QUESTION 1

Let:

$$A = \text{The value of } a \text{ when } \frac{4+2i}{1-i} \text{ is written in } a+bi \text{ form.}$$

$$B = \text{The the value of } b \text{ when } \frac{-2+3i}{3+2i} \text{ is written in } a+bi \text{ form.}$$

A complex root, $c+di$, where $c \neq 0$ and $d > 0$, exists in the polynomial $x^3 - 3x^2 + 7x - 5$. Let:

$$C = \text{The value of } c \text{ in } c+di$$

$$D = \text{The value of } d \text{ in } c+di$$

Find $A+B+C+D$

QUESTION 2

Let:

$$\begin{aligned}
A &= \log_2(\log_2(\log_2(2^{16}))) \\
B &= \text{The smaller solution to } x \text{ in the equation,} \\
&\quad (\log x)^2 - 5\log x + 6 = 0 \\
C &= \text{The solution to } x \text{ in the equation,} \\
&\quad 3^{2x} - 26(3^x) - 3^3 = 0 \\
D &= \text{The solution to the equation:} \\
&\quad \log(x-3) = \log 2 + \log(\frac{1}{x-2})
\end{aligned}$$

Find $ABCD$

QUESTION 3

Let:

$$\begin{aligned} A &= \text{The coefficient of the third term in the expansion of } (3x+2)^5\text{, when} \\ &\quad\ \text{written in decreasing exponential order.} \\ B &= \text{The constant term in the expansion of } (x^4 + \frac{1}{x^2})^6 \\ C &= \text{The coefficient of the } x^2yz \text{ term in the expansion of } (2x - y - z)^4 \\ D &= \text{The sum of the coefficients of the terms in the expansion of } (x + 2y)^3 \end{aligned}$$

Find $A + B + C + D$

QUESTION 4

In the equation $y = \dfrac{4x^4 - 12x^3 - 31x^2 + 102x - 63}{x^3 - 8x^2 + 19x - 12}$, there exists an oblique asymptote $y = Ax + B$, vertical asymptotes at $x = C$ and $x = D$, and a removable discontinuity at (E, F).

Find $A + B + C + D + E + 3F$.

QUESTION 5

Let:

$$
\begin{aligned}
A &= \text{The solution to } x \text{ in } \frac{3}{2} = x + \cfrac{1}{x + \cfrac{1}{\cdots}} \\
B &= \text{The value of } f^{\infty}(4)\text{, where } f(2x-1) = x\text{. Note: } f^{n}(x) = f(f(\ldots(x)))\text{ n times.} \\
C &= \text{The value of } g^{8}(2)\text{, given } g(x) = 1 - \frac{1}{x}\text{. Note: } g^{n}(x) = g(g(\ldots(x)))\text{ n times.} \\
D &= \text{The value of } f(g(\frac{\sqrt[3]{3}}{2})) - g(f(\frac{\sqrt[3]{3}}{2}))\text{, given } f(x) = \frac{x+3}{2} \text{ and } g(x) = 2x - 3
\end{aligned}
$$

Find $A + B^2 + C^3 + D^4$

QUESTION 6

Let:

$$\begin{aligned}
A &= \text{Find the sum of the roots to the polynomial } 2x^4 - 3x^2 + 4x^3 + 5x + 6 \\
B &= \text{Find the product of the roots to the polynomial } x^{2017} - 1 \\
C &= \text{Find the sum of the squares of the roots of } x^3 - 3x^2 + 2x + 1 \text{ in } a + bi \text{ form.} \\
D &= \text{Find the sum of the reciprocals of the complex roots of } x^3 - 5x^2 + 17x - 13 \text{ in } a + bi \text{ form.}
\end{aligned}$$

Find ABC + 13D in $a + bi$ form.

QUESTION 7

Sri is trying to maximize her tricep gains. Her gains can be numerically measured as the product between the amount of time she works out in hours and the intensity of her workout as a relative quantity. When she works out for 24 hours, she is only able to workout at 0 intensity (i.e. $24 \times 0 = 0$ tricep gains). For every 4 hours she works out less, she can have a 2 unit increase in intensity.

$$\begin{aligned} A &= \text{The number of hours she should work out to maximize her gains.} \\ B &= \text{The numerical amount of gains made when maximized.} \end{aligned}$$

Find $A + B$.

QUESTION 8

Let:

$$
\begin{aligned}
A &= \text{The ordinate of the vertex of } y = x^2 - 4x + \frac{3}{2} \\
B &= \text{The length of the focal radius of } 9x^2 - 16y^2 - 36x - 96y = 252 \\
C &= \text{The eccentricity of the conic: } 4x^2 + 8x + 4 + 4y^2 = 38 \\
D &= \text{The length of the latus rectum of } 4x^2 - 24x + 9y^2 - 18y + 9 = 0
\end{aligned}
$$

Find $A(B + C + D)$.

QUESTION 9

$$\begin{aligned}
A &= \text{The area bounded by the points } (1,\ 2),\ (0,\ 6),\ (3,\ 4),\ (2,\ 7) \\
B &= \text{The area bounded by the equations } y = -2(x-1)+11,\ y = -5(x-1)+11, \text{ and } y = 1 \\
C &= \text{The area above the x-axis for the equation } y = -|x-3|+10 \\
D &= \text{The area between the functions } y = -|x-4|+8 \text{ and } y = |x-2|-2
\end{aligned}$$

Find $2A + B + C + D$

QUESTION 10

Let:

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

$B =$ The sum of the elements of x, given that x is a 2×2 matrix that is a solution to,

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} + x \cdot \begin{bmatrix} 2 & 1 \\ 3 & 1 \end{bmatrix} = \begin{bmatrix} 9 & 3 \\ 3 & 3 \end{bmatrix}$$

Find $A + B$

QUESTION 11

$$\begin{aligned}
A &= \sum_{n=1}^{\infty}\left(\frac{1}{2}\right)^n \\
B &= \text{Find the mean of } 5, 13, 21, \ldots 125 \\
C &= \sum_{n=4}^{8}\left(\frac{n^2}{2} - 5n\right) \\
D &= \left(\prod_{i=0}^{5}\left(\frac{1}{2}\right)^i\right)\left(\left(\sum_{n=0}^{10} 2^n\right) + 1\right)
\end{aligned}$$

Find $(B + C + D)^A$

QUESTION 12

Let:

A = The probability of choosing a red marble and then a blue marble in a bag of 5 red marbles and 4 blue marbles, without replacement.

B = The number of terms in the simplified expansion of $(3x + 2y + z)^6$

C = The maximum number of points of intersection when 5 distinct lines and one circle are drawn in the same plane.

D = The number of terms where $deg(x) + deg(y) > 4$ in the simplified expansion of $(3x + 2y + z)^6$

Find $A + B - C - D$

QUESTION 13

Let $f(x) = \sin(x) \cdot x^3$, $g(x) = e^{-x^2}$, $h(x) = 3x^3 + 2x^2$. With an initial value of zero, add 1 for each even function below, and subtract 1 for every odd function below. Do nothing if the function is neither even nor odd.

1. $f(g(x))$
2. $f(x)$
3. $h(f(x))$
4. $g(h(x))$
5. $g(x)/f(x)$

Return the final value.

QUESTION 14

Let:

$$\begin{aligned} A &= \text{The solution to } x \text{ in the equation,} \\ &\quad \log_3 625 \cdot \log_5 343 \cdot \log_x 16 \cdot \log_2 27 = 144 \\ B &= \text{The value of } x^3 + \frac{1}{x^3} \text{ if } x + \frac{1}{x} = 4 \\ C &= \sqrt{6 + \sqrt{6 + \ldots}} \\ D &= \text{The sum of the reciprocals of the roots of } x^4 - 4x^3 + 2x^2 + 5x + 1 \end{aligned}$$

Find $A + B + C + D$