Question 1. Let $p = (1+i)^{2008}$ and $q = (1-i)^{2008}$. Compute:

A. $p+q$ B. $p-q$ C. pq D. $\frac{p}{q}$

Question 2. In order to get out of jail, the jailer requests that you evaluate the following limits:

A. $\lim_{x\to\infty} \frac{1}{x}$ B. $\lim_{x\to 2} \frac{x^2-x+2}{x-2}$ C. $\lim_{x\to 0} \frac{1337}{x}$ D. $\lim_{x\to 0} \left(1+\frac{14}{x}\right)^x$

Question 3. Let $f(x) = \sqrt{\sin\theta\cos\theta}$ and $g(x) = 3\sin\theta + 4\cos\theta$.

A. Find the maximum value of $f(x)$.
B. Find the maximum value of $g(x)$.
C. Find the minimum value of $f(x)$.
D. Find the minimum value of $g(x)$.

Question 4. Let $A = \langle 1, 0, 5\rangle$ and $B = \langle 5, 0, 1\rangle$.

A. Find the dot product $(A \bullet B)$.
B. Find the magnitude of A (that is, $|A|$).
C. Find the cross product $(A \times B)$.
D. Find the vector $A - B$.

Question 5. Evaluate the following trigonometric expressions.

A. $\sin 30^\circ \cos 30^\circ$ B. $3\sin 10^\circ - 4\sin^3 10^\circ$ C. $\sec^2(\frac{\pi}{4}) - 1$ D. $\sqrt{\frac{1-\cos 30^\circ}{1+\cos 30^\circ}}$

Question 6. Consider the graph of $y = 5\sin(\pi x - 4) + 3$. Give the:

A. Amplitude B. Period C. Horizontal/Phase Shift D. Vertical Shift

Question 7. Let $f(x) = (1+2+3+4+\cdots+x)^x$. Additionally, $g(x) = f^{-1}(x)$ and $h(x) = g^{-1}(x)$.

A. Evaluate $f(1)$. B. Evaluate $f(2)$. C. Evaluate $\lim_{x\to\infty} f(x)$ D. Evaluate $h^{-1}(216)$.

Question 8. Find x in the following equations involving logarithms:

A. $\frac{1}{\log_{75} x} - \frac{1}{\log_3 x} = 2$ B. $\ln(e^{5x-1}) = \ln 2$ C. $x = 6^{\log_6 5} + 3^{\log_{27} 7} - 2^{\log_8 9}$ D. $\frac{\ln(2^x)}{\ln(5^x)} = \frac{5}{2}\ln(e^5)$

Question 9. Waldo travels along the path defined by the parametric equations:

$$x(t) = 2t + 4 \qquad y(t) = t^2 + 1$$

A. Where's Waldo when $t = 0$? Give your answer as a coordinate pair (x, y).
B. At what value of $t > 0$ is Waldo at a point on the line $y = x$?
C. Waldo travels through the point $(10, y)$. What is y?
D. Give the name of the path that Waldo travels along (that is, name the conic section).

Question 10. Consider the conic $4x^2 + 9y^2 - 8x + 18y - 23 = 0$.

A. Find the area of the region enclosed by the conic.
B. Find the sum of the major and minor axes of the conic.
C. Find the length of the latus rectum of the conic.
D. Find the sum of the first 50 whole numbers.

Question 11. Consider the sequence $1, 1, 2, 3, 5, 8...$

A. Name this sequence, which was introduced to Western European mathematics by Leonardo of Pisa.
B. What is the sum of the next three terms in the sequence?
C. Consider the related sequence $\frac{1}{1}, \frac{2}{1}, \frac{3}{2}, \frac{5}{3}, \frac{8}{5}, ...$ What value does this sequence approach?
D. Let $f(n) = \dfrac{(1+\sqrt{5})^n - (1-\sqrt{5})^n}{2^n\sqrt{5}}$. What is $f(6)$?

Question 12. A positive integer x is **good** if it has an odd number of positive integral divisions.
A positive integer x **cool** if it has an even number of positive integral divisors.

A. How many **good** integers are there between 0 and 49^2, exclusive?
B. How many **cool** integers are there between 0 and 49^2, exclusive?
C. All **good** numbers are of the form m^k for integers m. What is k?
D. Let G_n and C_n represent the number of **good** and **cool** integers, respectively, on the interval $[0, n]$. What is $\lim\limits_{n\to\infty} \dfrac{G_n}{C_n}$?