Jh Venkateshwar International School

Sector-18, Dwarka, New Delhi-75

ANNUAL EXAMINATION (2023-24)

MATHEMATICS (041)

CLASS – XI

Time: 3 Hours **Max. Marks: 80**

General Instructions:

1. **The question paper consists of 5 sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.**
2. **Section A has 18 MCQs and 2 Assertion reasoning based questions of 1 mark each.**
3. **Section B consists of 5 Very Short Answer (VSA)-type questions of 2 marks each.**
4. **Section C consists of 6 Short Answer (SA)-type questions of 3 marks each.**
5. **Section D consists of 4 Long Answer(LA)-type questions of 5 marks each.**
6. **Section E consists of 3 case-based / source based questions of 4 marks each with sub-parts of the values 1, 1 and 2 marks each respectively.**

SECTION – A

Section A consists of 20 questions of 1 mark each

1. If two finite sets A and B are such that A ⊂ B, then which of the following is not correct? **(1)**

(a) A ∪ $B = B$ (b) A ∩ $B = A$ (c) A – B = ϕ (d) B – A = ϕ

2. A bag contains 5 green and 7 red balls, two balls are drawn at random, the probability that one is green and other is red. **(1)**

(a) $\frac{35}{66}$ (b) $\frac{35}{132}$ (c) $\frac{35}{33}$ (d) $\frac{35}{36}$

3. Let A be a finite sets containing 3 elements, then the number of functions from A to A is **(1)**

(a) 512 (b) 511 (c) 27 (d) 26

4. The domain and range of real function f defined by f(x) = $\frac{x-2}{2-x}$ are **(1)**

(a) Domain = R - $\{2\}$, Range =$\{-1\}$ (b) Domain = R - $\{-2\}$, Range =$\{-1\}$

(c) Domain = R - $\{2\}$, Range =$\{1\}$ (d) Domain = R - $\{-2\}$, Range =$\{1\}$

5. The coordinates of the image of the point (1, 3, -6) in YOZ plane are **(1)**

(a) (-1, 3, -6) (b) (1, -3, -6) (c) (-1, 3, 6) (d) (1, 3, 6)

6. The greatest value of 4 + 5 cosx is **(1)**

(a) 1 (b) 9 (c) -1 (d) 5

7. Total number of complex number Z satisfying Re(z^2) = 0, |Z| = $\sqrt{3}$ is equal to **(1)**

(a) 2 (b) -4 (c) 4 (d) None of these

8. The real value of θ for which the expression $\frac{1+ i cos\theta}{1- 2i\ cos\theta}$ is a purely real number is **(1)**

(a) n $\pi \pm \frac{\pi}{6}$, n $\in Z$ (b) n $\pi \pm \frac{\pi}{3}$, n $\in Z$

(c) (2n + 1) $\frac{\pi}{2}$, n $\in Z$ (d) n $\pi \pm \frac{\pi}{4}$, n $\in Z$

9. If $\frac{x+8}{x-2} \geq 0$ x $\in R$, then **(1)**

(a) x $\in [-5, 9]$ (b) x $\in$ (- 5, 9] (c) x $\in$ [2, ∞) (d) x$\in (-\infty$, - 8] $\cup$ (2, ∞)

10. Three of the six vertices of a regular hexagon are chosen at random. What is the probability that the triangles with these vertices is equilateral? **(1)**

(a) 0.03 (b) 0.15 (c) 0.05 (d) 0.10

11. The number of signals that can be made by 4 flags of different colours, taking one or more at a time is **(1)**

(a) 48 (b) 52 (c) 64 (d) 56

12. If f(x) = $\frac{x-4}{2\sqrt{x}}$ then $f'(1)$ is **(1)**

(a) 1 (b) 0 (c) $\frac{5}{4}$ (d) $\frac{4}{5}$

13. The number of terms in the expansion of $(x + a)^{53}$ + $(x - a)^{53}$ after simplification is **(1)**

(a) 106 (b) 26 (c) 27 (d) 53

14. The product of 5 terms of a G.P. whose 3rd term is 2 is **(1)**

(a) 25 (b) 32 (c) 9 (d) 243

15. The inclination of the line x – y + 5 = 0 with the positive direction of x-axis is **(1)**

(a) $45°$ $(b) 135°$ $(c) -45°$ $(d) -135°$

16. The tangent of the angle between the lines joining the points (-1, 2) , (3, -5) and (-2, 3) and (5, 0) is **(1)**

(a) $\frac{37}{49}$ (b) $\frac{49}{37}$ (c) $\frac{23}{47}$ (d) $\frac{47}{23}$

17. $\lim_{x \to 0} \frac{\sqrt{2} - \sqrt{1+\cos x}}{sin^2 x}$ is equal to **(1)**

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

18. The equation of circle whose centre is (3 , -2) and which touches the line 3x – 4y + 13 = 0 is **(1)**

(a) $x^2 + y^2$ + 6x – 4y – 23 = 0 (b) $x^2 + y^2$ - 6 x– 4y – 23 = 0

(c) $x^2 + y^2$ - 6x + 4y – 23 = 0 (d) $x^2 + y^2$+6x+4y +23 = 0

ASSERTION – REASON BASED QUESTIONS

Each question consists of two statements namely, Assertion (A) and Reason (R).For selecting the correct answer, use the following code:

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

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

(c) (A) is true and (R) is false.

(d) (A) is false and (R) is true.

19. **Assertion (A) :** In a set of prime numbers, any two elements are co-prime . **(1)**
Reason (R) : HCF of two co-prime numbers is 1.

20. **Assertion (A) :** Total number of terms in the expansion of $(x^2 + 2x + 1)^5$ are 11. **(1)**

Reason (R) : Total number of terms in the binomial expansion with exponent n are (n + 1).

SECTION – B

Section B consists of 5 questions of 2 marks each

21. Solve for real x : $3 \leq | 2x - 1 | < 7$ **(2)**

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

23. Show that if $\left|\frac{z-5i}{z+5i}\right|$ = 1, then z is a real number. **(2)**

OR

Solve the equation : $Z^2 + | Z |^2 = 0$, $Z \neq 0$

24. A and B are two events such that P(A) = 0.54, P(B) = 0.69 and P(A ∩ B) = 0.35, find **(2)**
(a) P(A ∪ B) (b) P($\bar{A} \cap \bar{B}$) (c) P(A∩ $\bar{B}$) (d) P($\bar{A} \cap B$)

25. Show that the points (5, -1, 1), (7, -4, 7), (1,-6, 10) and (-1, -3, 4) are the vertices of a rhombus. **(2)**

OR

If A and B are the points (1, 2, 3) and (-1, 4, -3) respectively, then find the locus of a point P such that $PA^2 - PB^2 = 2k^2$

SECTION - C

Section C consists of 6 questions of 3 marks each

26. Find the equation of a circle of radius 5 which is touching another circle

$x^2 + y^2 - 2x - 4y - 20 = 0$ at the point (5, 5). **(3)**

27. If $x\cos\theta = y\cos(\theta + \frac{2\pi}{3}) = z\cos(\theta + \frac{4\pi}{3})$, prove that xy + yz + zx = 0 **(3)**

28. Evaluate: $\lim_{y \to 0} \frac{(x+y)\sec(x+y) - x\sec x}{y}$ **(3)**

OR

Let $f(x) = \begin{cases} \frac{k\cos x}{\pi - 2x} & \text{when } x \neq \frac{\pi}{2} \\ 3 & When\ x = \frac{\pi}{2} \end{cases}$

Find the value of k if $\lim_{x \to \frac{\pi}{2}} f(x) = f(\frac{\pi}{2})$

29. By using binomial expansion, show that $2^{4n+4} - 15n - 16$ is divisible by 225 for all $n \in N$ **(3)**

OR

If a and b are distinct integers, prove that a – b is a factor of $a^n - b^n$, whenever n is a is positive integer.

30. Find the derivatives of the (a) $\frac{x\tan x}{\sec x + \tan x}$ (b) $\sin^3 x.\cos^3 x$ **(3)**

31. Show that tangent of the an angle between the lines $\frac{x}{a} + \frac{y}{b} = 1$ and $\frac{x}{a} - \frac{y}{b} = 1$

is $\frac{2ab}{a^2 - b^2}$ **(3)**

OR

Find the equations of the lines through origin and making an angle of θ with the line y = mx + c.

SECTION – D

Section D consists of 4 questions of 5 marks each

32. Prove that: $\tan x + \tan(\frac{\pi}{3} + x) - \tan(\frac{\pi}{3} - x) = 3\tan 3x$ **(5)**

OR

Prove that: $\frac{Sec8x-1}{Sec4x-1} = \frac{tan8x}{tan2x}$

33. (a) Find three numbers in G.P. whose sum is 7 and product is 8. **(2.5)**

(b) Find the sum of 50 terms of the sequence 7, 7.7, 7.77, 7.777… **(2.5)**

34. (a) If p and q are the lengths of perpendiculars 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

$p^2 + 4q^2 = k^2$ **(2.5)**

(b) Find the derivative using first principle: $f(x) = \sin\sqrt{x}$ **(2.5)**

35. Find mean, variance and standard deviation of the following data: **(5)**

C .I	30-40	40-50	50-60	60-70	70-80	80-90	90- 100
f_i	3	7	12	15	8	3	2

SECTION – E

Section E consists of Case Based / Source based questions of 4 marks each

36. 5-digit numbers are formed. One number is chosen at random
Based on the above information, answer the following questions.

(i) Find the probability of choosing odd number. **(1)**
(ii) Find the probability of choosing a number divisible by 5. **(1)**
(iii) Find the probability of choosing a number whose sum of digit is odd. **(2)**

OR

Find the probability of choosing a number whose sum of digits is divisible by 5.

37. A child during free time was reading a novel, during reading she came across the word '**DAUGHTER'.** Suddenly, she started thinking of forming different words from letters of the word '**DAUGHTER'.** The words formed may or may not have a dictionary meaning. Many questions came to her mind. Help her in answering the following questions:

(i) Find the number of words so that all the vowels are always together **(1)**

(ii) Find the number of words so that the letters G and H are together and in the middle **(1)**

(iii) Find the number of words which can be formed taking 2 vowels and 2 consonants. **(2)**

OR

Find the number of words so that all vowels and consonants come together.

38. Let $f : R \to [0, \infty]$ be a function defined by $f(x) = |x|$ and $g(x) = f(x + 1) + f(x - 1)$,for all $x \in R$.

Based on above information, answer the following questions:

(i) Find g(x). **(1)**

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

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

OR

Draw the graph of f(x).