For questions 1–3, use the following sequence of lines, for integers $n \geq 1$:

n	1	2	3	4	5
L_N	$y = x + 2$	$y = 8 - x$	$-x = 18 - y$	$-x = y - 32$	$y = x + 50$

1. What is the y-intercept of L_{74}?
   A. 119 B. 740 C. 5476 D. 10952 E. NOTA

2. Which of the following is NOT a valid expression for the slope of L_n? Assume that angles for trig functions are in radians.
   A. $(-1)^{n+1}$ B. $\cos(n\pi)$ C. $\sin\left(\frac{(2n-1)\pi}{2}\right)$ D. $\tan\left(\frac{(2n-1)\pi}{4}\right)$ E. NOTA

3. What are the degree measures of the angles of the triangle formed by the y-axis, the 565th line in the sequence, and the 6930th line in this sequence?
   A. 30-30-120 B. 30-60-90 C. 45-45-90 D. 60-60-60 E. NOTA

4. The Triforce symbol from The Legend of Zelda is formed by drawing the three midsegments of an equilateral triangle to form four smaller triangles. What is the ratio of the perimeter of one of the smaller triangles to that of the large triangle?
   A. 1:2 B. 1:3 C. 1:4 D. 2:3 E. NOTA

5. Which of the following matrices can be left multiplied to a vertex matrix $\begin{bmatrix} x_1 & x_2 & \dots & x_n \\ y_1 & y_2 & \dots & y_n \end{bmatrix}$ to produce a new vertex matrix that represents a 90 degree counter-clockwise rotation of the preimage about the origin?
   A. $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$ B. $\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$ C. $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$ D. $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$ E. NOTA

6. If one of the interior angles of a regular polygon is 178 degrees, how many sides does it have?
   A. 89 B. 90 C. 178 D. 180 E. NOTA

For questions 7–10, use the following: ΔXYZ has $XY = 6$, $m\angle ZXY = 45°$, and $XY \perp YZ$. Points $A(2,1)$ and $B(2,7)$ are on ΔABC, which lies entirely in the first quadrant, and $\Delta ABC \cong \Delta XYZ$.

7. Find the coordinates of point C.

A. $(-4, 7)$ B. $(5, 4)$ C. $(8, 1)$ D. $(8, 7)$ E. NOTA

8. What are the coordinates of the circumcenter of ΔABC?

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

9. Which of the following in ΔABC does not lie on the line $y = -x + 9$?

A. an angle bisector B. a perpendicular bisector
C. a median D. an altitude E. NOTA

10. What are the coordinates of the centroid of ΔABC?

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

Use the following for questions 11–13: the incircle and circumcircle of ΔDEF are concentric with center C. The circumcircle has circumference 24π.

11. What is $m\angle CFE$?

A. 15° B. 22.5° C. 30° D. 45° E. NOTA

12. What is the radius of the incircle?

A. $\frac{3}{2}$ B. 4 C. 6 D. 8 E. NOTA

13. What is the perimeter of ΔDEF?

A. $24\sqrt{3}$ B. 35 C. $36\sqrt{3}$ D. 54 E. NOTA

14. Kite KITE has side IT not congruent to side TE. $m\angle EIT = 2x + 10$, $m\angle IEK = x + 5$, and $m\angle EIK = 3x - 5$, where all angle measures are in degrees. Compute the measure of an exterior angle of KITE at vertex T.

A. 40° B. 60° C. 120° D. 160° E. NOTA

For problems 15–18, use the following: the two diagonals of parallelogram $ROFL$ intersect at point P, forming 4 triangles inside $ROFL$. Inside $ROFL$, a smaller parallelogram $ABCD$ is drawn so that AB is a midsegment of ΔRPO, BC is a midsegment of ΔOPF, CD is a midsegment of ΔFPL, and DA is a midsegment of ΔLPR.

15. If $RO = 3x + 4$, $RL = 4x - 2$, and $CD = x + 3$, find the perimeter of $ROFL$.

A. 16 B. 22 C. 30 D. 32 E. NOTA

16. If the perimeter of ΔOFL is 29 and the perimeter of triangle ΔCPD is 11, find the sum of the perimeters of ΔDPA and ΔOPR.

A. 27 B. 29 C. 31 D. 33 E. NOTA

17. In this figure, $RABO$ is a trapezoid. There are also 3 other trapezoids. The midsegments of these 4 trapezoids form another parallelogram larger than $ABCD$ but smaller than $ROFL$. What is the perimeter of this new parallelogram?

A. 16 B. 20 C. 24 D. 28 E. NOTA

18. Use the midsegments of ΔAPB, ΔBPC, ΔCPD, ΔDPA to create a new parallelogram $A_2B_2C_2D_2$ in the same manner that $ABCD$ is created from $ROFL$. Repeat this process to create $A_nB_nC_nD_n$ from $A_{n-1}B_{n-1}C_{n-1}D_{n-1}$. Let the infinite sequence p_n be the perimeter of $ABCD$ if $n = 1$ and the perimeter of $A_nB_nC_nD_n$ if $n \geq 2$. What is a general formula for p_n?

A. $\frac{16}{n}$ B. $\frac{16}{2n-1}$ C. $16\left(\frac{1}{2}\right)^n$ D. $32\left(\frac{1}{2}\right)^n$ E. NOTA

19. Kite KITE has side lengths $KI = 15, KE = 20$. Additionally, diagonal KT has length 24. Compute the length of diagonal IE.

A. 16 B. 25 C. 30 D. 32 E. NOTA

20. A rhombus has a perimeter of 52 and a diagonal of length 24. What is the length of the other diagonal?

A. 5 B. 8 C. 10 D. 12 E. NOTA

21. A regular hexagonal prism is inscribed in a cylinder. If the circumference of the base of the cylinder is 10π, and the height of both solids is 5, find the surface area of the prism.

A. 150 B. $75\left(2+\frac{\sqrt{3}}{2}\right)$ C. $75\left(2+\sqrt{3}\right)$ D. $150\left(1+\sqrt{3}\right)$ E. NOTA

22. Let $f(x)=ax^2+bx+c$ for positive integers a,b,c. For what ordered triple (a,b,c) does $f(x)$ have two distinct real roots, with $f(1)$ as small as possible?

A. $(1,1,1)$ B. $(1,2,1)$ C. $(1,3,1)$ D. $(2,1,1)$ E. NOTA

23. Simplify the following expression: $i^{1528}+2i^{560}-6i^{303}$

A. $-3-6i$ B. $3-6i$ C. $-3+6i$ D. $3+6i$ E. NOTA

24. Solve for x in the following equation: $16\cdot 2^{x-2}=8^{x-6}$

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

25. Find the product of all solutions to the following equation:

$$((2x+5)^{x+7})^{x-3}=(15x-72)^0$$

A. -126 B. -21 C. 6 D. 42 E. NOTA

26. Find the number of distinguishable permutations of the letters in GEMINI.

A. 120 B. 180 C. 360 D. 720 E. NOTA

For problems 27–30, use the following information: $f(x)$ is a polynomial function with integer coefficients and a leading coefficient of 1, with $f(3+\sqrt{7})=0$. A few additional values of $f(x)$ are listed in the table below. Additionally, the degree of $f(x)$ is the smallest possible to still satisfy all other given conditions.

x	-1	1	2	3	4
$f(x)$	144	-12	-6	0	-6

27. What is the degree of $f(x)$?
A. 2 B. 3 C. 4 D. 5 E. NOTA

28. Compute the y-intercept of $f(x)$.
A. 6 B. 18 C. 30 D. 36 E. NOTA

29. Compute the coefficient of the x^2 term of $f(x)$.
A. -66 B. -12 C. 0 D. 47 E. NOTA

30. Compute the sum of the coordinates of the x-intercepts of $h(x)=f(x)+6$.
A. 6 B. 8 C. 12 D. 24 E. NOTA