Let choice E. NOTA denote "None of the Above Answers is Correct"

1. Solve the inequality: $\log(x-2)-\log(7-x)<1$.

A. $2<x<\frac{9}{2}$ B. $2<x<\frac{72}{11}$ C. $\frac{72}{11}<x<7$ D. $\frac{9}{2}<x<7$ E. NOTA

2. Evaluate: $\cos\frac{5\pi}{24}\sin\frac{\pi}{24}+\sin\frac{5\pi}{24}\cos\frac{\pi}{24}$.

A. $\frac{\sqrt{2}}{2}$ B. $\frac{\sqrt{6}+\sqrt{2}}{4}$ C. $\frac{\sqrt{3}}{2}$ D. $\frac{1}{2}$ E. NOTA

3. Consider the graph of $y=\cos(x)$. Which of the following could be the equation of the graph after it has been stretched vertically by a factor of 3, then compressed horizontally by a factor of 2, then shifted up by $\frac{\pi}{2}$, and finally shifted to the left by $\frac{\pi}{6}$?

A. $y=\frac{1}{2}\cos\left(3(x+\frac{\pi}{6})\right)+\frac{\pi}{2}$ B. $y=\frac{1}{2}\cos\left(3(x-\frac{\pi}{6})\right)+\frac{\pi}{2}$

C. $y=3\cos\left(2(x+\frac{\pi}{6})\right)+\frac{\pi}{2}$ D. $y=3\cos\left(2(x-\frac{\pi}{6})\right)+\frac{\pi}{2}$

E. NOTA

4. Let $\mathbf{v}$ be a vector with a magnitude $|\mathbf{v}|=40$ and direction $\theta=120^\circ$. Find the sum of the horizontal and vertical components of $\mathbf{v}$.

A. $20+20\sqrt{3}$ B. 40 C. $20\sqrt{3}-20$ D. $20\sqrt{6}-20\sqrt{2}$ E. NOTA

5. Let $\mathbf{u}=\langle 2,6\rangle$ and $\mathbf{v}=\langle 1,-2\rangle$. What is the (vector) projection of $\mathbf{u}$ onto $\mathbf{v}$?

A. $\langle -2,4\rangle$ B. $\langle 2,-4\rangle$ C. $\left\langle \frac{1}{2},\frac{3}{2}\right\rangle$ D. $\left\langle -\frac{1}{2},-\frac{3}{2}\right\rangle$ E. NOTA

6. Let $z_1=8\left(\cos\frac{7\pi}{12}+i\sin\frac{7\pi}{12}\right)$ and $z_2=4\left(\cos\frac{\pi}{4}+i\sin\frac{\pi}{4}\right)$. Find $z_1z_2-\frac{z_1}{z_2}$.

A. $(-16\sqrt{3}-1)+(16-\sqrt{3})i$ B. $(-16\sqrt{3}+1)+(16+\sqrt{3})i$

C. $(-16\sqrt{3}-1)+(16+\sqrt{3})i$ D. $(16\sqrt{3}-1)+(-16-\sqrt{3})i$ E. NOTA

7. How many solutions are there to $2\cos^3 x - 7\cos^2 x + 3\cos x = 0$ such that $0 \le x < 2\pi$?

A. 0 B. 2 C. 4 D. 6 E. NOTA

8. Which conic section is defined as the set of all points in the plane, the difference of whose distances from two fixed points is a constant?

A. Circle B. Ellipse C. Parabola D. Hyperbola E. NOTA

9. Which of the following is a third degree polynomial with roots 1-2i, 1+2i, and 3?

A. $f(x) = x^3 - 5x^2 + 7x - 21$ B. $f(x) = x^3 - 5x^2 + 12x - 12$
C. $f(x) = x^3 - 5x^2 + 11x - 15$ D. $f(x) = x^3 - 5x^2 + 6x - 15$ E. NOTA

10. Find all of the asymptotes of $f(x) = \dfrac{x^2 - 4x - 5}{x - 3}$.

A. $y = x + 1, x = 3$ B. $y = x + 1, x = -3$ C. $y = x - 1, x = -3$ D. $y = x - 1, x = 3$ E. NOTA

11. Which of the following best describes the polar curve $r = 5 - 3\cos\theta$?

A. dimpled limaçon B. cardioid
C. convex limaçon D. limaçon with inner loop E. NOTA

12. Let the roots of $P(x) = 4x^5 - 13x^3 - 12x + 7$ be $r_1, r_2, r_3, r_4,$ and r_5 .

Evaluate: $r_2r_3r_4r_5 + r_1r_3r_4r_5 + r_1r_2r_4r_5 + r_1r_2r_3r_5 + r_1r_2r_3r_4$.

A. $\dfrac{13}{4}$ B. $\dfrac{7}{4}$ C. 0 D. -3 E. NOTA

13. Consider the following functions. Each function is assigned a weight (the number located directly to its left). Find the sum of the weights of all the even functions.

(-4) $\tan^3 x \sec x$ (7) $x^3 + 1$ (-10) $\cos(x)$ (6) $\sin(x)$ (2) $-x\log\left(\dfrac{1}{x}\right)$ (-5) $-x\log\left(\dfrac{1}{2^x}\right)$

A. -15 B. -13 C. -10 D. 2 E. NOTA

14. Evaluate: $\arccos\left(\frac{1}{2}\right)$

A. $\frac{\pi}{3}$ B. $-\frac{\pi}{3}$ C. $\frac{\pi}{6}$ D. $-\frac{\pi}{6}$ E. NOTA

15. In ΔABC, $AB = 13, BC = 14$, and $AC = 15$. Evaluate: $\cos\angle A$

A. $\frac{5}{13}$ B. $\frac{33}{65}$ C. $\frac{4}{5}$ D. $\frac{35}{37}$ E. NOTA

16. Evaluate: $\begin{vmatrix} 1 & 3 & 2 \\ 4 & 6 & 5 \\ -0.5 & -1.5 & -1 \end{vmatrix}$

A. 54 B. $\frac{215}{4}$ C. $-\frac{215}{4}$ D. -54 E. NOTA

Consider the following information for questions 17-19:

Let the *Minkowski sum* of two sets A and B in the coordinate plane be denoted as $A \oplus B$, where $A \oplus B = \{a + b \mid a \in A, b \in B\}$. In other words, the *Minkowski sum* is the result of adding every element of A to every element of B. For example, if the point (1, 1) was an element of A and (-2, 1) was an element of B, then the *Minkowski sum* contains the point (-1, 2), possibly among other points.

17. Let A= $\{(2,1),(-4,3)\}$ and B= $\{(0,2),(-1,-1)\}$. Find: $A \oplus B$.

A. $\{(2,3),(1,0),(-4,5),(-5,2)\}$ B. $\{(2,1),(-4,3),(0,2),(-1,-1)\}$

C. $\{(2,3),(1,0),(-4,5),(-5,2),(2,1),(-4,3),(0,2),(-1,-1)\}$ D. $\varnothing$

E. NOTA

18. Let A be the line segment from (4, 6) to (10, 6) and B be the line segment from (0, 0) to (-3,-2). What is the area of $A \oplus B$?

A. 6 B. $6\sqrt{2}$ C. 12 D. $12\sqrt{2}$ E. NOTA

19. Let A= $\{(5,0),(8,4)\}$ and Let B be the set of points in the interior of the circle with center (-3, 4) and radius 5. What is the area of $A \oplus B$?

A. 50π B. $\frac{100}{3}\pi + \frac{25\sqrt{3}}{2}$ C. $\frac{200}{3}\pi - \frac{25\sqrt{3}}{2}$ D. $50\pi - \frac{25\sqrt{2}}{3}$ E. NOTA

20. The solution to $\log_2(\log_4 x) = \log_8(\log_{16} x)$ can be written in the form $x = 2^a$. Which of the following is closest to a?

A. 1.25 B. 1.50 C. 1.75 D. 2.00 E. NOTA

21. Let a, b, c, d be the roots of the polynomial $P(x) = 5x^4 + x^2 - 7x + 5$.

Evaluate: $\frac{b+c+d}{a^2} + \frac{a+c+d}{b^2} + \frac{a+b+d}{c^2} + \frac{a+b+c}{d^2}$.

A. 0 B. $\frac{5}{7}$ C. $-\frac{5}{7}$ D. $\frac{7}{5}$ E. NOTA

22. What is the eccentricity of the polar curve $r = \frac{8}{1+3\sin\theta}$?

A. $\frac{1}{3}$ B. 3 C. 8 D. $\frac{1}{8}$ E. NOTA

23. Evaluate: $\arctan\left(\frac{\sqrt{3}+3\tan 20^\circ}{3-\sqrt{3}\tan 20^\circ}\right)$.

A. 10° B. 20° C. 40° D. 50° E. NOTA

24. Triangle ABC has AB=5, and AC=7. There exists a point D on line segment BC such that BD=3 and CD=8. What is $\frac{\sin\angle BAD}{\sin\angle CAD}$?

A. $\frac{40}{21}$ B. $\frac{21}{40}$ C. $\frac{56}{15}$ D. $\frac{15}{56}$ E. NOTA

25. Which of the following is a simplified version of $\frac{\sin\frac{\pi}{17}+\sin\frac{2\pi}{17}+\sin\frac{3\pi}{17}+\sin\frac{4\pi}{17}+\sin\frac{5\pi}{17}}{\cos\frac{\pi}{17}+\cos\frac{2\pi}{17}+\cos\frac{3\pi}{17}+\cos\frac{4\pi}{17}+\cos\frac{5\pi}{17}}$?

A. $\tan\frac{3\pi}{17}$ B. $\tan\frac{6\pi}{17}$ C. $\cot\frac{3\pi}{17}$ D. $\cot\frac{6\pi}{17}$ E. NOTA

26. Given that $x + y + z = 0$, $x^3 + y^3 + z^3 = 2000$, evaluate $\frac{x^2}{yz} + \frac{y^2}{xz} + \frac{z^2}{xy}$.

A. 5 B. 10 C. 15 D. 20 E. NOTA

27. What is the equation of the locus of all points in the xy-plane such that the distance from that point to the line 4x + 3y = 0 and the distance to (2, 3) is equal?

A. $9x^2 - 24xy + 16y^2 - 100x - 150y + 325 = 0$ B. $9x^2 - 12xy + 16y^2 - 100x - 150y + 325 = 0$
C. $16x^2 - 24xy + 9y^2 - 150x - 100y + 325 = 0$ D. $16x^2 - 12xy + 9y^2 - 150x - 100y + 325 = 0$
E. NOTA

28. Denote the real part of a complex number z by $\Re(z)$. Given that $\left|z + \frac{1}{z}\right| = 1$, what is the maximum possible value of $\Re(z)$?

A. $\frac{\sqrt{3}}{4}$ B. $\frac{1}{2}$ C. $\frac{\sqrt{5}}{4}$ D. $\frac{\sqrt{6}}{4}$ E. NOTA

29. An ellipse has a minor axis of length 48 and a major axis of length 50. ΔF_1F_2P, formed by the two foci of the ellipse, F_1 and F_2, and a point P on the ellipse, has an area of 144. Evaluate: $\tan(\angle F_1PF_2)$.

A. $\frac{1}{4}$ B. $\frac{7}{15}$ C. $\frac{8}{15}$ D. $\frac{3}{4}$ E. NOTA

30. In ΔABC with $\angle A = 60°$, $\sin^3\angle B + \sin^3\angle C = 1$. Evaluate: $\cos(\angle B - \angle C)$.

A. $\frac{3}{18}$ B. $\frac{5}{27}$ C. $\frac{8}{45}$ D. $\frac{11}{63}$ E. NOTA