Unless otherwise indicated, all points, lines, curves, and shapes mentioned in a given problem lie in the same Cartesian coordinate plane.

1. Two perpendicular lines have slopes b and d, where $b \neq 0$ and $d \neq 0$. Which of the following must be equal to the number 1?

   A) bd　　　　　B) $\dfrac{b}{d}$　　　　　C) $-bd$　　　　　D) $-\dfrac{b}{d}$　　　　　E) NOTA

2. Determine the center of the circle given by the equation $(x+4)^2 + (y-6)^2 = 2$.

   A) $(-4, 6)$　　　B) $(-2, 3)$　　　C) $(2, -3)$　　　D) $(4, -6)$　　　E) NOTA

3. If a line that is not a function contains the point (m, n), where $mn \neq 0$, then the line must also contain which of the following points?

   A) $(-m, n)$　　　B) $(-n, m)$　　　C) $(m, -n)$　　　D) $(n, -m)$　　　E) NOTA

4. A parallelogram has vertices at the points $(1, 5)$, $(3, 7)$, and $(7, 8)$. If the fourth vertex is at the point (m, n) and $mn > 0$, then find $|m - n|$.

   A) 0　　　　　B) 1　　　　　C) 2　　　　　D) 3　　　　　E) NOTA

5. Which word completes a true statement when placed in the blank below?

   The directrix of a parabola and the line containing the parabola's latus rectum are always _____.

   A) coincident　　　B) parallel　　　C) perpendicular　　　D) skew　　　E) NOTA

6. A sphere in space has a volume of $5\pi k$ cubic units, where $k > 0$. The distance from the center of the sphere to a point on the sphere is $\sqrt[3]{P}$ units. Find P.

   A) $\dfrac{4k}{15}$　　　　　B) $\dfrac{15k}{4}$　　　　　C) $\dfrac{20k}{3}$　　　　　D) $\dfrac{3k}{20}$　　　　　E) NOTA

7. The complex number $a + bi$, where a and b are real, lies in the real-imaginary plane. The distance from the number to zero is equal to which of the following expressions?

   I.　$|a + bi|$　　　　II.　$|a| + |b|$　　　　III.　$\sqrt{a^2 + b^2}$

   A) I & II only　　　B) II & III only　　　C) I & III only　　　D) I, II, & III　　　E) NOTA

8. A cube in space has a surface area of 48 square units. The distance from one vertex of the cube to another random vertex is k units. Which of the following could **not** equal k?

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

9. Consider the convex quadrilateral with vertices $(0, 0)$, $(10, -1)$, $(11, 4)$, and $(15, 1)$. The quadrilateral's centroid is the point (m, n). Evaluate $\sqrt{mn}$.

    A) 3   B) 4   C) 5   D) 6   E) NOTA

10. The line given by which of the following equations is parallel to the line containing the points (6, 6) and (9, 8) ?

    A) $y = -\dfrac{3}{2}x + 2$ B) $y = -\dfrac{2}{3}x + 2$ C) $y = \dfrac{2}{3}x + 2$ D) $y = \dfrac{3}{2}x + 2$ E) NOTA

11. One diagonal of the rhombus R has endpoints (8, 8) and (2, 0). The area of R is 30 square units. The other diagonal is a segment of the line given by which of the following equations?

    A) $3x + 4y = 31$ B) $4x + 3y = 31$ C) $3x + 4y = 32$ D) $4x + 3y = 32$ E) NOTA

12. Which of the following is a focus of the graph given by the equation $\dfrac{x^2}{13} - \dfrac{y^2}{12} + 1 = 0$?

    A) $(0,1)$ B) $(0,5)$ C) $(1,0)$ D) $(5,0)$ E) NOTA

13. The points (0, 8) and $(-8, 4)$ lie on a circle.. If the center of the circle is the point (m, n), then find $|2m + n|$.

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

14. Each leg of a right triangle coincides with an axis of the Cartesian plane. The triangle's hypotenuse measures $4\sqrt{2}$ units, and its area is 8 square units. If the point (m, n) is a vertex of the triangle and $m - n > 0$, then how many distinct values of the expression $(m - n)$ exist?

    A) 1   B) 2   C) 4   D) 8   E) NOTA

15. The circumference of the circle defined by the equation $x^2 - 2x = 6x - y^2$ is $2^N \cdot \pi$ units. Find N.

A) 2   B) 3   C) 4   D) 5   E) NOTA

16. Let **T** be the set of conic sections **{hyperbola, circle, parabola, non-circular ellipse}**. How many elements of **T** must have an eccentricity of at most 1?

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

17. Which expression completes a true statement when placed in the blank below?

"Define the fixed points F_1 and F_2, and the positive real number K.
Let d_1 = the distance from F_1 to a point P, and
let d_2 = the distance from F_2 to P.
The locus of all points P such that K = _____ must be a hyperbola."

A) $(d_1)^2 - (d_2)^2$ B) $-|(d_1) - (d_2)|$ C) $|(d_1)^2 + (d_2)^2|$ D) $(d_1 - d_2)^2$ E) NOTA

18. The distance between the foci of an ellipse is 6, and the length of its major axis is 10. Find the area of the ellipse, in square units.

A) 15π B) 20π C) 27π D) 30π E) NOTA

19. The latus rectum of a parabola measures 8, and the parabola's vertex is the point $(-4, 2)$. If the parabola opens to the right, then in how many quadrants does the parabola lie?

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

20. Circle C has a diameter measuring $20\pi^{\frac{-1}{2}}$ units, and is centered at the origin. Triangle T lies entirely within circle C and has vertices at the points $(-3, -1)$, $(2, -4)$, and $(3, 1)$. Let **p** be the probability that a point selected at random from within circle C also lies in triangle T. Find the hundredths digit of **p**.

A) 2   B) 4   C) 6   D) 8   E) NOTA

21. Consider a hyperbola. Let T be the length of its transverse axis, let N be the length of its conjugate axis, and let L be the length of its latus rectum. If $1 < N < 2 < L$, then how many of the following four statements must be true?

$$T \neq \frac{1}{2} \qquad\qquad T \neq 1 \qquad\qquad T \neq 2 \qquad\qquad T \neq 4$$

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

22. Consider the regular hexagon H. You need to draw a convex quadrilateral Q such that every vertex of Q is also a vertex of H. How many different quadrilaterals meet your need?

A) 10   B) 15   C) 20   D) 30   E) NOTA

23. Find the area (shaded below) of the region between the graph and the x axis. (Marked points have integral coordinates, and the graph is made exclusively of line segments. The scale on each axis is 1.)

A) 11.5
B) 12
C) 12.5
D) 13
E) NOTA
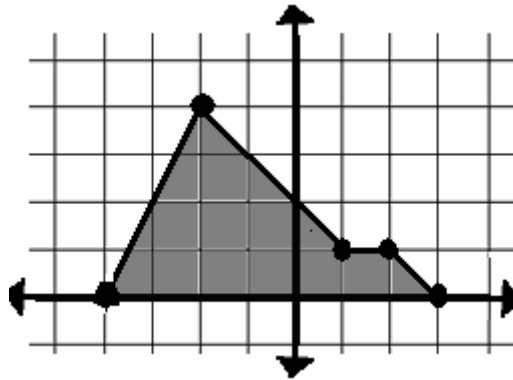
24. Let $m = (1-i)^4$ and $n = \left(\sqrt{-4}\right)\left(\sqrt{-16}\right)$. When the slope of the line containing m and n in the Argand plane is written as a simplified fraction in the form $\frac{a}{b}$, evaluate $|ab|$.

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

25. The vertices of a kite are the points (m, n), $(m-2, n+3)$, $(m+1, n+5)$, and $(m+3, n+K)$. Evaluate $|2K|$.

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

26. A parabola's axis of symmetry is a vertical line, and intersects the parabola's directrix at the point $(4, -4)$. The focus of the parabola is the point (m, n), and $mn = 0$. Which of the following points lies on the parabola?

A) $(-6, 2)$ B) $(-4, 4)$ C) $(2, -2)$ D) $(4, -2)$ E) NOTA

27. Find the total length of the curve determined by the equation $x = \sqrt{64 - y^2}$.

A) 8π B) 16π C) 32π D) 64π E) NOTA

28. How many times do the graphs of the equations $0.8x^2 = (2-y)(2+y)$ and $x^2 = 4x - y - 6$ intersect?

A) 0   B) 1   C) 2   D) 4   E) NOTA

29. A line with a negative slope has a y-intercept of 10. The line makes an acute angle, $\angle G$, with the y-axis. If $\tan(G) = \dfrac{2}{5}$, then find the line's x-intercept.

A) -25 B) -4 C) 4   D) 25   E) NOTA

30. Find the distance between the lines with equations $y = 2x$ and $y = 2x + 5$.

A) $\dfrac{5}{2}$ B) $\sqrt{5}$ C) $\sqrt{21}$ D) 5   E) NOTA