A square matrix A is called orthogonal, if

(a) $A = A^2$ **(b)** $A' = A^{-1}$

(c) $A = A^{-1}$ **(d)** $A = A'$

where A' is the transpose of A.

What is the value of

$$\left(\frac{-1+i\sqrt{3}}{2}\right)^{3n}+\left(\frac{-1-i\sqrt{3}}{2}\right)^{3n},$$

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

(a) 3

(b) 2

(c) 1

(d) 0

Let T_r be the r^{th} term of an AP for $r = 1, 2, 3, ...$ If for some distinct positive integers m and n we have $T_m = \frac{1}{n}$ and $T_n = \frac{1}{m}$, then what is T_{mn} equal to?

(a) $(mn)^{-1}$

(b) $m^{-1} + n^{-1}$

(c) 1

(d) 0

Consider the following in respect of matrices A and B of same order:

(1) $A^2 - B^2 = (A + B)(A - B)$

(2) $(A - I)(I + A) = O \Leftrightarrow A^2 = 1$

where I is the identity matrix and O is the null matrix.

Which of the above is/are correct?

(a) 1 only **(b)** 2 only

(c) Both 1 and 2 **(d)** Neither 1 nor 2

Consider the following statements:

(1) The distance between the lines $y = mx + c_1$ and $y = mx + c_2$ is $\dfrac{|c_1 - c_2|}{\sqrt{1+m^2}}$.

(2) The distance between the lines $ax + by + c_1 = 0$ and $ax + by + c_2 = 0$ is

$$\frac{|c_1 - c_2|}{\sqrt{a^2 + b^2}}.$$

(3) The distance between the lines $x = c_1$ and $x = c_2$ is $|c_1 - c_2|$.

Which of the above statements are correct?

(a) 1 and 2 only **(b)** 2 and 3 only

(c) 1 and 3 only **(d)** 1, 2 and 3

What is the area of the triangle with vertices $\left(x_1, \frac{1}{x_1}\right), \left(x_2, \frac{1}{x_2}\right), \left(x_3, \frac{1}{x_3}\right)$?

(a) $|(x_1 - x_2)(x_2 - x_3)(x_3 - x_1)|$

(b) 0

(c) $\left|\frac{(x_1 - x_2)(x_2 - x_3)(x_3 - x_1)}{x_1 x_2 x_3}\right|$

(d) $\left|\frac{(x_1 - x_2)(x_2 - x_3)(x_3 - x_1)}{2x_1 x_2 x_3}\right|$

If $|\vec{a}| = 3, |\vec{b}| = 4$ and $|\vec{a} - \vec{b}| = 5$, then what is the value of $|\vec{a} + \vec{b}|$?

(a) 8

(b) 6

(c) $5\sqrt{2}$

(d) 5

What is $\int e^{\ln(\tan x)}\, dx$ equal to?

(a) $\ln|\tan x| + c$

(b) $\ln|\sec x| + c$

(c) $\tan x + c$

(d) $e^{\tan x} + c$

Consider the following statements:

(1) If 10 is added to each entery on a list, then the average increases by 10.

(2) If 10 is added to each entry on a list, then the standard deviation increases by 10.

(3) If each entry on a list is doubled, then the average doubles.

Which of the above statements are correct?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

The variance of 25 observations is 4. If 2 is added to each observation, then the new variance of the resulting observations is

(a) 2 **(b)** 4

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

If the regression coefficient of Y on X is -6, and the correlation coefficient between X and Y is $-\frac{1}{2}$, then the regression coefficient of X on Y would be

(a) $\frac{1}{24}$

(b) $-\frac{1}{24}$

(c) $-\frac{1}{6}$

(d) $\frac{1}{6}$

What is the number of diagonals of an octagon?

(a) 48 **(b)** 40

(c) 28 **(d)** 20

What is $C(47, 4) + C(51, 3) + C(50, 3) + C(49, 3) + C(48, 3) + C(47, 3)$ equal to?

(a) $C(47, 4)$ **(b)** $C(52, 5)$

(c) $C(52, 4)$ **(d)** $C(47, 5)$

What is the value of

$1 - 2 + 3 - 4 + 5 - ..... + 101$?

(a) 51 **(b)** 55

(c) 110 **(d)** 111

If the sum of first n terms ot a series is $(n + 12)$, then what is its third term?

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

(c) 3 **(d)** 4

If α and β are the roots of $x^2 + x + 1 = 0$, then what is $\sum_{j=0}^{3}\left(\alpha^j + \beta^j\right)$ equal to ?

(a) 8 **(b)** 6

(c) 4 **(d)** 2

If $A = \begin{pmatrix} 1 & 2 \\ 2 & 3 \\ 3 & 4 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix}$, then which one of the following is correct?

(a) Both AB and BA exist

(b) Neither AB nor BA exists

(c) AB exists but BA does not exist

(d) AB does not exist but BA exists

Let $A \cup B = \{x \mid (x-a)(x-b) > 0$, where $a < b\}$, what are A and B equal to?

(a) $A = \{x \mid x > a\}$ and $B = \{x \mid x > b\}$

(b) $A = \{x \mid x < a\}$ and $B = \{x \mid x > b\}$

(c) $A = \{x \mid x < a\}$ and $B = \{x \mid x < b\}$

(d) $A = \{x \mid x > a\}$ and $B = \{x \mid x < b\}$

Let S_n be the sum of the first n terms of an AP. If $S_{2n} = 3n + 14n^2$, then what is the common difference?

(a) 5 **(b)** 6

(c) 7 **(d)** 9

A binary number is represented by $(cdccddcccddd)_2$, where $c > d$, what is its decimal equivalent?

(a) 1848 **(b)** 2048

(c) 2842 **(d)** 2872

If the angle between the lines joining the end points of minor axis of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ with one of its foci is $\frac{\pi}{2}$, then what is the eccentricity of the ellipse?

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

(b) $\frac{1}{\sqrt{2}}$

(c) $\frac{\sqrt{3}}{2}$

(d) $\frac{1}{2\sqrt{2}}$

What is $\sin(\alpha + \beta) - 2\sin\alpha\cos\beta + \sin(\alpha - \beta)$ equal to?

(a) 0 **(b)** $2\sin\alpha$

(c) $2\sin\beta$ **(d)** $\sin\alpha + \sin\beta$

If $2\tan A = 3\tan B = 1$, then what is $\tan(A - B)$ equal to?

(a) $\frac{1}{5}$ **(b)** $\frac{1}{6}$

(c) $\frac{1}{7}$ **(d)** $\frac{1}{9}$

What is the moment about the point $\hat{i}+2\hat{j}-\hat{k}$ of a force represented by $3\hat{i}+\hat{k}$ acting through the point $2\hat{i}-\hat{j}+3\hat{k}$?

(a) $-3\hat{i}+11\hat{j}+9\hat{k}$

(b) $3\hat{i}+2\hat{j}+9\hat{k}$

(c) $3\hat{i}+4\hat{j}+9\hat{k}$

(d) $\hat{i}+\hat{j}+\hat{k}$

What is the maximum value of $16 \sin \theta - 12\sin^2 \theta$?

(a) $\frac{3}{4}$

(b) $\frac{4}{3}$

(c) $\frac{16}{3}$

(d) 4

What is the period of the function $f(x) = \sin x$?

(a) $\frac{\pi}{4}$

(b) $\frac{\pi}{2}$

(c) π

(d) 2π

If $\int_a^b x^3 dx = 0$ and $\int_a^b x^2 dx = \frac{2}{3}$, then what are the values of a and b respectively?

(a) $-1, 1$ **(b)** $1, 1$

(c) $0, 0$ **(d)** $2, -2$

What is $\int_0^1 x(1-x)^9 \, dx$ equal to?

(a) $\frac{1}{110}$ **(b)** $\frac{1}{132}$

(c) $\frac{1}{148}$ **(d)** $\frac{1}{240}$

If $f(x)$ is an even function, whare $f(x) \neq 0$, then which one of the following is correct?

(a) $f'(x)$ is an even function.

(b) $f'(x)$ is an odd function.

(c) $f'(x)$ may be an even or odd function depending on the type of function.

(d) $f'(x)$ is a constant function.

What are the order and degree, respectively, of the differential equation

$$\left(\frac{d^3y}{dx^3}\right)^2 = y^4 + \left(\frac{dy}{dx}\right)^5 ?$$

(a) 4, 5

(b) 2, 3

(c) 3, 2

(d) 5, 4

Consider the following statements:

(1) Mean is independent of change in scale and change in origin.

(2) Variance is independent of change in scale but not in origin.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

Consider the following statements:

(1) The sum of deviations from mean is always zero.

(2) The sum of absolute deviations is minimum when taken around median.

Which of the above statements is/are correct?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

The standard deviation σ of the first N natural numbers can be obtained using which one of the following formulae?

(a) $\sigma = \dfrac{N^2 - 1}{12}$

(b) $\sigma = \sqrt{\dfrac{N^2 - 1}{12}}$

(c) $\sigma = \sqrt{\dfrac{N - 1}{12}}$

(d) $\sigma = \sqrt{\dfrac{N^2 - 1}{6N}}$

If $C(20, n+2) = C(20, n-2)$, then what is n equal to?

(a) 8 **(b)** 10

(c) 12 **(d)** 16

There are 10 points in a plane. No three of these points are in a straight line. What is the total number of straight lines which can be formed by joining the points?

(a) 90 **(b)** 45

(c) 40 **(d)** 30

If A is an identity matrix of order 3, then its inverse (A^{-1})

(a) is equal to null matrix

(b) is equal to A

(c) is equal to 3A

(d) does not exist

A is a square matrix of order 3 such that its determinant is 4. What is the determinant of its transpose?

(a) 64

(b) 36

(c) 32

(d) 4

What is the number of terms in the expansion of $[(2x - 3y\}^2 (2x + 3y)^2]^2$?

(a) 4 **(b)** 5

(c) 8 **(d)** 16

If A is a square matrix of order $n > 1$, then which one of the following is correct?

(a) $\det(-A) = \det A$

(b) $\det(-A) = (-1)^n \det A$

(c) $\det(-A) = -\det A$

(d) $\det(-A) = n \det A$

What is the least value of $25\,\text{cosec}^2 x + 36\,\sec^2 x$?

(a) 1

(b) 11

(c) 120

(d) 121

Consider the following for the next 02 (two) items:

Let A and B be (3×3) matrices with $\det A = 4$ and $\det B = 3$.

What is $\det(2AB)$ equal to?

(a) 96 **(b)** 72

(c) 48 **(d)** 36

What is $\det(3AB^{-1})$ equal to?

(a) 12 **(b)** 18

(c) 36 **(d)** 48

What is the value of $\tan 75^\circ + \cot 75^\circ$?

(a) 2

(b) 4

(c) $2\sqrt{3}$

(d) $4\sqrt{3}$

If $\sin 2\theta = \cos 3\theta$, where $0 < \theta < \frac{\pi}{2}$, then what is $\sin\theta$ equal to?

(a) $\frac{\sqrt{5}+1}{4}$ **(b)** $\frac{\sqrt{5}-1}{4}$

(c) $\frac{\sqrt{5}+1}{16}$ **(d)** $\frac{\sqrt{5}-1}{16}$

If the roots of the equation $x^2 + px + q = 0$ are $\tan 9°$ and $\tan 26°$, then which one of the following is correct?

(a) $q - p = 1$ **(b)** $p - q = 1$

(c) $p + q = 2$ **(d)** $p + q = 3$

Consider the following statements:

(1) For an equation of a line, $x\cos\theta + y\sin\theta = p$, in normal form, the length of the perpendicular from the point (α, β) to the line is $|\alpha\cos\theta + \beta\sin\theta + p|$.

(2) The length of the perpendicular from the point (α, β) to the line $\frac{x}{a} + \frac{y}{b} = 1$ is

$$\left|\frac{a\alpha + b\beta - ab}{\sqrt{a^2 + b^2}}\right|$$

which of the above statements is/are correct?

(a) 1 only **(b)** 2 only

(c) Both 1 and 2 **(d)** Neither 1 nor 2

The sum of the focal distances of a point on an ellipse is constant and equal to the

(a) length of minor axis

(b) length of major axis

(c) length of latus rectum

(d) sum of the lengths of semi-major and semi-minor axes

The equation $2x^2 - 3y^2 - 6 = 0$ represents

(a) a circle **(b)** a parabola

(c) an ellipse **(d)** a hyperbola

The centroid of the triangle with vertices $A(2, -3, 3)$, $B(5, -3, -4)$ and $C(2, -3, -2)$ is the point

(a) $(-3, 3, -1)$ **(b)** $(3, -3, -1)$

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

What are the direction cosines of z-axis?

(a) $< 1, 1, 1 >$ **(b)** $< 1, 0, 0 >$

(c) $< 0, 1, 0 >$ **(d)** $< 0, 0, 1 >$

If $y = a\cos 2x + b\sin 2x$, then

(a) $\frac{d^2y}{dx^2} + y = 0$

(b) $\frac{d^2y}{dx^2} + 2y = 0$

(c) $\frac{d^2y}{dx^2} - 4y = 0$

(d) $\frac{d^2y}{dx^2} + 4y = 0$

What is $\int e^{x\ln(a)}\,dx$ equal to?

(a) $\dfrac{a^x}{\ln(a)}+c$

(b) $\dfrac{e^x}{\ln(a)}+c$

(c) $\dfrac{e^x}{\ln(ae)}+c$

(d) $\dfrac{ae^x}{\ln(a)}+c$

Which one of the following is a square root of $2a + 2\sqrt{a^2 + b^2}$, where $a, b \in \mathrm{R}$?

(a) $\sqrt{a+ib} + \sqrt{a-ib}$

(b) $\sqrt{a+ib} - \sqrt{a-ib}$

(c) $2a + ib$

(d) $2a - ib$

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

Suppose 20 distinct points are placed randomly on a circle. Which of the following statements is/are correct?

1. The number of straight lines that can be drawn by joining any two of these points is 380.
2. The number of triangles that can be drawn by joining any three of these points is 1140.

Select the correct answer using the code given below.

(a) 1 only **(b)** 2 only

(c) Both 1 and 2 **(d)** Neither 1 nor 2

What is the period of the function $f(x) = \ln(2 + \sin^2 x)$?

(a) $\frac{\pi}{2}$

(b) π

(c) 2π

(d) 3π

If $\sum_{i=1}^{10} x_i = 110$ and $\sum_{i=1}^{10} x_i^2 = 1540$ then what is the variance?

(a) 22 **(b)** 33

(c) 44 **(d)** 55

If $C(20, n+2) = C(20, n-2)$, then what is n equal to?

(a) 18 **(b)** 25

(c) 10 **(d)** 12

For how many values of k, is the matrix $\begin{bmatrix} 0 & k & 4 \\ -k & 0 & -5 \\ -k & k & -1 \end{bmatrix}$ singular?

(a) Only one
(b) Only two
(c) Only four
(d) Infinite

What is $\sin 3x + \cos 3x + 4 \sin^3 x - 3 \sin x + 3 \cos x - 4 \cos^3 x$ equal to?

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

(c) $2 \sin 2x$ **(d)** $4 \cos 4x$

The value of ordinate of the graph of $y = 2 + \cos x$ lies in the interval

(a) [0, 1] **(b)** [0, 3]

(c) [– 1, 1] **(d)** [1, 3]

What is the value of $8 \cos 10^\circ . \cos 20^\circ . \cos 40^\circ$?

(a) $\tan 10^\circ$ **(b)** $\cot 10^\circ$

(c) $\operatorname{cosec} 10^\circ$ **(d)** $\sec 10^\circ$

Directions for the following three (03) items:

Read the following information and answer the three items that follow:

Let $\alpha = \beta = 15°$.

What is the value of $\sin \alpha + \cos \beta$?

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

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

What is the value of $\sin 7\alpha - \cos 7\beta$?

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

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

Let p, q and r be three distinct positive real number, If $D = \begin{vmatrix} p & q & r \\ q & r & p \\ r & p & q \end{vmatrix}$, then which one of the following is correct?

(a) $D < 0$ **(b)** $D \leq 0$

(c) $D > 0$ **(d)** $D \geq 0$

Let ABC be a triangle. If D(2, 5) and E(5, 9) are the mid-points of the sides AB and AC respectively, then what is the length of the side BC?

(a) 8 **(b)** 10

(c) 12 **(d)** 14

Into how many compartments do the coordinate planes divide the space?

(a) 2 **(b)** 4

(c) 8 **(d)** 16

If $|\vec{a} \times \vec{b}|^2 + |\vec{a} \cdot \vec{b}|^2 = 144$ and $|\vec{a}| = 4$, then what is $|\vec{b}|$ equal to?

(a) 3 **(b)** 4

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

If $\lim_{x \to 1} \frac{x^4 - 1}{x - 1} = \lim_{x \to k} \frac{x^3 - k^3}{x^2 - k^2}$, where $k \neq 0$, then what is the value of k?

(a) $\frac{2}{3}$

(b) $\frac{4}{3}$

(c) $\frac{8}{3}$

(d) 4

What is the minimum value of $|x - 1|$, where $x \in R$?

(a) 0

(b) 1

(c) 2

(d) – 1

What is the derivative of $\tan^{-1} x$ with respect to $\cot^{-1} x$?

(a) -1

(b) 1

(c) $\dfrac{1}{x^2+1}$

(d) $\dfrac{x}{x^2+1}$

What is the minimum value of $3\cos\left(A+\frac{\pi}{3}\right)$ where $A \in R$?

(a) -3

(b) -1

(c) 0

(d) 3