06.03.25

Delhi Public School, Howrah

FINAL EXAMINATION (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.

Time: 3 Hours **Subject: - Mathematics (Code No-041)** **F.M. 80**

General Instructions:

(i) This Question paper contains 38 questions. All questions are compulsory.
(ii) This Question paper is divided into five Sections - A, B, C, D and E.
(iii) In Section A, Questions no. 1 to 18 are multiple choice questions (MCQs) and Questions no. 19 and 20 are Assertion-Reason based questions of 1 mark each.
(iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
(v) In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
(vi) In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
(vii) In Section E, Questions no. 36 to 38 are Case study-based questions, carrying 4 marks each.
(viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
(ix) Use of calculators is not allowed.

Section- A

(This section comprises of multiple-choice questions (MCQs) of 1 mark each)

1. If $\sin\theta = -\frac{4}{5}$ *and* θ lies in third quadrant, then the value of $\cos\frac{\theta}{2}$ is
   a) $\frac{1}{5}$ b) $-\frac{1}{\sqrt{10}}$ c) $-\frac{1}{\sqrt{5}}$ d) $\frac{1}{\sqrt{10}}$
2. The domain of the function f defined by $f(x) = \frac{x^2+2x+1}{x^2-x-6}$ is
   a) $R - [3,-2]$ b) $R - \{3,-2\}$ c) $R - \{-3,2\}$ d) $R - (-3,2)$
3. The probability that at least one of the events A and B occurs is 0.6. If A and B occur simultaneously with probability 0.2, then $P(\bar{A}) + P(\bar{B}) =$?
   a) 0.4 b) 0.8 c) 1.2 d) 1.6
4. Two finite sets have m and n elements. The number of subsets of the first set is 112 more than that of the second. The values of m and n are respectively
   a) 4,7 b) 7,4 c) 4,4 d) 7,7
5. The value of $sin^2\frac{5\pi}{12} - sin^2\frac{\pi}{12}$ is
   a) 0 b) 1 c) $\frac{1}{2}$ d) $\frac{\sqrt{3}}{2}$
6. The complex number z which satisfies the condition $\left|\frac{i+z}{i-z}\right| = 1$ lies on the
   a) Circle $x^2 + y^2 = 1$ b) x - axis c) y - axis d) Line x + y =1
7. The solution set of the system of linear inequalities $2(x+1) \leq x+5, 3(x+2) > 2-x, x \in R$ is
   a) (-1,3] b) (-1,3) c) [-1,3] d) [-1,3)
8. The straight lines l_1, l_2 *and* l_3 are parallel and lie on the same plane. If m points are taken on l_1; n points on l_2; k points on l_3, then the maximum number of triangles formed with the vertices at these points are

a) ${}^{m+n+k}C_3$

b) ${}^{m+n+k}C_3 - {}^{m}C_3 - {}^{n}C_3 - {}^{k}C_3$

c) ${}^{m}C_3 + {}^{n}C_3 + {}^{k}C_3$

d) ${}^{m}C_3 \times {}^{n}C_3 \times {}^{k}C_3$

9. The number of ways in which 4 books of Mathematics and 3 books of English can be placed in a shelf, so that the books of the same subject always remain together is

a) 144 b) 210 c) 388 d) 288

10. If the coefficients of 2nd, 3rd and 4th terms in the expansion of $(1 + x)^n$ are in A.P., then value of n is

a) 2 b) 7 c) 2 or 7 d) 14

11. A G.P. consists of 200 terms. If the sum of odd terms of G.P. is m and the sum of even terms of G.P. is n, then the common ratio of G.P. is

a) $\frac{m}{n}$ b) $m + \frac{n}{m}$ c) $\frac{n}{m}$ d) $n + \frac{m}{n}$

12. A line passes through P (1,2) such that the portion of the line intercepted between the axes is bisected at P. The equation of the line is

a) $x + 2y - 5 = 0$ b) $x - y + 1 = 0$ c) $x + y - 3 = 0$ d) $2x + y - 4 = 0$

13. If the eccentricity of an ellipse is $\frac{5}{8}$ and the distance between its foci is 10, then length of its latus rectum is

a) $\frac{39}{4}$ b) $\frac{39}{2}$ c) $\frac{23}{2}$ d) $\frac{23}{4}$

14. X-axis is the intersection of which of the two planes?

a) xy and yz plane b) yz and zx plane c) xy and xz plane d) none of these

15. The mean of 100 observations is 40 and their standard deviation is 10. If 5 is added to each observation, then the new mean and new standard deviation respectively will be

a) 40,10 b) 40, 15 c) 50, 10 d) 45,10

16. If A, B, C are three mutually exclusive and exhaustive events of a random experiment such that $4P(A) = 3P(B) = 2P(C)$, then $P(B)$ is equal to

a) $\frac{1}{13}$ b) $\frac{2}{13}$ c) $\frac{3}{13}$ d) $\frac{4}{13}$

17. Let $A = \{3,5\}$ *and* $B = \{7,11\}$ and R be the relation from A to B defined as $R = \{(a, b): a \in A, b \in B, a - b \text{ is odd}\}$, then which of the following is true?

a) $R = A \times B$ b) $R = \emptyset$ c) $R \subset A \times B$ d) $R \subset B \times A$

18. The multiplicative inverse of $(3 + 2i)^2$ is

a) $\frac{-4}{169} + \frac{12}{169}i$ b) $\frac{5}{169} - \frac{12}{169}i$ c) $\frac{-5}{169} + \frac{12}{169}i$ d) $\frac{5}{169} + \frac{12}{169}i$

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 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.

19. **Assertion(A):** If the deviations of 9 observations about their mean are 3,-4,5,0,-3,6,-7,3,5, then mean deviation about mean is 4.

Reason (R): M.D. about mean=$\frac{\sum|x_i-\bar{x}|}{n}$, *where* $x_i-\bar{x}$ is the deviation of x_i about their mean $\bar{x}$.

20. **Assertion(A):** Rakesh has 8 friends. The number of ways in which Rakesh can invite one or more of his friends at a birthday party is 2^8-1.

Reason (R): Number of ways of selecting one or more objects out of r different objects=2^r-1.

Section-B

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

21. (a) Find the degree measure of the angle subtended at the centre of a circle of diameter 200 cm by an arc of length 22 cm. (use $\pi=\frac{22}{7}$)

OR

(b) Convert $5°37'30''$ into radian measure.

22. (a) If $x-iy=\sqrt{\frac{a-ib}{c-id}}$, prove that $(x^2+y^2)^2=\frac{a^2+b^2}{c^2+d^2}$.

OR

(b) Evaluate $\sum_{n=1}^{13}(i^n+i^{n+1})$, *where* $n\in N$.

23. Find the equation of the ellipse, with major axis along the x-axis and passing through the points (4, 3) and (– 1,4).

24. Find the positive integer n so that $\lim_{x\to 3}\frac{x^n-3^n}{x-3}=108$.

25. In drilling world's deepest hole it was found that the temperature T in degree Celsius, x km below the earth's surface was given by T = 30 + 25 (x – 3), 3 ≤ x ≤ 15. At what depth will the temperature be between 155°C and 205°C?

Section-C

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

26. (a) For all sets A, B and C, is (A – B) ∩ (C – B) = (A ∩ C) – B? Justify your answer.

OR

(b) Find the domain and range of the function $f(x)=\frac{1}{\sqrt{9-x^2}}$.

27. (a) Prove that $\left(1+\cos\frac{\pi}{8}\right)\left(1+\cos\frac{3\pi}{8}\right)\left(1+\cos\frac{5\pi}{8}\right)\left(1+\cos\frac{7\pi}{8}\right)=\frac{1}{8}$.

OR

(b) If $\tan(\alpha+x)=n\tan(\alpha-x)$, *show that* $(n+1)\sin 2x=(n-1)\sin 2\alpha$.

28. (a) A person writes a letter to four of his friends. He asks each one of them to copy the letter and mail to four different persons with instruction that they move the chain similarly. Assuming that the chain is not broken and that it costs 50 paise to mail one letter. Find the amount spent on the postage when 8th set of letters is mailed.

OR

(b) If A.M. and G.M. of roots of a quadratic equation are 8 and 5, respectively, then obtain the quadratic equation.

29. Find the derivative of function $f(x) = \sqrt{ax + b}$ using first principle.

30. A rod AB of length 15 cm rests in between two coordinate axes in such a way that the end point A lies on x-axis and end point B lies on y-axis. A point P(x, y) is taken on the rod in such a way that AP = 6 cm. Show that the locus of P is an ellipse.

31. If $f(x) = \begin{cases} \frac{k\cos x}{\pi - 2x}, & when\ x \neq \frac{\pi}{2} \\ 3, & when\ x = \frac{\pi}{2} \end{cases}$ and $\lim_{x \to \frac{\pi}{2}} f(x) = f\left(\frac{\pi}{2}\right)$, then find the value of k.

Section-D

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

32. (a) If $\sin(\theta + \alpha) = a\ and\ \sin(\theta + \beta) = b, prove\ that\ \cos 2(\alpha - \beta) - 4ab\cos(\alpha - \beta) = 1 - 2a^2 - 2b^2$.

OR

(b) If $\frac{\sin(x+\alpha)}{\cos(x-\alpha)} = \frac{1-m}{1+m}$, prove that $\tan\left(\frac{\pi}{4} - x\right)\tan\left(\frac{\pi}{4} - \alpha\right) = m$.

33. If a_1, a_2, a_3 and a_4 are the coefficient of any four consecutive terms in the expansion of $(1 + x)^n$, prove that $\frac{a_1}{a_1+a_2} + \frac{a_3}{a_3+a_4} = \frac{2a_2}{a_2+a_3}$.

34. A rectangle has two opposite vertices at the points (1,2) and (5,5). If the other vertices lie on the line x=3, find the equations of the sides of the rectangle.

35. (a) Calculate the mean deviation about the median of the following data:

Wages per week (in ₹)	10-20	20-30	30-40	40-50	50-60	60-70	70-80
No. of workers	4	6	10	20	10	6	4

OR

(b) Find the variance and standard deviation for the following distribution:

X:	4.5	14.5	24.5	34.5	44.5	54.5	64.5
f:	1	5	12	22	17	9	4

Section-E

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

36. **Case Study-1:**

A university is planning a graduation ceremony with 15 graduating students. The university will:

- **Form a committee:** 5 students will be selected for a graduation committee.
- **Distribute positions:** Each committee member will be assigned one of 3 distinct positions: President, Secretary, and Treasurer.

- **Choose guest speakers:** The committee must invite 2 guest speakers from a list of 6 people. The order in which the speakers are chosen does not matter.

Based on the given information, answer the following questions:

i. In how many ways can the committee of 5 students be selected? 1

ii. How many ways can the committee be formed if the President must be selected from the top 5 students in the class? 1

iii. (a) What is the total number of possible outcomes if the committee is formed first, then positions are assigned, and then guest speakers are chosen? 2

OR

(b) If the President is already chosen, how many ways can the remaining 4 committee members be selected from the 14 students left, and how many ways can the positions be assigned? 2

37. **Case Study-2:**

There are multiple prints on a wall where each print describes a function. Shweta randomly picks a print and find the function as f: R → [0, ∞) defined by f(x) = |x|. She then chooses another print and find function 'g' which is given by g(x) = f(x + 1) + f(x – 1), for all x ∈ R.

Based on the above information, answer the following questions.

(i) Find the value of function g(x) in terms of x i.e. independent of f(x). 1

(ii) Find the range of g(x). 1

(iii) Draw the graph of f(x). 2

OR

(iii) Draw the graph of g(x). 2

38. **Case Study-3:**

A coach is training 3 players. He observes that the player A can hit a target 4 times in 5 shots, player B can hit 3 times in 4 shots and the player C can hit 2 times in 3 shots.

i) What is the probability that any two of them will hit the target? 2

ii) What is the probability that A, B or C will hit the target? 2