OSDAV Public School, Kaithal

Half yearly Exams (2024-25)

SET- A

Class : XI

Subject : Core Maths

Time: 3 Hrs . **M.M. : 80**

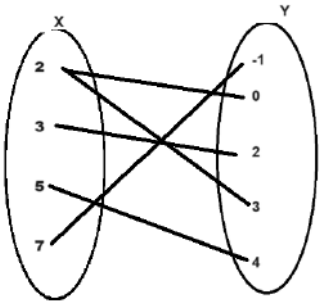
General Instructions:-

1 **All questions are compulsory.**

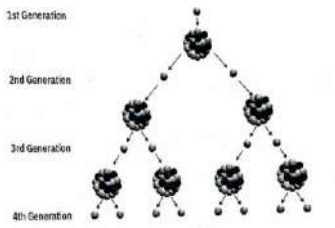
2 **This question paper has 5 Sections. Section A has 20 questions of 1 mark each which includes 18 M.C.Q.'s and 2 Assertion Reasons Section B has 5 Questions of 2 marks each. Section C has 6 questions of 3 marks each. Section D has 4 questions of 5 mark each and Section E has 3 case study based question of 4 marks each.**

Q.N.	Questions	Marks
1	If U = {1, 2, 3, 4, ……., 40}; P = {x: x is divisible by 2 and 3} and Q = {x: x = n^2, n ∈ N} then n(P) – n(Q) is a) 0 b) 1 c) 2 d) 3	1
2	Which of the following set is subset of A = {1, {2}, 3, 4, {7, 8}, 9} a) {2} b) {1,8} c) {7,8} d) {{7, 8}}	1
3	If R = {(x, y) : x, y ∈ W, 2x + y = 8}, then domain of R is a) {0, 1, 2, 3, 4, 5} c) {0, 1, 2, 3, 4, 5, 6} b) {0, 1, 2, 3, 4} d) {0, 1, 2, 3}	1
4	The value of [11.8] - [- 8.4] is (where [ ] stands for greatest integer function) a) -18 b) -19 c) 20 d) 3.4	1
5	The domain of the function f(x) = $\frac{x^2+2x+1}{x^2-8x+12}$ is a) R – {2, 6} b) R – { 1} c) R – { -1} d) R – {0}	1
6	The greatest value of (sin x cos x) is a) 1 b) 2 c) $\sqrt{2}$ d) $\frac{1}{2}$	1
7	The value of cot ($\frac{19\pi}{3}$) is a) $\sqrt{2}$ b) $\sqrt{3}$ c) $\frac{1}{\sqrt{3}}$ d) $\sqrt{7}$	1
8	Given x is a real number satisfying (1 – x) > (2x – 5), x belongs to a) (-∞, -2) b) (-∞, 2) c) (-2, ∞) d) (2, ∞)	1
9	The minimum value of $6^x + 6^{2-x}$, x ∈ R is a)6 b) 36 c) 12 d) 18	1

10	If x is a real number satisfying $(5x - 3) \leq (3x - 5)$, then the range of x is : a) $[1, \infty)$ b) $[-1, \infty)$ c) $(-\infty, 1]$ d) $(-\infty, -1]$	1
11	The total number of terms in the expansion of $(x + 3)^{40} + (x - 3)^{40}$ are a) 11 b) 41 c) 21 d) 20	1
12	$\sum_{k=0}^{n} C(n, k)\, 3^k$ is equal to a) 4^{2n} b) 3^n c) 4^n d) 3^{2n}	1
13	If two complex numbers z_1, z_2 are represented by the points (2, -1) and (-3, 4) in the Argand plane, then $\overline{z_1 - z_2}$ is a) -1 – 5i b) 5(1 – i) c) -1 + 5i d) 5(1 + i)	1
14	$i^{25} + i^{36} + i^{42} + i^{55}$ is equal to a) 0 b) 2 c) 2i d) 2 + 2i	1
15	Number of 5 - digit even numbers that can be formed using the digits 1, 3, 4, 7, 8 if repetition of digit is not allowed, is a) 500 b) 60 c) 48 d) 24	1
16	If $5 \times 5^{\frac{1}{3}} \times 5^{\frac{1}{9}} \times 5^{\frac{1}{27}} \ldots\ldots\ldots\infty = 5^m$, then m is equal to a) $\frac{3}{2}$ b) $\frac{2}{3}$ c) $\frac{3}{4}$ d) 1	1
17	A group consists of 4 girls and 7 boys then in how many ways a team of 5 members be selected if the team has atmost 1 girl a)121 b) 141 c) 161 d) 181	1
18	The solution of the inequality : $-8x + 6 \leq -2$, for $x \in N$ is a) $[1, \infty)$ b) $(1, \infty)$ c) N d) {1}	1
	Assertion Reason Based Questions: **Choose according to these options in Q 19 and 20** **a) Both A and R are true and R is the correct explanation of A.** **b) Both A and R are true and R is not the correct explanation of A.** **c) A is true and R is false.** **d) A is false and R is true.**	
19	**Assertion(A) :** C(10, 6) : P(10, 4) = 1:12 **Reason (R) :** C(n, r) = C(n, n – r) , $0 \leq r \leq n$	1
20	**Assertion(A)** : Let A = { 1,2} and B = { 3, 4} then number of relations from A to B are 16 **Reason (R)**: If n(A) = p and n(B) = q then number of relations from A to B are 2^{pq}	1

	Section – B	
21	If U = {x: x ∈ N and 1 ≤ x≤ 20} A = {x: x ∈ N and 1 ≤ x≤ 15} B = {x: x ∈ N and x = 2n – 1, n ≤ 5} Find the value of $A' - B'$	2
22	The figure shows a relation from a set X to a set Y.  Write the above relation in Roster form. Is the above relation a function? Give reason in support of your answer.	2
23	If 2p + iq = $\frac{a+ib}{a-ib}$ then show that 4 $p^2 + q^2 = 1$	2
24	In how many ways can 5 girls and 3 boys be seated in a row so that no two boys are together?	2
25	Using binomial theorem evaluate $(101)^4$	2
	Section – C	
26	Draw the graph of signum function. Hence find its domain and range.	3
27	Complete the following table for the function y = 4 cos x	3
28	Solve the inequalities and represent the solution on number line for real value of x: $-15 < \frac{3(x-2)}{5} \leq 0$	3
29	Find the number of arrangements of the letters of the word SELFIE. In how many of these arrangements there are exactly 2 letters between 2 E's.	3
30	Find the real numbers x and y if (x – iy) (3 + 5i) is the conjugate of -6 – 24i.	3
31	Evaluate $\sum_{k=1}^{11}(2 + 3^k)$	3
	Section – D	
32	Find the coefficient of x^5 in the product $(x + 3)^5(2 - x)^6$.	5
33	Find the domain of the real function f(x) = $\sqrt{6 - x - x^2}$	5

X	π	$\frac{7\pi}{6}$	$\frac{4\pi}{3}$	$\frac{3\pi}{2}$	$\frac{5\pi}{3}$	$\frac{11\pi}{6}$	2π
Y	-4	?	?	?	?	?	?

34	Prove that cos 2x cos $\frac{x}{2}$ - cos 3x cos $\frac{9x}{2}$ = sin 5x sin $\frac{5x}{2}$ OR If sin x = $\frac{1}{4}$, x lies in second quadrant , then find sin $\frac{x}{2}$, cos $\frac{x}{2}$, tan $\frac{x}{2}$.	5
35	The sum of two numbers is 6 times their geometric mean, show that the numbers are in the ratio (3 + 2 $\sqrt{2}$) : (3 - 2 $\sqrt{2}$)	5
	Section – E	
36	After explaining operations on sets, Mathematics teacher in class wrote three sets as A = {2, 3, 4, 5}, B = {6, 7, 8} and C = {x : x is prime number less than 10}. She asked the students that the following questions will judge how much you have understood. i) A ∪ B ii) C – B iii) (A ∩ C) – B iv) (A ∪ B) ∩ C	4
37	The assembly Incharge of a school wants to generate signals for calling classes for the assembly. He has got 5 coloured flags viz. yellow, red, orange, green and blue to make signals. Based on the above information answer the following questions: i) How many different signals can be generated by using all the 5 flags? ii) To call the middle section for the assembly, he has to generate different signals by using 3 flags only. How many such arrangements are possible? iii) To call the senior section for the assembly, he has to generate different signals by using 4 flags only. How many such arrangements are possible? iv) How many different signals can be generated by him by arranging at least 3 flags at a time?	4
38	In a nuclear fission chain reaction, a free neutron interacts with the nucleus of an atom and causes that nucleus to split apart into two new, less massive nuclei. The nuclei in turn repeat the process and split into four new nuclei and the process goes on. The picture given below shows the process till 4th generation.  On the basis of above case, answer the following questions. i) Write the number of nuclei formed starting from Ist generation to fourth generation. Identify the sequence so formed. ii) Write the number of nuclei formed in the 10th generation. iii) Find the total number of nuclei formed till 7th generation?	4

Half Yearly Exam 2024-25
Subject → Core Maths
Class - XI
Marking Scheme / Hints to Soln

Set - A

Note :- Any other relevant answer not given here in but given by the Students is suitably awarded.

Q.No	Value Points / Key Points	Value Point	Total Point
1	a) 6		1
2	d) {7, 8}		1
3	b) {0, 1, 2, 3, 4}		1
4	c) 20		1
5	a) $R - \{2, 6\}$		1
6	d) $\frac{1}{2}$		1
7	b) $\frac{1}{\sqrt{3}}$		1
8	b) $(-\infty, 2)$		1
9	c) 12		1
10	d) $(-\infty, -1]$		1
11	c) 21		1
12	c) 4^n		1
13	d) $5(1+i)$		1
14	a) 0		1
15	c) 48		1
16	a) 3/2		1
17	c) 161		1
18	c) N		1
19	d) A is false and R is true		1
20	a) Both A and R are true and R is the correct explanation of A.		1

Section B

(21) $U = \{1, 2, 3, \ldots 20\}$
$A = \{1, 2, \ldots 15\}$
$B = \{1, 3, 5, 7, 9\}$
$A' - B' = \{16, 17, 18, 19, 20\} - \{2, 4, 6, 8, 10, 11, 12, \ldots 20\}$
$= \phi$ — $\frac{1}{2}$ each — 2

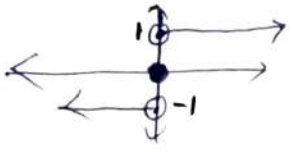
(22) $R = \{(2, 0), (2, 3), (3, 2), (5, 4), (7, -1)\}$
No, given relation is not a function because the element 2 of X has two images in Y. — 1+1 — 2

(23) $2p + iq = \frac{a+ib}{a-ib}$ — (1)
Take conjugate both sides
$2p - iq = \frac{a-ib}{a+ib}$ — (2) $\left[\because \overline{\left(\frac{z_1}{z_2}\right)} = \frac{\overline{z_1}}{\overline{z_2}}\right)$. — 1
Multiply (1) and (2)
$(2p)^2 + (q)^2 = \frac{a+ib}{a-ib} \times \frac{a-ib}{a+ib}$ — 1 — 2
$4p^2 + q^2 = 1$
Hence Proved

(24) $-G_1 - G_2 - G_3 - G_4 - G_5 -$
No. of ways $= {}^6P_3 \times 5!$ — 1
$= \frac{6!}{3!} \times 5! = 6 \times 5 \times 4 \times 120$ — 1 — 2
$= 14400$

(25) $(101)^4 = (100+1)^4$
$= {}^4C_0 (100)^4 + {}^4C_1 (100)^3 + {}^4C_2 (100)^2 +$ — $\frac{1}{2}$
${}^4C_3 (100) + {}^4C_4$
$= 100000000 + 4 \times 1000000 + 6 \times 10000$ — $1\frac{1}{2}$ — 2
$+ 400 + 1$
$= 104060401$

(26) Signum function: Domain $= R$
Range $= \{-1, 0, 1\}$ — $1\frac{1}{2} + 1\frac{1}{2}$ — 3



(27) $y = \cos x$

x	π	$\pi/6$	$4\pi/3$	$3\pi/2$	$5\pi/3$	$11\pi/6$	2π
y	-4	$-2\sqrt{3}$	-2	0	2	$2\sqrt{3}$	4

$\frac{1}{2}$ each 3

(28)
$$-15 < \frac{3(x-2)}{5} \leq 0$$
$$-75 < 3x - 6 \leq 0$$
$$-75+6 < 3x - 6 + 6 \leq 6$$
$$-69 < 3x \leq 6$$
$$-\frac{69}{3} < x \leq \frac{6}{3}$$
$$-23 < x \leq 2$$
$$\Rightarrow x \in (-23, 2]$$

$\frac{1}{2}$

$1\frac{1}{2}$ 3

1

(29) SELFIE

No. of words from selfie $= \frac{6!}{2!} = \frac{6\times5\times4\times3\times2\times1}{2}$
$= 360$

1

When 2 letters between 2 E's

E _ _ E _ _ No. of cases → 3

No. of ways $= 3 \times 4! = 72$

2 3

(30) $(x - iy)(3 + 5i) = -6 - 24i = -6 + 24i$

$\frac{1}{2}$

$5(3x + 5y = -6)$ | $3(-3y + 5x = 24)$

$15x + 25y = -30$
$15x - 9y = 72$
$34y = -102$
$y = \frac{-102}{34} = -3$

$2\frac{1}{2}$ 3

$\boxed{y = -3} \Rightarrow \boxed{x = 3}$

(31) $\sum_{k=1}^{11} 2 + 3^k = (2 + 3^1) + (2 + 3^2) + \cdots + (2 + 3^{11})$

$\frac{1}{2}$

$= 2 \times 11 + (3^1 + 3^2 + \cdots + 3^{11})$
$= 22 + \frac{3(3^{11} - 1)}{3 - 1}$
$= 22 + \frac{3}{2}(3^{11} - 1)$

$1\frac{1}{2}$ 3

(32) $(x+3)^5(2-x)^6$

$= \{{}^5C_0 x^5 + {}^5C_1 x^4(3) + {}^5C_2 x^3(3)^2 + {}^5C_3 x^2(3)^3 +$
$ {}^5C_4 x(3)^4 + {}^5C_5(3)^5\}$ 1

$\{{}^6C_0 2^6 + {}^6C_1 2^5(-x) + {}^6C_2 2^4(-x)^2 + {}^6C_3 2^3(-x)^3$
$ + {}^6C_4 (2)^2(-x)^4 + {}^6C_5(2)(-x)^5 + {}^6C_6(-x)^6\}$ 1

$= (x^5 + 15x^4 + 90x^3 + 270x^2 + 405x + 243)$ 1
$(64 - 192x + 240x^2 - 160x^3 + 60x^4 - 12x^5 + x^6)$ 1

coeff of $x^5 = (64 - 15\times192 + 90\times240 - 270\times160$
$ + 405\times60 - 243\times12)$ 1 5

$= -3032$

(33) $f(x) = \sqrt{6-x-x^2}$ 5

Same as done in Set-B

(34) LHS $\frac{1}{2}\{2\cos 2x \cos\frac{x}{2} - 2\cos 3x \cos\frac{9x}{2}\}$ $\frac{1}{2}$

$= \frac{1}{2}\left[\cos\left(2x+\frac{x}{2}\right) + \cos\left(2x-\frac{x}{2}\right) - \cos\left(3x+\frac{9x}{2}\right)\right.$ 1
$\left. - \cos\left(3x-\frac{9x}{2}\right)\right]$

$= \frac{1}{2}\left[\cos\frac{5x}{2} + \cos\frac{3x}{2} - \cos\frac{15x}{2} - \cos\frac{3x}{2}\right]$ $\frac{1}{2}$

$= \frac{1}{2}\left[\cos\frac{5x}{2} - \cos\frac{15x}{2}\right]$ $\frac{1}{2}$

$= \frac{1}{2}\left[-2\sin\left(\frac{\frac{5x}{2}+\frac{15x}{2}}{2}\right)\cdot\sin\left(\frac{\frac{5x}{2}-\frac{15x}{2}}{2}\right)\right]$ 1 5

$= -\sin\frac{20x}{4}\cdot\sin\left(\frac{-10x}{4}\right)$ 1

$= \sin 5x \sin\frac{5x}{2} = RHS$ $\frac{1}{2}$

or Part → Same as done in Set B

(35) $a + b = 6\sqrt{ab}$ $\frac{1}{2}$

$\frac{a+b}{2\sqrt{ab}} = \frac{3}{1}$

Apply C and D rule 1

$\frac{a+b+2\sqrt{ab}}{a+b-2\sqrt{ab}} = \frac{3+1}{3-1}$

$\frac{(\sqrt{a}+\sqrt{b})^2}{(\sqrt{a}-\sqrt{b})^2} = \frac{4}{2} = 2$ 1

$\frac{\sqrt{a}+\sqrt{b}}{\sqrt{a}-\sqrt{b}} = \frac{\sqrt{2}}{1}$

Again apply C & D rule

$\frac{\sqrt{a}+\sqrt{b}+\sqrt{a}-\sqrt{b}}{\sqrt{a}+\sqrt{b}-\sqrt{a}+\sqrt{b}} = \frac{\sqrt{2}+1}{\sqrt{2}-1}$ 1

$\frac{2\sqrt{a}}{2\sqrt{b}} = \frac{\sqrt{2}+1}{\sqrt{2}-1}$

Squaring both sides 1

$\frac{a}{b} = \frac{2+1+2\sqrt{2}}{2+1-2\sqrt{2}}$

$\boxed{\frac{a}{b} = \frac{3+2\sqrt{2}}{3-2\sqrt{2}}}$ Hence Proved $\frac{1}{2}$

Section - E

Q 36 Same as set B (Q37)

Q37 " " (Q36)

Q38 " " (Q38)

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General Instructions:-

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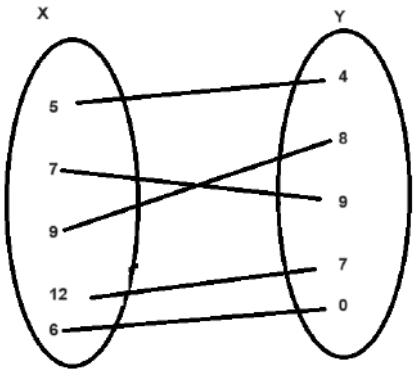
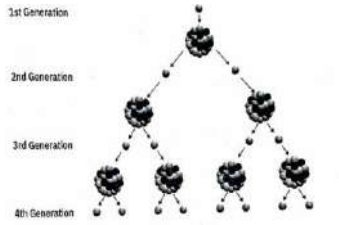
2 **This question paper has 5 Sections. Section A has 20 questions of 1 mark each which includes 18 M.C.Q.'s and 2 Assertion Reasons Section B has 5 Questions of 2 marks each. Section C has 6 questions of 3 marks each. Section D has 4 questions of 5 mark each and Section E has 3 case study based question of 4 marks each.**

Q.N.	Questions	Marks
1	The solution of the inequality : $-2x \geq -2$, for $x \in N$ is [1, ∞) b) (1, ∞) c) N d) {1}	1
2	The number of non empty subsets of the given set A = {1, {2}, 3, 4, {7, 8}, 9}are a) 2^6 b) 2^7 c) $2^6 - 1$ d) $2^7 - 1$	1
3	If R = {(x, y) : x, y ∈ W, 2x + y = 8}, then domain of R is a) {0, 1, 2, 3, 4, 5} c) {0, 1, 2, 3, 4, 5, 6} b) {0, 1, 2, 3, 4} d) {0, 1, 2, 3}	1
4	The value of [-8.9] - [24.4] is (where [ ] stands for greatest integer function) a) -32 b) -33 c) 20 d) 37	1
5	The domain of the function f(x) = $\frac{x^2-8x+12}{x^2+2x+1}$ is a) R – {2, 6} b) R – { 1} c) R – { -1} d) R – {0}	1
6	$\sum_{k=0}^{n} C(n,k)\, 6^k$ is equal to a) 7^{2n} b) 6^n c) 7^n d) 6^{2n}	1
7	The radian measure of $40°20'$ is a) $\frac{121\pi}{540}$ b) $\frac{101\pi}{540}$ c) $\frac{57\pi}{540}$ d) $\frac{71\pi}{540}$	1
8	Given x is a real number satisfying $(x + \frac{x}{2} + \frac{x}{3}) \leq 11$, x belongs to a) (-∞, 6) b) (-∞, 6] c) (-6, ∞) d) (6, ∞)	1
9	The minimum value of $7^{2(1-x)} + 49^x$ is a) 14 b) $\frac{2}{7}$ c) 7 d) 49	1
10	If x is a real number satisfying (3x – 7) > (5x – 1) , then the range of x is : a) [3, ∞) b) [-3, ∞) c) (-∞, -3) d) (-∞, -3]	1

11	The total number of terms in the expansion of $(x+6)^{20} + (x-6)^{20}$ are a) 11 b) 41 c) 21 d) 20	1
12	The greatest value of (sin x cos x) is a) 1 b) 2 c) $\sqrt{2}$ d) $\frac{1}{2}$	1
13	If two complex numbers z_1, z_2 are represented by the points (-3, 4) and (2, -1) in the Argand plane, then $\overline{z_1 - z_2}$ is a) -1 – 5i b) -5(1 + i) c) -1 + 5i d) 5(1 + i)	1
14	$i^{35} + i^{46} + i^{24} + i^{44}$ is equal to a) 0 b) 1 + i c) 2i d) 1 - i	1
15	Number of 5 - digit odd numbers that can be formed using the digits 1, 3, 4, 7, 8 if repetition of digit is not allowed, is a) 72 b) 60 c) 48 d) 24	1
16	If 3 X $3^{\frac{1}{5}}$ X $3^{\frac{1}{25}}$ X $3^{\frac{1}{125}}$ $- - - - - - - \infty = 3^m$, then m is equal to a) $\frac{4}{5}$ b) $\frac{5}{4}$ c) $\frac{5}{2}$ d) 1	1
17	A group consists of 4 girls and 7 boys then in how many ways a team of 5 members be selected if the team has atleast 3 girl a)121 b) 141 c) 161 d) 91	1
18	If U = {1, 2, 3, 4, ……., 50}; P = {x: x is divisible by 2 and 5} and Q = {x: x = n^2, n ∈ N} then n(Q) – n(P) is a) 4 b) 3 c) 2 d) 1	1
	Assertion Reason Based Questions: **Choose according to these options in Q 19 and 20** **a) Both A and R are true and R is the correct explanation of A.** **b) Both A and R are true and R is not the correct explanation of A.** **c) A is true and R is false.** **d) A is false and R is true.**	
19	**Assertion(A) :** C(10, 6) : P(10, 4) = 1:12 **Reason (R) :** C(n, r) = C(n, n – r) , $0 \le r \le n$	1
20	**Assertion(A)** : Let A = { 1, 2, 6} and B = { 3, 4} then number of relations from A to B are 16 **Reason (R)**: If n(A) = p and n(B) = q then number of relations from A to B are 2^{pq}	1

	Section – B	
21	If x + iy = $\frac{a+ib}{a-ib}$ then show that $x^2 + y^2 = 1$	2
22	The figure shows a relation from a set X to a set Y.  Write the above relation in Roster form. Is the above relation a function? Give reason in support of your answer.	2
23	If U = {x: x ∈ N and 1 ≤ x≤ 20} A = {x: x ∈ N and 1 ≤ x≤ 15} B = {x: x ∈ N and x = 2n – 1, n ≤ 5} Find the value of $B' - A'$	2
24	In how many ways can 6 boys and 4 girls be seated in a row so that no two girls are together?	2
25	Using binomial theorem evaluate $(99)^4$	2
	Section – C	
26	Draw the graph of Greatest Integer function. Hence find its domain and range.	3
27	Complete the following table for the function y = 4 sin x X: π, $\frac{7\pi}{6}$, $\frac{4\pi}{3}$, $\frac{3\pi}{2}$, $\frac{5\pi}{3}$, $\frac{11\pi}{6}$, 2π Y: 0, ?, ?, ?, ?, ?, ?	3
28	Solve the inequalities and represent the solution on number line for real value of x: $-12 < 4 - \frac{3x}{-5} \leq 2$	3
29	In how many of the distinct permutations of the letters in TELANGANA do the three A's not come together ?	3
30	Find the conjugate of $\frac{1+i}{1-i} - \frac{1-i}{1+i}$	3
31	Find the sum of the sequence 7 + 77 + 777 + 7777 + ……. to n terms.	3

	Section – D	
32	Find the domain and range of the real function f(x) = $\sqrt{6 - x - x^2}$	5
33	Find the coefficient of x^5 in the product $(x - 3)^5(2 + x)^6$.	5
34	Prove that $cos^2x + cos^2(x + \frac{\pi}{3}) + cos^2(x - \frac{\pi}{3}) = \frac{3}{2}$ OR If sin x = $\frac{1}{4}$, x lies in second quadrant , then find sin $\frac{x}{2}$, cos $\frac{x}{2}$, tan $\frac{x}{2}$.	5
35	Find the value of n so that $\frac{a^{n+1} + b^{n+1}}{a^n + b^n}$ may be the geometric mean between a and b.	5
	Section – E	
36	The assembly Incharge of a school wants to generate signals for calling classes for the assembly. He has got 5 coloured flags viz. yellow, red, orange, green and blue to make signals. Based on the above information answer the following questions: i) How many different signals can be generated by using all the 5 flags? ii) To call the middle section for the assembly, he has to generate different signals by using 3 flags only. How many such arrangements are possible? iii) To call the senior section for the assembly, he has to generate different signals by using 4 flags only. How many such arrangements are possible? iv) How many different signals can be generated by him by arranging at least 3 flags at a time?	4
37	After explaining operations on sets, Mathematics teacher in class wrote three sets as A = {2, 3, 4, 5}, B = {6, 7, 8} and C = {x : x is prime number less than 10}. She asked the students that the following questions will judge how much you have understood. i) A ∪ B ii) C – B iii) (A ∩ C) – B iv) (A ∪ B) ∩ C	4
38	In a nuclear fission chain reaction, a free neutron interacts with the nucleus of an atom and causes that nucleus to split apart into two new, less massive nuclei. The nuclei in turn repeat the process and split into four new nuclei and the process goes on. The picture given below shows the process till 4th generation.  On the basis of above case, answer the following questions. i) Write the number of nuclei formed starting from Ist generation to fourth generation. Identify the sequence so formed. ii) Write the number of nuclei formed in the 10th generation. iii) Find the total number of nuclei formed till 7th generation?	4

Half Yearly Exams 2024-25

Class - XI

Set B

Subject - Core Maths

Marking Scheme / Hints to Solution

Note:- Any other relevant answer not given here in but given by the students are suitably awarded.

Q.No.	Value Points / Key Points	Value Point	Total Points
1	d) $\{13$		1
2	c) $2^6 - 1$		1
3	b) $\{0, 1, 2, 3, 4\}$		1
4	b) -33		1
5	b) $R - \{13$		1
6	c) 7^n		1
7	a) $\frac{121}{540}\pi$		1
8	b) $(-\infty, 6]$		1
9	a) 14		1
10	c) $(-\infty, -3)$		1
11	a) 11		1
12	d) 1/2		1
13	b) $-5(1+i)$		1
14	d) $1-i$		1
15	a) 72		1
16	b) 5/4		1
17	d) 91		1
18	c) 2		1
19	d) A is false and R is true.		1
20	d) A is false and R is true.		1

Section-B

(21) $x+iy = \frac{a+ib}{a-ib}$ — (1)

Take conjugate both sides

$x-iy = \frac{a-ib}{a+ib}$ — (2) $\left(\because \overline{\left(\frac{z_1}{z_2}\right)} = \frac{\overline{z_1}}{\overline{z_2}}\right)$ 1

Multiply (1) and (2)

$(x+iy)(x-iy) = \frac{(a+ib)(a-ib)}{(a-ib)(a+ib)}$ 1 2

$x^2+y^2 = 1$

Hence Proved

(22) $R = \{(5,4), (7,9), (9,8), (12,7), (6,0)\}$. 1

Yes, given relation is function because every element in X has unique image in Y. 1 2

(23) $U = \{1,2,3, \_\_\_ 20\}$

$A = \{1,2,3, \_\_ 15\}$

$B = \{1,3,5,7,9\}$

$B' = \{2,4,6,8,10,11,12, \_\_20\}$ $\frac{1}{2}$ each 2

$A' = \{16,17,18,19,20\}$

$B'-A' = \{2,4,6,8,10,11,12,13,14,15\}$

(24) $\_B_1\_ \ B_2\_ \ B_3\_ \ B_4\_ \ B_5\_ \ B_6\_$

No. of ways $= {}^7P_4 \times 6! = \frac{7!}{3!} \times 6!$ 1

$= \frac{7\times6\times5\times4\times3!\times6\times5\times4\times3\times2}{3!}$

$= 54\times20\times6\times120$

$= 7776\times100$ 1 2

$= 777600$

(25) $(99)^4 = (100-1)^4$

$= {}^4C_0(100)^4 + {}^4C_1(100)^3(-1) + {}^4C_2(100)^2(-1)^2 +$ $\frac{1}{2}$

$ {}^4C_3\,100(-1)^3 + {}^4C_4(-1)^4$

$= 100000000 + 4\times1000000(-1) + 6\times10000 +$

$4\times100\times(-1) + 1$

$= 100000000 - 4000000 + 60000 - 400 + 1$ $1\frac{1}{2}$ 2

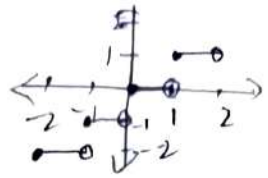
$= 96059601$

Section - C

26) Greatest integer function

Domain = $\mathbb{R}$

Range = $\mathbb{Z}$



$1\frac{1}{2} + 1\frac{1}{2}$ 3

27)

X	π	$\frac{7\pi}{6}$	$\frac{4\pi}{3}$	$\frac{3\pi}{2}$	$\frac{5\pi}{3}$	$\frac{11\pi}{6}$	2π
Y	0	-2	$-2\sqrt{3}$	-4	$-2\sqrt{3}$	-2	0

$\frac{1}{2}$ each 3

28)

$$-12 < 4 - \frac{3x}{5} \leq 2$$

$$-12-4 < 4-4+\frac{3x}{5} \leq 2-4$$

$$-16 < \frac{3x}{5} \leq -2$$

$$-80 < 3x \leq -10 \qquad 1\frac{1}{2}$$

$$-\frac{80}{3} < x \leq -\frac{10}{3}$$

$$\Rightarrow x \in \left(-\frac{80}{3}, -\frac{10}{3}\right] \qquad \frac{1}{2}$$

1 3

29)

TELANGANA

No. of words formed when 3 A's come together

$$\text{TELNGN}\boxed{\text{AAA}} = \frac{7! \times 3!}{2!\,3!}$$

$$= \frac{7!}{2!} \qquad 1$$

Total no. of words formed using all letters

$$= \frac{9!}{3!\,2!} \qquad 1$$

So, No. of words formed when 3 A's are not together $= \frac{9!}{3!2!} - \frac{7!}{2!}$ 1 3

$$= \frac{7!}{2!}\left[\frac{9\times8\times4}{3\times2} - 1\right]$$

$$= 7\times6\times5\times4\times3\times11$$

$$= 27,720$$

(30) $\frac{1+i}{1-i} - \frac{1-i}{1+i}$

$= \frac{(1+i)^2 - (1-i)^2}{(1-i)(1+i)} = \frac{1+i^2+2i - 1 - i^2 + 2i}{1+1}$

$= \frac{4i}{2} = 2i$ $2\frac{1}{2}$

Conjugate of $2i = -2i$ $\frac{1}{2}$ 3

(31) $7 + 77 + 777 + \text{---} + n \text{ terms}$

$= 7(1 + 11 + 111 + \text{---} + n \text{ terms})$

$= \frac{7}{9} \times (9 + 99 + 999 + \text{---} + n \text{ terms})$

$= \frac{7}{9}[(10-1) + (100-1) + \text{---}]$

$= \frac{7}{9}[(10 + 10^2 + 10^3 + \text{---} \; n \text{ terms}) - n]$

$= \frac{7}{9}\left[10\left(\frac{10^n - 1}{10-1}\right) - n\right]$

$= \frac{7}{9}\left[\frac{10}{9}(10^n - 1) - n\right]$ $\frac{1}{2}$ each 3

Section-D

(32) $f(x) = \sqrt{6 - x - x^2}$

For $f(x)$ to exist on real line

$6 - x - x^2 \geq 0$

$\Rightarrow -(x^2 + x - 6) \geq 0$

$\Rightarrow x^2 + x - 6 \leq 0$

$\Rightarrow x^2 + 3x - 2x - 6 \leq 0$

$\Rightarrow (x+3)(x-2) \leq 0$ $1\frac{1}{2}$

$x+3 \geq 0$ and $x-2 \leq 0$ | or | $x+3 \leq 0$ and $x-2 \geq 0$

$\Rightarrow x \geq -3$ and $x \leq 2$ | | $x \leq -3$ and $x \geq 2$

$\Rightarrow x \in [-3, 2]$

$\Rightarrow x \in \phi$

No soln

$1\frac{1}{2} + 1\frac{1}{2}$

$\Rightarrow x \in [-3, 2] \cup \phi$

$x \in [-3, 2]$ So, Domain $= [-3, 2]$ $\frac{1}{2}$ 5

(33) $(x-3)^5(2+x)^6$

$= [{}^5C_0 x^5 + {}^5C_1 x^4(-3) + {}^5C_2 x^3(-3)^2 + {}^5C_3 x^2(-3)^3 + {}^5C_4 x(-3)^4 + {}^5C_5(-3)^5]$ 1

$[{}^6C_0(2)^6 + {}^6C_1(2)^5 x + {}^6C_2(2)^4 x^2 + {}^6C_3(2)^3 x^3 + {}^6C_4(2)^2 x^4 + {}^6C_5(2)x^5 + {}^6C_6 x^6]$ 1

$= [x^5 - 15x^4 + 90x^3 - 270x^2 + 405x - 243]$

$[64 + 192x + 240x^2 + 160x^3 + 60x^4 + 12x^5 + x^6]$ 1

Now we have to find the coefficients of x^5

So, coefficients of x^5 are $\rightarrow x^5[64 - 15\times192 + 90\times240 - 270\times160 + 405\times60 - 243\times12]$ 1

$= 64 - 2880 + 21600 - 43200 + 24300 - 2916$ 5

$= 45964 - 48996$ 1

$= -3032$

(34) LHS $\cos^2 x + \cos^2\left(x+\frac{\pi}{3}\right) + \cos^2\left(x-\frac{\pi}{3}\right)$

$= \frac{1+\cos 2x}{2} + \frac{1+\cos 2\left(x+\frac{\pi}{3}\right)}{2} + \frac{1+\cos 2\left(x-\frac{\pi}{3}\right)}{2}$ 1

$= \frac{3}{2} + \cos 2x + \cos\left(2x+\frac{2\pi}{3}\right) + \cos\left(2x-\frac{2\pi}{3}\right)$

$= \frac{3}{2} + \cos 2x + 2\cos\left(\frac{2x+\frac{2\pi}{3}+2x-\frac{2\pi}{3}}{2}\right)\cdot\cos\left(\frac{2x+\frac{2\pi}{3}-2x+\frac{2\pi}{3}}{2}\right)$ 1

$= \frac{3}{2} + \cos 2x + 2\cos 2x\cdot\cos\frac{2\pi}{3}$ 1

$= \frac{3}{2} + \cos 2x + 2\cos 2x\cdot\cos\left(\pi-\frac{\pi}{3}\right)$ 1

$= \frac{3}{2} + \cos 2x + 2\cos 2x\left(-\cos\frac{\pi}{3}\right)$ 1

$= \frac{3}{2} + \cos 2x + 2\cos 2x\times\left(-\frac{1}{2}\right)$ 1 5

$= \frac{3}{2} + \cos 2x - \cos 2x = \frac{3}{2} = RHS$

OR

(24) $\sin x = \frac{1}{4}$, x lies in II nd quadrant

$90^\circ \le x \le 180^\circ$

$\frac{90^\circ}{2} \le \frac{x}{2} \le \frac{180^\circ}{2}$

$45^\circ \le \frac{x}{2} \le 90^\circ$

$\Rightarrow \frac{x}{2}$ lies in Ist quadrant (★)

$\Rightarrow$ All $\sin\frac{x}{2}$, $\cos\frac{x}{2}$ and $\tan\frac{x}{2}$ are (+ve) 1

$\cos^2 x = 1 - \sin^2 x$

$= 1 - \frac{1}{16}$

$= \frac{15}{16}$

$\cos x = \pm\sqrt{\frac{15}{16}}$

$= \pm\frac{\sqrt{15}}{4}$

$\Rightarrow \boxed{\cos x = -\frac{\sqrt{15}}{4}}$ → (as x lies in II nd quadrant) 1

Now We know $\cos^2\frac{x}{2} = \frac{1+\cos x}{2}$

$= \frac{1 - \frac{\sqrt{15}}{4}}{2}$

$\cos^2\frac{x}{2} = \frac{4-\sqrt{15}}{8}$

$\Rightarrow \cos\frac{x}{2} = \pm\sqrt{\frac{4-\sqrt{15}}{8}}$

$\Rightarrow \cos\frac{x}{2} = \pm\frac{\sqrt{4-\sqrt{15}}}{2\sqrt{2}}$

$\Rightarrow \cos\frac{x}{2} = \frac{\sqrt{4-\sqrt{15}}}{2\sqrt{2}}$ (Using ★) 1

Now $\sin^2\frac{x}{2} = \frac{1-\cos x}{2}$

$= \frac{1 + \frac{\sqrt{15}}{4}}{2} = \frac{4+\sqrt{15}}{8}$

$\Rightarrow \sin^2\frac{x}{2} = \pm\sqrt{\frac{4+15}{8}}$

$= \pm\frac{\sqrt{4+\sqrt{15}}}{2\sqrt{2}}$

$\Rightarrow \sin\frac{x}{2} = \frac{\sqrt{4+\sqrt{15}}}{2\sqrt{2}}$ (Using ★) 1

$$\tan\frac{\pi}{2} = \frac{\sin\frac{\pi}{2}}{\cos\frac{\pi}{2}} = \frac{\frac{\sqrt{4+\sqrt{15}}}{2\sqrt{2}}}{\frac{\sqrt{4-\sqrt{15}}}{2\sqrt{2}}} = \frac{\sqrt{4+\sqrt{15}}}{\sqrt{4-\sqrt{15}}}$$

$$\tan\frac{\pi}{2} = \frac{\sqrt{4+\sqrt{15}}}{\sqrt{4-\sqrt{15}}} \times \frac{\sqrt{4+\sqrt{15}}}{\sqrt{4+\sqrt{15}}}$$

$$= \frac{\sqrt{(4+\sqrt{15})(4+\sqrt{15})}}{\sqrt{(4-\sqrt{15})(4+\sqrt{15})}}$$

$$= \frac{4+\sqrt{15}}{\sqrt{16-15}} = 4+\sqrt{15}$$ 1

$$\Rightarrow \tan\frac{\pi}{2} = 4+\sqrt{15}$$

(35) $\frac{a^{n+1}+b^{n+1}}{a^n+b^n} = \sqrt{ab}$ $\frac{1}{2}$

$$a^{n+1}+b^{n+1} = (ab)^{\frac{1}{2}}(a^n+b^n)$$ $\frac{1}{2}$

$$a^{n+1}+b^{n+1} = a^{n+\frac{1}{2}}b^{\frac{1}{2}} + a^{\frac{1}{2}}b^{n+\frac{1}{2}}$$

$$\Rightarrow a^{n+1} - a^{n+\frac{1}{2}}b^{\frac{1}{2}} + b^{n+1} - a^{\frac{1}{2}}b^{n+\frac{1}{2}} = 0$$ 1

$$\Rightarrow a^{n+\frac{1}{2}}\left[a^{\frac{1}{2}} - b^{\frac{1}{2}}\right] + b^{n+\frac{1}{2}}\left[b^{\frac{1}{2}} - a^{\frac{1}{2}}\right] = 0$$

$$\Rightarrow \left[a^{\frac{1}{2}} - b^{\frac{1}{2}}\right]\left[a^{n+\frac{1}{2}} - b^{n+\frac{1}{2}}\right] = 0$$ 1

$\Rightarrow$ either $a^{\frac{1}{2}} - b^{\frac{1}{2}} = 0$ or $a^{n+\frac{1}{2}} - b^{n+\frac{1}{2}} = 0$

$\Rightarrow$ $a = b$ not possible

$$a^{n+\frac{1}{2}} = b^{n+\frac{1}{2}}$$ 1

$$\left(\frac{a}{b}\right)^{n+\frac{1}{2}} = 1 = \left(\frac{a}{b}\right)^0$$

$$\Rightarrow n+\frac{1}{2} = 0$$

$$\Rightarrow \boxed{n = -\frac{1}{2}}$$ Ans

(36) i) No. of signals using all 5 flags $= {}^5P_5 = 5! = 120$ | 1

ii) No. of signals using 3 flags $= {}^5P_3 = 5 \times 4 \times 3 = 60$ | 1

iii) No. of signals using 4 flags $= {}^5P_4 = 5 \times 4 \times 3 \times 2 = 120$ | 1

iv) No. of signals using at least 3 flags $= 3f + 4f + 5f$ | 1 | 4
$= 60 + 120 + 120$
$= 300$

(37) $A = \{2, 3, 4, 5\}$, $B = \{6, 7, 8\}$, $C = \{2, 3, 5, 7\}$

i) $A \cup B = \{2, 3, 4, 5, 6, 7, 8\}$ | 1

ii) $C - B = \{2, 3, 5\}$ | 1

iii) $(A \cap C) - B = \{2, 3, 5\} - \{6, 7, 8\} = \{2, 3, 5\}$ | 1 | 4

iv) $(A \cup B) \cap C = \{2, 3, 5, 7\}$ | 1

(38) 1, 2, 4, 8, 16, ...

(i) No. of nuclei formed from 1st generation to fourth generation are S_4
This seq is G.P. with $a = 2$, $a = 1$
$S_4 = \frac{1(2^4 - 1)}{2 - 1} = 16 - 1 = 15$ | 2

ii) $a_{10} = ar^9 = 2^9 = 512$ | 1

iii) $S_7 = \frac{1(2^7 - 1)}{2 - 1} = 128 - 1 = 127$ | 1