For a square matrix A, which of the following properties hold?

(1) $(A^{-1})^{-1} = A$

(2) $\det(A^{-1}) = \frac{1}{\det A}$

(3) $(\lambda A)^{-1} = \lambda A^{-1}$, where λ is a scalar

Select the correct answer using the code given below:

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Which one of the following factors does the expansion of the determinant $\begin{vmatrix} x & y & 3 \\ x^2 & 5y^3 & 9 \\ x^3 & 10y^5 & 27 \end{vmatrix}$ contain?

(a) $x - 3$

(b) $x - y$

(c) $y - 3$

(d) $x - 3y$

Let matrix B be the adjoint of a square matrix A, l be the identity matrix of same order as A. If k ($\neq 0$), is the determinant of the matrix A, then what is AB equal to?

(a) l

(b) kl

(c) $k^2 l$

(d) $\left(\frac{1}{k}\right) l$

If a, b, c are in A.P. or G.P. or H.P., then $\frac{a-b}{b-c}$ is equal to

(a) $\frac{b}{a}$ or 1 or $\frac{b}{c}$

(b) $\frac{c}{a}$ or $\frac{c}{b}$ or 1

(c) 1 or $\frac{a}{b}$ or $\frac{a}{c}$

(d) 1 or $\frac{a}{b}$ or $\frac{c}{a}$

For the function $f(x) = |x - 3|$, which one of the following is not correct?

(a) The function is not continuous at $x = -3$

(b) The function is continuous at $x = 3$

(c) The function is differentiable at $x = 0$

(d) The function is differentiable at $x = -3$

What is $\int_a^b [x]dx + \int_a^b [-x]dx$ equal to,

where [.] is the greatest integer function?

(a) $b - a$ **(b)** $a - b$

(c) 0 **(d)** $2(b - a)$

What is the inverse of the matrix

$$A = \begin{pmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix} ?$$

(a) $\begin{pmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$ **(b)** $\begin{pmatrix} \cos\theta & 0 & -\sin\theta \\ 0 & 1 & 0 \\ \sin\theta & 0 & \cos\theta \end{pmatrix}$

(c) $\begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{pmatrix}$ **(d)** $\begin{pmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$

If the roots of the equation $a(b-c)x^2 + b(c-a)x + c(a-b) = 0$ are equal, then which one of the following is correct?

(a) a, b and c are in AP

(b) a, b and c are in GP

(c) a, b and c are in HP

(d) a, b and c do not follow any regular pattern

If $x + a + b + c = 0$, then what is the value of

$$\begin{vmatrix} x+a & b & c \\ a & x+b & c \\ a & b & x+c \end{vmatrix} ?$$

(a) 0

(b) $(a+b+c)^2$

(c) $a^2+b^2+c^2$

(d) $a+b+c-2$

If $A = \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$, then the expression $A^3 - 2A^2$ is

(a) a null matrix

(b) an identity matrix

(c) equal to A

(d) equal to –A

What is the value of

$$\left[\frac{i+\sqrt{3}}{2}\right]^{2019}+\left[\frac{i-\sqrt{3}}{2}\right]^{2019} ?$$

(a) 1 **(b)** – 1

(c) $2i$ **(d)** – $2i$

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 $P(n, r) = 2520$ and $C(n, r) = 21$, then what is the value of $C(n + 1, r + 1)$?

(a) 7 **(b)** 14

(c) 28 **(d)** 56

How many terms are there in the expansion of $(1 + 2x + x^2)^5 + (1 + 4y + 4y^2)^5$?

(a) 12 **(b)** 20

(c) 21 **(d)** 22

If the middle term in the expansion of $\left(x^2+\frac{1}{x}\right)^{2n}$ is $184756x^{10}$, then what is the value of n?

(a) 10

(b) 8

(c) 5

(d) 4

If $n!$ has 17 zeroes, then what is the value of n?

(a) 95

(b) 85

(c) 80

(d) No such values of n exists

Let a, b, c be in AP and $k \neq 0$ be a real number, Which of the following are correct?

(1) ka, kb, kc are in AP

(2) $k-a, k-b, k-c$ are in AP

(3) $\frac{a}{k}, \frac{b}{k}, \frac{c}{k}$ are in AP

Select the correct answer using the code given below:

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

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

If 3^{rd}, 8^{th} and 13^{th} terms of a GP are p, q and r respectively, then which one of the following is correct?

(a) $q^2 = pr$

(b) $r^2 = pq$

(c) $pqr = 1$

(d) $2q = p + r$

How many real roots does the equation $x^2 + 3|x| + 2 = 0$ have?

(a) Zero

(b) One

(c) Two

(d) Four

Consider the following statements:

(1) $\cos\theta + \sec\theta$ can never be equal to 1.5.

(2) $\tan\theta + \cot\theta$ can never be less than 2.

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 equations for two vectors $\vec{a}$ and $\vec{b}$:

(1) $\left(\vec{a}+\vec{b}\right).\left(\vec{a}-\vec{b}\right)=\left|\vec{a}\right|^2-\left|\vec{b}\right|^2$

(2) $\left(\left|\vec{a}+\vec{b}\right|\right)\left(\left|\vec{a}-\vec{b}\right|\right)=\left|\vec{a}\right|^2-\left|\vec{b}\right|^2$

(3) $|\vec{a}.\vec{b}|^2 + |\vec{a} \times \vec{b}|^2 = |\vec{a}|^2 |\vec{b}|^2$

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

If $\vec{a}$ and $\vec{b}$ are unit vectors and θ is the angle between them, then what is $\sin^2\left(\frac{\theta}{2}\right)$ equal to?

(a) $\frac{|\bar{a}+\bar{b}|^2}{4}$

(b) $\frac{|\bar{a}-\bar{b}|^2}{4}$

(c) $\frac{|\bar{a}+\bar{b}|^2}{2}$

(d) $\frac{|\bar{a}-\bar{b}|^2}{2}$

The equation $ax + by + c = 0$ represents a straight line

(a) for all real numbers a, b and c

(b) only when $a \neq 0$

(c) only when $b \neq 0$

(d) only when at least one of a and b is non-zero

If the angles of a triangle ABC are in AP and $b : c = \sqrt{3} : \sqrt{2}$, then what is the measure of angle A?

(a) 30°

(b) 45°

(c) 60°

(d) 75°

What is the degree of the differential equation

$$\frac{d^3y}{dx^3}+\left(\frac{dy}{dx}\right)^2-x^2\left(\frac{d^4y}{dx^4}\right)=0?$$

(a) 1

(b) 2

(c) 3

(d) 4

Directions for the following three (03) items :

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

Consider the function $f(x) = g(x) + h(x)$

where $g(x) = \sin\left(\frac{x}{4}\right)$ and $h(x) = \cos\left(\frac{4x}{5}\right)$

What is the period of the function $g(x)$?

(a) π **(b)** 2π

(c) 4π **(d)** 8π

What is the period of the function $h(x)$?

(a) π **(b)** $\frac{5\pi}{2}$

(c) $\frac{5\pi}{2}$ **(d)** $\frac{3\pi}{2}$

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

(a) 10π **(b)** 20π

(c) 40π **(d)** 80π

For what value of k is the function

$$f(x)=\begin{cases}2x+\dfrac{1}{4}, & x<0\\ k, & x=0\\ \left(x+\dfrac{1}{2}\right)^2, & x>0\end{cases}$$

continuous ?

(a) $\frac{1}{4}$

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

(c) 1

(d) 2

The mean of 5 observations is 4.4 and variance is 8.24. If three of the five observations are 1, 2 and 6, then what are the other two observations?

(a) 9, 16 **(b)** 9, 4

(c) 81, 16 **(d)** 81, 4

The mean weight of 150 students in a certain class is 60 kg. The mean weight of boys is 70 kg and that of girls is 55 kg. What are the number of boys and girls respectively in the class?

(a) 75 and 75

(b) 50 and 100

(c) 70 and 80

(d) 100 and 50

If $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$, then the malrix A is a/an

(a) Singular matrix **(b)** Involutory matrix

(c) Nilpotent matrix **(d)** Idempotent matrix

If A is a matrix of order 3×5 and B is a matrix of order 5×3, then the order of AB and BA will respectively be

(a) 3×3 and 3×3 **(b)** 3×5 and 5×3

(c) 3×3 and 5×5 **(d)** 5×3 and 3×5

If p^2, q^2 and r^2 (where $p, q, r > 0$) are in GP, then which of the following is/are correct?

(1) p, q and r are in GP.

(2) $\ln p$, $\ln q$ and $\ln r$ are in AP.

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

The roots α and β of a quadratic equation, satisfy the relations $\alpha + \beta = \alpha^2 + \beta^2$ and $\alpha\beta = \alpha^2\beta^2$. What is the number of such quadratic equations?

(a) 0 **(b)** 2

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

What is the argument of the complex number $\frac{1-i\sqrt{3}}{1+i\sqrt{3}}$, where $i = \sqrt{-1}$?

(a) 240° **(b)** 210°

(c) 120° **(d)** 60°

Consider the following in respect of a non-singular matrix of order 3:

(1) A (adj A) = (adj A) A

(2) |adj A| = |A|

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 center of the circle

$(x - 2a)(x - 2b) + (y - 2c)(y - 2d) = 0$ is

(a) $(2a, 2c)$ **(b)** $(2b, 2d)$

(c) $(a + b, c + d)$ **(d)** $(a - b, c - d)$

Let $P(x, y)$ be any point on the ellipse $25x^2 + 16y^2 = 400$. If $Q(0, 3)$ and $R(0, -3)$ are two points, then what is $(PQ + PR)$ equal to?

(a) 12 **(b)** 10

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

If *a* line has direction ratios $< a+b, b+c, c+a >$, then what is the sum of the squares of its direction cosines?

(a) $(a+b+c)^2$ **(b)** $2(a+b+c)$

(c) 3 **(d)** 1

If $x^2 + x + 1 = 0$, then what is the value of $x^{199} + x^{200} + x^{201}$?

(a) -2 **(b)** 0

(c) 1 **(d)** 3

If x, y, z are in GP, then which of the following is/are correct?

(1) $\ln(3x), \ln(3y), \ln(3z)$ are in AP

(2) $xyz + \ln(x), xyz + \ln(y), xyz + \ln(z)$ are in HP

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

If $\log_{10} 2$, $\log_{10} (2^x - 1)$, $\log_{10} (2^x + 3)$ are in AP, then what is x equal to?

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

(c) $\log_2 5$ **(d)** $\log_5 2$

If $\frac{1}{b+c}, \frac{1}{c+a}, \frac{1}{a+b}$ are in HP, then which of the following is/are correct?

(1) a, b, c are in AP

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

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 $\sum_{n=1}^{8n+7} i^n$ equal to, where $i = \sqrt{-1}$?

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

(c) i **(d)** $-i$

If $z = x + iy$, where $i = \sqrt{-1}$, then what does the equation $z\bar{z} + + |z|^2 + 4(z + \bar{z}) - 48 = 0$ represent?

(a) Straight line

(b) Parabola

(c) Circle

(d) Pair of straight lines