QUESTION 1

Where defined,

Let $A = \dfrac{\sin(2x)\sec(x)}{2}$

Let $B = \sin(x)\cos(x)\tan(x)\csc(x)\cot(x)$

Express $\sqrt{A^2 + B^2 + \frac{A^2}{B^2}}$ as a single trigonometric function.

QUESTION 2

Let

$$\begin{aligned} A &= \sin^2\left(\frac{\pi}{12}\right) - \cos^2\left(\frac{\pi}{12}\right). \\ B &= \sin(75^\circ) + cos(75^\circ) \\ C &= \sin(2\theta) \text{ where } \cos\theta = \frac{5}{13},\ 0 < \theta < 90^\circ. \\ D &= \cot^2\left(\frac{7\pi}{6}\right). \end{aligned}$$

Find $\dfrac{CD}{AB}$

QUESTION 3

$$\frac{(x-2011)^2}{16}+\frac{(y-2011)^2}{9}=1 \text{ is the graph of an ellipse.}$$

Let A equal the distance between the two foci.

Let B equal the area of the ellipse.

Let C equal the length of the semi-major axis.

Let D equal the length of the semi-minor axis.

Find $\frac{AB}{CD}$

QUESTION 4

With respect to the sinusoidal function $f(x) = -2\sin(-8x + 7) - 2$, let

$$\begin{aligned} A &= \text{the amplitude of the function.} \\ B &= \text{the phase shift of the function.} \\ C &= \text{the period of the function.} \\ D &= \text{the vertical shift of the function.} \end{aligned}$$

Find $ABCD$

QUESTION 5

Let

$$
\begin{aligned}
A &= \text{the length of diagonal } BD \text{ in quadrilateral } ABCD \text{ with } AB = 6,\ AD = 2,\ \text{and } \angle A = 75^\circ. \\
B &= \text{the area of } \triangle ABC \text{ with } AB = 6,\ AC = 8 \text{ and } \angle BAC = 15^\circ. \\
C &= \text{the area of a regular octogan with a side length of } 2\sqrt{3}.
\end{aligned}
$$

Find $A + B + C$

QUESTION 6

$$M = \begin{bmatrix} 3 & 3 & -4 \\ 2 & 3 & -4 \\ 3 & 0 & -1 \end{bmatrix}$$

$A =$ The trace of matrix M. (The trace of a matrix is equal to the sum of the entries in its main diagonal)

$B =$ The determinant of matrix M

$C = M^2$

Find $(A + B)C$

QUESTION 7

Let $A =$ The cosine of the acute angle formed by the vectors $\langle 6, 8\rangle$ and $\langle 5, 12\rangle$

Let $B = \|\langle 3, 4\rangle\|$

Let $C = \langle -4, 10\rangle \cdot \langle 5, 2\rangle$

Let $D = \langle 1, 2, 3, 4, 5, 6, 7, 8\rangle \cdot \langle -2, 3, -4, 5, -6, 7, -8, 9\rangle$

Find $AB + C + D$ as a fraction in simplest terms

QUESTION 8

Let $A = \sqrt{\dfrac{(1+8+27+...+N^3)^5}{(1+2+3+...+N)^5(1+4+9+...+N^2)^5}}$ if $2N+1=169$

Let $B =$ The sum of the infinite series $\dfrac{1}{2}+\dfrac{3}{4}+\dfrac{5}{8}+...$

Let $C = \sin^2(x)+\cos^2(x)-\csc^2(x)-\sec^2(x)+\tan^2(x)+\cot^2(x)$

Find ABC

QUESTION 9

Let A be $\sin^2(x) + \csc^2(x)$, given that $\sin(x) + \csc(x) = 5$.

Let B be $\sin^3(x) + \csc^3(x)$, given that $\sin(x) + \csc(x) = 3$.

Let C be $\cos^2(x) + \sec^2(x)$, given that $\cos(x) + \sec(x) = 4$.

Let D be $\cos^3(x) + \sec^3(x)$, given that $\cos(x) + \sec(x) = 2$.

Find $A + B + C + D$.

QUESTION 10

Let $d(x)$ yield the number of positive integral divisors of x, and $s(x)$ yield the sum of the positive integral factors of x.

Let $A = d(s(10!))$

Let $n = 1 + s(4^{171})$. n can also be writen as A^x, where A is a positive integer. Let B be equal to the largest value of x

Let C be the smallest integer such that $d(C) = 10$.

Find $A - B - C$

QUESTION 11

The Trigonama Tree has 6 branches with heights $|\sin(x)|$, $|\cos(x)|$, $|\tan(x)|$, $|\sec(x)|$, $|\csc(x)|$, and $|\cot(x)|$.

Let A be the height of the tallest branch when $x = \dfrac{\pi}{12}$

Let B be the height of the shortest branch when $x = \dfrac{\pi}{12}$

Let C be the height of the tallest branch when $x = \dfrac{7\pi}{8}$

Let D be the height of the shortest branch when $x = \dfrac{7\pi}{8}$

Find $4ABCD$

QUESTION 12

Let A be the probability that a randomly chosen two digit positive integer is divisible by a two digit prime number.

Let B be the probability that a randomly chosen prime number less than 40 ends in 7.

Let C be the probability that a randomly chosen positive integer between 1 and 100 contains a 7.

Find $\frac{AB}{C}$

QUESTION 13

$A =$ The shortest distance between the point $(-4, 5)$ and the circle
$x^2 - 16x + y^2 - 20y + 148 = 0$

Rectangle $ABCD$ is drawn such that $AB > BC$. Point E is drawn somewhere on side CD. If $AE = 20$, angle $DAE = 30°$ and angle $ABE = 75°$, then let $B =$ The length of BE.

The area of a triangle with side lengths $15, 16$ and 17 can be written as $C\sqrt{D}$, with C and D both integers and D not divisible by the square of any prime.

Find $A + B + C - D$