CHENNAI SAHODAYA SCHOOLS COMPLEX

(General instructions)

- ❖ Please check that this question paper contains 5 printed pages.
- ❖ Please check that this question paper contains 38 questions.
- ❖ Please write down the serial number of the question before attempting it.
- ❖ Reading time of 15 minutes is given to read the question paper alone. No writing during this time

Read the following instructions very carefully and strictly follow them :

(i) This question paper contains 38 questions.
(ii) All questions are compulsory.
(iii) This question paper is divided into five Sections – A, B, C, D and E.
(iv) In **Section A, Questions no. 1 to 18** are multiple choice questions (MCQs) and questions number 19 and 20 are Assertion-Reason based questions of 1 mark each.
(v) In Section B, **Questions no. 21 to 25** are very short answer (VSA) type questions, **carrying 2 marks each.**
(vi) In Section C, **Questions no. 26 to 31** are short answer (SA) type questions, **carrying 3 marks each.**
(vii) In Section D, **Questions no. 32 to 35** are long answer (LA) type questions **carrying 5 marks each.**
(viii) In Section E, **Questions no. 36 to 38** are case study based questions **carrying 4 marks each.**

COMMON EXAMINATION
CLASS 12
APPLIED MATHEMATICS-241
SET -1

Roll No: **Maximum Marks: 80**
Date: 06/01/2025 **Time allowed : 3hours**

SECTION A(one mark each)

Q.NO	QUESTION
1	In a 200 meters race, Prateek beats Samarth by 35 meters or 7 seconds. How much time did prateek take to cover the race? a. 40 sec | b. 47 sec | c. 33 sec | d. None
2	If $\frac{x+1}{x+2} \geq 1$ then $x \in$ a. $[-\infty, 2]$ | b. $(-\infty, -2)$ | c. $(-\infty, 2]$ | d. $(-\infty, 2)$
3	If $A = \begin{pmatrix} 2 & x+7 \\ 2x-3 & x+8 \end{pmatrix}$ is symmetric then x is equal to a. 10 | b. $-\frac{4}{3}$ | c. -10 | d. $\frac{4}{3}$
4	Find the value of $\begin{vmatrix} 2 & 7 & 65 \\ 3 & 8 & 75 \\ 5 & 9 & 86 \end{vmatrix}$ a. 1 | b. -3 | c. 0 | d. -1
5	If $f(x) = log_a x$, then $f'(e) =$ a. $\frac{1}{e\ log a}$ | b. $\frac{1}{e}$ | c. $\frac{1}{e\ log_a e}$ | d. $\frac{1}{a\ log a}$
6	The function $f(x) = \frac{1}{x^2+1}, x \geq 0$ a. $increasing\ for\ x \geq 0$ | b. $increasing\ for\ x > 0$ c. $decreasing\ for\ x > 0$ | d. Decreasing for $x \geq 0$
7	The order and degree of differential equation is $\left(\frac{d^2y}{dx^2}\right)^3 + \frac{d^2y}{dx^2} + log\left(\frac{dy}{dx}\right) = 2x$ a) order 2 degree 3 | b)$Order\ 3\ degree\ 2$ | c) order degree not defined | d) order 3 degree not defined

8 An urn contains 5 red and 2 black balls. Two balls are randomly drawn without replacement. X represent number of black balls. Then the expectation of X is

(a) $\frac{12}{21}$	(b) $\frac{11}{21}$	(c) $\frac{10}{21}$	(d) $\frac{20}{21}$

9 The least non-negative remainder when 6^{12} is divided by 7 is

a. 1	b. 3	c. 4	d. 6

10 A fire in a factory delaying production for some weeks is

a. $secular\ trend$	b. irregular trend	c. cyclical trend	d. seasonal trend

11 A 95% confidence interval for a population was reported to be 152 to 160. If $\sigma = 15$, then the margin of error is

a. 156	b. 4
c. 8	d. 312

12 For the given values 23, 32, 40, 47, 58, 33, 42, the 5-yearly moving averages are

a. 38,40,42	b. 40,42,44	c. 40,42,46	d. 42,44,46

13 If $\int_0^{40} \frac{dx}{2x+1} = logk$, then the value of k is

a. 3	b. $\frac{9}{2}$
c. 9	d. 81

14 One type of liquid contains 20% water and the second type of liquid contains 35% of water. A glass is filled with 10 parts of first liquid and 4 parts of second liquid. The water in the new mixture in the glass is

a. $12\frac{1}{7}\%$	b. $24\frac{2}{7}\%$
c. 37%	d. 46%

15 A vehicle costing Rs.125000 has scrap value of Rs 25000. If annual depreciation charge is 12500, then useful life of the vehicle is

a. 4 years	b. 6years	c. 8 years	d. 10 years

16 What sum of money should be deposited at the end of every 6 months to accumulate Rs50000 in 8 years, if money is worth 6% p.a. compounded semi-annually? [Given : $(1.03)^{16} = 1.6047$]

(a) 3432.53	(b) 2783.08	(c) 2480.57	(d) 2149.93

17 If the objective function for a L P P is $Z = 5x + 7y$ and the corner points of the bounded feasible region are (0,0) (7,0) (3,4) and (0,2) then the maximum value of Z occurs at

a. (0,0)	b. (7,0)	c. (3,4)	d. (0,2)

18 $$\int_0^1 [3x]dx =$$

a. 0	b. 1	c. 3	d. 2

ASSERTION REASON BASED QUESTIONS

In the following 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 $2x + 1 < |2x + 1|, x \in R$ then $x \in \left(-\infty, -\frac{1}{2}\right)$

Reason: If $|x| \geq |y|\ iff\ x^2 \geq y^2$

20. Assertion : If $\begin{vmatrix} 2x & 5 \\ 8 & x \end{vmatrix} = \begin{vmatrix} 6 & -2 \\ 7 & 3 \end{vmatrix}$ then $x = \pm 6$

Reasoning:If A and B are matrices of order 3 and $|A| = 4, |B| = 6, then \quad |2AB| = 182$

SECTION B (2 marks each)

21 If $A = \begin{pmatrix} 3 & 1 & 2 \\ 2 & -3 & -1 \\ 1 & 2 & 1 \end{pmatrix}$ Find $A(adj\ A)$

Or

	Find the matrix X if $\begin{pmatrix} 5 & 4 \\ 1 & 1 \end{pmatrix} X = \begin{pmatrix} 1 & -2 \\ 1 & 3 \end{pmatrix}$
22	A chemist has prepared a solution in which the volume of water is 30% of the total volume. It is observed that on adding 5L of water in the solution, the volume of water increases to 40%. Find the quantity of water(in L) in original solution.
23	Evaluate $\int_{-5}^{0}(\|x\| + \|x+2\| + \|x+5\|)dx$
24	A bag contains 2 white and 4 black balls. A ball is drawn 5 times with replacement. Find the probability that at least 4 of the balls drawn are white. **Or** The lifetime of an item produced by a machine has a normal distribution with mean 12 months and standard deviation of 2 months. Find the probability of an item produced by this machine will last a) less than 7 months b) between 7 and 14 months Given $P\left(z < \frac{5}{2}\right) = 0.9938 \quad and\ P(z < 1) = 0.8413$
25	The marginal cost of producing x pairs of tennis shoes is given by MC= $60 + \frac{400}{x+1}$. If the fixed cost is Rs 3000, find the total cost function.
	SECTION C(3 marks each)
26.	The mean weekly sales of mango candy in candy stores was 225.4 mango candy per store. After an advertising campaign the mean weekly sales in 25 stores for a typical week increased to 237.6 and showed a standard deviation of 21.3 . Was the advertising campaign successful? Level of confidence 5% [given $t_{24}(0.05) = 1.711$)
27	Evaluate $\int \frac{dx}{\sqrt{3x^2-x-1}}$ Or $\int_{2}^{4} \frac{log(x^2)}{log(x^2) + log(36 - 12x + x^2)} dx$
28	Form the differential equation of the family of curves $y = e^{2x}(a + bx)$, where a and b are arbitrary constants.
29	If $y = log\left(x + \sqrt{x^2+1}\right)$ Prove that $(x^2+1)\frac{d^2y}{dx^2} + x\frac{dy}{dx} = 0$
30	A box contains 200 tickets, each bearing one of the numbers from 1 to 200. 20 tickets are drawn successively with replacement from the box. Find the probability that at most 4 tickets bear numbers divisible by 20. Given $e^{-1} = 0.368$
31	A machine costs a company Rs525000 and its effective life is estimated to be 20 years. A sinking fund is created for replacing the machine at the end of its lifetime when its scrap realizes a sum of Rs 25000 only. Calculate what amount should be provided every year out of profit for the sinking fund if it accumulates an interest of 5% per annum. Given $(1.05)^{20} = 2.655$ **Or** Mr. Naresh has bought 200 shares of city look company at Rs 100 each in 2015. After selling them he has received Rs 30000 which accounts for 22.47% CAGR. Calculate the number of years for which he was holding the shares.
	SECTION D(5 marks each)
32	Using Cramer's rule, find the quadratic polynomial defined by $f(x) = ax^2 + bx + c$ if $f(1) = 0,\ f(2) = -2 \quad f(3) = -6$ **Or** If $A = \begin{pmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{pmatrix}, Find\ A^{-1}$ and hence solve $x + 2y + z = 4, -x + y + z = 0,\ x - 3y + z = 2$
33	Mr. Rajni deposited Rs 10000 in a bank at 4% interest compounded continuously. How much amount will she get after 10 years? ($e^{0.4} = 1.49182$)
34.	A window is in the form of a rectangle surmounted by a semicircular opening. If the perimeter of the window is 10m, find the dimensions of the rectangular part of the window to admit maximum light through the window.

35. Fit a straight line trend by the method of least square to the following data on sales (Rs. In lakhs) for the period 1962-1972

Year	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
Sale(in lakhs)	2	4	3	4	4	2	4	9	7	10	8

a) Calculate the trend values from 1962-1972
b) What will be predicted sales for 1980, assuming that the same rate of change continues?

Or

The quarterly profits of a small-scale industry (Rs in thousands) are as follows.

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4
2020	39	47	20	56
2021	68	59	66	72
2022	88	60	60	67

Calculate 4-quarterly moving averages.

SECTION E (case study) (4 marks each)

36. An oil company has two depots A and B with capacities 7000 litres and 4000 litres respectively. The company is to supply oil to three petrol pumps D E and F, whose requirements are 4500 litres, 3000 litres and 3500 litres respectively. The distance (in Km) between the depots and the petrol pumps is given in the following table:

Distance from the depot(in km		
To \ From	A	B
D	7	3
E	6	4
F	3	2

Assuming that the transportation cost per km is Rs 1 per km.
a. Formulate the objective function and the constraints of the above Linear programming problem.
b. How should the delivery be scheduled in order that the transportation cost is minimum. Also find the minimum cost.

37. EMI is a part of equally divided monthly outgoes to clear off an outstanding loan within a stipulated time frame. For a fixed interest rate loan, the EMI remains fixed for the entire tenure of the loan, provided there is no default or part payment in between. The EMI is used off both the principal and interest components of an outstanding loan. The first EMI has the highest interest component and the lowest principal component.
Rajesh purchased a house from a company for Rs 2500000 and made a down payment of Rs 500000. He repays the balance in 25 years by monthly installments at the rae of 9% per annum compounded monthly. (given $(1.0075)^{-300} = 0.1062$)

a) Find the number of payment
b) Find the rate of interest per month
c) What are the monthly payment

Or

What is the total interest payment.

38. Read the following passage and answer the questions given below
Let X denote the number of hours a person watches television during a randomly selected day. The probability that X can take the values $x_{i,}$ has the following form, where k is some unknown constant.

	$P(X = x_i) = \begin{cases} 0.2 & x_i = 0 \\ kx_i & x_i = 1 \text{ or } 2 \\ k(5 - x_i) & x_i = 3 \end{cases}$ $P(X = x_i) = 0 \text{ otherwise}$ a) What is the value of k b) What is the probability that a person watches two hours of television on a selected day? c) What is the probability that the person watches at least two hours of television on a selected day? **Or** What is the probability that the person watches at most two hours of television on a selected day?

******End of paper******