 units of B that costs ₹10, the supplier T has a mix of 1 units of A and 1 unit of B that costs ₹4. How many mixes from S and T should the company purchase to honor contract requirements and yet minimize cost? **[5]**

OR

A diet of two foods F_1 and F_2 contains nutrients thiamine, phosphorous and iron. The amount of each nutrient in each of the food (in milligrams per 25 gms) is given in the following table:

Nutrients/Food	F_1	F_2
Thiamine	0.25	0.10
Phosphorous	0.75	1.50
Iron	1.60	0.80

The minimum requirement of the nutrients in the diet are 1.00 mg of thiamine, 7.50 mg of phosphorous and 10.00 mg of iron. The cost of F_1 is 20 paise per 25 gms while the cost of F_2 is 15 paise per 25 gms. Find the minimum cost of diet.

33. Solve the following system of inequalities graphically: **[5]**

$2x + y \leq 24, x + y < 11, 2x + 5y \leq 40, x > 0, y \geq 0.$

34. A die is tossed twice. A success is getting an odd number on a random toss. Find the variance of the number of **[5]**

successes.

OR

If a set of measurements are normally distributed, what percentage of these differ from the mean by

i. more than half the standard deviation
ii. less than three quarters of the standard deviation?

35. Rohit buys a car for which he makes down payment of ₹150,000 and the balance is to be paid in 2 years by monthly installment of ₹25,448 each. If the financer charges interest at the rate of 20% p.a, find the actual price of the car. (Given $\left(\frac{61}{60}\right)^{-24} = 0.6725335725$) **[5]**

Section E

36. **Read the text carefully and answer the questions:** **[4]**

A tank with a rectangular base and rectangular sides of length x metre, width y metre , open at the top is to be constructed so that the depth is 1 m and volume is $9m^3$. If the building of the tank is ₹ 70 per square metre for the base and ₹ 45 per square metre for the sides?

(i) What is the cost of the base?

(ii) What is the cost of making all the sides?

(iii) If ‘C’ be the total cost of the tank, then find the value of C.

OR

For what value of x, C is minimum?

37. **Read the text carefully and answer the questions:** **[4]**

An equated monthly installment (EMI) is a set monthly payment provided by a borrower to a creditor on a set day, each month. EMIs apply to both interest and principal each month, and the loan is paid off in full over some years.

How is EMI calculated?

There are two ways in which EMI can be calculated. These methods are:

- **The flat rate method:** When the loan amount is progressively being repaid, each interest charge is computed using the original principal amount in the flat rate method.
- **The reducing balance method:** The reducing balance technique, compared to the flat rate method, determines the interest payment according to the outstanding principal.

Example:

A loan of ₹250000 at the interest rate of 6% p.a. compounded monthly is to be amortized by equal payments at the end of each month for 5 years.

(Given $(1.005)^{60} = 1.3489$, $(1.005)^{21} = 1.1104$)

(i) Find the size of each monthly payment.

(ii) Find the principal outstanding at beginning of 40th month.

(iii) Find interest paid in 40th payment.

OR

Find principal contained in 40th payment.

38. In an engineering workshop there are 10 machines for drilling, 8 machines for turning and 7 machines for grinding. Three types of brackets are made. Type I brackets require 0 minutes for drilling, 5 minutes for turning and 4 minutes for grinding. The corresponding times for type II and III brackets are 3, 3, 2 and 3, 2, 2, minutes respectively. How many brackets of each type should be produced per hour so that all the machines remain fully occupied during an hour? Solve by using matrix method. **[4]**

OR

If A = $\begin{bmatrix} 2 & 0 & -3 \\ 1 & 4 & 5 \end{bmatrix}$, B = $\begin{bmatrix} 3 & 1 \\ -1 & 0 \\ 4 & 2 \end{bmatrix}$ and C = $\begin{bmatrix} 4 & 7 \\ 2 & 1 \\ 1 & -1 \end{bmatrix}$, verify that A(B + C) = AB + AC.