



Delhi Public School, Howrah

PERIODIC TEST - III (2024 - 2025)

Class - XI

Care must be taken not to write anything on the question paper. All the questions must be attempted in the correct sequence.

Subject: - Applied Mathematics (Code No. - 241)

Time: 3 Hours

F.M.80

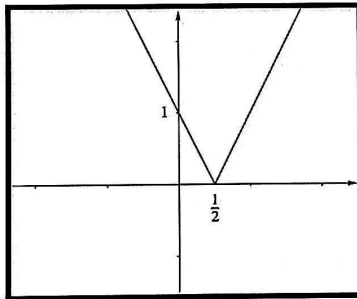
General Instructions:

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

SECTION A

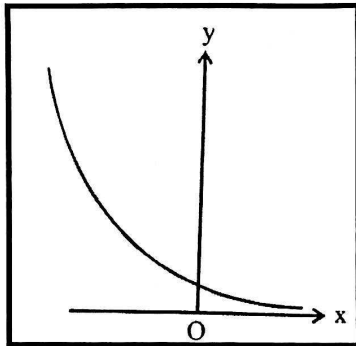
(All Questions are compulsory. No internal choice is provided in this section)

- 1) If a circle passes through the points $(0,0)$, $(a, 0)$ and $(0, b)$, then the coordinates of its centre are 1
 (a) (a, b) (b) $(-\frac{a}{2}, -\frac{b}{2})$ (c) $(\frac{a}{2}, \frac{b}{2})$ (d) $(-a, -b)$
- 2) If $f(x) = px + q$, where p and q are integers and $f(-1)=1$ and $f(2) = 13$, then the values of p and q are 1
 (a) $p = 4, q = 5$ (b) $p = -4, q = 5$
 (c) $p = -4, q = -5$ (d) $p = 4, q = -5$
- 3) Find the range of the following function: 1



- (a) $(-\infty, \infty)$ (b) $(0, \infty)$ (c) $R - \{1\}$ (d) $R - \{\frac{1}{2}\}$
- 4) The two lines $ax + by + c = 0$ and $a'x + b'y + c' = 0$ are perpendicular if 1
 (a) $ab' = a'b$ (b) $ab + a'b' = 0$ (c) $ab' + a'b = 0$ (d) $aa' + bb' = 0$
- 5) In a certain language if 'LUCKNOW' is coded as 'NWEMPQY', how is 'DELHI' coded? 1
 (a) FGNIK (b) GNJKF (c) KJNGF (d) GHNIJ
- 6) The decimal equivalent of the binary number 10101 is 1
 (a) 21 (b) 12 (c) 22 (d) 31
- 7) If $n(U) = 50, n(A) = 38, n(B) = 30$, then the least value of $n(A \cap B)$ is 1
 (a) 30 (b) 38 (c) 50 (d) 18

8) The curve given below shows the graph of the function a^x under which one of the following conditions?



- (a) $a > 1$ (b) $a \geq 1$ (c) $0 < a < 1$ (d) $0 < a \leq 1$
- 9) If for a sequence $S_n = 2(3^n - 1)$, then the third term is 1
 (a) 18 (b) 14 (c) 36 (d) 48
- 10) In a certain language, 'hi mi si' means 'Air is life'; 'si ni zi' means 'Balloon of air' and 'ci zi mi' means 'Life of Pi'. Which of the following represents 'Pi' in that language? 1
 (a) hi (b) mi (c) ci (d) si
- 11) Find the characteristic of the logarithm of the number 7124000. 1
 (a) 6 (b) 3 (c) 5 (d) 4
- 12) If $f(x) = \frac{x^{100}}{100} + \frac{x^{99}}{99} + \dots + \frac{x^2}{2} + x + 1$, then find the value of $f'(1)$. 1
 (a) 100 (b) 99 (c) 1 (d) 0
- 13) The number of 3 digit odd numbers, when repetition of digits is allowed is 1
 (a) 450 (b) 360 (c) 400 (d) 420
- 14) In a day, how many times is a right angle formed between minute hand and hour hand? 1
 (a) 11 (b) 22 (c) 33 (d) 44
- 15) Which of the following is true for the coefficient of correlation r ? 1
 (a) $r > 1$ (b) $r \leq -1$ (c) $-1 < r < 1$ (d) $-1 \leq r \leq 1$
- 16) The value of $9^{\frac{1}{3}} \times 9^{\frac{1}{9}} \times 9^{\frac{1}{27}} \times \dots \infty$ is 1
 (a) 1 (b) 3 (c) 9 (d) None of these
- 17) How many odd days are there in a century? 1
 (a) 2 (b) 3 (c) 4 (d) 5
- 18) If $n_{Pr} = 720 \times n_{Cr}$, then find the value of r . 1
 (a) 6 (b) 5 (c) 4 (d) 7

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

- (i) Both A and R are true and R is the correct explanation of A.
 (ii) Both A and R are true and R is not the correct explanation of A.
 (iii) A is true but R is false.
 (iv) A is false but R is true.

19) Assertion(A): The standard deviation of a data set is always non-negative. 1
 Reason(R): Standard deviation measures the dispersion of data values from the mean and is calculated as the square root of the variance.

- (a) (i) (b) (ii) (c) (iii) (d) (iv)

(j) Assertion (A): The n th derivative of $f(x) = x^n$ is $f^{(n)}(x) = n!$
 Reason (R): Differentiating x^n successively reduces the power of x by 1, and the process stops when the power reaches zero. 1

- (a) (i) (b) (ii) (c) (iii) (d) (iv)

SECTION B

(All Questions are compulsory. In case of internal Choice, attempt any one question only)

21) If $x^{\frac{2}{3}} + y^{\frac{2}{3}} = 2$, then find $\frac{dy}{dx}$ at $(1,1)$. 2

22) (a) If $a + b + c \neq 0$, and $\frac{b+c}{a}, \frac{c+a}{b}, \frac{a+b}{c}$ are in A.P., prove that $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are also in A.P. 2

OR

(b) If each term of an infinite G.P is twice the sum of all terms following it, then find the common ratio of the G.P. 2

23) The second and third central moments of a distribution are 9.2 and -3.6 respectively. Find the moment coefficients of skewness i.e. β_1 and γ_1 . 2

24) (a) The line through the points $(h, 3)$ and $(4,1)$ intersects the line $7x - 9y - 19 = 0$ at right angles. Find the value of h . 2

OR

(b) Find the equation of a circle concentric with the circle $x^2 + y^2 - 8x + 2y + 3 = 0$ and of radius 3 units. 2

25) Find the value of x if $\log_{10} x - \log_{10}(2x - 1) = 1$. 2

SECTION C

(All Questions are compulsory. In case of internal Choice, attempt any one question only)

26) (a) 100 persons begin to work together on a project which was expected to be completed in 40 days. But after few days 40 persons left. As a result, the project got delayed by 10 days. How many days after the commencement of the project did the 40 persons leave? 3

OR

(b) A conical vessel of radius 6 cm and height 8 cm is completely filled with water. A sphere is lowered into the water and its size is such that when it touches the sides it is just immersed. What fraction of the water overflows? 3

27) (a) Find the number of arrangements that can be made out of the word: COMMERCE. 2

(b) Everybody in a room shakes hands with everybody else. The total number of shake hands is 66. How many people are there in the room? 1

28) How many terms of the sequence $3, \frac{3}{2}, \frac{3}{4}, \dots$ are needed to give the sum of $\frac{3069}{512}$? 3

29) (a) Find the number of signals which can be given with 3 flags of different colours hoisted one above the other, by using any number of flags. 3

OR

(b) In a class of 35 students, 17 have taken Mathematics. 10 have taken Mathematics but not Economics. If each student has taken either of the two subjects, then find the number of students who have taken Economics but not Mathematics. 3

30) Prove that the function $f(x) = \begin{cases} \frac{x}{|x|+2x^2}, & x \neq 0 \\ k, & x = 0 \end{cases}$ remains discontinuous at $x = 0$, regardless of the choice of k . 3

31) The first four central moments of a frequency distribution are 0, 6, 19 and 42 respectively. Examine the Skewness and Kurtosis of the distribution. 3

SECTION D

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

32) (a) Calculate the covariance for the following bi-variate data:

5

X	11	12	13	14	15	17	18	19	20	21
Y	14	8	12	21	19	19	23	22	17	25

OR

(b) Calculate the Karl Pearson's coefficient of skewness using mean and median for the following data: 5

Class Interval	0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80
Frequency	6	12	22	48	56	32	18	6

33) A family of Ravi, Rekha, Gaurav, Saurabh, Payal, Mohit, Monika, Swasti and Shaurya consists of 3 generations. Ravi is husband of Rekha and has two sons and one daughter Payal. Mohit is Rekha's son-in-law. Saurabh is Payal's brother and Monika's brother - in-law. Gaurav has two children. Based on the information, answer the following questions:

- (a) How is Gaurav related to Mohit? 1
- (b) How is Saurabh related to Ravi? 1
- (c) How is Ravi related to Shaurya? 1
- (d) How is Mohit related to Payal? 1
- (e) How is Mohit related to Swasti? 1

34) (a) (i) Differentiate the function $f(x) = \frac{\sqrt{x^2+1} + \sqrt{x^2-1}}{\sqrt{x^2+1} - \sqrt{x^2-1}}$ with respect to x . 3

(ii) If $y = x + \frac{1}{x}$, prove that $x^2 \frac{dy}{dx} - xy + 2 = 0$. 2

OR

(b) (i) Find the domain and range of the function $f(x) = \frac{x+2}{|x+2|}$. 3

(ii) If $\lim_{x \rightarrow 3} \frac{x^n - 3^n}{x - 3} = 108, n \in \mathbb{N}$, then find the value of n . 2

35) Seven friends A, B, C, D, E, F and G are playing cards sitting around a circular table facing towards centre. F is second to the right of G. B is neighbor of F but not of C. E is a neighbor of C and sitting fourth at the right of G. D is sitting between E and A. Based on the information, answer the following questions:

- (a) Write the seating arrangement. 1
- (b) Who is fourth to the left of G? 1
- (c) Who is sitting left of G? 1
- (d) Who are the neighbours of F? 1
- (e) Who are the neighbours of B? 1

SECTION E

(This section comprises of 3 source based questions (Case Studies) of 4 marks each)

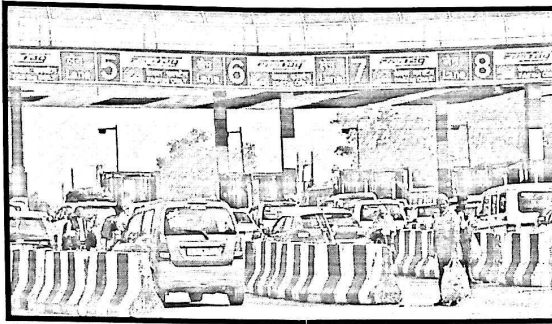
36) Case Study - 1 :

The Government of the country has introduced a FASTag system to streamline toll payments on national highways. There are three different types of FASTag available for vehicle owners based on the type of vehicle and the toll payment package. These types are:

- **Type A:** For private vehicles with a standard toll payment option.
- **Type B:** For commercial vehicles with discounts on multiple crossings.
- **Type C:** For VIP vehicles with full toll waiver.

The system allows vehicle owners to select one FASTag type at the time of registration. However, the authorities have set certain restrictions regarding the number of tags issued to each vehicle type and the available slots on each type.

Now, the authorities are working on distributing the FASTags across the country and have to consider different combinations based on the availability of each type.



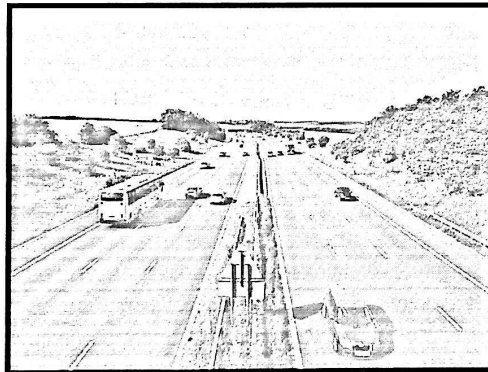
Based on the above information, answer the following questions:

- (i) If a toll plaza issues 5 FASTags of each type (A, B, and C), how many different ways can 3 different vehicles (say V_1, V_2, V_3) choose a FASTag? 2
- (ii) If 2 vehicles out of 5 are to receive a FASTag of Type A, 2 vehicles will get Type B, and 1 vehicle will get Type C, how many ways can the FASTags be distributed? 1
- (iii) A toll booth distributes 3 types of FASTags, each to 4 different vehicles. How many ways can the FASTags be distributed if there are no restrictions on the type of FASTag for each vehicle? 1
- OR**
- (iv) How many ways can 6 vehicles be assigned FASTags, given that exactly 2 vehicles must receive Type A, 2 vehicles receive Type B, and 2 vehicles receive Type C? 1

37) Case Study – 2:

Three countries—Triviana, Quadrica, and Hexora —are planning to establish trade routes between their capitals. The positions of their capitals on a coordinate plane are as follows:

- Capital of Triviana: A(2,3)
- Capital of Quadrica: B(6,7)
- Capital of Hexora: C(4,-1)



The countries decide that the roads connecting their capitals will follow the shortest possible paths or maintain parallel or perpendicular alignments wherever necessary. Based on the above information, answer the following questions:

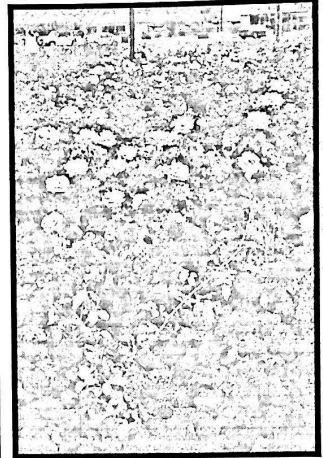
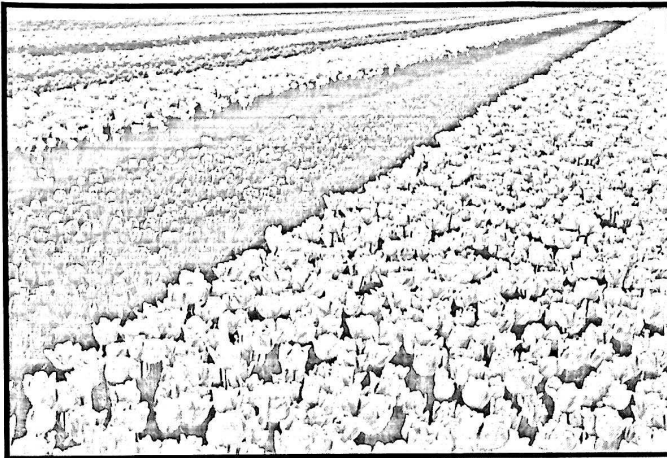
- (i) Find the equation of the line joining the capitals of Triviana and Quadrica. 1
- (ii) Find the equation of the line perpendicular to the road joining Triviana and Quadrica and passing through the capital of Hexora. 1
- (iii) Determine the shortest distance between the capital of Hexora and the line joining the capitals of Triviana and Quadrica. 2

OR

(iv) Find the equation of a line parallel to the line joining Triviana and Quadrica and passing through the capital of Hexora. 2

38) Case Study – 3 :

A botanical research center is working to optimize the growth of different flowers in a garden. The researchers have created a model to predict the height of the flowers at any given time. Based on this data, they are trying to determine the best way to arrange and care for the flowers to maximize growth.



The height of the Rose is modeled by $h_R(t) = 2t^3 - 3t^2 + 4$, where t is the time in weeks.

The height of the Tulip is modeled by $h_T(t) = 5e^{0.2t}$, where t is again the time in weeks.

Based on the above information, answer the following question:

- (a) What is the growth rate of the Rose flower? 1
- (b) At $t = 4$ weeks, how fast is the Tulip flower growing? [Use $e^{0.8} = 2.2255$] 1
- (c) For the Rose flower, the team wants to analyze the critical points of the growth function to understand its turning points. What is the first critical point (when the rate of change equals zero) for the Rose's growth? 2
