**NIMBUS DEFENCE ACADEMY**
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## DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO

**T.B.C. : SURN–B–MTH**

**Test Booklet Series**

**B**

Serial No. 1141110

### TEST BOOKLET

### MATHEMATICS

**Time Allowed : Two Hours and Thirty Minutes**

**Maximum Marks : 300**

### INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.

2. **Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.**

3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.

4. This Test Booklet contains **120** items (questions). Each item is printed both in **Hindi** and **English**. Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.

5. You have to mark all your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.

6. *All* items carry equal marks.

7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.

8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet*. You are permitted to take away with you the Test Booklet.

9. Sheets for rough work are appended in the Test Booklet at the end.

10. **Penalty for wrong answers :**
    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.
    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.
    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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## DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO

ध्यान दें : अनुदेशों का हिन्दी रूपान्तर इस पुस्तिका के मुखपृष्ठ पर छपा है।

**Direction** : Consider the following for the two (02) items that follow :

Let $f(x) = |x^2 - x - 2|$.

1. What is $\int_0^2 f(x)\, dx$ equal to?

   (a) 0·

   (b) 1

   (c) 5/3

   (d) 10/3

2. What is $\int_1^3 f(x)\, dx$ equal to?

   (a) 2

   (b) 3·

   (c) 4

   (d) 5

**Direction** : Consider the following for the two (02) items that follow :

Let $f(t) = \ln(t + \sqrt{1+t^2})$ and $g(t) = \tan(f(t))$.

3. Consider the following statements :
   I.   $f(t)$ is an odd function.
   II.  $g(t)$ is an odd function.
   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

4. What is $\int_{-\pi}^{\pi} g(t)\, dt$ equal to?

   (a) −1

   (b) 0·

   (c) 1/2

   (d) 1

**Direction** : Consider the following for the two (02) items that follow :

Let $f : (-1, 1) \to R$ be a differentiable function with $f(0) = -1$ and $f'(0) = 1$. Let $h(x) = f(2f(x) + 2)$ and $g(x) = (h(x))^2$.

5. What is $h'(0)$ equal to?

   (a) −2

   (b) −1

   (c) 0·

   (d) 2

6. What is $g'(0)$ equal to?

   (a) −4

   (b) −2

   (c) 0·

   (d) 4

**Direction :** Consider the following for the two (02) items that follow :

Let $I = \int_0^{\pi/2} \dfrac{f(x)}{g(x)} \, dx$, where $f(x) = \sin x$ and $g(x) = \sin x + \cos x + 1$.

7. What is $\int_0^{\pi/2} \dfrac{dx}{g(x)}$ equal to?

(a) $\dfrac{\ln 2}{2}$

(b) $\dfrac{\ln 2}{4}$

(c) $\ln 2$

(d) $2 \ln 2$

8. What is $I$ equal to?

(a) $\dfrac{\pi}{4} + \ln 2$

(b) $\dfrac{\pi}{4} - \ln 2$

(c) $\dfrac{\pi}{4} - \dfrac{\ln 2}{2}$

(d) $\dfrac{\pi}{4} + \dfrac{\ln 2}{2}$

**Direction :** Consider the following for the two (02) items that follow :

Let

$$2 \int \dfrac{x^2 - 1}{\sqrt{x^2 + 1}} \, dx = U(x)\, V(x) - 3 \ln\{U(x) + V(x)\} + c$$

9. What is $|U^2(x) - V^2(x)|$ equal to?

(a) 0

(b) 1

(c) 2

(d) 3

10. What is $U(x)\, V(x)$ equal to?

(a) $\sqrt{x^2 + x^4}$

(b) $\sqrt{x + x^3}$

(c) $\dfrac{\sqrt{x^2 + x^4}}{2}$

(d) $2\sqrt{x^2 + x^4}$

11. Let $z = [y]$ and $y = [x] - x$, where $[\cdot]$ is the greatest integer function. If $x$ is not an integer but positive, then what is the value of $z$?

   (a) $-1$

   (b) $0$

   (c) $1$

   (d) $2$

12. If $f(x) = 4x + 1$ and $g(x) = kx + 2$ such that $f \circ g(x) = g \circ f(x)$, then what is the value of $k$?

   (a) $7$

   (b) $5$

   (c) $4$

   (d) $3$

13. What is the minimum value of the function $f(x) = \log_{10}(x^2 + 2x + 11)$?

   (a) $0$

   (b) $1$

   (c) $2$

   (d) $10$

14. Which one of the following is correct regarding $\lim_{x \to 3} \dfrac{|x - 3|}{x - 3}$?

   (a) Limit exists and is equal to $1$

   (b) Limit exists and is equal to $0$

   (c) Limit exists and is equal to $-1$

   (d) Limit does not exist

15. What is the maximum value of $a\cos x + b \sin x + c$?

   (a) $\sqrt{a^2 + b^2} + c$

   (b) $\sqrt{a^2 + b^2} + c$

   (c) $\sqrt{a^2 + b^2} - c$

   (d) $\sqrt{a^2 + b^2}$

16. If $f(2x) = 4x^2 + 1$, then for how many real values of $x$ will $f(2x)$ be the GM of $f(x)$ and $f(4x)$?

   (a) Four

   (b) Two

   (c) One

   (d) None

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**17.** If $f(x) = [x]^2 - 30[x] + 221 = 0$, where $[x]$ is the greatest integer function, then what is the sum of all integer solutions?

(a) 13

(b) 17

(c) 27

(d) 30

**18.** If $f(x) = 9x - 8\sqrt{x}$ such that $g(x) = f(x) - 1$, then which one of the following is correct?

(a) $g(x) = 0$ has no real roots

(b) $g(x) = 0$ has only one real root which is an integer

(c) $g(x) = 0$ has two real roots which are integers

(d) $g(x) = 0$ has only one real root which is not an integer

**19.** What is $\lim\limits_{x \to \frac{\pi}{2}} (\sec\theta - \tan\theta)$ equal to?

(a) $-1$

(b) $0$

(c) $1/2$

(d) $1$

**20.** Let $f(x)\, f(y) = f(xy)$ for all real $x, y$. If $f(2) = 4$, then what is the value of $f(1/2)$?

(a) $1/4$

(b) $1/2$

(c) $1$

(d) $4$

**21.** What is $3\alpha + 2\beta$ equal to if

$$(2\hat{i} + 6\hat{j} + 27\hat{k}) \times (\hat{i} + \alpha\hat{j} + \beta\hat{k})$$

is a null vector?

(a) 36

(b) 33

(c) 30

(d) 27

**22.** For what value of the angle between the vectors $\vec{a}$ and $\vec{b}$ is the quantity $|\vec{a} \times \vec{b}| + \sqrt{3}|\vec{a} \cdot \vec{b}|$ maximum?

(a) $0°$

(b) $30°$

(c) $45°$

(d) $60°$

**23.** Let $\theta$ be the angle between two unit vectors $\vec{a}$ and $\vec{b}$. If $\vec{a} + 2\vec{b}$ is perpendicular to $5\vec{a} - 4\vec{b}$, then what is $\cos\theta + \cos 2\theta$ equal to?

(a) $0$

(b) $1/2$

(c) $1$

(d) $\dfrac{\sqrt{3} + 1}{2}$

**24.** Let $ABCDEF$ be a regular hexagon. If $\overrightarrow{AD} = m\overrightarrow{BC}$ and $\overrightarrow{CF} = n\overrightarrow{AB}$, then what is $mn$ equal to?

(a) $-4$

(b) $-2$

(c) $2$

(d) $4$

**25.** The vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ are of the same length. If taken pairwise, they form equal angles. If $\vec{a} = \hat{i} + \hat{j}$ and $\vec{b} = \hat{j} + \hat{k}$, then what can $\vec{c}$ be equal to?

I.  $\hat{i} + \hat{k}$

II.  $\dfrac{-\hat{i} + 4\hat{j} - \hat{k}}{3}$

Select the correct answer using the code given below.

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

**26.** The diagonals of a quadrilateral $ABCD$ are along the lines $x - 2y = 1$ and $4x + 2y = 3$. The quadrilateral $ABCD$ may be a

(a) rectangle

(b) cyclic quadrilateral

(c) parallelogram

(d) rhombus .

**27.** The foci of the ellipse $4x^2 + 9y^2 = 1$ are at $Q$ and $R$. If $P(x, y)$ is any point on the ellipse, then what is $PQ + PR$ equal to?

(a) 2

(b) 1

(c) 2/3

(d) 1/3

**28.** If $P(2, 4)$, $Q(8, 12)$, $R(10, 14)$ and $S(x, y)$ are vertices of a parallelogram, then what is $(x + y)$ equal to?

(a) 8

(b) 10

(c) 12

(d) 14

**29.** The equation of a circle is

$$(x^2 - 4x + 3) + (y^2 - 6y + 8) = 0$$

Which of the following statements are correct?

I.  The end points of a diameter of the circle are at $(1, 2)$ and $(3, 4)$.

II.  The end points of a diameter of the circle are at $(1, 4)$ and $(3, 2)$.

III.  The end points of a diameter of the circle are at $(2, 4)$ and $(4, 2)$.

Select the answer using the code given below.

(a) I and II only

(b) II and III only

(c) I and III only

(d) I, II and III

**30.** Consider the points $P(4k, 4k)$ and $Q(4k, -4k)$ lying on the parabola $y^2 = 4kx$. If the vertex is $A$, then what is $\angle PAQ$ equal to?

(a) 60°

(b) 90°

(c) 120°

(d) 135°

**31.** Let $\sum_{i=1}^{9} x_i^2 = 855$. If $M$ is the mean and $\sigma$ is the standard deviation of $x_1, x_2, \cdots, x_9$, then what is the value of $M^2 + \sigma^2$?

(a) 100

(b) 95

(c) 90 .

(d) 85

**32.** The mean of the series $x_1, x_2, \cdots, x_n$ is $\bar{x}$. If $x_n$ is replaced by $k$, then what is the new mean?

(a) $\bar{x} - x_n + k$

(b) $\dfrac{n\bar{x} - \bar{x} + k}{n}$

(c) $\dfrac{\bar{x} - x_n - k}{n}$ .

(d) $\dfrac{n\bar{x} - x_n + k}{n}$

**33.** A fair coin is tossed till two heads occur in succession. What is the probability that the number of tosses required is less than 6?

(a) 5/64

(b) 15/32

(c) 31/64

(d) 19/32

**34.** Urn $A$ contains 2 white and 2 black balls while urn $B$ contains 3 white and 2 black balls. One ball is transferred from urn $A$ to urn $B$ and then a ball is drawn out of urn $B$. What is the probability that the ball is white?

(a) 11/20

(b) 7/12

(c) 3/5

(d) 1

**35.** For two events $A$ and $B$, $P(A) = P(A|B) = 0 \cdot 25$ and $P(B|A) = 0 \cdot 5$. Which of the following are correct?

I. $A$ and $B$ are independent.

II. $P(A^c \cup B^c) = 0 \cdot 875$

III. $P(A^c \cap B^c) = 0 \cdot 375$

Select the answer using the code given below.

(a) I and II only

(b) II and III only

(c) I and III only

(d) I, II and III

36. Two perfect dice are thrown. What is the probability that the sum of the numbers on the faces is neither 9 nor 10?

(a) 1/36

(b) 5/36

(c) 7/36

(d) 29/36

37. The occurrence of a disease in an industry is such that the workers have 20% chance of suffering from it. What is the probability that out of 6 workers chosen at random, 4 or more will suffer from the disease?

(a) 53/3125

(b) 63/3125

(c) 73/3125

(d) 83/3125

38. Three perfect dice are rolled. Under the condition that no two show the same face, what is the probability that one of the faces shown is an ace (one)?

(a) 5/9

(b) 2/3

(c) 1/3

(d) 1/2

39. Three perfect dice $D_1$, $D_2$ and $D_3$ are rolled. Let $x$, $y$ and $z$ represent the numbers on $D_1$, $D_2$ and $D_3$ respectively. What is the number of possible outcomes such that $x < y < z$?

(a) 20

(b) 18

(c) 14

(d) 10

40. In a binomial distribution, if the mean is 6 and the standard deviation is $\sqrt{2}$, then what are the values of the parameters $n$ and $p$ respectively?

(a) 18 and 1/3

(b) 9 and 1/3

(c) 18 and 2/3

(d) 9 and 2/3

**41.** If $4\sin^{-1}x + \cos^{-1}x = \pi$, then what is $\sin^{-1}x + 4\cos^{-1}x$ equal to?

(a) $\pi/2$

(b) $\pi$

(c) $3\pi/2$

(d) $2\pi$

**42.** What is $\cot^2(\sec^{-1}2) + \tan^2(\text{cosec}^{-1}3)$ equal to?

(a) $11/12$

(b) $11/24$

(c) $7/24$

(d) $1/24$

**43.** In a triangle $ABC$

$$\frac{a}{\cos A} = \frac{b}{\cos B} = \frac{c}{\cos C}$$

What is the area of the triangle if $a = 6$ cm?

(a) $9\sqrt{3}$ square cm

(b) $12$ square cm

(c) $18\sqrt{3}$ square cm

(d) $24$ square cm

**44.** The roots of the equation $7x^2 - 6x + 1 = 0$ are $\tan\alpha$ and $\tan\beta$, where $2\alpha$ and $2\beta$ are the angles of a triangle. Which one of the following is correct?

(a) The triangle is equilateral

(b) The triangle is isosceles but not right-angled

(c) The triangle is right-angled

(d) The triangle is right-angled isosceles

**45.** In a triangle $ABC$, $\angle A = 75°$ and $\angle B = 45°$. What is $2a - b$ equal to?

(a) $c$

(b) $\sqrt{2}\,c$

(c) $2c$

(d) $2\sqrt{2}\,c$

**46.** What is the number of solutions of the equation $\cot 2x \cdot \cot 3x = 1$ for $0 < x < \pi$?

(a) Only one

(b) Only two

(c) Only five

(d) ore than five

47. What is the general solution of $\cos^{100} x - \sin^{100} x = 1$?

(a) $n\pi$

(b) $(2n + 1)\pi$

(c) $2n\pi$

(d) $(2n + 1)\pi / 2$

where $n$ is an integer.

48. In a triangle $ABC$

$$\tan A + \tan B + \tan C = k$$

What is the value of $\cot A \cot B \cot C$?

(a) $0 \cdot 5k$

(b) $1/k$

(c) $3/k$

(d) $1/k^3$

49. What is $\sin 12° \sin 48°$ equal to?

(a) $\dfrac{\sqrt{5} - 1}{4}$

(b) $\dfrac{\sqrt{5} + 1}{4}$

(c) $\dfrac{\sqrt{5} - 1}{8}$

(d) $\dfrac{\sqrt{5} + 1}{8}$

50. What is $\dfrac{\cos 17° - \sin 17°}{\cos 17° + \sin 17°}$ equal to?

(a) $\tan 34°$

(b) $\cot 34°$

(c) $\tan 62°$

(d) $\cot 62°$

51. Let $x > 1$, $y > 1$, $z > 1$ be in GP. Then

$$\frac{1}{1 + \ln x}, \quad \frac{1}{1 + \ln y}, \quad \frac{1}{1 + \ln z}$$

are

(a) in AP

(b) in GP

(c) in HP

(d) neither in AP nor in GP nor in HP

52. If

$$\omega = -\frac{1}{2} + i \frac{\sqrt{3}}{2}$$

then what is

$$\begin{vmatrix} 1+\omega & 1+\omega^2 & \omega+\omega^2 \\ 1 & \omega & \omega^2 \\ \dfrac{1}{\omega} & \dfrac{1}{\omega^2} & 1 \end{vmatrix}$$

equal to?

(a) $0$

(b) $\omega$

(c) $\omega^2$

(d) $1 - \omega^2$

**53.** If the sum of the first $n$ terms of a series is $n(2n+1)$, then what is the nth term?

(a) $4n-1$

(b) $4n$

(c) $4n+1$

(d) $4n+3$

**54.** In how many ways can the letters of the word INDIA be permutated such that in each combination, vowels should occupy odd positions?

(a) 3

(b) 6

(c) 9

(d) 12

**55.** The letters of the word EQUATION are arranged in such a way that all vowels as well as consonants are together. How many such arrangements are there?

(a) 240

(b) 720

(c) 1440

(d) 1620

**56.** If $n$ is a root of the equation $x^2 + px + m = 0$ and $m$ is a root of the equation $x^2 + px + n = 0$, where $m \neq n$, then what is the value of $p + m + n$?

(a) $-1$

(b) 0

(c) 1

(d) 2

**57.** In how many ways can a student choose $(n-2)$ courses out of $n$ courses if 2 courses are compulsory $(n > 4)$?

(a) $(n-3)(n-4)$

(b) $(n-1)(n-2)$

(c) $(n-3)(n-4)/2$

(d) $(n-2)(n-3)/2$

**58.** If

$$D_n = \begin{vmatrix} n & 20 & 30 \\ n^2 & 40 & 50 \\ n^3 & 60 & 70 \end{vmatrix}$$

then what is the value of $\sum_{n=1}^{4} D_n$?

(a) $-10000$

(b) $-10$

(c) 10

(d) 10000

**59.** Consider the following in respect of the matrices

$$P = \begin{bmatrix} 0 & c & -b \\ -c & 0 & a \\ b & -a & 0 \end{bmatrix} \text{ and } Q = \begin{bmatrix} a^2 & ab & ac \\ ab & b^2 & bc \\ ac & bc & c^2 \end{bmatrix}$$

I. $PQ$ is a null matrix.

II. $QP$ is an identity matrix of order 3.

III. $PQ = QP$

Which of the above is/are correct?

(a) I only

(b) II only

(c) I and III

(d) II and III

**60.** If $P$ is a skew-symmetric matrix of order 3, then what is $\det(P)$ equal to?

(a) −1

(b) 0

(c) 1

(d) 3

**61.** Let $X$ be a matrix of order $3 \times 3$, $Y$ be a matrix of order $2 \times 3$ and $Z$ be a matrix of order $3 \times 2$. Which of the following statements are correct?

I. $(ZY)X$ is defined and is a square matrix of order 3.

II. $Y(XZ)$ is defined and is a square matrix of order 2.

III. $X(YZ)$ is not defined.

Select the answer using the code given below.

(a) I and II only

(b) II and III only

(c) I and III only

(d) I, II and III

**62.** Consider the following statements :

I. The set of all irrational numbers between $\sqrt{12}$ and $\sqrt{15}$ is an infinite set.

II. The set of all odd integers less than 1000 is a finite set.

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

**63.** How many 4-digit numbers are there having all digits as odd?

(a) 625

(b) 400

(c) 196

(d) 120

**64.** If $\omega \neq 1$ is a cube root of unity, then what is $(1 + \omega - \omega^2)^{100} + (1 - \omega + \omega^2)^{100}$ equal to?

(a) $2^{100}\,\omega^2$

(b) $2^{100}\,\omega$

(c) $2^{100}$

(d) $-2^{100}$

**65.** Let $A$ and $B$ be two square matrices of same order. If $AB$ is a null matrix, then which one of the following is correct?

(a) Both $A$ and $B$ are null matrices

(b) Either $A$ or $B$ is a null matrix

(c) $B$ is a null matrix if $A$ is a non-singular matrix

(d) Both $A$ and $B$ are singular matrices

**66.** In the expansion of $(1 + x)^p (1 + x)^q$, if the coefficient of $x^3$ is 35, then what is the value of $(p + q)$?

(a) 5

(b) 6

(c) 7

(d) 8

**67.** If $p$ times the $p$th term of an AP is equal to $q$ times the $q$th term $(p \neq q)$, then what is the $(p + q)$th term equal to?

(a) 0

(b) $p + q$

(c) $pq$

(d) $pq(p + q)$

**68.** Let $p = ln(x)$, $q = ln(x^3)$ and $r = ln(x^5)$, where $x > 1$. Which of the following statements is/are correct?

I. $p$, $q$ and $r$ are in AP.

II. $p$, $q$ and $r$ can never be in GP.

Select the answer using the code given below.

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

**69.** If

$$Z = \frac{1}{3}\begin{vmatrix} i & 2i & 1 \\ 2i & 3i & 2 \\ 3 & 1 & 3 \end{vmatrix} = x + iy;\ i = \sqrt{-1}$$

then what is modulus of $Z$ equal to?

(a) 1

(b) $\sqrt{2}$

(c) 2

(d) $\sqrt{3}$

**70.** What is the value of the sum

$$\sum_{n=1}^{20} (i^{n-1} + i^n + i^{n+1})$$

where $i = \sqrt{-1}$?

(a) $-2i$

(b) 0

(c) 1

(d) $2i$

**Direction :** Consider the following for the two (02) items that follow :

A triangle $ABC$ is inscribed in the circle $x^2 + y^2 = 100$. $B$ and $C$ have coordinates $(6, 8)$ and $(-8, 6)$ respectively.

**71.** What is $\angle BAC$ equal to?

(a) $\pi/2$

(b) $\pi/3$ or $2\pi/3$

(c) $\pi/4$ or $3\pi/4$

(d) $\pi/6$ or $5\pi/6$

**72.** What are the coordinates of $A$?

(a) $(-6, 8)$

(b) $(-6, -8)$

(c) $(5\sqrt{2}, 5\sqrt{2})$

(d) Cannot be determined due to insufficient data

**Direction :** Consider the following for the two (02) items that follow :

$ABCD$ is an isosceles trapezium and $AB$ is parallel to $DC$. Let $A(2, 3)$, $B(4, 3)$, $C(5, 1)$ be the vertices.

**73.** What are the coordinates of vertex $D$?

(a) $(2, 1)$    (b) $(1, 2)$

(c) $(1, 1)$    (d) $(3, 1)$

**74.** What is the point of intersection of the diagonals of the trapezium?

(a) $(3, 7/2)$    (b) $(3, 7/3)$

(c) $(7/2, 2)$    (d) $(5/2, 2)$

**Direction :** Consider the following for the **two (02)** items that follow :

Let $2x^2 + 2y^2 + 2z^2 + 3x + 3y + 3z - 6 = 0$ be a sphere.

**75.** What is the diameter of the sphere?

(a) $\dfrac{5\sqrt{3}}{4}$

(b) $\dfrac{5\sqrt{3}}{2}$

(c) $\dfrac{3\sqrt{5}}{4}$

(d) $\dfrac{3\sqrt{5}}{2}$

**76.** The centre of the sphere lies on the plane

(a) $2x + 2y + 2z - 3 = 0$

(b) $4x + 4y + 4z - 3 = 0$

(c) $4x + 8y + 8z - 15 = 0$

(d) $4x + 8y + 8z + 15 = 0$

**Direction :** Consider the following for the **two (02)** items that follow :

Let $S$ be the line of intersection of two planes $x + y + z = 1$ and $2x + 3y - 4z = 8$.

**77.** Which of the following are the direction ratios of $S$?

(a) $\langle -7, -6, 1 \rangle$

(b) $\langle -7, 6, 1 \rangle$

(c) $\langle -6, 5, 1 \rangle$

(d) $\langle 6, 5, 1 \rangle$

**78.** If $\langle l, m, n \rangle$ are direction cosines of $S$, then what is the value of $43(l^2 - m^2 - n^2)$?

(a) 6

(b) 5

(c) 4

(d) 1

**Direction :** Consider the following for the **two (02)** items that follow :

Let $L: x + y + z + 4 = 0 = 2x - y - z + 8$ be a line and $P: x + 2y + 3z + 1 = 0$ be a plane.

**79.** What are the direction ratios of the line?

(a) $\langle 2, 1, -1 \rangle$

(b) $\langle 0, -1, 2 \rangle$

(c) $\langle 0, 1, -1 \rangle$

(d) $\langle 2, 3, -3 \rangle$

**80.** What is the point of intersection of $L$ and $P$?

(a) $(4, 3, -3)$

(b) $(4, -3, 3)$

(c) $(-4, -3, -3)$

(d) $(-4, -3, 3)$

**81.** Let $x - 3y + 4 = 0$ and $2x - 7y + 8 = 0$ be two lines of regression computed from some bivariate data. If $b_{yx}$ and $b_{xy}$ are regression coefficients of lines of regression of $y$ on $x$ and $x$ on $y$ respectively, then what is the value of $b_{xy} + 7b_{yx}$?

(a)  $-2$

(b)  $1$

(c)  $2$

(d)  $5$

**82.** The mean of $n$ observations

$$1,\ 4,\ 9,\ 16,\ \cdots,\ n^2$$

is 130. What is the value of $n$?

(a)  18

(b)  19

(c)  20

(d)  21

**83.** Three distinct natural numbers are chosen at random from 1 to 10. What is the probability that they are consecutive?

(a)  $1/12$

(b)  $3/40$

(c)  $1/15$

(d)  $7/120$

**84.** $A$, $B$, $C$ are three mutually exclusive and exhaustive events associated with a random experiment. If $3P(B) = 4P(A)$ and $3P(C) = 2P(B)$, then what is $P(A)$ equal to?

(a)  $7/29$

(b)  $8/29$

(c)  $9/29$

(d)  $10/29$

**85.** A die has two faces with number 4, three faces with number 5 and one face with number 6. If the die is rolled once, then what is the probability of getting 4 or 5?

(a)  $1/3$

(b)  $2/3$

(c)  $5/6$

(d)  $1/2$

**86.** A box contains 2 black, 4 yellow and 6 white balls. Three balls are drawn in succession with replacement. What is the probability that all three are of the same colour?

(a)  $1/6$

(b)  $1/36$

(c)  $1/12$

(d)  $5/12$.

**87.** A can hit a target 5 times in 6 shots, B can hit 4 times in 5 shots and C can hit 3 times in 4 shots. What is the probability that A and C may hit but B may lose?

(a) 1/8

(b) 1/6

(c) 1/4

(d) 1/3

**88.** The letters of the word ZOOLOGY are arranged in all possible ways. What is the probability that the consonants and vowels occur alternatively?

(a) 6/35

(b) 3/35

(c) 2/35

(d) 1/35

**89.** A natural number $x$ is chosen at random from the first 100 natural numbers. What is the probability that $x^2 + x > 50$?

(a) 93/100

(b) 47/50

(c) 24/25

(d) 23/25

**90.** What is the mean deviation of the first 10 natural numbers?

(a) 2

(b) 2·5

(c) 3

(d) 3·5

**Direction :** Consider the following for the two (02) items that follow :

Let $f \circ g(x) = \cos^2 \sqrt{x}$ and $g \circ f(x) = |\cos x|$.

**91.** Which one of the following is $f(x)$?

(a) $\cos x$

(b) $\cos x^2$

(c) $\cos^2 x$

(d) $\cos |x|$

**92.** Which one of the following is $g(x)$?

(a) $\sqrt{x}$

(b) $|x|$

(c) $x^2$

(d) $x|x|$

**Direction :** Consider the following for the two (02) items that follow :

Let $f(x) = [x]^2 - [x^2]$.

**93.** What is $f(0 \cdot 999) + f(1 \cdot 001)$ equal to?

(a) $-1$

(b) 0

(c) 1

(d) 2

**94.** Consider the following statements :

I.   $f(x)$ is continuous at $x = 0$.

II.  $f(x)$ is continuous at $x = 1$.

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

**Direction** : Consider the following for the two (02) items that follow :

Let $f(x) = \cos 2x + x$ on $[-\pi/2, \pi/2]$.

**95.** What is the greatest value of $f(x)$?

(a)  $\dfrac{\sqrt{3}}{2} - \dfrac{\pi}{12}$

(b)  $\dfrac{\sqrt{3}}{2} + \dfrac{\pi}{12}$

(c)  $\dfrac{\sqrt{3}}{2} + \dfrac{\pi}{9}$

(d)  $\dfrac{\sqrt{3}}{2} + \dfrac{\pi}{6}$

**96.** What is the least value of $f(x)$?

(a)  $-\left(1 + \dfrac{\pi}{2}\right)$

(b)  $-\left(\dfrac{1}{2} + \dfrac{\pi}{2}\right)$

(c)  $-\left(1 + \dfrac{\pi}{4}\right)$

(d)  $-2\left(\dfrac{1}{2} - \dfrac{\pi}{4}\right)$

**Direction** : Consider the following for the two (02) items that follow :

The area bounded by the parabola $y^2 = kx$ and the line $x = k$, where $k > 0$, is 4/3 square units.

**97.** What is the value of $k$?

(a)  1/2

(b)  1

(c)  $\sqrt{2}$

(d)  2

**98.** What is the area of the parabola bounded by the latus rectum?

(a) 1/6 square unit

(b) 2/3 square unit

(c) 1 square unit

(d) 4/3 square units

**Direction** : Consider the following for the **two (02)** items that follow :

Let $y\,dx + (x - y^3)\,dy = 0$ be a differential equation.

**99.** What are the order and degree respectively of the differential equation?

(a) 1 and 1

(b) 1 and 2

(c) 2 and 1

(d) 1 and 3

**100.** What is the solution of the differential equation?

(a) $y^4 + 2x = c$

(b) $y^4 + 3x = c$

(c) $2xy^4 + x = c$

(d) $4xy - y^4 = c$

**Direction** : Consider the following for the **two (02)** items that follow :

Let $Z_1$ and $Z_2$ be any two complex numbers such that $Z_1^2 + Z_2^2 + Z_1 Z_2 = 0$.

**101.** What is the value of $\left| \dfrac{Z_1}{Z_2} \right|$?

(a) 1

(b) 2

(c) 3

(d) 4

**102.** What is the value of

$$\frac{1}{2} + \mathrm{Re}\left( \frac{Z_1}{Z_2} \right)?$$

(a) $-1$

(b) 0

(c) 1

(d) 2

**Direction** : Consider the following for the **two (02)** items that follow :

The product of 5 consecutive terms of an AP is 229635. The first, second and fifth terms are in GP.

**103.** What is the common difference?

(a) 3

(b) 4

(c) 5

(d) 6 ·

**104.** What is the sum of all five terms?

(a) 60

(b) 65

(c) 75

(d) 80

**Direction :** Consider the following for the two (02) items that follow :

Let $(8 + 3\sqrt{7})^{20} = U + V$ and $(8 - 3\sqrt{7})^{20} = W$, where $U$ is an integer and $0 < V < 1$.

**105.** What is $V + W$ equal to?

(a) 8

(b) 4

(c) 2

(d) 1

**106.** What is the value of $(U + V)W$?

(a) 1/2

(b) 1

(c) 3/2

(d) 2

**Direction :** Consider the following for the two (02) items that follow :

The roots of the quadratic equation

$$a^2(b^2 - c^2)x^2 + b^2(c^2 - a^2)x + c^2(a^2 - b^2) = 0$$

are equal $(a^2 \neq b^2 \neq c^2)$.

**107.** Which one of the following statements is correct?

(a) $a^2$, $b^2$, $c^2$ are in AP.

(b) $a^2$, $b^2$, $c^2$ are in GP.

(c) $a^2$, $b^2$, $c^2$ are in HP.

(d) $a^2$, $b^2$, $c^2$ are neither in AP nor in GP nor in HP.

**108.** Which one of the following is a root of the equation?

(a) $\dfrac{b^2(c^2 - a^2)}{a^2(c^2 - b^2)}$

(b) $\dfrac{b^2(c^2 - a^2)}{a^2(b^2 - c^2)}$

(c) $\dfrac{b^2(c^2 - a^2)}{2a^2(c^2 - b^2)}$

(d) $\dfrac{b^2(c^2 - a^2)}{2a^2(b^2 - c^2)}$

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**Direction :** Consider the following for the two (02) items that follow :

Let

$$A = \begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$$

**109.** What is $A\,(\text{adj}\,A)$ equal to?

(a) $\begin{bmatrix} 5 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{bmatrix}$

(b) $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$

(c) $\begin{bmatrix} 1/2 & 0 & 0 \\ 0 & 1/2 & 0 \\ 0 & 0 & 1/2 \end{bmatrix}$

(d) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

**110.** What is $A^{-1}$ equal to?

(a) $\begin{bmatrix} 1 & -1 & 0 \\ -2 & 3 & -4 \\ -2 & 3 & -3 \end{bmatrix}$

(b) $\begin{bmatrix} 1/2 & -1/2 & 0 \\ -1 & 3/2 & -2 \\ -1 & 3/2 & -3/2 \end{bmatrix}$

(c) $\begin{bmatrix} 2 & -2 & 0 \\ -4 & 6 & -8 \\ -4 & 6 & -6 \end{bmatrix}$

(d) $\begin{bmatrix} 1/5 & -1/5 & 0 \\ -2/5 & 3/5 & -4/5 \\ -2/5 & 3/5 & -3/5 \end{bmatrix}$

**111.** Consider the following numbers :

I. $\tan 22\cdot 5°$

II. $\cot 22\cdot 5°$

III. $\tan 22\cdot 5° - \cot 22\cdot 5°$

How many of the above are irrational numbers?

(a) None

(b) Only one

(c) Only two

(d) All three

**112.** If

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

then what is $x + y + z$ equal to?

(a) $-1$

(b) $0$

(c) $1$

(d) $3$

**113.** If $p\tan(\theta - 30°) = q\tan(\theta + 120°)$, then what is $(p+q)/(p-q)$ equal to?

(a) $\sin 2\theta$

(b) $\cos 2\theta$

(c) $2\sin 2\theta$

(d) $2\cos 2\theta$

**114.** Let $P$ and $Q$ be two non-void relations on a set $A$. Which of the following statements are correct?

I. $P$ and $Q$ are reflexive $\Rightarrow P \cap Q$ is reflexive.

II. $P$ and $Q$ are symmetric $\Rightarrow P \cup Q$ is symmetric.

III. $P$ and $Q$ are transitive $\Rightarrow P \cap Q$ is transitive.

Select the answer using the code given below.

(a) I and II only

(b) II and III only

(c) I and III only

(d) I, II and III

**115.** If $A$ and $B$ are two non-empty sets having 10 elements in common, then how many elements do $A \times B$ and $B \times A$ have in common?

(a) 10

(b) 20

(c) 40

(d) 100

**116.** What is the remainder when $7^n - 6n$ is divided by 36 for $n = 100$?

(a) 0

(b) 1

(c) 2

(d) 6

**117.** What is the maximum number of possible points of intersection of four straight lines and a circle (intersection is between lines as well as circle and lines)?

(a) 6

(b) 10

(c) 14

(d) 16

**118.** In an AP, the ratio of the sum of the first $p$ terms to the sum of the first $q$ terms is $p^2 : q^2$. Which one of the following is correct?

(a) The first term is equal to the common difference

(b) The first term is equal to twice the common difference

(c) The common difference is equal to twice the first term

(d) The first term is equal to square of the common difference

**119.** What is the number of real roots of the equation $(x - 1)^2 + (x - 3)^2 + (x - 5)^2 = 0$?

(a) None

(b) Only one

(c) Only two

(d) Three

**120.** In a class of 240 students, 180 passed in English, 130 passed in Hindi and 150 passed in Sanskrit. Further, 60 passed in only one subject, 110 passed in only two subjects and 10 passed in none of the subjects. How many passed in all three subjects?

(a) 60

(b) 55

(c) 40

(d) 35