"NOTA" stands for "None of These Answers are correct." Good luck!

1. What is the vertex of the parabola $y = x^2 + 4x + 7$?

A) $(2, 3)$ B) $(2, -3)$ C) $(-2, -3)$ D) $(-2, 3)$ E) NOTA

2. What is the circumference of the circle $x^2 - 2x + y^2 + 8y - 8 = 0$?

A) 50π B) 20π C) 40π D) 10π E) NOTA

3. Which of the following is a focus of the conic $9x^2 - 54x - 16y^2 + 160y - 463 = 0$?

A) $(0, 5)$ B) $(3, 10)$ C) $(-1, 5)$ D) $(3, 8)$ E) NOTA

4. What is the length of the major axis of the ellipse $9x^2 + 36x + 4y^2 - 8y + 4 = 0$?

A) 9 B) 6 C) 18 D) 3 E) NOTA

5. What is the shortest distance between the circle $(x + 3)^2 + (y - 2)^2 = 36$ and the line $y = \frac{3}{4}x - 7$?

A) $\frac{11}{5}$ B) 3 C) $\frac{14}{5}$ D) 2 E) NOTA

6. What is the length of the latus rectum of the parabola $x = \frac{-3}{8}y^2 + \frac{3}{4}y + \frac{21}{8}$?

A) $\frac{8}{3}$ B) $\frac{3}{2}$ C) $\frac{2}{3}$ D) $\frac{3}{8}$ E) NOTA

7. What is the area of the ellipse $4x^2 - 48x + 25y^2 + 100y + 144 = 0$?

A) 100π B) 10π C) 50π D) 5π E) NOTA

8. What is the product of the x-coordinates of the intersection points of the conics $x^2 + (y - 6)^2 = 4$ and $y = 2x^2$?

A) 0 B) $\frac{32}{23}$ C) 8 D) $\frac{23}{4}$ E) NOTA

9. What are the asymptotes of the hyperbola $\frac{(x+5)^2}{4} - \frac{(y-7)^2}{16} = 1$?

A) $y = 2x + 17,\ y = \frac{1}{2}x + \frac{19}{2}$ C) $y = 2x + 17,\ y = -2x - 3$ E) NOTA

B) $y = \frac{1}{2}x + \frac{19}{2},\ y = \frac{-1}{2}x + \frac{9}{2}$ D) $y = -2x - 3,\ y = \frac{-1}{2}x + \frac{9}{2}$

10. What is the eccentricity of the ellipse $25x^2 - 50x + 36y^2 - 875 = 0$?

A) $\frac{\sqrt{11}}{6}$ B) $\frac{\sqrt{61}}{5}$ C) $\frac{7}{9}$ D) $\frac{\sqrt{61}}{6}$ E) NOTA

11. Which of the following accurately describes the graph of the degenerate conic $x^2 - y^2 = 0$?

A) Two parallel lines C) One line E) NOTA
B) One point D) Two intersecting lines

12. What is the length of the minor axis of the ellipse with vertices at $(-6, -1)$ and $(-3, 3)$ and a covertex at $\left(-3, -\frac{1}{8}\right)$?

A) $\frac{15}{8}$ B) $\frac{5}{2}$ C) $\frac{15}{4}$ D) 5 E) NOTA

13. What is the equation of the directrix of the parabola $y = \frac{1}{4}x^2 - \frac{1}{2}x - \frac{7}{4}$?

A) $y = -1$ B) $x = -3$ C) $x = -1$ D) $y = -3$ E) NOTA

14. Which of the following conics is the locus of points where the positive difference between the distances to $(-2\sqrt{2}, -2)$ and $(2\sqrt{2}, -2)$ is equal to 4?

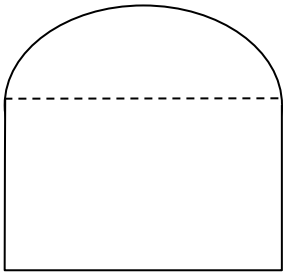
A) $x^2 - 4y^2 + 16y - 32 = 0$ C) $x^2 - y^2 + 4y - 8 = 0$ E) NOTA

B) $x^2 - y^2 - 4y - 8 = 0$ D) $x^2 - 4y^2 - 16y - 32 = 0$

15. What is the length of a latus rectum of the ellipse $16(x + 3)^2 + 5(y - 4)^2 = 80$?

A) $\frac{5}{2}$ B) $\frac{32\sqrt{5}}{5}$ C) $\frac{5\sqrt{5}}{2}$ D) $\frac{32}{5}$ E) NOTA

16. The underpass of a bridge is in the shape of a region bounded by a semi-ellipse and a rectangle with one side coinciding with the major axis of the semi-ellipse. The rectangle has a width of 12 ft. and a height of 10 ft. The whole underpass has a height of 14 ft. If a truck in the shape of a rectangular prism with a width of 8 ft. must pass through the underpass, what is its maximum height in feet?



Not drawn to scale

A) $\frac{30+6\sqrt{5}}{3}$ C) $\frac{50+6\sqrt{5}}{5}$ E) NOTA

B) $\frac{4\sqrt{5}}{3}$ D) $\frac{20\sqrt{5}}{3}$

17. What is the equation of the parabola with a vertex at $(7, 3)$ and a focus at $\left(\frac{55}{8}, 3\right)$?

A) $y = -\frac{1}{8}(x-7)^2 + 3$ C) $x = \frac{1}{8}(y-3)^2 + 7$ E) NOTA

B) $x = -2(y-3)^2 + 7$ D) $x = 2(y-7)^2 + 3$

18. The right branch of a hyperbola with a horizontal transverse axis has a directrix of $x = 2$ and a focus of $(5, 0)$. If the point $(6, 7)$ is on the branch, what is the eccentricity of the hyperbola?

A) $\frac{4\sqrt{2}}{5}$ B) $\frac{3\sqrt{2}}{2}$ C) $\frac{5\sqrt{2}}{4}$ D) $\frac{2\sqrt{2}}{5}$ E) NOTA

19. What is the area of the quadrilateral whose vertices are coincident with the vertices and covertices of the ellipse $\frac{x^2}{16} + \frac{y^2}{81} = 1$?

A) 108 B) 72 C) 36 D) 144 E) NOTA

20. The intersection points of the parabolas $y = x^2 - 3x - 7$ and $y = -x^2 - 5x + 5$ are (a, b) and (c, d). What is $a + b + c + d$?

A) 1 B) 6 C) 5 D) 2 E) NOTA

21. A hyperbola with perpendicular asymptotes has a center at $(3, -2)$ and a vertex at $(3, 1)$. Which of the following is a covertex of the hyperbola?

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

Please Use the Following Information to Answer Questions 22 and 23:

When a projectile is launched on a planet with a mass different from Earth, its height at time t can nonetheless be modeled by a quadratic function $h(t)$. Suppose a ball is thrown from 1 meter above the ground such that 2 seconds after it is thrown, it reaches its maximum height of 33 meters.

22. In meters, what is the height of the ball 3 seconds after it is thrown?

A) 25 B) 16 C) 8 D) 27 E) NOTA

23. If the ball moves horizontally at a constant rate of 5 meters per second, which of the following functions $h(x)$ model the height of the ball at its horizontal displacement in meters x?

A) $h(x) = -\frac{64}{5}x^2 + 16x + 1$ C) $h(x) = -\frac{4}{9}x^2 + \frac{16}{3}x + 1$ E) NOTA

B) $h(x) = -\frac{8}{25}x^2 + \frac{32}{5}x + 1$ D) $h(x) = -\frac{8}{5}x^2 + \frac{16}{5}x + 1$

24. The graph of the non-degenerate conic $6x^2 + 8xy + 2y^2 - 2x + 4y - 4 = 0$ has what shape?

A) Parabola C) Circle E) NOTA
B) Hyperbola D) Non-circular ellipse

25. What is the center of the conic $-2x^2 - 10x + 3y^2 - \frac{4}{3}y - 16 = 0$?

A) $\left(\frac{2}{9}, -\frac{5}{2}\right)$ B) $\left(-\frac{5}{2}, \frac{2}{9}\right)$ C) $\left(-5, \frac{4}{9}\right)$ D) $\left(\frac{4}{9}, -5\right)$ E) NOTA

26. Let $y = ax^2 + bx + c$ be the equation of the parabola that goes through the points $(-1, 2), (4, 2)$, and $(6, 10)$. What is $7(a + b + c)$?

A) -4 B) -16 C) -10 D) -24 E) NOTA

27. An ant walks counterclockwise along the circle $x^2 + y^2 = 4$ at a constant rate of $\frac{\pi}{6}$ units per second. If the ant starts at the point $\left(1, -\sqrt{3}\right)$, how many seconds does it take for the ant to reach $\left(\sqrt{2}, \sqrt{2}\right)$ for the first time?

A) 9 B) 8 C) 7 D) 10 E) NOTA

28. For what value of k is the line $y = x + k$ tangent to the parabola $y = \frac{1}{2}(x-6)^2 + 7$?
Hint: Consider what occurs at the point of tangency.

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

29. Which of the following is a vertex of the ellipse $4x^2 - 32x + 16y^2 - 96y + 144 = 0$?

A) $(4, 0)$ B) $(4, 6)$ C) $(1, 3)$ D) $(8, 3)$ E) NOTA

30. What is the equation of the parabola with a focus at $(-1, 1)$ and a directrix of the line $y = x$?

A) $\frac{1}{2}x^2 + xy + \frac{1}{2}y^2 + 2x - 2y + \frac{5}{2} = 0$

B) $x^2 + 2xy + y^2 + 4x - 4y + 4 = 0$

C) $\frac{1}{2}x^2 + 2xy + \frac{1}{2}y^2 + x - y + \frac{5}{4} = 0$

D) $2x^2 + 4xy + 2y^2 + 2x - 2y + 2 = 0$

E) NOTA