QUESTION 1

For $x^3 - 5x^2 = 7x + 6$, let

$$\begin{aligned} A &= \text{the number of complex roots} \\ B &= \text{the sum of the roots} \\ C &= \text{the sum of the roots taken two at a time} \\ D &= \text{the sum of the squares of the roots} \end{aligned}$$

Find $A + B + C - D$.

QUESTION 2

Let $\sin(x) = \dfrac{3}{5}$ and $\cos(y) = \dfrac{-15}{17}$ such that x is in the first quadrant and y is in the third quadrant. Let

$$\begin{aligned} A &= \sin(x-y) \\ B &= \cos(x+y) \\ C &= \tan(x+y) \\ D &= \sin(2y) \end{aligned}$$

Find $85A - 85B + 36C - 289D$.

QUESTION 3

Let

$$\begin{aligned} A &= \text{the length of the radius of } x^2+y^2-6x-10y+7=0 \\ B &= \text{the length of the latus rectum of } y=3x^2+18x+28 \\ C &= \text{the length of the transverse-axis of } 4x^2+9y^2-48x+72y+144=0 \\ D &= \text{the sum of the slopes of the asymptotes of } 16x^2-9y^2-64x+18y-89=0 \end{aligned}$$

Find $(A^2+B-C)^D$.

QUESTION 4

Let

$$\begin{aligned} A &= \sum_{i=1}^{90} \sin^2(i^\circ) \\ B &= \prod_{i=2}^{1023} \log_i(i+1) \\ C &= \sum_{i=0}^{8} \cos(\frac{\pi}{10} + \frac{2i\pi}{9}) \\ D &= \prod_{x=2}^{11} e^{(\frac{ix\pi}{6})} \end{aligned}$$

Find $A + B + C + D$.

QUESTION 5

Jasmine is riding a ferris wheel such that her distance to the ground varies sinusoidally over time. If she starts slightly past the bottom of the ride, it takes her 4 seconds to reach the top of the Ferris wheel, which stands 40 feet above the ground. The radius of the wheel is 15 feet and takes 20 seconds for a complete revolution. Jasmine's height above the ground can be described by $y = A\cos(\frac{\pi}{B}(t - C)) + D$ such that y is in feet and t is in seconds.

Find $A + B + C - D$.

QUESTION 6

Let

$$\begin{aligned} A &= \langle 2,1,-1\rangle \cdot \langle -3,4,1\rangle \\ B &= |\langle 2,1,-1\rangle \times \langle -3,4,1\rangle| \\ C &= \text{tangent of the angle between } \langle 2,1,-1\rangle \text{ and } \langle -3,4,1\rangle \\ D &= \langle 2015,2014\rangle \cdot \langle 2015,-2014\rangle \end{aligned}$$

Find $\dfrac{A}{B} + C + D$.

QUESTION 7

The planes $-3x + 6y + 7z = 2$ and $x + Ay + Bz = 6$ are perpendicular. The plane of the second equation also passes through the point (-3,6,5). Find the values of A and B.

A circle contains the points (1,3) and (-2,9). Find the value of X such that (X,2015) cannot be on the same circle.

Find $(A + B)X$.

QUESTION 8

Let

$$\begin{aligned} A &= i^0 + i^1 + i^2 + \ldots + i^{2013} + i^{2014} + i^{2015} \\ B &= \sqrt{2}cis(\frac{\pi}{4}) \text{ expressed as a complex number in the form } a + bi \\ C &= (\frac{1}{2} + \frac{i\sqrt{3}}{2})^{2015} \\ D &= (\frac{1}{2} - \frac{i\sqrt{3}}{2})^{2015} \end{aligned}$$

Find $A + B + C + D$.

QUESTION 9

Evaluate the following:

$$\begin{vmatrix} 3 & 0 & 3 & -1 \\ 1 & 3 & 4 & -2 \\ 4 & -2 & 2 & 1 \\ 1 & -1 & 2 & 0 \end{vmatrix}$$

QUESTION 10

Let

$$\begin{aligned} A &= \cos(\frac{\pi}{6}) + \sin(\frac{\pi}{4}) \\ B &= \cos(\frac{5\pi}{12})\sin(\frac{\pi}{12}) \\ C &= \sin(15^\circ) + \sin(75^\circ) \\ D &= \cos(15^\circ) + \cos(75^\circ) \end{aligned}$$

Find $A + 2B + C + D$.

QUESTION 11

Evaluate $\sqrt{[(\sqrt{2}+\sqrt{5}+\sqrt{13})(\sqrt{5}+\sqrt{13}-\sqrt{2})(\sqrt{2}+\sqrt{13}-\sqrt{5})(\sqrt{2}+\sqrt{5}-\sqrt{13})]}$. *Hint*: Use Heron's Formula

QUESTION 12

The roots of $(x+2)(x+3)(x-4)(x-5)-44$ can be expressed as $A \pm \sqrt{B}$ and $C \pm D\sqrt{E}$, such that A, B, C, D, and E are positive integers.

Find $A + B + C + D + E$.

QUESTION 13

Kyle yells "voat.co" so Aditya now must meet him to say "free speech". The two are in the polar system; Kyle is at $(2, \frac{\pi}{12})$ and Aditya is at $(2, \frac{5\pi}{12})$. Let A be the shortest distance Aditya must walk to meet Kyle.

Kim is busy watching The Office so she decides to bribe Jasmine with gummies to do her math homework. Let B be equal to the length of the latus-rectum, and C be equal to the eccentricity for $r = \dfrac{2}{3 + 5\sin(\theta)}$.

Find $A + B + C$.

QUESTION 14

Let

$$\begin{aligned} A &= \text{the volume of the shape formed when the ellipse } \frac{x^2}{9}+\frac{y^2}{4}=1 \text{ is revolved around the x-axis} \\ B &= \text{the volume of the shape formed when the ellipse } \frac{x^2}{9}+\frac{y^2}{4}=1 \text{ is revolved around the y-axis} \\ C &= \text{the volume of the tetrahedron with vertices at (0,0,0), (-3,2,1), (2,-3,5), and (3,-1,2)} \end{aligned}$$

Find $\frac{A}{B}+C$.