QUESTION 1

Given that $F(x) = 3\sin(\frac{x}{2}) + 4\cos(\frac{x}{2})$ and $G(x) = 2\sin(2x) + 4\cos(2x)$, let

$$\begin{aligned} A &= \text{the period of F(x)} \\ B &= \text{the amplitude of F(x)} \\ C &= \text{the amplitude of G(x)} \\ D &= \text{the value of F}(\pi) - \text{G}(\pi) \end{aligned}$$

Find A + $\sqrt{B} \times C \times D$.

QUESTION 2

If the statement is true, then the value is equal to 2. If the statement is false, then the value is equal to -1.

A = the vector product can be computed for vectors in two dimensions

B = the dot product is the same as the scalar product

C = the range of $f(x) = \sin^{-1}(x)$ is $[\frac{-\pi}{2}, \frac{\pi}{2}]$

D = $\sin^4(\theta) + \cos^4(\theta) = 1$

E = $\arctan(0)$ is defined

F = $\text{arcsec}(0)$ is defined

Find A + B + C - D - E + F.

QUESTION 3

$$f(x) = x^6$$

$$\begin{aligned} A &= i^{2014} \\ B &= \text{the product of the values of } x \text{ such that } f(x) = 1 \\ C &= \text{the sum of the values of } x \text{ such that } f(x) = 1 \\ D &= \text{the value of } |z| \text{ when } z = \frac{a+bi}{a-bi} \end{aligned}$$

Find A + B + C + D.

QUESTION 4

A = the number of petals on the graph $r = 16\sin(4\theta)$

B = the number of petals on the graph $r = 5\cos(3\theta)$

C = area of the curve expressed by the polar equation $r = 3\cos(\theta)$

D = the length of the petal (distance from the origin to the tip of the petal) of $r = 3\cos(3\theta)$

Find $A^B - CD$.

QUESTION 5

When a complex number z is cubed, it is $7 + 4i$ more than when it is raised to the fifth power.

$$\begin{aligned} A &= \text{sum of all complex numbers z that hold true for this statement} \\ B &= \text{product of all complex numbers z that hold true for this statement} \\ C &= \text{number of complex numbers z that hold true for this statement} \end{aligned}$$

Find $\dfrac{A \times B}{C}$.

QUESTION 6

For the following polar equations, add 2 for every hyperbola, add 5 for every parabola, and subtract 3 for every ellipse. Also, subtract 1 for all polar equations that represent other figures. (Assume that you start out with 4.)

$$r = \frac{16}{5 - 3\cos(\theta)} \qquad r = \frac{1}{2 + 2\sin(\theta)}$$

$$r = \frac{2}{\sin(\theta) - 3\cos(\theta)} \qquad r = 2 + 2\theta$$

$$r^2 = 8\cos(2\theta)$$

What is the value after performing all of the operations?

QUESTION 7

Siddarth likes to doodle during math class. He drew a regular polygon RAINBOW inscribed in a circle. Jenny steals his masterpiece and draws the triangle WIN.

$$
\begin{aligned}
A &= \sin\left(\frac{7\angle N}{2}\right) \text{ for Jenny's triangle} \\
B &= \text{the sum of the interior angles in Siddarth's polygon expressed in radians} \\
C &= \text{the value of D if } \sin\left(\frac{D\pi}{7}\right) \text{ equals } 4\cos(\angle W)\sin(\angle I)\cos(\angle N) \text{ in Jenny's triangle}
\end{aligned}
$$

Find A + B + C.

QUESTION 8

Given that:

$$\text{Vector } u =< 2, 4, 6 >$$
$$\text{Vector } v =< -6, 2, 3 >$$

$$\begin{aligned} A &= u \cdot v \\ B &= \text{sum of the components of } u \times v \\ C &= \cos(\theta) \text{ where } \theta \text{ is the angle between the two vectors} \\ D &= ||u|| + ||v|| \end{aligned}$$

Find A + B + 14C + D.

QUESTION 9

A = distance between the polar coordinates C_1 and C_2 given that $C_1 = (3, 30^\circ)$ and $C_2 = (5, 90^\circ)$

B = distance between the polar coordinates C_3 and C_4 given that $C_3 = (4, 45^\circ)$ and $C_4 = (2, 165^\circ)$

C = area of a triangle with side lengths 13, 14, and 15

Find A $\times$ B + C.

QUESTION 10

A = length of the shortest median in a triangle with side lengths of 10, 24, and 26

B = given a triangle with side lengths 20, 21, and 29, find the cosine of the angle opposite the side with side length 29

C = $(\tan 10°)(\tan 20°)(\tan 30°)\ldots(\tan 80°)$

D = the area of the incircle of a triangle with side lengths 7, 8, and 9

The sum of A + B + C + D can be expressed as $X + Y\pi$.

Find X + Y.

QUESTION 11

$$\begin{aligned} A &= \sin(75^\circ) + \sin(15^\circ) \\ B &= \sin(75^\circ) - \sin(15^\circ) \\ C &= \cos(75^\circ) + \cos(15^\circ) \\ D &= \cos(75^\circ) - \cos(15^\circ) \end{aligned}$$

Express A - B + C - D in simplest radical form.

QUESTION 12

$$\begin{aligned} A &= \cot^{-1}(1) + \cot^{-1}(2) + \cot^{-1}(-2) \text{ in radians} \\ B &= \cot(\text{arcsec}(2)) \\ C &= \sin(\arctan(1)) \end{aligned}$$

Find $\dfrac{A}{B \times C}$.

QUESTION 13

Conic A is expressed by $\frac{(x-9)^2}{16} + \frac{(y-6)^2}{9} = 1$ and Conic B is expressed by $\frac{(x-5)^2}{16} + \frac{(y-3)^2}{4} = 1$.

Let C equal the eccentricity of Conic A.
Let D equal the distance between the centers of the two conics.
Let E equal the latus rectum of Conic A.
Let F equal the latus rectum of Conic B.

Find $C\sqrt{7} + D + E + F$

QUESTION 14

$$\cos(3\theta) = A\cos^3(\theta) + B\cos(\theta)$$
$$\sin(3\theta) = C\sin^3(\theta) + D\sin(\theta)$$

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