NOTA means "None of the Above" e is the natural base, and $i = \sqrt{-1}$

1. How many of the following six expressions are equivalent to 1 ($x \in \mathbb{R}$)?
   I. $\sin^2 x + \cos^2 x$ II. $e^{i\pi}$ III. $-i^n$, if n = 2004!
   IV. $\sec^2 x + \tan^2 x$ V. the multiplicative inverse of -1
   VI. the additive inverse of 1

   A) 1 B) 2 C) 3 D) 4 E) NOTA

2. Give the product of the solutions of $3x^7 - 2x^6 + 5x^4 - 9x^3 + 2x^2 - x + 13 = 1$.

   A) -4 B) $-\frac{13}{3}$ C) $\frac{13}{3}$ D) 4 E) NOTA

3. Identify the following: $3x^2 + 4y^2 - 12x + 8y + 4 = 0$.
   A) parabola B) hyperbola C) ellipse D) point E) NOTA

4. An odd function defined for all reals must
   A) pass through the origin
   B) be symmetric to the y-axis
   C) be symmetric to both the x- and y-axes
   D) be symmetric with respect to $y = x$
   E) NOTA

5. What is the range of $y = \tan^{-1} x$?

   A) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ B) $(-\infty, +\infty)$ C) $[-1,1]$ D) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ E) NOTA

6. If $\sin x \cos y = 0.234$ and $\sin x + \cos y = 0.999$, then find $\sin^2 x + \cos^2 y$.

   A) 1 B) 0.53 C) 1.466001 D) 0.530001 E) NOTA

7. Find the sum of the first 19 terms of an arithmetic series whose tenth term is 41.

   A) 844 B) 779 C) 819 D) not enough info E) NOTA

8. What is the radius of the circle inscribed in a triangle with side lengths 6, 8, and 12? Disregard units, and round to the nearest tenth.

A) 6.8 B) 1.6 C) 5.2 D) 1.4 E) NOTA

9. Which of the following are vector quantities (are usually represented as vectors)?
I. Force II. Mass III. Speed IV. Acceleration V. Energy VI. Pressure

A) I, III, IV, VI B) I, II, III, V C) I, IV, V D) I, IV, VI E) NOTA

10. Find the sum of the digits when $4^{2004} \bullet 5^{4009}$ is expanded.

A) 10 B) 6 C) 5 D) 2 E) NOTA

11. Find the coefficient of $x^2y^2z^3$ in $(2x+3y-5z)^7$.

A) -69,457,500 B) -945,000 C) -9,500,000 D) -954,005 E) NOTA

12. In a Cartesian space where the axes are measured in feet, how long in yards is a vector <3, 4, -2>? Round to the nearest hundredth.

A) 1.79 B) 1.80 C) 5.38 D) 5.39 E) NOTA

13. If $M = \begin{bmatrix} 2 & 4 & 2 \\ 8 & 3 & 2 \\ 8 & 6 & 4 \end{bmatrix}$, then find $|M|$.

A) -18 B) -16 C) -14 D) -12 E) NOTA

14. Find the acute dihedral angle, rounded to the nearest hundredth of a degree, of $2x - y + 7z - 12 = 0$ and $3x + 15y - 2z + 6 = 0$.

A) $65.93°$ B) $78.29°$ C) $101.71°$ D) $114.07°$ E) NOTA

15. An equilateral triangle fits perfectly atop one side of a rectangle (such that the side of the triangle is the side of the rectangle), while the opposite side of the rectangle fits on top of a semicircle (so that the diameter of the circle is the side of the rectangle) such that there is no overlap anywhere. If the radius of the semicircle is 4 units, and the length of the figure from the vertex of the triangle not on the rectangle to the farthest point on the semicircle is 18 units, find the area of the entire figure (in square units).

A) $112+8\pi-96\sqrt{3}$ B) $80+8\pi+16\sqrt{3}$ C) $40+8\pi+4\sqrt{3}$
D) $112+8\pi-16\sqrt{3}$ E) NOTA

16. If h is the x-coordinate of the center of a circle tangent to the line 3x + y + 2 = 0 at (-1, 1) and passing through the point (3, 5), then what is the value of $\frac{\ln h}{h}$ to the nearest hundredth?

A) 0.27 B) 0.36 C) 0 D) 0.35 E) NOTA

17. Find the sum of all the natural numbers less than 2004 that are not divisible by 2 or 3.

A) 337,674 B) 337,677 C) 357,679 D) 337,680 E) NOTA

18. How many triangles with positive area are there whose vertices are points in the xy-plane whose coordinates are integers (x,y) such that $0\le x\le 3$ and $0\le y\le 3$?

A) 496 B) 500 C) 512 D) 516 E) NOTA

19. A cubic polynomial with integral coefficients has a root $4-7i$ and possesses the form $y=x^3+Ax+B$. Find $\frac{B^A}{65}$.

A) 10 B) -8 C) 8 D) $\frac{1}{65}$ E) NOTA

20. Find the sum of the values of x that make $\left(x^2-5x+5\right)^{x^2-9x+20}=1$.

A) 14 B) 8 C) 13 D) 10 E) NOTA

21. Find n: $7^{2004} - 2 \bullet 7^{2005} + 7^{2006} - 7^{2007} = n \bullet 7^{2004}$

A) -307 B) -300 C) 251 D) 300 E) NOTA

22. An infinite geometric series with common ratio 1.1 and first term 0.4 has the sum

A) 0.40 B) 0.44 C) 0.51 D) 0.55 E) NOTA

23. How many positive integral factors does 4,172,004 have?

A) 18 B) 36 C) 54 D) 108 E) NOTA

24. For $x < y < z$, $\begin{cases} x + y + z = -1 \\ xy + yz + xz = -17 \\ xyz = -15 \end{cases}$ find $\frac{x}{yz}$.

A) $-\frac{3}{5}$ B) $-\frac{5}{3}$ C) $\frac{1}{3}$ D) 3 E) NOTA

25. Find the coefficient of the fourth term in the binomial expansion of $(b-2)^{-\frac{1}{2}}$.

A) -2.5 B) $-\frac{5}{16}$ C) 2.5 D) 6 E) NOTA

26. $g(\ln x) = x^4 + 5x^3 - 2x^2 + 3x - 7$. $g(2)$ is closest to

A) 47 B) 4,890 C) 4,895 D) 4,904 E) NOTA

27. An elliptical dartboard has a major axis of length 19 feet, and minor axis of length 16.4 feet. Sharing the same center as the ellipse is a square of side length 5.7 feet, and inscribed in the square is a circle. If Mrs. Sowers were to throw a dart at the dartboard, what is the probability that she would hit it in the area inside the square, but outside the circle (but inside the ellipse, and please round to the nearest hundredth, and Mrs. Sowers will hit the dartboard… she's a natural)?

A) 0.01 B) 0.02 C) 0.03 D) 0.04 E) NOTA

28. The Irrational Bank of America gives an interest rate of $\pi\%$, compounded biannually. If Mr. Tuffhill invests \$1,125, then to the nearest year, how long will it take Mr. Tuffhill's investment to grow to $(2222e)$ dollars? (Note that biannually is twice a year)

A) 53 B) 54 C) 55 D) 56 E) NOTA

29. A hyperbola at the origin has transverse axis $y = x$. It has a focus at (4, 4) and eccentricity 8. Which of the following is a co-vertex of this hyperbola?

A) $\left(-\frac{\sqrt{127}}{2}, \frac{\sqrt{127}}{2}\right)$ B) $\left(-\frac{\sqrt{254}}{4}, \frac{\sqrt{254}}{4}\right)$ C) $\left(-\frac{3\sqrt{7}}{2}, \frac{3\sqrt{7}}{2}\right)$

D) $\left(-\frac{\sqrt{127}}{4}, \frac{\sqrt{127}}{4}\right)$ E) NOTA

30. Find the area of an ellipse with major axis length 4 and minor axis length 8.

A) 32π B) 8π C) 16π D) 24π E) NOTA