For all questions, answer (E) NOTA means "None of the Above Answers are Correct"
Also, let $\sqrt{-1} = i$ and let $\mathbb{R}$ be the set of Real Numbers.

(1) What is the shape of the graph $r = 16\sin\theta$?

(A) circle (B) ellipse (C) cardioid (D) limicon (E) NOTA

(2) What is the equation of a circle centered at (4,3) that has a radius of 4?

(A) $x^2 + y^2 = 4$ (B) $x^2 - 8x + y^2 - 6y = -9$

(C) $x^2 + y^2 = 16$ (D) $x^2 - 8x + y^2 - 6y = -12$ (E) NOTA

(3) Let $\vec{x} =< 1, 1, 1 >$ and $\vec{y} = 2\hat{\imath} - 10\hat{\jmath} - 1\hat{k}$. Find $\vec{x} \cdot \vec{y}$.

(A) -11 (B) -10 (C) 10 (D) 13 (E) NOTA

(4) What is the shortest distance between the two planes represented by $3x + 2y - 2z = 10$ and $3x + 2y + -2z = 12$?

(A) 0 (B) $\frac{2\sqrt{17}}{17}$ (C) $\frac{\sqrt{17}}{3}$ (D) $\frac{\sqrt{17}}{2}$ (E) NOTA

(5) The slopes of the asymptotes of $9x^2 - 36x - 4y^2 + 8y = 4$ are a and b. Given that $a > b$, what is a?

(A) $\frac{4}{9}$ (B) $\frac{3}{2}$ (C) $\frac{2}{3}$ (D) $\frac{9}{4}$ (E) NOTA

(6) Evaluate: $\sinh^2(6y) - \cosh^2(6y)$ given that $\sinh(x) = \frac{e^x - e^{-x}}{2}$ and $\cosh(x) = \frac{e^x + e^{-x}}{2}$.

(A) $-\frac{1}{6}$ (B) -1 (C) $\frac{1}{6}$ (D) 1 (E) NOTA

(7) What is the acute angle (in degrees) between two line segments both starting at the orgin with one ending at the point (3,4) and the other ending at the point (3,-1)?

(A) $\arccos(\frac{\sqrt{5}}{5})$ (B) $180 - \arccos(\frac{\sqrt{10}}{5})$ (C) $180 - \arccos(\frac{\sqrt{10}}{10})$
(D) $\arcsin(\frac{\sqrt{10}}{10})$ (E) NOTA

(8) What is the area of the pentagon with vertices at (0,1), (3,3), (2,2), (-1,4), and (3,8) ?

(A) 5 (B) 11 (C) 16 (D) 18 (E) NOTA

(9) Which of the following is/are true?
I) The number of non-collinear points needed to uniquely determine a parabola is 3.

II) $f(x) = \dfrac{x+a}{x+c}$ is a conic section.

(A) Only I (B) Only II (C) I,II (D) None (E) NOTA

(10) A line segment starts at the origin and ends at (7,1) and is then rotated 30° counter-clockwise about the origin. What is the new end point?

(A) $(\frac{7\sqrt{3}}{2} - \frac{1}{2}, \frac{7}{2} + \frac{\sqrt{3}}{2})$ (B) $(\frac{\sqrt{3}}{2} + \frac{7}{2}, \frac{1}{2} + \frac{7\sqrt{3}}{2})$ (C) $(\frac{\sqrt{3}}{2} + \frac{7}{2}, \frac{1}{2} - \frac{\sqrt{3}}{2})$
(D) $(\frac{7\sqrt{3}}{2} - \frac{1}{2}, \frac{7}{2} - \frac{\sqrt{3}}{2})$ (E) NOTA

(11) Where do the circle represented by $x^2 - 10x + y^2 - 8y + 16 = 0$ and the line represented by $3x - 4y = -1$ intersect?
(A) (1,-1) and (5,4) (B) (1,1) and (2,6) (C) (13,10) and (9,7)
(D) (1,1) and (9,7) (E) NOTA

(12) What is the period of the graph of $f(x) = e^{\pi}\sin(3x)\cos(x) + e^{\pi}\cos(3x)\sin(x)$?

(A) $\dfrac{\pi}{2}$ (B) π (C) 1 (D) 2 (E) NOTA

(13) It is given that relation R is the locus of points (x,y) in a plane such that the sum of the distances from (x,y) to the points (4,0) and (-4,0) is equal to 10. Let a be the maximum x value of R and let b be the maximum y value of R. How many positive integeral factors does ab have?

(A) 2 (B) 4 (C) 5 (D) 6 (E) NOTA

(14) What is the square of the amplitude of $f(x) = 4\sin(45x) + 19\cos(45x)$?

(A) 23 (B) 81 (C) 377 (D) 415 (E) NOTA

(15) What is the radius of a sphere centered at (1,2,2) and tangent to the plane $x + 2y + 2z = 10$?

(A) $\frac{1}{3}$ (B) $\frac{1}{2}$ (C) 2 (D) 3 (E) NOTA

(16) Amit drew a triangle ABC with coordinates A (1,3), B (5,4), and C (10,13). A line passes through A and intersects $\overline{BC}$ at P such that the area of triangle ABP is equal to the area of triangle ACP. What is the slope of the line segment $\overline{AP}$?

(A) $\frac{2}{3}$ (B) $\frac{11}{13}$ (C) $\frac{13}{11}$ (D) $\frac{3}{2}$ (E) NOTA

(17) $f(x) = \dfrac{x^2\cos(x) + x^4 + 3}{3 - \sin^2(x)}$ is reflected across the y-axis. What is the equation of this new relation?

(A) $f(x) = \frac{x^2\sin(x)+x^4+3}{3-\cos^2(x)}$ (B) $f(x) = \frac{x^{.5}\cos(x)+x^{.25}+3}{3-\sin^2(x)}$
(C) $f(x) = \frac{x^{-2}\cos(x)+x^{-4}+3}{3-\sin^2(x)}$ (D) $f(x) = \frac{x^2\cos(x)+x^{.5}}{3+\sin^2(x)}$ (E) NOTA

(18) What is $(1+i)^5$?

(A) $2i$ (B) $-32i$ (C) $-4-4i$ (D) $4-4i$ (E) NOTA

(19) Which of the following vectors is perpendicular to $< 1, 0, 4 >$ and $< 3, 2, 8 >$?

(A) $< 4, 7, -1 >$ (B) $< 2, -7, 1 >$ (C) $< -4, 5, 1 >$ (D) $< 4, -2, -1 >$ (E) NOTA

(20) What is the eccentricity of the graph described by the parametric equations:

$$x = 5\cos(t) - 5$$
$$y = 5\sin(t) - 2$$

(A) $\frac{1}{5}$ (B) $\frac{2}{5}$ (C) 1 (D) $\frac{7}{5}$ (E) NOTA

(21) What is the sum of the values of k that make $f(x)$ continuous on the real xy plane?

$$f(x) = \begin{cases} x^2 - k^3x^2 + k^4 + 2k^2 & \text{if } x \geq 2, \\ k^2x - 1 + k^3 + k & \text{if } x \leq 2. \end{cases}$$

(A) 5 (B) 6 (C) 7 (D) 10 (E) NOTA

(22) Given a line segment $\overline{AB}$ that starts at A(3,2,1) and ends at B(6,-4,13), which point on the line segment is one third the distance from A to B?

(A) (2,-3, 6) (B) (5,-2,9)

(C) (1, -2, 4) (D) (4,0,5) (E) NOTA

(23) Given that $f(x) = \frac{e^x + e^{-x}}{2}$, which of the following answers is equal to the function $g(x) = 1 + 2(\frac{e^x - e^{-x}}{2})^2$?

(A) $f(2x)$ (B) $f(\frac{1}{2}x)$ (C) $1 - f^2(x)$ (D) $if(ix)$ (E) NOTA

(24) What is the eccentricity of the following non-degenerate conic section:
$2x^2 + 4xy + 2y^2 - 5x + 10y + 130 = 0$?

(A) 0 (B) $\frac{1}{4}$ (C) $\frac{5}{8}$ (D) 1 (E) NOTA

(25) What is the area of the region that is common to both A and B where A is a rectangle with vertices (4,2),(10,2),(10,8), and (4,8) and B is a rectangle with vertices (6,5),(14,5),(14,10), and (6,10)?

(A) 4 (B) 8 (C) 16 (D) 32 (E) NOTA

(26) Find the volume of the tetrahedron with vertices O,A,B, and C given that O, A, B, and C are located at (1,0,-5), (2,2,4), (1,6,1) and (1,3,7)?

(A) 8 (B) 9 (C) 48 (D) 54 (E) NOTA

(27) What is the product of the x-coordinates of the two points of intersection of the parabola $y = x^2 - 6x + 9$ and the line $y = 1$.

(A) -6 (B) 1
(C) 6 (D) 8 (E) NOTA

(28) Given that a point (x,y) is on $x^2 - 10x + y^2 - 6y + 30 = 0$, what is the maximum possible value of $\frac{y}{x}$?

(A) $\frac{5}{7} - \frac{2\sqrt{30}}{21}$ (B) $\frac{5}{7} + \frac{2\sqrt{30}}{21}$ (C) 1 (D) 5 (E) NOTA

(29) Which of the following is/are true?

I) The graph of a function can cross its asymptote
II) If $\lim_{x\to\infty} f(x) = k$ (where k is a real number), then $f(x)$ has an asymptote at $y = k$

(A) Only I (B) Only II (C) I,II (D) None (E) NOTA

(30) What are the x-intercepts of $f(x) = x\sin(2x) + x\cos(x)$ (k is an arbitrary integer)?

(A) $\frac{\pi}{6} + \pi k$ (B) $\frac{\pi}{6} + 2\pi k$ (C) $\frac{\pi}{3} + \pi k$ (D) $\frac{\pi}{3} + 2\pi k$ (E) NOTA