

Roll No. ....11081.....

No. of Printed Pages : 7

MG-180

HALF YEARLY EXAMINATION 2024-25

MATHEMATICS (Theory)

Time : 3 hrs. ]

Class XI

[ M.M. : 80

General Instructions—

- (i) This question paper contains - five sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
- (ii) Section A has 18 MCQ's and 02 Assertion-Reason based questions of 1 mark each.
- (iii) Section B has 5 Very Short Answer (VSA)-type questions of 2 marks each.
- (iv) Section C has 6 Short Answer (SA)-type questions of 3 marks each.
- (v) Section D has 4 Long Answer (LA)-type questions of 5 marks each.
- (vi) Section E has 3 source based/case based/passage based/integrated units of assessment (4 marks each) with sub parts.

SECTION-A

1×20=20

1. Two finite sets A and B are such that  $A \subset B$ , then which of the following is not correct ? 1
  - (a)  $A \cup B = B$
  - (b)  $A \cap B = A$
  - (c)  $A - B = \phi$
  - (d)  $B - A = \phi$
2. If  $n(A \cup B) = 18$ ,  $n(A - B) = 5$ ,  $n(B - A) = 3$ , then  $n(A \cap B)$  is : 1
  - (a) 18
  - (b) 10
  - (c) 15
  - (d) 12
3. The value of  $\tan \frac{19\pi}{3}$  is  $\sqrt{n}$ . Value of 'n' is : 1
  - (a) 1
  - (b) 2
  - (c) 3
  - (d) 5

P. T. O.



4. If  $A = \{1, 2, 3, 4, 5\}$  then the number of proper subsets of  $A$  is : 1  
 (a) 120 (b) 30  
 (c) 31 (d) 32
5. The number of all five digit numbers that can be formed by using the digits 0, 1, 2, 3 and 4 is— 1  
 (a)  ${}^5P_5$  (b)  $5^5$   
 (c)  $4 \times {}^4P_4$  (d)  $4 \times 5^4$
6. The set of real  $x$  satisfying the inequality  $\frac{5-2x}{3} \leq \frac{x}{6} - 5$  is  $[a, \infty)$ . The value of 'a' is :  $sc$   
 (a) 2 (b) 4  $uv$   
 (c) 6 (d) 8  $2v$   $3v$   $3c3$   $4c2$
7. Total number of words that can be formed by using 2 vowels and 3 consonants selected from 4 vowels and 5 consonants is equal to (no repetition is allowed) 1  
 (a) 60 (b) 7200  
 (c) 120 (d) 720
8. If  $A$  and  $B$  are two given sets, then  $A \cap (A \cap B)^c$  is equal to : 1  
 (a)  $B$  (b)  $A$   
 (c)  $A \cap B^c$  (d)  $\phi$
9. If  $R$  is a relation from a finite set  $A$  having  $m$  elements to a finite set  $B$  having  $n$  elements, then the number of relations from  $A$  to  $B$  is : 1  
 (a)  $2^{mn}$  (b)  $2^{mn} - 1$   
 (c)  $2mn$  (d)  $m^n$
10. Let  $A = \{1, 2, 3\}$ ,  $B = \{2, 3, 4\}$ , then which of the following is a function from  $A$  to  $B$ ? 1  
 (a)  $\{(1, 2), (1, 3), (2, 3), (3, 3)\}$  (b)  $\{(1, 3), (2, 4)\}$   
 (c)  $\{(1, 3), (2, 2), (3, 3)\}$  (d)  $\{(1, 2), (2, 3), (3, 2), (3, 4)\}$



11. The value of expression  $\sin \theta + \cos \theta$  lies between : 1  
 (a)  $-2$  and  $2$  both inclusive (b)  $0$  and  $\sqrt{2}$  both inclusive  
 (c)  $-\sqrt{2}$  and  $\sqrt{2}$  both inclusive (d)  $0$  and  $2$  both inclusive
12. Which of the following is an empty set? 1  
 (a)  $\{x : x \in \mathbb{R}, x^2 - 1 = 0\}$  (b)  $\{x : x \in \mathbb{R}, x^2 + 1 = 0\}$   
 (c)  $\{x : x \in \mathbb{R}, x^2 - 4 = 0\}$  (d)  $\{x : x \in \mathbb{R}, x^2 - x - 2 = 0\}$
13. Number of relations that can be defined on the set  $A = \{a, b, c, d\}$  is : 1  
 (a) 24 (b) 44  
 (c) 16 (d)  $2^{16}$
14. The standard form  $i^{19} - 2i^{27} + 6$  is : 1  
 (a)  $6 + 2i$  (b)  $6 + i$   
 (c)  $6 - i$  (d)  $6i$
15. If  $z = (3i - 1)^2$  then  $|z| = ?$  1  
 (a) 10 (b) None of these  
 (c) 8 (d) 4
16. The total number of terms in the expansion of  $(1+x)^{1000} - x^{1001}$  is : 1001-1012 1  
 (a) 1002 (b) 1003  
 (c) 1001 (d) 1000
17. The value of  $\cos 63\pi$  is : 1  
 (a) 1 (b) 2  
 (c) 0 (d)  $-1$
18. Value of  $\sqrt{3} \operatorname{cosec} 20^\circ - \sec 20^\circ$  is : 1  
 (a) 3 (b)  $\frac{3}{2}$   
 (c) 1 (d) 4

Question numbers 19 and 20 are Assertion and Reason based questions. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (a), (b), (c) and (d) as given below.



- (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
- (b) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).
- (c) Assertion (A) is true but Reason (R) is false.
- (d) Assertion (A) is false but Reason (R) is true.

19. Assertion (A) :  $T = \left\{ x \mid \frac{x+5}{x-7} - 5 = \frac{4x-40}{13-x} \right\}$ , then T is an empty set. 1

Reason (R) : A set without any element is called an empty set.

20. Assertion (A) : If  ${}^{2023}C_{2x-2} = {}^{2023}C_x$ , then sum of all positive values of x is 677.

Reason (R) : If  ${}^nC_x = {}^nC_y$ , then  $x = y$  or  $x + y = n$  1

SECTION-B

2×5=10

21. IQ of a person is given the formula  $Q = \frac{MA}{CA} \times 100$ ; where MA is mental age and CA is chronological age. If  $80 \leq IQ \leq 140$  for a group of 12 year children, find the range of mental age. 2

22. Which is larger  $(1.01)^{1000000}$  or  $10,000$ ? Show the steps of the solution. 2

23. If  $\tan(A+B) = p$  and  $\tan(A-B) = q$  then prove that  $\tan 2A = \frac{p+q}{1-pq}$  2

24. Let  $A = \{4, 9, 16, 25, 36\}$ ,  $B = \{1, 2, 3, 4\}$ . If R is the relation "is square of" from set A to the set B, write the set corresponding to the relation R. Write the roster form of R. Also find the domain, co-domain and the range of R. 2

25. If  $A = \{x : x \in \mathbb{R}, x \text{ is the root of the equation } x^3 - x = 0\}$ ,  $B = \{x : x \in \mathbb{R}, x \text{ is the root of } x^3 + 2x^2 - x - 2 = 0\}$ . Then find the values of (i)  $A \cup B$  (ii)  $A \cap B$  2

SECTION-C

3×6=18

26. Using binomial theorem, prove that  $6^n - 5n - 1$  is divisible by  $5^2$ , for all  $n \in \mathbb{N}$ . 3

OR



✓ Find  $(a+b)^4 - (a-b)^4$ . Hence evaluate :  $(2+\sqrt{3})^4 - (2-\sqrt{3})^4$

27. A group consists of 4 girls and 7 boys. In how many ways can a team of 5 members be selected if the team has : 3

- (i) No girl
- (ii) At least one boy and one girl
- (iii) At least 3 girls

OR

Find the number of words with or without meaning that can be formed from the letters of the word AGAIN. If these words are written as in a dictionary, what will be the 50<sup>th</sup> word.

28. If  $(x+iy)^3 = u+iv$  then show that  $\frac{u}{x} + \frac{v}{y} = 4(x^2 - y^2)$  3

29. Prove that— 3

$$\frac{1 + \sin \theta - \cos \theta}{1 + \sin \theta + \cos \theta} = \tan \left( \frac{\theta}{2} \right)$$

30. Let  $A = \{1, 2, 4, 5\}$ ,  $B = \{2, 3, 5, 6\}$ ,  $C = \{4, 5, 6, 7\}$ , verify the following identity  $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$ . 3

31. Find the coefficient of  $a^4$  in the product  $(1+2a)^4(2-a)^5$  using binomial theorem. 3

SECTION-D

5×4=20

32. If  $\tan \frac{\theta}{2} = \sqrt{\frac{a-b}{a+b}} \tan \frac{\phi}{2}$ , then  $\cos \theta = \frac{a \cos \phi + b}{a + b \cos \phi}$  5

OR

If  $\tan x = \frac{3}{4}$ ,  $x$  lies in third quadrant, find the value of  $\sin \frac{x}{2}$ ,  $\cos \frac{x}{2}$  and  $\tan \frac{x}{2}$ .

33. (i) Find the range of  $2+3\cos x$ . 2+3=5

S. d.



(ii) The function defined by :

$$f(x) = \begin{cases} 1-x & , x < 0 \\ 1 & , x = 0 \\ x+1 & , x > 0 \end{cases}$$

Draw the graph of  $f(x)$ .

34. If  $z_1$  and  $z_2$  are  $1-i$  and  $-2+4i$  respectively, find  $\text{Im} \left( \frac{z_1 z_2}{z_1} \right)$  2+2+1=5

✓ Represent the complex number  $-3+5i$  and its complex conjugate on a complex number plane (Argand plane) and find its absolute value.

✓ 35. A manufacturer has 600 litres of a 12% solution of acid. How many litres of a 30% acid solution must be added to it so that the acid content in resulting mixture will be more than 15% but less than 18%? 5

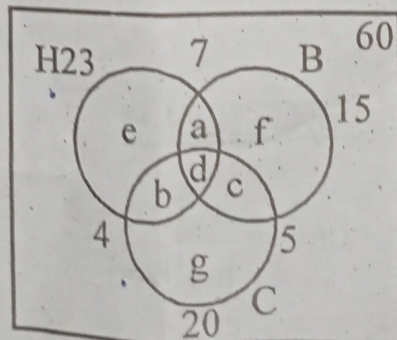
**SECTION-E**

4×3=12

(Case/Source based questions)

Read the following text carefully and answer the questions(Q. 36-38)

36. In a class of 60 students, 23 play hockey, 15 play basketball, 20 play cricket and 7 play hockey and basketball, 5 play cricket and basketball, 4 play hockey and cricket, 15 do not play any of the three games. (Refer to the Venn diagram) 1+1+2



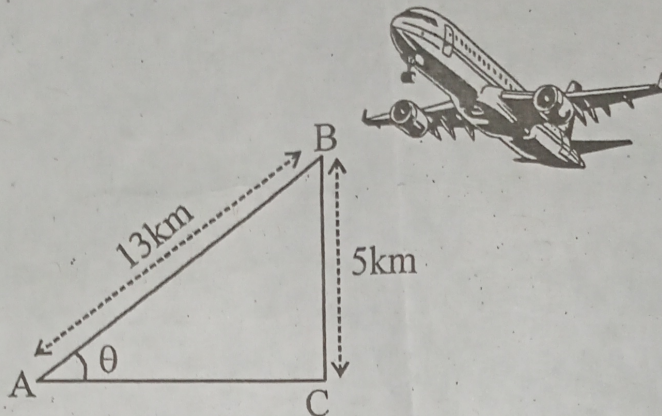
Based on the above information, find

- (i) How many play hockey, basketball and cricket ?
- (ii) How many play hockey but not cricket ?
- (iii) How many play hockey and cricket but not basketball ?



37. An airplane is observed to be approaching a point that is at a distance of 13 km from the point of observation and makes an angle of elevation of  $\theta$  and the height of the airplane above the ground is 5 km. Based on the above information answer the following questions—

2+2



- (i) Find the value of  $\sin 2\theta$ .  
 (ii) Find the value of  $\cos 2\theta$ .
38. During the Mathematics class, A teacher clears the concept of permutations and combinations to the 11th class students. After the class was over he asks the students some more questions.

1+1+2



On the basis of the information given above answer the following—

- (a) Find the number of arrangements of the letters of the word INDEPENDENCE.  
 (b) In How many of these do the words begin with I and end in P.  
 (c) In How many of these do all the vowels never occur together.

OR

In How many of these do all the four E's do not occur together ?