

COMMON ANNUAL SCHOOL EXAMINATION (2024-25)

CLASS : XI

SUBJECT: MATHEMATICS (041)

Time Allowed : 3 hours

Maximum Marks : 80

समय : 3 घंटे

अधिकतम अंक - 80

सामान्य निर्देश:

निम्नलिखित निर्देशों को बहुत सावधानी से पढ़िए और उनका सख्ती से पालन कीजिए।

1. इस प्रश्न पत्र में 38 प्रश्न हैं। सभी प्रश्न अनिवार्य हैं।
2. यह प्रश्न पत्र पाँच खंडों में विभाजित है - क, ख, ग, घ, एवं ङ।
3. खंड क में प्रश्न संख्या 1 से 18 तक बहुविकल्पीय तथा प्रश्न 19 एवं 20 अभिकथन एवं कारण आधारित एक-एक अंक के प्रश्न हैं।
4. खंड ख में प्रश्न संख्या 21 से 25 तक अति लघुउत्तरीय (VSA) प्रकार के दो-दो अंक के प्रश्न हैं।
5. खंड ग में प्रश्न संख्या 26 से 31 तक अति लघुउत्तरीय (SA) प्रकार के तीन-तीन अंक के प्रश्न हैं।
6. खंड घ में प्रश्न संख्या 32 से 35 तक दीर्घ-उत्तरीय (LA) प्रकार के पाँच-पाँच अंकों के प्रश्न हैं।
7. खंड ङ में प्रश्न संख्या 36 से 38 तक प्रकरण अध्ययन आधारित चार-चार अंकों के प्रश्न हैं।
8. प्रश्न-पत्र में समग्र विकल्प नहीं दिया गया है। यद्यपि, खण्ड ख के 2 प्रश्नों में, खण्ड ग के 3 प्रश्नों में, खण्ड घ के 2 प्रश्नों में, खण्ड ङ के 2 प्रश्नों में आंतरिक विकल्प का प्रावधान दिया गया है।
9. कैल्कुलेटर का उपयोग वर्जित है।

GENERAL INSTRUCTIONS:

Read the following instructions very carefully and strictly follow them :

1. This question paper contains 38 questions. All questions are compulsory.
2. This section paper is divided into five sections - A, B, C, D and E.
3. In Section-A, questions No. 1 to 18 are multiple choice questions (MCQ's) and questions number 19 and 20 are Assertion-Reason based questions of 1 mark each.
4. In Section-B, questions No. 21 to 25 are very short answer (VSA) type questions, carrying 2 marks each.
5. In Section-C, questions No. 26 to 31 are Short answer (SA) type questions, carrying 3 marks each.
6. In Section-D, questions No. 32 to 35 are long answer (LA) type questions, carrying 5 marks each.
7. In Section-E, questions No. 36 to 38 are case study based questions carrying 4 marks each.
8. 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 2 questions in Section E.
9. Use of calculator is not allowed.

SECTION-A

This section comprises multiple choice questions (MCQ's) of 1 mark each.

1. Let $A = \{x : x \text{ is a positive number which is a multiple of 3 and less than } 100\}$
 $B = \{x : x \text{ is a prime number less than } 20\}$, then $n(A) + n(B) =$ 1
 - (a) 38 (b) 39
 - (c) 43 (d) 41
2. If $f(x) = ax + b$, where a and b are integers, $f(-1) = -5$ and $f(3) = 3$ then $(a + b) =$ 1
 - (a) -2 (b) -1
 - (c) 0 (d) 1
3. The range of the function $f(x) = 2 - |x - 0.1|$ is : 1
 - (a) $(-\infty, 2)$ (b) $(-\infty, 2]$
 - (c) $(-\infty, 1.9]$ (d) $[1.9, 2.1]$
4. The greatest value of $\sin 15^\circ \cos x$ is : 1
 - (a) 0 (b) 1
 - (c) $\frac{1}{2}$ (d) $\frac{\sqrt{3}-1}{2\sqrt{2}}$
5. The value of $(\sin 2\pi + \cos \pi)^2$ is : 1
 - (a) 0 (b) 0.25
 - (c) 1 (d) 4
6. If $\tan \theta = 3$ and θ lies in third quadrant, then the value of $(\sqrt{10} \sin \theta)$ is : 1
 - (a) -1 (b) -3
 - (c) 1 (d) -2
7. If $z = 3i^{15} + 4i^{-15}$, where $\sqrt{-1} = i$ then $|z| =$ 1
 - (a) 1 (b) 5
 - (c) 7 (d) $\sqrt{5}$
8. Solution of the inequalities comprising a system in variable x are represented on number line as given below, then : 1
 - (a) $(1, 2)$ (b) $[1, 2]$
 - (c) $[1, 2]$ (d) $[1, 2)$

9. In how many ways a committee consists of 3 men and 2 women, can be chosen from 8 men and 6 women? 1
- (a) 350 (b) 480
(c) 840 (d) 900
10. The number of terms in the expansion of $(a + b)^{27} - (a - b)^{27}$ after simplification is : 1
- (a) 28 (b) 27
(c) 13 (d) 14
11. The equation of the line passing through (3, 5) and perpendicular to line $x - y + 8 = 0$ is : 1
- (a) $x + y + 8 = 0$ (b) $x + y = 8$
(c) $x - y = 8$ (d) $5x + y = 20$
12. The distance of point A (4, 3, 5) from the yz-plane is : 1
- (a) 3 units (b) 4 units
(c) 5 units (d) 7 units
13. $\lim_{x \rightarrow 0} x \cdot \sin\left(\frac{1}{x}\right)$ is equal to : 1
- (a) 0 (b) 1
(c) $\frac{1}{2}$ (d) does not exist
14. $\lim_{x \rightarrow 0} \frac{\sin 2x}{x(1 + \cos 2x)}$ is equal to : 1
- (a) 1 (b) 0.5
(c) 0.25 (d) 2
15. If $y = \frac{x^2 + 1}{x^2 - 1}$, then $\frac{dy}{dx} =$ 1
- (a) $\frac{4x}{(x^2 - 1)^2}$ (b) $\frac{-4x}{(x^2 - 1)^2}$
(c) $\frac{2x}{(x^2 - 1)^2}$ (d) $\frac{-2x}{(x^2 - 1)^2}$
16. The mean deviation of the data 2, 2, 3, 3, 2, 2, 4, 5, 5, 6 from the median is : 1
- (a) 1 (b) 1.1
(c) 1.2 (d) 1.3



17. Three squares of chess board, are selected at random. The probability of getting 2 squares of one colour and other of a different colour is : 1

- (a) $\frac{3}{8}$ (b) $\frac{8}{21}$
(c) $\frac{16}{21}$ (d) $\frac{5}{21}$

18. If $P(A \cup B) = P(A \cap B)$ for any two events A and B, then : 1

- (a) $P(A) = P(B)$ (b) $P(A) < P(B)$
(c) $P(A) > P(B)$ (d) $P(A) + P(B) = 2$

Assertion-Reason Based Questions

Question Number 19 to 20 each carry one mark.

In the following questions, a statement of Assertion (A) is followed by statement of Reason (R). Choose the correct answer out of 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 reason 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) : The solution set of $4x + 2 \leq 2x + 18$, $x \in W$ is $\{0, 1, 2, 3, 4, 5\}$

Reason (R) : The number system, the symbol W denotes the set of whole numbers i.e. $\{0, 1, 2, 3, 4, \dots\}$ 1

20. Assertion (A) : If $i = \sqrt{-1}$, then $i^{4n} = 1$, $i^{4n+1} = i$, $i^{4n+2} = -1$ and $i^{4n+3} = -i$ $n \in N$

Reason (R) : $i^{4n} + i^{4n+1} + i^{4n+2} + i^{4n+3} = 1 + 0i$, $n \in N$ 1

SECTION-B

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

21. Two finite sets have m and n elements respectively. The total number of subsets of first set is 48 more than the total number of subsets of the second set. Find the value of $(3m + 2n)$. 2

22. (a) Let $A = \{1, 2, 3\}$, $B = \{3, 4\}$ and $C = \{4, 5, 6\}$, find :

(i) $A \times (B \cap C)$

(ii) $A \times (B \cup C)$ 2

OR

- (b) Write the relation $R = \{(x, x^3) : x \text{ is a prime number less than } 12\}$ in roster form. 2

23. (a) Find the values of $\operatorname{cosec}(-1410^\circ)$ and $\sin\left(\frac{-11\pi}{3}\right)$. 2

OR

- (b) Prove that: $\tan 3x - \tan 2x - \tan x = \tan 3x \cdot \tan 2x \cdot \tan x$

24. In an experiment, a solution of hydrochloric acid is to be kept between 30° and 35° celsius. What is the range of temperature in degree Fahrenheit if conversion formula is given by

$$C = \frac{5}{9}(F - 32)$$

where C and F represent temperature in degree celsius and degree Fahrenheit, respectively. 2

25. Evaluate: $\lim_{x \rightarrow \frac{\pi}{6}} \frac{2 \sin^2 x + \sin x - 1}{2 \sin^2 x - 3 \sin x + 1}$ 2

SECTION-C

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

26. (a) Find the image of the point (3, 8) with respect to the line $x + 3y = 7$ assuming the line to be a ~~plane~~ mirror. 3

OR

- (b) If p and q are the lengths of perpendicular from the origin to the lines $x \cos \theta - y \sin \theta = k \cos 2\theta$ and $x \sec \theta + y \operatorname{cosec} \theta = k$, respectively, prove that $p^2 + 4q^2 = k^2$.

27. (a) Find the range of the function $f(x) = \frac{x^2}{1+x^2}$. 3

OR

- (b) Find the domain of the function $f(x) = \sqrt{9-x^2} + \sqrt{x^2-4}$.

28. Show that the points A (1, 2, 3), B (-1, -2, -1), C (2, 3, 2) and D (4, 7, 6) are the vertices of a parallelogram ABCD, but it is not a rectangle. 3
29. Find the derivative of the function $f(x) = \sin x \cdot \cos x + \frac{x^3 - 1}{x - 1} + (\sqrt{x} - 1)(\sqrt{x} + 1)(x + 1)$ with respect to x. 3
30. Prove that : $\sin x + \sin 3x + \sin 5x + \sin 7x + 4 \cos x \cos 2x \sin 4x$ 3
31. (a) If α and β are different complex numbers with $|\beta| = 1$, then find $\left| \frac{\beta - \alpha}{1 - \bar{\alpha}\beta} \right|$. 3

OR

(b) Let $z_1 = 2 - i$, $z_2 = -2 + i$. Find :

(i) $\operatorname{Re} \left(\frac{z_1 z_2}{\bar{z}_1} \right)$

(ii) $\operatorname{Im} \left(\frac{1}{z_1 \bar{z}_1} \right)$

SECTION-D

Question Number 32 to 35 are long answer (LA) type questions of 5 marks each.

32. Write the sets A and B in Roaster form, where universal set, $\cup = \{1, 2, 3, 4, 5, 6, 7\}$ and
 $A = \{x : x \text{ is a natural number less than } 6\}$
 $B = \{x : x, \text{ is a prime number which is divisor of } 60\}$
 Also, verify that (i) $(A \cup B)' = A' \cap B'$ (ii) $(A \cap B)' = A' \cup B'$ 5
33. (a) The sum of the three numbers in G.P. is 56. If we subtract 1, 7, 21 from these numbers in that order, we obtain an arithmetic progression. Find the numbers. 5

OR

- (b) Find the sum to n-terms of the sequence 8, 88, 888, 8888
34. (a) Calculate the mean, variance and standard deviation for the following distribution: 5

Class	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Frequency	3	7	12	15	8	3	2

OR

- (b) The mean of 5 observations is 4.4 and their variance is 8.24. If three of the observations are 1, 2 and 6, find the other two observations.

35. Using Binomial theorem, expand $\left(\frac{2}{x} - \frac{x}{2}\right)^5$, $x \neq 0$.

5

SECTION-E

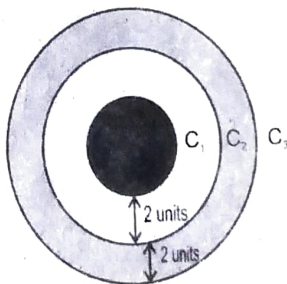
Case-Based Questions

This section comprises 3 case study/passage based questions of 4 marks each.

36. This Diwali Shilpa, a student of class 11, made a Mathematical rangoli in which she draw 3 concentre circles namely C_1 , C_2 and C_3 as shown in the given figure.

Further the width in between each circle is 2 units (throughout).

If the equation of circle c_1 is $x^2 + y^2 - 2x - 4y - 4 = 0$, then on the basis of information given, answer the following :



- (i) Find the radius of circle C_1 .
(ii) Find the centre of circle C_2 .
(iii) (a) Find the equation of circle C_1 .

1

1

2

OR

- (b) Find the equation of circle C_3 .

37. Delhi Eye is a 45-metre massive ferris wheel. It is located in the lush green spaces of Kalindi Kunj Park and provides stunning panoramic views of the city and the famous monuments like Qutub Minar, Red Fort, Akshardham, Lotus Temple.

A group consists of 4 girls and 7 boys went there to enjoy the view on Delhi Eye. Unfortunately there was a rush and only 5 tickets are available.



On the basis of above information answer the following :

- (i) In how many ways can they choose 5 members for the ride if no girl want to go for the ride. 1
- (ii) In how many ways can they choose 5 members for the ride if all girls want to go for the ride. 1
- (iii) (a) In how many ways can they choose 5 members for the ride if atleast 3 girls want to go for ride? 2

OR

- (b) In how many ways can they choose 5 members for the ride if atleast one boy and one girl want to go for the ride?

38. The National Cadet Corps (NCC) and the National Service Scheme (NSS) are both important for students because they help develop a sense of duty, discipline and community involvement.

On understanding the importance of these, in a class of 60 students, 30 opted for NCC, 32 opted for NSS and 24 opted for both NCC and NSS.

One of these students is selected at random from the class. On the basis of the information given answer the following :

- (i) Find the probability that the student has opted neither NCC nor NSS. 2
- (ii) Find the probability that the student has opted NSS but not NCC. 2