QUESTION 1

Let

$$\begin{aligned}
A &= i^{-2015} \\
B &= \sum_{n=0}^{2037} i^n \\
C &= b \text{ when } \frac{2}{3i-6} \text{ is put into } a+bi \text{ form.} \\
D &= \text{the magnitude of } 20-11i
\end{aligned}$$

Find $A - B + 15C - D$.

QUESTION 2

Starting from 20, add 2 for each true statement and subtract 3 for each false statement

1. For any set of natural numbers the Arithmetic Mean $\geq$ the Geometric Mean $\geq$ the Harmonic Mean.
2. The Remainder Theorem states that if a polynomial $f(x)$ is divided by $(x - c)$, then the remainder is $f(c)$ where the variable is negligibile.
3. All circles are ellipses.
4. If a function has an inverse, then the graph of the inverse is the reflection of the original function over the line $x = y$.
5. If $z = 3 + 89i$, then $\overline{z}$ is the reflection across the imaginary axis in the Complex Plane.
6. $f(x) = x^3 + 1$ is a one-to-one function.

What is your final number?

QUESTION 3

Let

A = the area of the largest possible triangle such that its base is the latus rectum of the parabola defined by $y = x^2 - 2x - 8$, and has a vertex on the directrix

B = the area of the largest possible rectangle such that all 4 vertices lie on the latus rectums of the ellipse defined by $4x^2 + 9y^2 - 48x + 72y + 144 = 0$

Find AB.

QUESTION 4

Let

$$\begin{aligned}
A &= \text{the sum of the integers from 1 to 100 that satisfy the equation } i^n = 1 \\
B &= \text{the number of times Anvitha the cow moos by the end of Day 8 if on Day 1 she moos 9 times, on Day 2 she} \\
&\quad \text{moos 16 times, and on Day 3 she moos 25 times (assuming that the pattern continues)} \\
C &= \frac{1}{5} + \frac{1}{25} + \frac{1}{125} + \ldots
\end{aligned}$$

Find $A + B + 12C$.

QUESTION 5

Let

$$\begin{aligned} A &= (\log_7 256)(\log_3 625)(\log_5 343)(\log_{13} 81)(\log_2 2197) \\ B &= \lceil y \rceil \text{ where } y \text{ equals the sum of the roots of } 2(\ln(x))^2 - 10\ln(x) + 12 = 0, \text{ and } \lceil x \rceil \text{ refers to the least integer function.} \\ & \text{Hint: } e = 2.7, e^2 = 7.4, e^3 = 20.1 \end{aligned}$$

Find $A - B$.

QUESTION 6

Given the equation $6x^5 + 2x^4 + x^3 - x^2 - 2x + 12 = 0$, let:

$$\begin{aligned} A &= \text{the sum of the roots taken three at a time} \\ B &= \text{the product of the roots} \\ C &= \text{the sum of the reciprocal of the roots} \\ D &= \text{the sum of the roots} \end{aligned}$$

Find $A + B - C - D$.

QUESTION 7

Let

$$\begin{aligned} A &= \text{the arithmetic mean of the solutions of } (x^2-11x+29)^{(x^2-9x+20)}=1 \\ B &= \text{Given the function } f(x)=2x^4-kx^3+3x^2+x-27\text{, find the positive difference between the} \\ &\quad\ \text{maximum number of positive and negative zeroes, given that k is a negative integer.} \\ C &= \text{the sum of the reciprocal of the roots of the equation } x^7+3x^6-9x^4+2x^3-x^2-9x-13=0 \end{aligned}$$

Find $\dfrac{A}{B}+39C$.

QUESTION 8

Karthik the fly is flying along a vertical ellipse. The foci of the ellipse are k_1 and k_2. He decides to stop at Point X to rest. The distance between Point X and k_2 is 2 meters. The length of the minor axis is 4 meters. The area of the ellipse is $6\pi\ m^2$ and the center of the ellipse is at (2,-5).

$$\begin{aligned} A &= \text{the distance between Point X and } k_1 \\ B &= \text{x+y if the uppermost vertex of the ellipse can be written as (x,y)} \end{aligned}$$

Given the equation: $x = \frac{1}{3}y^2 + \frac{1}{15}y + \frac{1}{100}$

$$\begin{aligned} C &= \text{the length of the latus rectum} \\ D &= x - y \text{ if the focus is expressed as } (x, y) \end{aligned}$$

Find $A - C + B + D$.

QUESTION 9

Katie painted a $4 \times 4 \times 4$ cube on its outer layer. The cube is made up of unit cubes. Let

A = the number of unit cubes that have 2 sides covered with paint

B = the number of unit cubes that have 3 sides covered with paint

C = the number of distinct ways RJ and his 8 friends can be seated around a circular table

D = Pruthak is sitting in his biology class which ends at 11:20 A.M. He groans at the fact that he still has 44 minutes of class left. Find the larger degree between the clock's hands at the current time.

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

QUESTION 10

Let

$$\begin{aligned}
A &= \text{the harmonic mean of the } x \text{ values that would make } \frac{x^2+4x+3}{x^3-6x^2+11x-6} \text{ undefined} \\
B &= x-y \text{ if point } (x,y) \text{ is } \frac{1}{4} \text{ of the distance from (13,7) and (25,11)} \\
C &= x-y \text{ when the point of discontinuity of } \frac{x^4+2x^3-21x^2-22x+40}{x^3+x^2-22x-40} \text{ is expressed as } (x,y)
\end{aligned}$$

Calculate $14C + 231A - B$.

QUESTION 11

$$\begin{aligned} A &= x+y \text{ in the system: } \frac{6}{x}+\frac{5}{y}=10 \text{ and } \frac{3}{y}+\frac{15}{x}=6 \\ B &= E\text{, given the equation } \frac{2}{2x^2+10x+12}=\frac{E}{x+2}+\frac{F}{x+3} \end{aligned}$$

Compute $B-A$.

QUESTION 12

Given $(2x^3 + \frac{1}{x})^{12}$, let

$$\begin{aligned} A &= \text{the constant term of the expansion} \\ B &= \text{the coefficient of the } x^{24} \text{ term} \\ C &= \text{the number of terms in } (U + V + W + X + Y + Z)^5 \end{aligned}$$

Evaluate $A - \dfrac{B \times C}{1024}$.

QUESTION 13

Let

$$\begin{aligned}
A &= \text{the number of distinct arrangements of the letters in the word CHERRY} \\
B &= \text{the sum of the first 200 natural numbers} \\
C &= \text{the remainder when } 2x^3 - 4x^2 + x - 20 \text{ is divided by } (x-2) \\
D &= \text{the determinant of the matrix } \begin{bmatrix} -2 & 14 \\ 3 & 6 \end{bmatrix}
\end{aligned}$$

Find $A + B - C + D$.

QUESTION 14

Let

$$\begin{aligned} A &= \text{the characteristic of } 3\phi 5 \text{ where } a\phi b = \log_a(\log_b(15625)) \\ B &= \text{the determinant of } \begin{bmatrix} 3 & -1 & 4 \\ 1 & -5 & -4 \\ -2 & 2 & 1 \end{bmatrix} \end{aligned}$$

Find $-A \times B$.