NDA/NA

23 PREVIOUS YEARS' SOLVED PAPERS

(2014 to Sept 2025)

CHAPTERWISE AND TOPICWISE

MATHEMATICS
GENERAL ABILITY

Latest
September 2025 (NDA-II) Paper

Trend Analysis
of Last 5 Years Papers

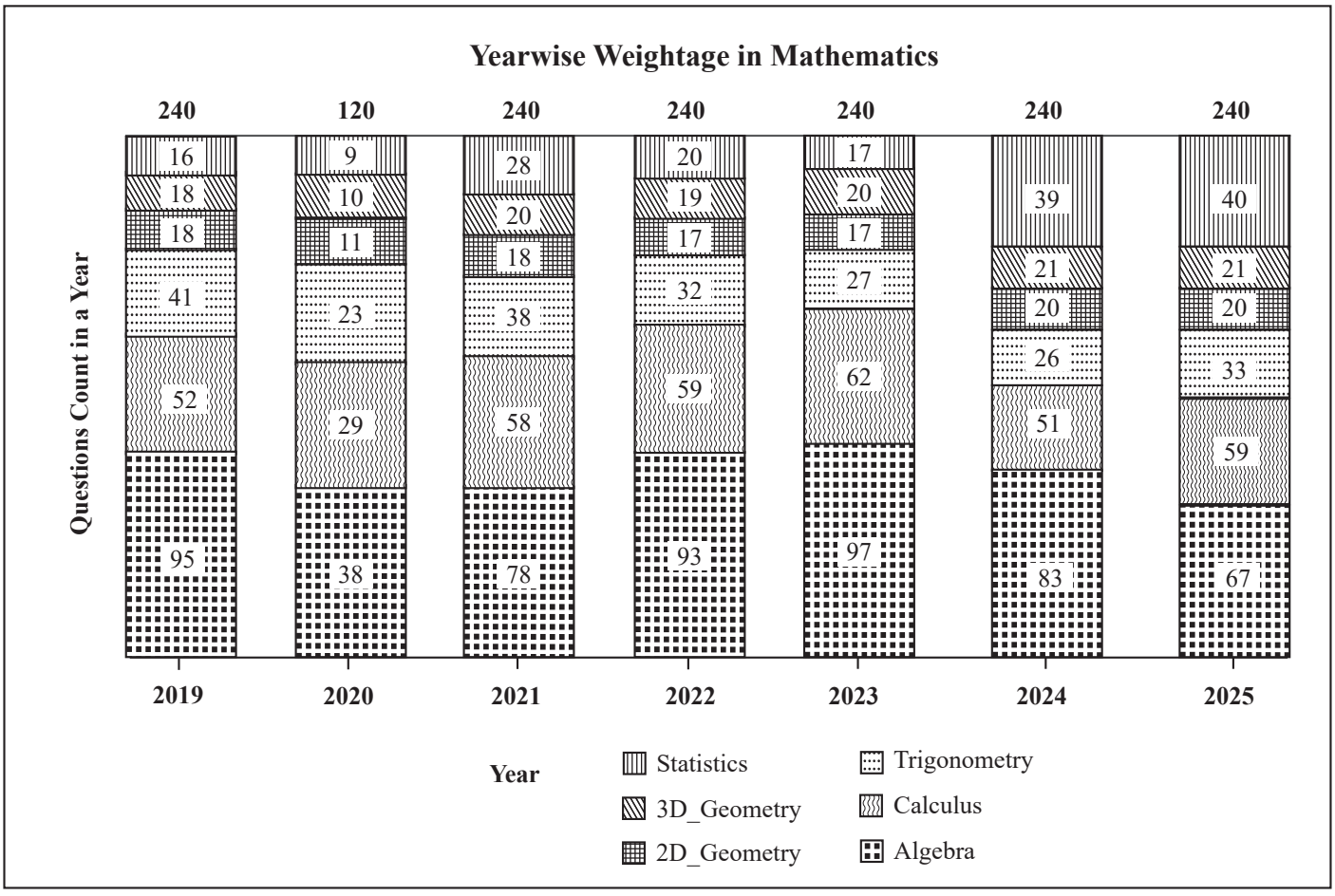
Detailed Solutions
with 100% Accuracy

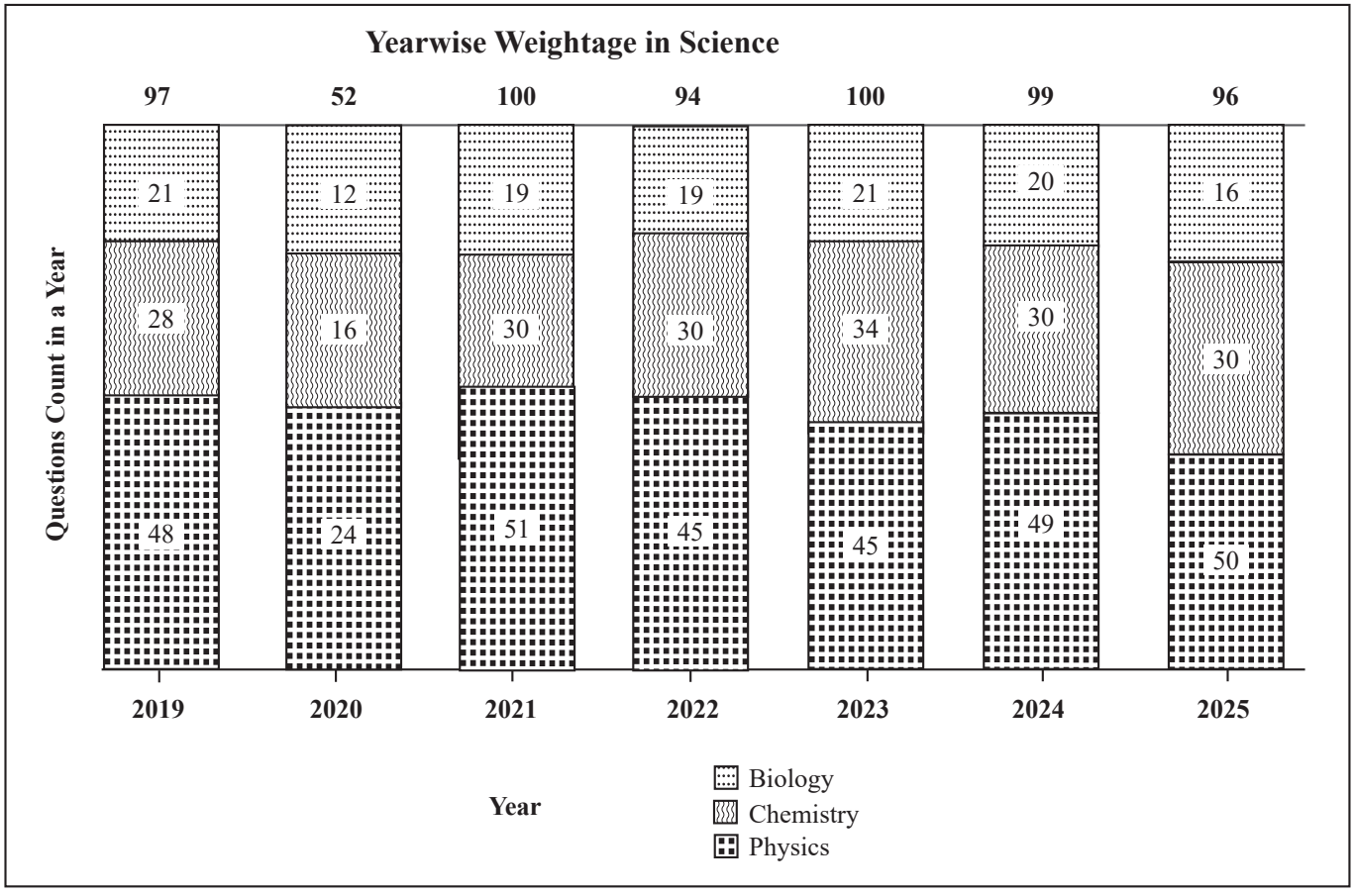
7520+
Previous Years' Questions

NDA Past 5 Years Paper Analysis

MATHEMATICS

		2021-I	2021-II	2022-I	2022-II	2023-I	2023-II	2024-I	2024-II	2025-I	2025-II
1.	Basic Maths	0	0	1	0	3	0	0	5	0	0
2.	Logarithm	1	1	0	1	0	0	3	2	0	2
3.	Sets	1	1	4	8	0	1	1	3	0	3
4.	Quadratic Equations	4	4	4	2	5	4	3	7	2	6
5.	Trigonometric Functions	13	13	10	9	6	8	9	7	11	9
6.	Properties of Triangle	2	2	1	4	6	2	3	3	5	0
7.	Height and Distance	2	2	2	3	2	0	0	0	3	0
8.	Binomial Theorem	3	3	2	3	3	4	4	1	3	2
9.	Sequence and Series	6	6	5	3	5	6	2	5	4	6
10.	Permutations and Combinations	4	4	8	7	9	2	6	4	6	5
11.	Complex Number	5	5	2	3	4	6	5	6	3	3
12.	Basics of Coordinate Geometry	1	1	1	0	0	0	1	4	2	1
13.	Straight Lines	5	5	6	2	2	5	6	1	3	6
14.	Circles	1	1	1	2	0	2	3	1	2	1
15.	Parabola and Ellipse	1	1	2	3	2	5	2	2	2	1
16.	Hyperbola and Rectangular Hyperbola	1	1	0	0	0	1	0	0	1	1
17.	Relation and Function	5	5	5	8	6	11	7	9	7	6
18.	Inverse Trigonometric Functions	2	2	2	1	0	3	2	2	3	2
19.	Matrices	2	2	5	3	3	4	2	6	5	3
20.	Determinants	8	8	5	6	9	7	8	1	6	6
21.	Methods of Differentiation	3	3	4	5	5	2	1	0	4	4
22.	Limits	2	2	2	4	4	5	1	1	5	3
23.	Continuity and Differentiability	3	3	2	0	2	4	2	4	2	2
24.	Application of Derivatives	5	5	4	4	3	3	4	4	4	6
25.	Indefinite Integration	3	3	2	3	0	0	4	3	1	3
26.	Definite Integration	2	2	2	3	5	3	7	4	2	2
27.	Area Under the Curve	1	1	2	3	3	1	1	2	3	2
28.	Differential Equations	5	5	4	2	3	2	4	2	0	3
29.	Vector Algebra	8	8	5	6	6	5	5	5	5	7
30.	3-D Geometry	2	2	5	3	4	5	5	6	5	4
31.	Probability	5	5	7	12	8	14	12	14	11	16
32.	Statistics	14	14	13	7	12	5	7	6	9	4
33.	Binary Numbers	0	0	2	0	0	0	0	0	1	1


Yearwise Weightage in Mathematics
240
120
240
240
240
240
240
16
18
18
41
52
95
9
10
11
23
29
38
28
20
18
38
58
78
20
19
17
32
59
93
17
20
17
27
62
97
39
21
20
26
51
83
40
21
20
33
59
67
Questions Count in a Year
2019
2020
2021
2022
2023
2024
2025
Year
Statistics
3D_Geometry
2D_Geometry
Trigonometry
Calculus
Algebra


Yearwise Weightage in Science
97
52
100
94
100
99
96
21
28
48
12
16
24
19
30
51
19
30
45
21
34
45
20
30
49
16
30
50
Questions Count in a Year
2019
2020
2021
2022
2023
2024
2025
Year
Biology
Chemistry
Physics

Year-wise Seat Availability

Year	National Defence Academy (NDA)		Naval Academy (10 + 2 Cadet Entry Scheme)		Total
	NDA (I)	NDA (II)	NDA (I)	NDA (II)	
2025	370	370	36	36	**812**
2024	370	370	30	34	**804**
2023	370	370	25	25	**790**
2022	370	370	30	30	**800**
2021	370	370	30	43	**813**
2020	370	—	48	—	**418**

Cut Off Trends

Year	Cut Off (Written Exam) (Aggregate marks of last qualified candidate) (Max Marks = 900)		Cut Off (Merit/ Final) (Marks of last recommended candidate) (Out of 1800 Marks) (Written + SSB = 900 + 900)	
	NDA (I)	NDA (II)	NDA (I)	NDA (II)
2024	291	305	654	673
2023	301	292	664	656
2022	360	355	720	720
2021	343	355	709	726
2020	355	—	723	—

CONTENTS

PART-A: MATHEMATICS

PART-B: GENERAL ABILITY

English

Physics

Chemistry

Biology

History

Geography

Political Science & Economics

GK & Current Affairs

1 Logarithm

Introduction to Logarithm and Properties of Logarithm

1. If $\log_{10} 2$, $\log_{10}(2^x - 1)$ and $\log_{10}(2^x + 3)$ are three consecutive terms of an A.P, then the value of x is ***[2015-I]***

(*a*) 1 (*b*) $\log_5 2$ (*c*) $\log_2 5$ (*d*) $\log_{10} 5$

2. If $\log_8 m + \log_8 \frac{1}{6} = \frac{2}{3}$, then m is equal to ***[2015-II]***

(*a*) 24 (*b*) 18 (*c*) 12 (*d*) 4

3. If $\log_a (ab) = x$, then what is $\log_b (ab)$ equal to? ***[2016-I]***

(*a*) $\frac{1}{x}$ (*b*) $\frac{x}{x+1}$ (*c*) $\frac{x}{1-x}$ (*d*) $\frac{x}{x-1}$

4. If $x + \log_{10}(1 + 2^x) = x \log_{10} 5 + \log_{10} 6$ then x is equal to ***[2017-I]***

(*a*) 2, –3 (*b*) 2 only (*c*) 1 (*d*) 3

5. If $n = (2017)!$, then what is ***[2018-I]***

$$\frac{1}{\log_2 n} + \frac{1}{\log_3 n} + \frac{1}{\log_4 n} + \ldots + \frac{1}{\log_{2017} n}$$ equal to?

(*a*) 0 (*b*) 1 (*c*) $\frac{n}{2}$ (*d*) n

6. If $x + \log_{15}(1 + 3^x) = x \log_{15} 5 + \log_{15} 12$, where x is an integer, then what is x equal to? ***[2018-I]***

(*a*) –3 (*b*) 2 (*c*) 1 (*d*) 3

7. What is $\frac{1}{\log_2 N} + \frac{1}{\log_3 N} + \frac{1}{\log_4 N} + \ldots + \frac{1}{\log_{100} N}$ equal to $(N \neq 1)$? ***[2018-I]***

(*a*) $\frac{1}{\log_{100!} N}$ (*b*) $\frac{1}{\log_{99!} N}$

(*c*) $\frac{99}{\log_{100!} N}$ (*d*) $\frac{99}{\log_{99!} N}$

8. If $0 < a < 1$, the value of $\log_{10} a$ is negative. This is justified by ***[2018-I]***

(*a*) Negative power of 10 is less than 1
(*b*) Negative power of 10 is between 0 and 1
(*c*) Negative power of 10 is positive
(*d*) Negative power of 10 is negative

9. What is the value of $\log_7 \log_7 \sqrt{7\sqrt{7\sqrt{7}}}$ equal to? ***[2018-II]***

(*a*) $3 \log_2 7$ (*b*) $1 - 3 \log_2 7$

(*c*) $1 - 3 \log_7 2$ (*d*) $\frac{7}{8}$

10. What is the value of $\log_9 27 + \log_8 32$? ***[2018-II]***

(*a*) $\frac{7}{2}$ (*b*) $\frac{19}{6}$ (*c*) 4 (*d*) 7

11. If $(0.2)^x = 2$ and $\log_{10} 2 = 0.3010$, then what is the value of x to the nearest tenth? ***[2018-II]***

(*a*) – 10.0 (*b*) – 0.5 (*c*) – 0.4 (*d*) – 0.2

12. If $x^{\log_7 x} > 7$ where $x > 0$, then which one of the following is correct? ***[2019-II]***

(*a*) $x \in (0, \infty)$ (*b*) $x \in \left(\frac{1}{7}, 7\right)$

(*c*) $x \in \left(0, \frac{1}{7}\right) \cup (7, \infty)$ (*d*) $x \in \left(\frac{1}{7}, \infty\right)$

13. What is the value of $\frac{1}{10}\log_5 1024 - \log_5 10 + \frac{1}{5}\log_5 3125$?

[2020-I & II]

(*a*) 0 (*b*) 1 (*c*) 2 (*d*) 3]

14. If $x = \log_c(ab), y = \log_a(bc), z = \log_b(ca)$, then which of the following is correct? ***[2020-I & II]***

(*a*) $xyz = 1$
(*b*) $x + y + z = 1$
(*c*) $(1 + x)^{-1} + (1 + y)^{-1} + (1 + z)^{-1} = 1$
(*d*) $(1 + x)^{-2} + (1 + y)^{-2} + (1 + z)^{-2} = 1$

15. The value of x, satisfying the equation $\log_{\cos x} \sin x = 1$, where $0 < x < \frac{\pi}{2}$, is ***[2021-I]***

(*a*) $\frac{\pi}{12}$ (*b*) $\frac{\pi}{3}$ (*c*) $\frac{\pi}{4}$ (*d*) $\frac{\pi}{6}$

16. If $n = 100!$, then what is the value of the following?

$$\frac{1}{\log_2 n} + \frac{1}{\log_3 n} + \frac{1}{\log_4 n} + \ldots + \frac{1}{\log_{100} n}$$

(*a*) 0 (*b*) 1 (*c*) 2 (*d*) 3

17. If $\log_{10} 2 \cdot \log_2 10 + \log_{10}(10^x) = 2$, then what is the value of x? ***[2021-II]***

(*a*) 0 (*b*) 1

(*c*) $\log_2 10$ (*d*) $\log_5 2$

18. If $\log_b a = p$, $\log_d c = 2p$ and $\log_f e = 3p$, then what is $(ace)^{1/p}$ equal to? ***[2024-I]***

(*a*) bd^2f^3 (*b*) bdf (*c*) b^3d^2f (*d*) $b^2d^2f^2$

19. What is the number of solutions of $\log_4(x-1) = \log_2(x-3)$? ***[2024-I]***

(*a*) Zero (*b*) One (*c*) Two (*d*) Three

20. For $x \geq y > 1$, let $\log_x\left(\frac{x}{y}\right) + \log_y\left(\frac{y}{x}\right) = k$, then the value of k can never be equal to ***[2024-I]***

(*a*) –1 (*b*) $-\frac{1}{2}$ (*c*) 0 (*d*) 1

ANSWER KEY

1. (*c*)	**2.** (*a*)	**3.** (*d*)	**4.** (*c*)	**5.** (*b*)	**6.** (*c*)	**7.** (*a*)	**8.** (*b*)	**9.** (*c*)	**10.** (*b*)
11. (*c*)	**12.** (*c*)	**13.** (*a*)	**14.** (*c*)	**15.** (*c*)	**16.** (*b*)	**17.** (*b*)	**18.** (*a*)	**19.** (*b*)	**20.** (*d*)

EXPLANATIONS

1. (*c*) $\log_{10} 2$, $\log_{10}(2^x - 1)$ and $\log_{10}(2^x + 3)$ are in A.P.

Hence, common difference will be same.

$\therefore \log_{10}(2^x - 1) - \log_{10} 2 = \log(2^x + 3) - \log_{10}(2^x - 1)$

$$\therefore \log_{10}\left(\frac{2^x - 1}{2}\right) = \log_{10}\left(\frac{2^x + 3}{2^x - 1}\right)$$

$$\Rightarrow \frac{2^x - 1}{2} = \frac{2^x + 3}{2^x - 1}$$

$\Rightarrow (2^x - 1)^2 = 2(2^x + 3) \Rightarrow 2^{2x} - 2^{x+2} = 5$

Let $2^x = y$, then

$\Rightarrow y^2 - 4y - 5 = 0$

$\Rightarrow y = -1, y = 5$ $[2^x = -1$ (not possible)]

Therefore, $2^x = 5 \Rightarrow x = \log_2 5$.

2. (*a*) $\log_8 m + \log_8 \frac{1}{6} = \frac{2}{3}$

$$\Rightarrow \log_8\left(m \cdot \frac{1}{6}\right) = \frac{2}{3}$$

$$\Rightarrow (8)^{\frac{2}{3}} = m \cdot \frac{1}{6} \Rightarrow m = 24$$

3. (*d*) $\log_a ab = x$

$\Rightarrow \log_a a + \log_a b = x$

$$\Rightarrow \frac{1}{\log_b a} = x - 1 \Rightarrow \log_b a = \frac{1}{x-1}$$

$\log_b ab = \log_b^a + \log_b^b$

$$= \frac{1}{x-1} + 1 = \frac{1 + x - 1}{x - 1} = \frac{x}{x-1}$$

4. (*c*) $x + \log_{10}(1 + 2^x) = x \log_{10} 5 + \log_{10} 6$

$\Rightarrow x - x \log_{10} 5 = \log_{10} 6 - \log_{10}(1 + 2^x)$

$\Rightarrow x(1 - \log_{10} 5) = \log_{10} 6 - \log_{10}(1 + 2^x)$

$$\Rightarrow x(\log_{10} 10 - \log_{10} 5) = \log_{10}\left(\frac{6}{1 + 2^x}\right)$$

$$\Rightarrow x\left(\log_{10}\left(\frac{10}{5}\right)\right) = \log_{10}\left(\frac{6}{1 + 2^x}\right)$$

$$\Rightarrow x \log_{10} 2 = \log_{10}\left(\frac{6}{1 + 2^x}\right)$$

This is possible only when $x = 1$.

5. (*b*) $n = (2017)!$

$$\frac{1}{\log_2 n} + \frac{1}{\log_3 n} + \frac{1}{\log_4 n} + \ldots + \frac{1}{\log_{2017} n}$$

$$= \frac{1}{\frac{\log n}{\log 2}} + \frac{1}{\frac{\log n}{\log 3}} + \frac{1}{\frac{\log n}{\log 4}} + \ldots + \frac{1}{\frac{\log n}{\log 2017}}$$

$$= \frac{\log 2}{\log n} + \frac{\log 3}{\log n} + \frac{\log 4}{\log n} + \ldots + \frac{\log_{2017}}{\log n}$$

$$= \frac{\log 2 + \log 3 + \log 4 + \ldots + \log 2017}{\log n}$$

$$= \frac{\log(2.3.4 \ldots 2017)}{\log n}$$

$$= \frac{\log(2017!)}{\log n} = \frac{\log n}{\log n} = 1$$

6. (*c*) $x + \log_{15}(1 + 3^x) = x \log_{15} 5 + \log_{15} 12$

$\Rightarrow x.\log_{15} 15 + \log_{15}(1 + 3^x) = x \log_{15} 5 + \log_{15} 12$ $(\because \log_{15} 15 = 1)$

$\Rightarrow \log_{15} 15^x (1 + 3^x) = \log_{15}(5^x \times 12)$

$\Rightarrow 15^x (1 + 3^x) = 5^x \times 12$

$\Rightarrow 3^x (1 + 3^x) = 12 \Rightarrow 3^x + 3^{2x} = 12.$

$x = 1$ satisfies the above equation.

7. (*a*) $\frac{1}{\log_2 N} + \frac{1}{\log_3 N} + \frac{1}{\log_4 N} + \ldots + \frac{1}{\log_{100} N}$

$$= \frac{1}{\frac{\log N}{\log 2}} + \frac{1}{\frac{\log N}{\log 3}} + \frac{1}{\frac{\log N}{\log 4}} + \ldots + \frac{1}{\frac{\log N}{\log 100}}$$

$$\left(\because \log_a b = \frac{\log b}{\log a}\right)$$

$$= \frac{\log 2}{\log N} + \frac{\log 3}{\log N} + \frac{\log 4}{\log N} + \ldots + \frac{\log 100}{\log N}$$

2 Number System

Operations on Binary Numbers

1. What is the sum of the two numbers $(11110)_2$ and $(1010)_2$? ***[2014-I]***

(a) $(101000)_2$ (b) $(110000)_2$
(c) $(100100)_2$ (d) $(101100)_2$

2. The number 251 in decimal system is expressed in binary system by: ***[2014-I]***

(a) 11110111 (b) 11111011 (c) 11111101 (d) 11111110

3. What is $(1001)_2$ equal to? ***[2014-II]***

(a) $(5)_{10}$ (b) $(9)_{10}$ (c) $(17)_{10}$ (d) $(11)_{10}$

4. The decimal number $(127.25)_{10}$, when converted to binary number, takes the form ***[2015-I]***

(a) $(1111111.11)_2$ (b) $(1111110.01)_2$
(c) $(1110111.11)_2$ (d) $(1111111.01)_2$

5. If $(11101011)_2$ is converted decimal system, then the resulting number is ***[2015-I]***

(a) 235 (b) 175 (c) 160 (d) 126

6. What is $(1000000001)_2 - (0.0101)_2$ equal to? ***[2015-II]***

(a) $(512.6775)_{10}$ (b) $(512.6875)_{10}$
(c) $(512.6975)_{10}$ (d) $(512.0909)_{10}$

7. What is the binary equivalent of the decimal number 0.3125? ***[2016-I]***

(a) 0.0111 (b) 0.1010 (c) 0.0101 (d) 0.1101

8. If the number 235 in decimal system is converted into binary system, then what is the resulting number? ***[2016-II]***

(a) $(11110011)_2$ (b) $(11101011)_2$
(c) $(11110101)_2$ (d) (11011011)2

9. In the binary equation ***[2017-I]***

$(1p101)_2 + (10q1)_2 = (100r00)_2$

where p, q and r are binary digits, what are the possible values of p, q and r respectively?

(a) 0, 1, 0 (b) 1, 1, 0 (c) 0, 0, 1 (d) 1, 0, 1

10. The remainder and the quotient of the binary division $(101110)_2 \div (110)_2$ are respectively ***[2017-II]***

(a) $(111)_2$ and $(100)_2$ (b) $(100)_2$ and $(111)_2$
(c) $(101)_2$ and $(101)_2$ (d) $(100)_2$ and $(100)_2$

11. The binary number expression of the decimal number 31 is ***[2018-I]***

(a) 1111 (b) 10111 (c) 11011 (d) 11111

12. The sum of the binary numbers $(11011)_2$, $(10110110)_2$ and $(10011x0y)_2$ is the binary number $(101101101)_2$. What are the values of x and y? ***[2018-II]***

(a) $x = 1, y = 1$ (b) $x = 1, y = 0$
(c) $x = 0, y = 1$ (d) $x = 0, y = 0$

13. A binary number is represented by $(cdccddcccddd)_2$, where $c > d$. What is its decimal equivalent? ***[2019-II]***

(a) 1848 (b) 2048 (c) 2842 (d) 2872

14. The number $(1101101 + 1011011)_2$ can be written in decimal system as ***[2020-I & II]***

(a) $(198)_{10}$ (b) $(199)_{10}$ (c) $(201)_{10}$ (d) $(200)_{10}$

15. What is $(1110011)_2 \div (10111)_2$ equal to ? ***[2022-I]***

(a) $(101)_2$ (b) $(1001)_2$ (c) $(111)_2$ (d) $(1011)_2$

16. If $x^3 + y^3 = (100010111)_2$ and $x + y = (11111)_2$, then what is $(x - y)^2 + xy$ equal to? ***[2022-I]***

(a) $(1101)_2$ (b) $(1001)_2$
(c) $(1011)_2$ (d) $(1111)_2$

17. What is the binary number equivalent to decimal number 1011? ***[2023-I]***

(a) 1011 (b) 111011 (c) 11111001 (d) 111110011

ANSWER KEY

1. (a)	**2.** (b)	**3.** (b)	**4.** (d)	**5.** (a)	**6.** (b)	**7.** (c)	**8.** (b)	**9.** (a)	**10.** (b)
11. (d)	**12.** (b)	**13.** (d)	**14.** (d)	**15.** (a)	**16.** (b)	**17.** (*)			

EXPLANATIONS

1. (*a*) $(11110)_2 = 2^4 \times 1 + 2^3 \times 1 + 2^2 \times 1 + 2^1 \times 1 + 2^0 \times 0$

$= 16 + 8 + 4 + 2 + 0 = 30$

$(1010)_2 = 2^3 \times 1 + 2^2 \times 0 + 2^1 \times 1 + 2^0 \times 0$

$= 8 + 0 + 2 + 0 = 10$

Adding their decimal equivalent, we have

Sum = 30 + 10 = 40

Now, converting 40 to binary

2	40	
2	20	0
2	10	0
2	5	0
2	2	1
	1	0

$\therefore 40 = (101000)_2$

2. (*b*)

2	251	
2	125	1
2	62	1
2	31	0
2	15	1
2	7	1
2	3	1
	1	1

Therefore, $(251)_{10} = (11111011)_2$

3. (*b*) $(1001)_2 = (2^3 \times 1 + 2^2 \times 0 + 2^1 \times 0 + 2^0 \times 1)_{10} = (8 + 1)_{10} = (9)_{10}$

4. (*d*) $(127.25)_{10}$

Now,

2	127	
2	63	1
2	31	1
2	15	1
2	7	1
2	3	1
	1	1

$127 = (1111111)_2$

Now,

$0.25 \times 2 = 0.5$ carry 0

$0.5 \times 2 = 1.0$ carry 1

$\therefore (127.25)_{10} = (1111111.01)_2$

5. (*a*) $(11101011)_2$

$= (1 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0)_{10}$

$= (128 + 64 + 32 + 8 + 2 + 1)_{10}$

$= (235)_{10}$

6. (*b*) $(1000000001)_2$

$= 1 \times 2^9 + 0 \times 2^8 + 0 \times 2^7 + ... + 1 \times 2^0$

$= 512 + 0 + 0 + ... + 1$

$= (513)_{10}$

$(0.0101)_2 = 0 \times 2^{-1} + 1 \times 2^{-2} + 0 \times 2^{-3} + 1 \times 2^{-4}$

$= \frac{1}{4} + \frac{1}{16} = \frac{5}{16} = (0.3125)_{10}$

$\therefore (1000000001)_2 - (0.0101)_2$

$= 513 - 0.3125 = (512.6875)_{10}$

7. (*c*)

$0.3125 \times 2 =$ | 0.6250

$0.6250 \times 2 =$ | 1.2500

$0.2500 \times 2 =$ | 0.5000

$0.5000 \times 2 =$ ↓ 1.0000

$\therefore (0.3125)_{10} = (0.0101)_2$

8. (*b*)

2	235	
2	117	1
2	58	1
2	29	0
2	14	1
2	7	0
2	3	1
	1	1

So, $(235)_{10} = (11101011)_2$

9. (*a*) $(1p101)_2 + (10q1)_2 = (100r00)_2$

$\Rightarrow (1 \times 2^4 + p \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0) + (1 \times 2^3 + 0 \times 2^2 + q \times 2^1 + 1 \times 2^0)$

$= 1 \times 2^5 + 0 + 0 + r \times 2^2 + 0 + 0$

$\Rightarrow 16 + 8p + 4 + 1 + 8 + 2q + 1 = 32 + 4r$

$\Rightarrow 30 + 8p + 2q = 32 + 4r$

$\Rightarrow 8p + 2q = 2 + 4r$

from options, substitute $p = 0$, $q = 1$, $r = 0$ we get

$0 + 2\,(1) = 2 + 0 \Rightarrow 2 = 2$.

10. (*b*) $(101110)_2 = 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = (46)_{10}$

Similarly, $(110)_2 = 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$

$= (6)_{10}$

Quotient = $7 = (111)_2$

Remainder = $4 = (100)_2$

11. (*d*)

2	31	
2	15	1
2	7	1
2	3	1
	1	1

So, binary form of 31 is $(11111)_2$

12. (*b*) On substraction, we get

$$\begin{array}{r} 101101101 \\ -10110110 \\ \hline 10110111 \\ -11011 \\ \hline 10011100 \end{array}$$

$\Rightarrow x = 1, y = 0$

13. (*d*) Binary number = $(cdccddcccddd)_2$

Where $c > d$ we know, only two bit (digits) 0 and 1 be any binary numbers.

$(cdccddcccddd)_2 = (101100111000)_2$

$(101100111000)_2 = (1 \times 2^{11})_{10} + (0 \times 2^{10})_{10} + (1 \times 2^9)_{10} + \ldots\ldots\ldots + (0 \times 2^0)_{10} = (2872)_{10}$

14. (*d*) The value of $(1101101)_2$ is obtained as: 109

The value of $(1011011)_2$ is obtained as: 91

The sum is then obtained as:

$(1101101 + 1011011)_2$

$= (109 + 91)_{10} = (200)_{10}$

15. (*a*) $(1110011)_2 = (115)_{10}$

$(10111)_2 = (23)_{10}$

$(1110011)_2 \div (10111)_2$

$= (115)_{10} \div (23)_{10} = (5)_{10} = (101)_2$

16. (*b*) $x^3 + y^3 = (100010111)_2$

$x^3 + y^3 = (279)_{10}$ ... (i)

$x + y = (11111)_2 = (31)_{10}$ ...(ii)

$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$

$\Rightarrow 279 = (31)[(x - y)^2 + xy]$

$\therefore (x - y)^2 + xy = 9 = (1001)_2$

17. (*)

2	1011	
2	505	1
2	252	1
2	126	0
2	63	0
2	31	1
2	15	1
2	7	1
2	3	1
	1	1

Binary equivalent of 1011 is $(1111110011)_2$

2025-II NDA/NA Solved Paper

Paper I: Mathematics

1. If $p^x = q^y = r^z$, where x, y and z are in GP, then consider the following statements:

I. p, q and r are in AP.

II. $ln\ p$, $ln\ q$ and $ln\ r$ are in GP.

Which of the statements given above is/are correct?

(*a*) I only (*b*) II only

(*c*) Both I and II (*d*) Neither I nor II

2. If A and B are non-empty subsets of a set, and A^c and B^c represent their complements, then which of the following is/are correct?

I. $A - B = B^c - A^c$

II. $A - B^c = A^c - B$

Select the answer using the code given below.

(*a*) I only (*b*) II only

(*c*) Both I and II (*d*) Neither I nor II

3. Let $y = x!$ and $z = (2x)!$. If $(z/y) = 120$, then what is the value of $(3x)!$?

(*a*) 362880 (*b*) 181440 (*c*) 90720 (*d*) 45360

4. Let n be a natural number. The number of consecutive zeros at the end of the expansion of $n!$ is exactly 2. How many values of n are possible?

(*a*) 3 (*b*) 4 (*c*) 5 (*d*) More than 5

5. If $(10 + \log_{10}x)$, $(10 + \log_{10}y)$ and $(10 + \log_{10}z)$ are in AP, then consider the following statements:

I. The GM of x and z is y^2 .

II. The AM of $\log_{10}x$ and $\log_{10}z$ is $\log_{10}y$.

Which of the statements given above is/are correct?

(*a*) I only (*b*) II only

(*c*) Both I and II (*d*) Neither I nor II

6. How many terms of the series $1 + 3 + 5 + 7 + ...$ amount to a sum equal to 12345678987654321?

(*a*) 11111111 (*b*) 110000011

(*c*) 111101111 (*d*) 111111111

7. How many terms are identical in the two APs 19, 21, 23,... up to 110 terms and 19, 22, 25, 28, ... up to 75 terms?

(*a*) 35 (*b*) 36

(*c*) 37 (*d*) 38

8. If $\alpha = \dfrac{-1+\sqrt{-3}}{2}$

then what is the value of

$(1 + \alpha^{19} - \alpha^{35})^{100} - (1 - 3\alpha^{25} + \alpha^{38})^{50}$?

(*a*) -2 (*b*) -1

(*c*) 0 (*d*) 2

9. What is the remainder when 5^{99} is divided by 13?

(*a*) 10 (*b*) 9

(*c*) 8 (*d*) 6

10. What is the value of the determinant of the inverse of the matrix

$\begin{bmatrix} -4 & -5 \\ 2 & 2 \end{bmatrix}$?

(*a*) $\dfrac{1}{2}$ (*b*) 1 (*c*) 2 (*d*) 4

11. In a class of 45 students, 34 like to play cricket and 26 like to play football. Further, each student likes to play at least one of the two games. How many students like to play exactly one game?

(*a*) 45 (*b*) 30 (*c*) 25 (*d*) 15

12. The system of equations

$2x - 3y - 5 = 0$, $15y - 10x + 50 = 0$

(*a*) has a unique solution

(*b*) has infinitely many solutions

(*c*) is inconsistent

(*d*) is consistent and has exactly two solutions

13. If $\left(\dfrac{1-i}{1+i}\right)^{2m}\left(\dfrac{1+i}{1-i}\right)^{2n} = 1$

where $i = \sqrt{-1}$, then what is the smallest positive value of $(m - n)$?

(*a*) 1

(*b*) 2

(*c*) 4

(*d*) 8

14. In obtaining the solution of the system of equations $x + y + z = 7$, $x + 2y + 3z = 16$ and $x + 3y + 4z = 22$ by Cramer's rule, the value of y is obtained by dividing D by D_2, where

$$D = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 3 & 4 \end{vmatrix}$$

What is the value of the determinant D_2?

(*a*) –13 (*b*) –3 (*c*) 3 (*d*) 13

15. Consider the following in respect of non-singular matrices A and B:

I. $(AB)^{-1} = A^{-1} B^{-1}$

II. $(BA)(AB)^{-1} = I$, where I is the identity matrix

III. $(AB)^T = A^T B^T$

How many of the above are correct?

(*a*) None (*b*) One (*c*) Two (*d*) All three

16. The value of the determinant

$$\begin{vmatrix} a & b & c \\ l & m & n \\ p & q & r \end{vmatrix}$$

is equal to

(*a*) $\begin{vmatrix} a & b & c \\ p & q & r \\ l & m & n \end{vmatrix}$ (*b*) $\begin{vmatrix} l & m & n \\ a & b & c \\ p & q & r \end{vmatrix}$

(*c*) $\begin{vmatrix} p & q & r \\ a & b & c \\ l & m & n \end{vmatrix}$ (*d*) $\begin{vmatrix} a & p & l \\ b & q & m \\ c & r & n \end{vmatrix}$

17. Let 1, ω, ω^2 be three cube roots of unity. If $x = a + b$, $y = a\omega + b\omega^2$, $z = a\omega^2 + b\omega$, then what is $x^2 + y^2 + z^2$ equal to?

(*a*) $6ab$ (*b*) $3ab$ (*c*) $a^2 + b^2$ (*d*) 1

18. How many 4-digit numbers that are divisible by 4 can be formed using the digits 1, 2, 3 and 4 (repetition of digits is not allowed)?

(*a*) 3 (*b*) 6 (*c*) 9 (*d*) 12

19. If a, b, c are the sides of a triangle ABC and p is the perimeter of the triangle then what is $\begin{vmatrix} p+c & a & b \\ c & p+a & b \\ c & a & p+b \end{vmatrix}$ equal to

(*a*) p^3 (*b*) $2p^3$ (*c*) $3p^3$ (*d*) $4p^3$

20. Which one of the following is the greatest coefficient in the expansion of $(1 + x)^{100}$?

(*a*) The coefficient of x^{100}

(*b*) The coefficient of x^{99}

(*c*) The coefficient of x^{51}

(*d*) The coefficient of x^{50}

For the following **two (02)** items:

Let α and β be the roots of the quadratic equation

$x^2 + (\log_{0.5}(a^2))x + (\log_{0.5}(a^2))^4 = 0$

where $a^2 \neq 1$ and $\log_{0.5}(a^2) > 0$. Further, $\beta^2 = \alpha(\log_{a^2}(0.5))$.

21. What is β equal to?

(*a*) $\log_{a^2}(0.5)$ (*b*) $\log_{0.5}(a^2)$

(*c*) $2(\log_{a^2}(0.5))$ (*d*) $2(\log_{0.5}(a^2))$

22. What is the relation between α and β?

(*a*) $\alpha = 2\beta$ (*b*) $2\alpha = \beta$ (*c*) $\alpha = -2\beta$ (*d*) $2\alpha = -\beta$

For the following **two (02)** items:

Let $p = \sum_{j=1}^{n} \log_{10} 2^j$ and $q = \sum_{j=1}^{n} \log_{10} 5^j$

23. If $p + q = 66$, then which one of the following is correct?

(*a*) $n < 7$ (*b*) $7 < n < 9$

(*c*) $9 < n < 12$ (*d*) $n > 12$

24. If $p + q = 15$, then what is $q - p$ equal to?

(*a*) $\log_{10} 2.5$ (*b*) $5\log_{10} 2.5$

(*c*) $10 \log_{10} 2.5$ (*d*) $15\log_{10} 2.5$

For the following **two (02)** items:

Let $\sin A + \sin B = p$ and $\cos A + \cos B = q$.

25. What is $\frac{p}{q}$ equal to?

(*a*) $\tan\left(\frac{A-B}{2}\right)$ (*b*) $\cot\left(\frac{A-B}{2}\right)$

(*c*) $\tan\left(\frac{A+B}{2}\right)$ (*d*) $\cot\left(\frac{A+B}{2}\right)$

26. What is $\frac{p^2 - q^2}{p^2 + q^2}$ equal to?

(*a*) $\cos(A + B)$ (*b*) $\cos(A - B)$

(*c*) $\cos\left(\frac{\pi}{2} - A - B\right)$ (*d*) $\cos(\pi - A - B)$

For the following **two (02)** items:

Let $p = \text{cosec}20°$ and $q = \text{cosec}\ 70°$

27. What is $\left(\frac{\sqrt{3p}}{4} - \frac{q}{4}\right)$ equal to?

(*a*) –1 (*b*) 0

(*c*) 1 (*d*) 2

28. What is $\frac{p^2 + q^2}{p^2 q^2}$ equal to

(*a*) $\frac{1}{2}$ (*b*) 1

(*c*) $\frac{3}{2}$ (*d*) 2

For the following **two (02)** items:

Let $\cos(2x + 3y) = \frac{1}{2}$ and $\cos(3x + 2y) = \frac{\sqrt{3}}{2}$

where $-\pi < (2x + 3y) < \pi$ and $-\pi < (3x + 2y) < \pi$.

29. How many values does $(x + y)$ have?

(*a*) Two (*b*) Three

(*c*) Four (*d*) More than four

30. How many values does $(y - x)$ have?

(*a*) Two (*b*) Three

(*c*) Four (*d*) More than four

147. For a material under static conditions, which one among the following statements is correct?

(*a*) An insulator can be charged

(*b*) A perfect conductor can be charged

(*c*) Both perfect conductor and insulator can be charged

(*d*) Both perfect conductor and insulator cannot be charged

148. A person can see nearby objects clearly but cannot see distant object distinctly, the person is suffering with

(*a*) Hypermetropia

(*b*) Presbyopia

(*c*) Myopia

(*d*) None of above

149. The energy is always conserved for a system which is

(*a*) isolated only

(*b*) non-isolated only

(*c*) both isolated and non-isolated

(*d*) none of above

150. Suppose, a ball of mass M is thrown upwards from a point A and it reaches up to the highest point B and returns back to point A, which one among the following is correct?

(*a*) Kinetic Energy at A Potential Energy at B

(*b*) Kinetic Energy at A Potential Energy at A

(*c*) Kinetic Energy at B Potential Energy at B

(*d*) Kinetic Energy at B Kinetic Energy at A

ANSWER KEY

Paper I: Mathematics

1. (*b*)	**2.** (*a*)	**3.** (*a*)	**4.** (*c*)	**5.** (*b*)	**6.** (*d*)	**7.** (*c*)	**8.** (*c*)	**9.** (*c*)	**10.** (*a*)
11. (*b*)	**12.** (*c*)	**13.** (*b*)	**14.** (*b*)	**15.** (*a*)	**16.** (*d*)	**17.** (*a*)	**18.** (*b*)	**19.** (*b*)	**20.** (*d*)
21. (*b*)	**22.** (*c*)	**23.** (*c*)	**24.** (*d*)	**25.** (*c*)	**26.** (*d*)	**27.** (*c*)	**28.** (*b*)	**29.** (*c*)	**30.** (*c*)
31. (*d*)	**32.** (*c*)	**33.** (*d*)	**34.** (*c*)	**35.** (*d*)	**36.** (*c*)	**37.** (*c*)	**38.** (*c*)	**39.** (*b*)	**40.** (*c*)
41. (*a*)	**42.** (*d*)	**43.** (*c*)	**44.** (*a*)	**45.** (*c*)	**46.** (*a*)	**47.** (*c*)	**48.** (*c*)	**49.** (*b*)	**50.** (*b*)
51. (*b*)	**52.** (*a*)	**53.** (*b*)	**54.** (*a*)	**55.** (*b*)	**56.** (*b*)	**57.** (*b*)	**58.** (*d*)	**59.** (*b*)	**60.** (*a*)
61. (*c*)	**62.** (*c*)	**63.** (*d*)	**64.** (*a*)	**65.** (*b*)	**66.** (*d*)	**67.** (*d*)	**68.** (*c*)	**69.** (*a*)	**70.** (*a*)
71. (*a*)	**72.** (*c*)	**73.** (*a*)	**74.** (*d*)	**75.** (*c*)	**76.** (*a*)	**77.** (*d*)	**78.** (*a*)	**79.** (*c*)	**80.** (*c*)
81. (*b*)	**82.** (*b*)	**83.** (*a*)	**84.** (*c*)	**85.** (*d*)	**86.** (*d*)	**87.** (*a*)	**88.** (*d*)	**89.** (*a*)	**90.** (*d*)
91. (*a*)	**92.** (*c*)	**93.** (*c*)	**94.** (*b*)	**95.** (*c*)	**96.** (*a*)	**97.** (*a*)	**98.** (*d*)	**99.** (*c*)	**100.** (*c*)
101. (*a*)	**102.** (*c*)	**103.** (*b*)	**104.** (*a*)	**105.** (*c*)	**106.** (*d*)	**107.** (*a*)	**108.** (*b*)	**109.** (*d*)	**110.** (*a*)
111. (*d*)	**112.** (*d*)	**113.** (*b*)	**114.** (*d*)	**115.** (*a*)	**116.** (*a*)	**117.** (*b*)	**118.** (*d*)	**119.** (*d*)	**120.** (*b*)

Paper II: General Ability

1. (*d*)	**2.** (*a*)	**3.** (*d*)	**4.** (*b*)	**5.** (*d*)	**6.** (*c*)	**7.** (*c*)	**8.** (*c*)	**9.** (*d*)	**10.** (*c*)
11. (*c*)	**12.** (*a*)	**13.** (*d*)	**14.** (*a*)	**15.** (*b*)	**16.** (*d*)	**17.** (*a*)	**18.** (*a*)	**19.** (*b*)	**20.** (*a*)
21. (*b*)	**22.** (*c*)	**23.** (*a*)	**24.** (*a*)	**25.** (*a*)	**26.** (*a*)	**27.** (*a*)	**28.** (*b*)	**29.** (*b*)	**30.** (*a*)
31. (*c*)	**32.** (*b*)	**33.** (*a*)	**34.** (*d*)	**35.** (*b*)	**36.** (*a*)	**37.** (*b*)	**38.** (*c*)	**39.** (*a*)	**40.** (*d*)
41. (*b*)	**42.** (*c*)	**43.** (*a*)	**44.** (*a*)	**45.** (*c*)	**46.** (*b*)	**47.** (*a*)	**48.** (*d*)	**49.** (*a*)	**50.** (*a*)
51. (*d*)	**52.** (*c*)	**53.** (*b*)	**54.** (*b*)	**55.** (*c*)	**56.** (*d*)	**57.** (*a*)	**58.** (*c*)	**59.** (*d*)	**60.** (*a*)
61. (*a*)	**62.** (*a*)	**63.** (*a*)	**64.** (*b*)	**65.** (*b*)	**66.** (*a*)	**67.** (*b*)	**68.** (*c*)	**69.** (*c*)	**70.** (*b*)
71. (*c*)	**72.** (*b*)	**73.** (*a*)	**74.** (*c*)	**75.** (*d*)	**76.** (*c*)	**77.** (*d*)	**78.** (*c*)	**79.** (*d*)	**80.** (*d*)
81. (*c*)	**82.** (*d*)	**83.** (*b*)	**84.** (*b*)	**85.** (*c*)	**86.** (*d*)	**87.** (*c*)	**88.** (*c*)	**89.** (*d*)	**90.** (*a*)
91. (*b*)	**92.** (*b*)	**93.** (*d*)	**94.** (*c*)	**95.** (*c*)	**96.** (*c*)	**97.** (*a*)	**98.** (*a*)	**99.** (*b*)	**100.** (*d*)
101. (*c*)	**102.** (*c*)	**103.** (*d*)	**104.** (*d*)	**105.** (*c*)	**106.** (*a*)	**107.** (*c*)	**108.** (*b*)	**109.** (*d*)	**110.** (*d*)
111. (*c*)	**112.** (*c*)	**113.** (*c*)	**114.** (*d*)	**115.** (*b*)	**116.** (*b*)	**117.** (*b*)	**118.** (*d*)	**119.** (*b*)	**120.** (*b*)
121. (*b*)	**122.** (*d*)	**123.** (*c*)	**124.** (*c*)	**125.** (*d*)	**126.** (*d*)	**127.** (*b*)	**128.** (*c*)	**129.** (*d*)	**130.** (*b*)
131. (*c*)	**132.** (*d*)	**133.** (*a*)	**134.** (*a*)	**135.** (*b*)	**136.** (*c*)	**137.** (*a*)	**138.** (*d*)	**139.** (*b*)	**140.** (*b*)
141. (*b*)	**142.** (*b*)	**143.** (*a*)	**144.** (*b*)	**145.** (*c*)	**146.** (*c*)	**147.** (*a*)	**148.** (*c*)	**149.** (*a*)	**150.** (*a*)

EXPLANATION

Paper I: Mathematics

1. (*b*) We have $p^x = k \Rightarrow x = \log_p k$

$q^y = k \Rightarrow y = \log_q k$

$r^z = k \Rightarrow z = \log_r k$

Given x, y, z are in G.P. $\Rightarrow y^2 = xz$

$(\log_q k)^2 = (\log_p k).(\log_r k)$

$$\Rightarrow \left(\frac{\log k}{\log q}\right)^2 = \frac{\log k}{\log p} \times \frac{\log k}{\log r}$$

$\Rightarrow (\log q)^2 = \log p . \log r$

Hence $\log p, \log q$ and $\log r$ are in G.P.

2. (*a*) $A - B = A \cap B^C$

I. $B^C - A^C = (U - B) \cap (U - A)^C$

$= (U - B) \cap A = A \cap B^C$

Since statement I is true.

II. $A - B^C = A \cap B$

$A^C - B = A^C \cap B^C = (A \cup B)^C$

Hence $A - B^C \neq A^C - B$

Since statement (II) is false.

3. (*a*) $y = x!, z = (2x)!$

$$\frac{z}{y} = \frac{(2x)!}{x!} = 120$$

Check factorial ratios:

$$\frac{(2.3)!}{3!} = \frac{6!}{3!} = \frac{6 \times 5 \times 4 \times 3!}{3!} = 120$$

$\Rightarrow x = 3$

$\therefore (3x)! = (9)! = 362880$

4. (*c*) Number of trailing zeros $= V_5 (n!) = [n/5] + [n/25] + ... = 2.$

$\because [n/25] = 0 \Rightarrow n < 25$

So $[n/5]=2 \Rightarrow 10 \leq n \leq 14 \rightarrow 5$ values.

5. (*b*) $10 + \log x$, $10 + \log y$, $10 + \log z$ are in A.P

$\Rightarrow 2 \log y = \log x + \log z$

$\Rightarrow \log(xz) = \log(y^2) \Rightarrow xz = y^2$

I. $GM(x, z) = \sqrt{xz} = \sqrt{y^2} = y$ (not y^2)

So statement I is false.

II. $AM(\log x, \log z) = \dfrac{\log x + \log z}{2}$

$$= \frac{\log(xz)}{2} = \frac{\log y^2}{2} = \log(y)$$

Hence, statement II is correct.

6. (*d*) Series: $1 + 3 + 5 + ...$ (n odd numbers).

Sum of n odd numbers $= n^2$.

So need $n^2 = 12345678987654321$.

$\sqrt{12345678987654321} = 1111111111$

7. (*c*) Given two arithmetic progressions

19, 21, 23,…up to 110 (a_1=19, d_1= 2)

and 19, 22, 25,…up to 75 (a_2 = 19, d_2 = 3)

Common term condition:

$\Rightarrow 19 + 2(n - 1) = 19 + 3(m - 1)$

$\Rightarrow 2n - 2 = 3m - 3 \Rightarrow 2n = 3m - 1$

$$\Rightarrow n = \frac{3m - 1}{2}$$

For n to be an integer, $3m - 1$ must be even, i.e., m must be odd.

The maximum term in AP1:

$19 + 109 \times 2 = 237$

The maximum term in AP2:

$19 + 74 \times 3 = 241$

So common terms ≤ 237

General common term:

$19 + 3 (m - 1) \leq 237 \Rightarrow m \leq 73$

Odd m from 1 to 73

$$\text{Count} = \frac{73 + 1}{2} = 37$$

8. (*c*) $\alpha = \dfrac{-1 + \sqrt{-3}}{2}$ = Cube root of unity

$(1 + \alpha^{19} - \alpha^{35})^{100} - (1 - 3\alpha^{25} + \alpha^{38})^{50}$

Since $\alpha^3 = 1$, simplify powers of α:

$\alpha^{19} = \alpha, \alpha^{35} = \alpha^2, \alpha^{25} = \alpha, \alpha^{38} = \alpha^2$

Substitute:

$(1 + \alpha - \alpha^2)^{100} - (1 - 3\alpha + \alpha^2)^{50}$

Using $\alpha^2 + \alpha + 1 = 0$:

$1 + \alpha - \alpha^2 = 2 (\alpha + 1), 1 - 3\alpha + \alpha^2 = -4\alpha$

Simplified expression:

$(2 (\alpha + 1))^{100} - (-4\alpha)^{50}$

$= (2(-\alpha^2))^{100} - 4^{50} . \alpha^{50} = 0$

9. (*c*) Since, $5^{12} = 1$ (mod 13),

So, $5^{99} = 5^{12 \times 8 + 3} = (5^{12})^8 \times 5^3$

We simplify to:

$5^{99} = 5^3$ (mod 13).

$5^3 = 125$, and $125 \div 13 = 9$ remainder 8.

10. (*a*) $|A| = (-4)(2) - (-5)(2) = -8 + 10 = 2.$

$$\therefore |A^{-1}| = \frac{1}{|A|} = \frac{1}{2}$$

11. (*b*) We have, $n(C) = 34, n(F) = 20,$

$\therefore n(C \cup F) = 34 + 26 - n(C \cap F)$

$\Rightarrow 45 = 60 - n(C \cap F) \Rightarrow n(C \cap F) = 15$

Students who like exactly one game:

$= 45 - 15 = 30$

12. (*c*) The system of equations is: $2x - 3y = 5$ and $15y - 10x + 50 = 0$

We have $\dfrac{2}{-10} = \dfrac{-3}{15} \neq \dfrac{-5}{50}$

So the system of equations is inconsistent

13. (*b*) Simplifying the given expression:

$$\left(\frac{1-i}{1+i}\right)^{2m}\left(\frac{1+i}{1-i}\right)^{2n} = 1$$

We get:

$$\frac{1-i}{1+i} = -i \text{ and } \frac{1+i}{1-i} = i$$

So the equation becomes:

$(-i)^{2m} . i^{2n} = 1$

This simplifies to:

$i^{2m + 2n} = 1$

For $i^{2m + 2n} = 1$

Here $2m + 2n$ must be a multiple of 4. The smallest value of $2m + 2n = 4$, $\Rightarrow m + n = 2$

The smallest positive value of $m - n = 2$.

14. (*b*) The system of equations is:

$x + y + z = 7$

$x + 2y + 3z = 16$

$x + 3y + 4z = 22$

The given matrix for D is:

$$D = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 3 & 4 \end{vmatrix}, D_2 = \begin{vmatrix} 1 & 7 & 1 \\ 1 & 16 & 3 \\ 1 & 22 & 4 \end{vmatrix}$$

$$D_2 = 1 \times \begin{vmatrix} 16 & 3 \\ 22 & 4 \end{vmatrix} - 7 \times \begin{vmatrix} 1 & 3 \\ 1 & 4 \end{vmatrix} + 1 \times \begin{vmatrix} 1 & 16 \\ 1 & 22 \end{vmatrix}$$

$D_2 = 1 \times (-2) - 7 \times 1 + 1 \times 6$

$= -2 - 7 + 6 = -3$

15. (*a*) $A A^{-1} = I \Rightarrow (AB)^{-1} \neq A^{-1}B^{-1}$

$(BA)(BA)^{-1} = I \Rightarrow (BA)(AB)^{-1} \neq I$

$(AB)^T = B^T A^T \Rightarrow (AB)^T \neq A^T B^T$

16. (*d*) The given determinant is

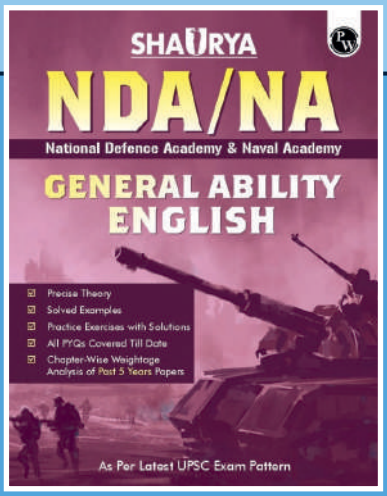
$$\begin{vmatrix} a & b & c \\ l & m & n \\ p & q & r \end{vmatrix} = a\begin{vmatrix} m & n \\ q & r \end{vmatrix} - b\begin{vmatrix} l & n \\ p & r \end{vmatrix} + c\begin{vmatrix} l & m \\ p & q \end{vmatrix}$$

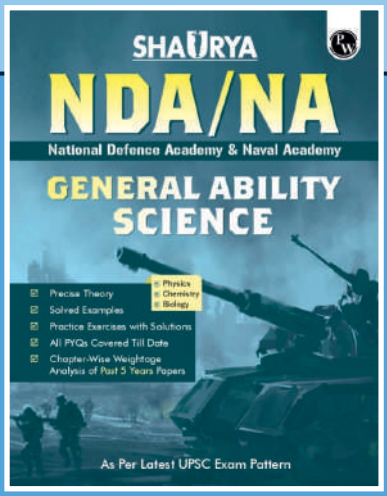
$= a (mr - nq) - b (lr - np) + c(lq - mp)$

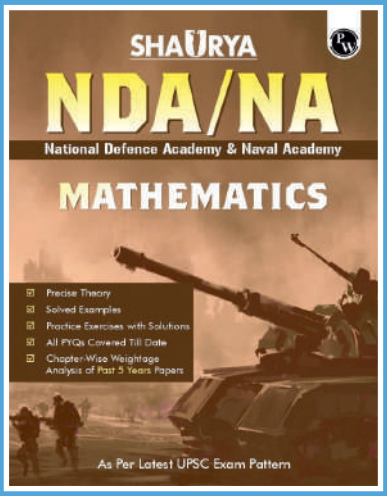
Now, Interchange the rows in option (*c*) as follows:

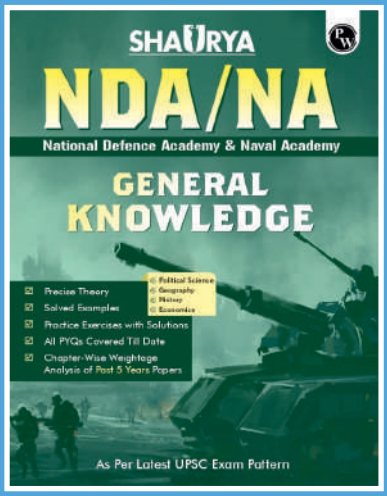
$$\begin{vmatrix} p & q & r \\ a & b & c \\ l & m & n \end{vmatrix} \; R_1 \leftrightarrow R_2, R_3 \leftrightarrow R_1, R_2 \leftrightarrow R_3,$$

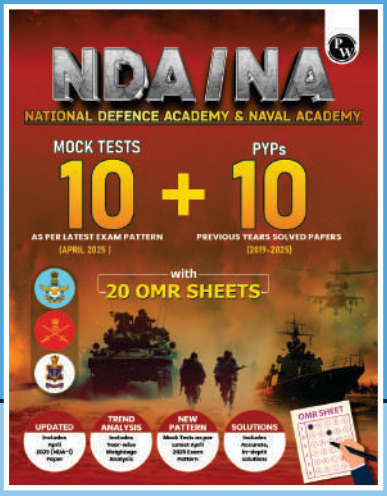
OTHER HELPFUL BOOKS

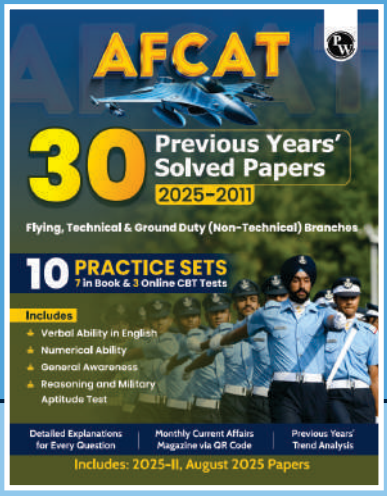












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