

For all questions, answer choice "E) NOTA" means none of the above answers is correct.

1. Find the coordinates of point A , which is the point three-fourths of the distance from $D(-2,22)$ to $L(10,-78)$.

- A) $(1,-3)$ B) $(7,-53)$ C) $(1,-53)$ D) $(7,-3)$ E) NOTA

2. Find the tangent of the acute angle formed by the intersection of the lines $3x + 2y = 6$ and $x - y = 1$.

- A) 4.5 B) -4.5 C) -5 D) 5 E) NOTA

3. Given a point $P(x,y)$, the slope of the line segment connecting P with the point $(1,2)$ is one-half the slope of the line segment connecting P with the point $(2,5)$. Find a Cartesian equation of the locus of all such points P .

- A) $xy + x - 3y + 3 = 0, x \neq 1, x \neq 2$ B) $xy + y - 3x + 3 = 0, y \neq 1, y \neq 2$
C) $xy - 8x + 6 = 0, x \neq 1, x \neq 2$ D) $xy - 8x + 6 = 0, y \neq 2, y \neq 5$ E) NOTA

4. Find the equation of the tangent to the graph of $x^6 - 7x^3y^2 + y^4 + 2x - 3y = 0$ at the origin.

- A) $y = 3x$ B) $y = -\frac{1}{2}x$ C) $y = -\frac{1}{7}x$ D) $y = \frac{2}{3}x$ E) NOTA

5. Find the equation of the line passing through the point $(4,6)$ that has an angle of inclination of 60° with the horizontal.

- A) $y - 6 = \sqrt{3}(x - 4)$ B) $y - 6 = \frac{1}{2}(x - 4)$ C) $y - 6 = \frac{\sqrt{3}}{3}(x - 4)$
D) $y - 6 = 2(x - 4)$ E) NOTA

6. Find the displacement vector \overline{AB} if $A(6,15)$ and $B(-10,43)$.

- A) $\langle 16, -28 \rangle$ B) $\langle -16, 28 \rangle$ C) $\langle -4, 58 \rangle$ D) $\langle -4, 28 \rangle$ E) NOTA

7. Find the y -intercept of the perpendicular bisector of the line segment with endpoints $(4,6)$ and $(6,-2)$.

- A) $-\frac{3}{4}$ B) 22 C) $\frac{3}{4}$ D) $\frac{9}{2}$ E) NOTA

8. Find the eccentricity of the curve defined by the equation $3x^2 - 5y^2 = 2$.

- A) $16\sqrt{5}/45$ B) $2\sqrt{10}/5$ C) $\sqrt{34}/3$ D) $2\sqrt{51}/15$ E) NOTA

9. In a particular scalene triangle, the distance from the De Longchamp's point to the circumcenter is 9 units, the distance from the orthocenter to the center of the nine-point circle is 4.5 units, and the distance from the circumcenter to the centroid is 3 units. What is the distance from the circumcenter to the orthocenter?

- A) 1.5 B) 4.5 C) 6 D) 9 E) NOTA

10. A triangle has vertices at the points $(0,10)$, $(20,2)$, and $(-8,-20)$. What are the coordinates of its centroid?

- A) $(11,-4)$ B) $(2\sqrt{3}, -2\sqrt{3})$ C) $(4,-3)$ D) $(6,-3)$ E) NOTA

11. Find the area enclosed by quadrilateral *MATH* whose vertices are located at the points $(0,10)$, $(20,2)$, $(-8,-20)$, and $(1,-1)$, respectively.

- A) 273 B) 218 C) 109 D) 89 E) NOTA

12. The non-degenerate conic with equation $x^2 - 2xy + y^2 + 3x = 0$ has what shape?

- A) ellipse B) parabola C) hyperbola D) circle E) NOTA

13. The intersection of a double cone with a plane perpendicular to the bases of the double cone forms a portion of which conic section?

- A) ellipse B) parabola C) circle D) hyperbola E) NOTA

14. Find the distance between the foci of the graph with equation $xy = -72$.

- A) 24 B) $24\sqrt{2}$ C) 36 D) 48 E) NOTA

15. Find the equation of the part of the hyperbola with equation $\frac{y^2}{5} - \frac{(x-2)^2}{3} = 1$ that is to the left of the hyperbola's major axis.

- A) $y = \sqrt{5 + \frac{5}{3}(x-2)^2}$ B) $x = 2 - \sqrt{\frac{1}{5}(3y^2 - 15)}$ C) $x = 2 + \sqrt{\frac{1}{5}(3y^2 - 15)}$
 D) $x = -2 - \sqrt{\frac{1}{5}(3y^2 - 15)}$ E) NOTA

16. A point T on a parabola is a distance of $\sqrt{317}$ units from the parabola's focus. Find the distance from T to the parabola's directrix.

- A) $\frac{1}{2}\sqrt{317}$ B) $\sqrt{317}$ C) $2\sqrt{317}$ D) $4\sqrt{317}$ E) NOTA

17. Find the slope of the asymptotes of the graph of $4x^2 - y^2 - 4x + 3y - 26 = 0$.

- A) $\pm \frac{8}{99}$ B) ± 4 C) ± 2 D) $\pm \frac{99}{8}$ E) NOTA

18. Find the area enclosed by the ellipse with equation $2x^2 + \sqrt{3}xy + y^2 - 10 = 0$. All answers are in square units.

- A) $4\pi\sqrt{5}$ B) $\pi\sqrt{5}$ C) $\frac{20\pi\sqrt{14}}{49}$ D) $4\pi\sqrt{10}$ E) NOTA

19. Find the length of the radius of the circle passing through the points $(1,0)$, $(0,1)$, and $(2,2)$.

- A) $5\sqrt{2}/6$ B) $\sqrt{74}/4$ C) $\sqrt{74}/2$ D) $\sqrt{2}/2$ E) NOTA

20. Find the equation of the hyperbola that is conjugate to $9x^2 - 16y^2 - 18x + 96y - 279 = 0$.

- A) $\frac{(x-1)^2}{9} - \frac{(y-3)^2}{16} = 1$ B) $\frac{(y-3)^2}{16} - \frac{(x-1)^2}{9} = 1$ C) $\frac{(x-1)^2}{16} - \frac{(y-3)^2}{9} = 1$
 D) $\frac{(y-3)^2}{9} - \frac{(x-1)^2}{16} = 1$ E) NOTA

21. Find the surface area of a solid hemisphere cut from the solid sphere produced by the inequality $x^2 + y^2 + z^2 - 4x - 2y + 2z \leq 10$. Answers are in cubic units.

- A) 32π B) 64π C) $64\pi/3$ D) $128\pi/3$ E) NOTA

22. Find the point of inflection of the graph of the equation $y = \frac{5}{1 + 8e^{-3x}}$.

- A) $\left(\ln\frac{3}{8}, \frac{5}{2}\right)$ B) $\left(\frac{1}{3}\ln 8, \frac{5}{16}\right)$ C) $\left(\ln 2, \frac{5}{2}\right)$ D) $\left(\frac{5}{8}, \frac{5}{2}\right)$ E) NOTA

23. What graph is produced by the equation $4y^2 - 12xy + 10x^2 + 2x + 1 = 0$?

- A) circle B) ellipse C) a single point D) no points E) NOTA

24. Find the circumference of the circle with polar equation $r = 8\cos\theta$.

- A) $4\pi\sqrt{2}$ B) $8\pi\sqrt{2}$ C) 16π D) $16\pi\sqrt{2}$ E) NOTA

25. Find the positive difference of the distances from the point $\left(8, \frac{8\sqrt{7}}{3}\right)$ to the two foci of the hyperbola with equation $64x^2 - 36y^2 = 2304$.

- A) 12 B) 16 C) 20 D) 36 E) NOTA

26. Find the focal width of the ellipse with major and minor axes of lengths 16 and 10, respectively.

- A) $25/4$ B) $25/8$ C) $50\sqrt{39}/39$ D) $64\sqrt{39}/39$ E) NOTA

27. The St. Louis Arch is an example of which of the following?

- A) parabola B) hyperbola C) catenary D) nibelung E) NOTA

28. Find the focal width of the graph of the polar equation $r = \frac{1}{1 - \cos\theta}$.

- A) $1/4$ B) $1/2$ C) 1 D) 2 E) NOTA

29. Find the maximum value of the function $f(x) = \frac{1}{x^2 - 2|x| + 2}$.

- A) $\frac{1}{4}$ B) $\frac{1}{2}$ C) 1 D) 2 E) NOTA

30. The equations of six conic sections are written on tiles and placed into a bag. Students are told that the eccentricities of the conic sections represented by these equations are 0, 1, $0.\bar{9}$, $\frac{1+\sqrt{2}}{5}$, $\frac{1+\sqrt{5}}{2}$, and $\frac{\sqrt{3}+1}{3}$. Soojin draws a tile from the bag first and states that she got an equation for a closed figure. What is the probability that she drew an ellipse?

- A) $\frac{2}{3}$ B) $\frac{1}{3}$ C) $\frac{1}{6}$ D) $\frac{3}{4}$ E) NOTA