

In this test, answer choice E. NOTA denotes 'None of These Answers.'

1. The perpendicular line to $3x - 4y = 7$ at $(5, 2)$ includes the point $(d - 2, d + 2)$. Find d .
- A. 0 B. 3 C. 4 D. 28 E. NOTA

2. Of the following, which is the cosecant of the angle θ between the vectors $\vec{a} \langle -4, 3 \rangle$ and $\vec{b} \langle 12, 5 \rangle$, $0^\circ \leq \theta \leq 180^\circ$?

- A. $\frac{33}{65}$ B. $\frac{65}{33}$ C. $\frac{56}{65}$ D. $\frac{65}{56}$ E. NOTA

3. The points $\alpha(-1, 4)$, $\beta(2, 5)$ and $\gamma(6, q)$ lie on a straight line. Which is the value of q ?

- A. 6 B. $\frac{19}{3}$ C. $\frac{11}{3}$ D. $\frac{5}{3}$ E. NOTA

4. If the centroid of triangle TUV at $T(3, 7)$, $U(5, -1)$ and $V(-2, 0)$ is at the point (Φ, Ψ) , then the sum $\Phi + \Psi$ equals...

- A. 4 B. 6 C. 8 D. 12 E. NOTA

5. Let a circle be inscribed in the square $MATH$ defined by $M(0, 0)$, $A(10, 0)$, $T(10, 10)$ and $H(0, 10)$. If $x > 0$, $y > 0$, $x < 10$ and $y < 10$, what is the probability that the point (x, y) is outside the circle?

- A. $\frac{1}{4}$ B. $\frac{\pi}{4}$ C. $\frac{3\pi}{4}$ D. $\frac{1}{2}$ E. NOTA

6. Consider the following limerick:

I began my short stroll from the vertex of a graph.
I decided to make a straight line my path.
I eventually decide to stop; however,
I noticed that I could continue on that line forever.
And never again cross the trace of that graph.

If the graph was $f(x) = x^2 - 6x + 8$, which of $f(x)$'s lines could be my path?

- A. Directrix B. Axis of symmetry C. Focus D. Eccentricity E. NOTA

7. The line $qx - y + 8 = 0$ (where q is a constant) makes an acute angle of 11.4° with the y -axis. Of the following, which value approximates the value of q to the tenths digit?

- A. -5.0 B. 5.0 C. -2.0 D. Both A and B E. NOTA

8. The graph of $3x^2 - 5y^2 + 6xy + 4x - 7y = 12$ must be rotated through an angle of ξ , $|\xi| < \frac{\pi}{2}$ to eliminate the xy term. Find $\cos(\xi)$.

- A. $-\frac{4}{5}$ B. $\frac{4}{5}$ C. $-\frac{24}{25}$ D. $\frac{24}{25}$ E. NOTA

9. What is the point at which the graph of $f(x) = -x^2 + 8x - 10$ has a minimum value?
- A. (2, 2) B. (4, 6) C. (8, -10) D. No minimum. E. NOTA
10. Given $\Gamma(3\sqrt{2}, \frac{3\pi}{4})$ and $\Delta(7, \frac{\pi}{2})$ in polar coordinates, find the rectangular representation of the midpoint of $\overline{\Gamma\Delta}$.
- A. $(2, \frac{3}{2})$ B. $(\frac{3}{2}, 2)$ C. $(-\frac{3}{2}, 5)$ D. $(-2.15, 5.19)$ E. NOTA
11. Find the cross product $\vec{u} \times \vec{v}$, where $\vec{u} = 5i - 2j + 6k$ and $\vec{v} = 3i + j - 4k$.
- A. -11 B. $2i - 38j + 11k$ C. $2i + 38j + 11k$ D. $2i + 2j + 11k$ E. NOTA
12. What is the area (square units) of triangle KAT , if K and A are the transverse axis endpoints of $9x^2 - 16y^2 - 36x - 160y - 508 = 0$ and T is the focus of $y^2 - 6y - 8x + 1 = 0$?
- A. 16 B. 8 C. 3 D. 1 E. NOTA
13. Use the following parametric expressions to write y as a function of x :
- $$y = t^3 + t^2 \qquad x = 1 - t$$
- A. $y(x) = 2 - 5x + 4x^2 - x^3$ B. $y(x) = x^3 + x^2 - 2$
 C. $y(x) = x^3 + 4x^2 + 5x + 2$ D. $y(x) = x^3 - 2x^2 + x$ E. NOTA
14. A circle with center $(-5, 9)$ is tangent to the line $12x - 5y = 64$. The circle's radius is...
- A. $\sqrt{26}$ B. 26 C. $\frac{13}{2}$ D. 13 E. NOTA
15. Which of the following is a degenerate conic section?
- A. Circle B. Line C. Parabola D. Parallelogram E. NOTA
16. The endpoints of the latera recta of $\frac{x^2}{36} + \frac{y^2}{9} = 1$ are joined to form a rectangle of what area?
- A. $\frac{9}{2}\sqrt{3}$ B. $18\sqrt{3}$ C. $72\sqrt{3}$ D. $\frac{9}{16}$ E. NOTA
17. Let $f(a, b)$ equal the least possible distance between the point (a, b) and the graph of $x^2 + y^2 - 6x + 10y - 30 = 0$. If $f(3, d) = 10$, then what is the sum of all negative values of d ?
- A. -15 B. -10 C. -3 D. 5 E. NOTA

18. If $f(x) = x + x\sqrt{3}i$, which of the following are the values of $(f(2))^{\frac{3}{2}}$?
- A. $2 \operatorname{cis} \frac{\pi}{6}, 2 \operatorname{cis} \frac{7\pi}{6}$ B. $2 \operatorname{cis} \frac{\pi}{2}, 2 \operatorname{cis} \frac{3\pi}{2}$
 C. $2\sqrt{2} \operatorname{cis} \frac{\pi}{2}, 2 \operatorname{cis} \frac{3\pi}{2}$ D. $8 \operatorname{cis} \frac{\pi}{2}, 8 \operatorname{cis} \frac{3\pi}{2}$ E. NOTA
19. Which is an asymptote of the hyperbola defined by $49y^2 - 4x^2 + 196y + 32x - 64 = 0$?
- A. $2x - 7y = 22$ B. $2x + 7y = -22$ C. $7x - 2y = 24$ D. A, B are correct. E. NOTA
20. What is the radius of a circle which includes the points $\alpha(3, 9)$, $\beta(8, 8)$, and $\gamma(15, 1)$?
- A. 11 B. 12 C. 13 D. 14 E. NOTA
21. Let $f(x, y)$ denote the area of an ellipse with major axis length x and minor axis length y . If $S = \sum_{i=1}^{\infty} f\left[1, \left(\frac{3}{4}\right)^i\right]$, what is the value of S ?
- A. $\frac{3\pi}{2}$ B. 3π C. $\frac{3\pi}{4-3\pi}$ D. ∞ (diverges) E. NOTA
22. Which equation defines a relation whose graph contains all points such that the differences of the distances from each point to the points $(-5, -2)$ and $(15, -2)$ is 12?
- A. $\frac{(x+5)^2}{36} + \frac{(y-7)^2}{25} = 1$ B. $\frac{(y+2)^2}{256} - \frac{(x-5)^2}{144} = 1$
 C. $\frac{(x-5)^2}{36} - \frac{(y+2)^2}{64} = 1$ D. $\frac{(x-5)^2}{100} - \frac{(y+2)^2}{4} = 1$ E. NOTA
23. A 10ft wide hallway is perpendicular to a 15ft wide hallway. If l is the length (in feet) of the longest pipe that fits around the hallways' corner, find $[l]$, the greatest integer function of l .
- A. 4 B. 10 C. 18 D. 35 E. NOTA
24. Which of the following conic sections has an eccentricity e , where $\frac{1}{2} < e < 1$?
- A. $(y-4)^2 = 3(x+1)$ B. $\frac{(x+5)^2}{36} + \frac{(y-7)^2}{25} = 1$
 C. $\frac{(x+2)^2}{36} - \frac{(y-5)^2}{18} = 1$ D. $\frac{(x-3)^2}{64} + \frac{(y+2)^2}{81} = 1$ E. NOTA