

NOTA means "None of the Above"

1. A dart is thrown and hits somewhere inside the pentagon that is traced out when the following coordinates are drawn in succession: $(-5, 1)$, $(-1, 5)$, $(2, 7)$, $(3, -2)$, and $(-1, -6)$. What is the probability that the dart is also in the triangle defined by connecting $(-1, 3)$, $(2, 2.5)$, and $(0, -1.5)$?

- A) $\frac{23}{344}$ B) $\frac{1}{9}$ C) $\frac{13}{86}$ D) $\frac{1}{8}$ E) NOTA

2. Given oblique triangle ABC with sides a, b, c across from their respective angles. What is the length of c ?

- A) $a^2 + b^2 - 2ab \cos C$ C) $b^2 + c^2 - 2bc \cos A$
 B) $\frac{\sin B}{b \sin C}$ D) $\frac{a \sin C}{\sin A}$ E) NOTA

3. If $f(x) = \frac{1}{(x+1)(x-2)}$ and $g(x) = \frac{1}{x}$, then what is the domain of $f(g(x))$?

- A) $\left\{ \mathbf{R} \neq -1, \frac{1}{2}, 0 \right\}$ B) $\left\{ \mathbf{R} \neq -1, \frac{1}{2} \right\}$ C) $\{ \mathbf{R} \neq -1, 2 \}$
 D) $\{ \mathbf{R} \neq -1, 2, 0 \}$ E) NOTA

4. Find the solution set for $\log_e(x+5) - \ln(x+2) = \frac{1}{2} \ln(x+4)^2 - \frac{\log(x+3)}{\log e}$

- A) $\{-5, -4\}$ B) $\left\{ -\frac{7}{2} \right\}$ C) \emptyset D) $\left\{ -\frac{1}{2} \pm \frac{\sqrt{-13}}{2} \right\}$ E) NOTA

5. $f(x) = \csc x$ $g(x) = \sin^{-1} x$ $h(x) = |\sin x|$ $j(x) = \cos\left(x - \frac{\pi}{2}\right)$

$k(x) = e^{x^2}$ $r(x) = \ln|x|$ $t(x) = x^3 + x$

Of the preceding seven graphs, let A = the number of odd functions, let B = the number of even functions, and let $C = r \circ k(2)$. Find $A \div B \div C$ to the nearest hundredth.

- A) .33 B) 1 C) .67 D) .25 E) NOTA

6. $b(x) = i^x$. Find $b(1)b(4)b\left(\frac{1}{2}\right)b\left(\frac{1}{8}\right)$.

- A) $i(-1)^{\frac{5}{16}}$ B) 1 C) $i^{\frac{5}{8}}$ D) $-i^{\frac{5}{8}}$ E) NOTA

7. Find the locus of points such that the sum of the distances between (8, 4) and (-1, 4) is a constant 15. Give its area.

- A) 48π B) 45π C) $\frac{135}{4}\pi$ D) 2025π E) NOTA

8. $\lim_{x \rightarrow 1^+} \frac{x^2 - 3x - 10}{x^3 - 4x^2 - 7x + 10}$

- A) 0 B) $-\infty$ C) undefined D) ∞ E) NOTA

9. What is the frequency of $y = \sin 2x + \cos x$ to the nearest hundredth?

- A) .32 B) .16 C) 3.14 D) 6.28 E) NOTA

10. What is the range of $y = \text{Csc}^{-1}x$?

- A) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ B) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ C) $\left[0, \frac{\pi}{2}\right) \cup \left(\frac{\pi}{2}, \pi\right]$ D) $\left[-\frac{\pi}{2}, 0\right) \cup \left(0, \frac{\pi}{2}\right]$ E) NOTA

11. $f(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \frac{x^9}{9!} - \frac{x^{11}}{11!} + \dots$ Give the value of $f(2)$ to seven decimal places.

- A) -.4161468 B) 2.7182818 C) .9092974 D) .9092975 E) NOTA

12. Which of the following are the roots of $x^4 + \frac{625}{2} - \frac{625}{2}\sqrt{3}i = 0$?

I. $\frac{5}{2} + \frac{5}{2}\sqrt{3}i$ III. $\frac{5}{2} - \frac{5}{2}\sqrt{3}i$ V. $-\frac{5}{2} + \frac{5}{2}\sqrt{3}i$ VII. $-\frac{5}{2} - \frac{5}{2}\sqrt{3}i$

II. $\frac{5}{2}\sqrt{3} + \frac{5}{2}i$ IV. $\frac{5}{2}\sqrt{3} - \frac{5}{2}i$ VI. $-\frac{5}{2}\sqrt{3} + \frac{5}{2}i$ VIII. $-\frac{5}{2}\sqrt{3} - \frac{5}{2}i$

- A) I, IV, V, VIII B) I, IV, VI, VII C) II, III, VI, VII D) II, III, V, VIII E) NOTA

13. $\frac{\sin x \tan x}{\cot x \csc x} =$

- A) $\sin^2 x$ B) $\tan^2 x$ C) $\frac{\sin^2 x}{\cos^4 x}$ D) 1 E) NOTA

14. Sarah and Lina are playing tether ball. The ball itself is negligible (like a point), and swings around the pole at a constant distance of 5 feet from the pole. Lina hits it very, very hard, and it swings 13 times around and another $\frac{720}{13}$ degrees of the circle. To the nearest hundredth of a foot, how far did the ball travel?

- A) 685.33 B) 685.34 C) 413.24 D) 413.25 E) NOTA

15. The number of loops in $r^2 = 9 \cos 2\theta$ plus the number of petals in $r = 4 \cos 3\theta$ is

- A) 10 B) 8 C) 7 D) 5 E) NOTA

16. How many of the following six statements are identities?

I. $\tan 2x = \frac{2 \tan x}{1 - \tan^2 x}$

II. $\tan \frac{1}{2}x = \frac{\sin x}{1 - \cos x}$

III. $\sin A \cos B = \frac{1}{2}[\sin(A + B) + \sin(A - B)]$

IV. $\sin(A + B) = \sin A \cos B - \cos A \sin B$

V. $1 + \cot^2 x = \sec^2 x$

VI. $\cos^4 x - \sin^4 x = \cos^2 x - \sin^2 x$

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

17. What is the area of a regular 27-gon with side length of 4 inches, to the nearest square inch?

- A) 924 B) 936 C) 967 D) 1242 E) NOTA

18. The centroid of the triangle with vertices (10, 17), (-10, 20), and (-1, -15) has coordinates (a, b) . Find $\ln|ab|$ to the nearest hundredth.

- A) 1.70 B) .89 C) 1.99 D) 2.40 E) NOTA

19. What substitutions for x and y could be made in order to eliminate the xy term in $7x^2 - 6\sqrt{3}xy + 13y^2 - 16 = 0$?

A) $x = x' \left(\frac{\sqrt{3}}{2} \right) + y' \left(\frac{1}{2} \right)$

B) $x = x' \left(\frac{1}{2} \right) - y' \left(\frac{\sqrt{3}}{2} \right)$

C) $y = x' \left(\frac{1}{2} \right) + y' \left(\frac{\sqrt{3}}{2} \right)$

D) $y = x' \left(\frac{\sqrt{3}}{2} \right) + y' \left(\frac{1}{2} \right)$

E) $x = x' \left(\frac{1}{2} \right) + y' \left(\frac{\sqrt{3}}{2} \right)$

F) $x = x' \left(\frac{\sqrt{3}}{2} \right) - y' \left(\frac{1}{2} \right)$

G) $y = x' \left(\frac{\sqrt{3}}{2} \right) + y' \left(\frac{1}{2} \right)$

H) $y = x' \left(\frac{1}{2} \right) + y' \left(\frac{\sqrt{3}}{2} \right)$

E) NOTA

20. Describe, in accurate detail, the polar graph $r = 4 \cos \theta - 2$.

- A) cardioid/cardioid
 B) dimpled (dented) limaçon
 C) limaçon with an inner loop
 D) convex limaçon
 E) NOTA

21. $\sqrt{x}\sqrt[6]{x} = \sqrt[3]{x} - \frac{1}{4}$. Give $\frac{\ln x}{x}$ to the nearest hundredth.
 A) -16.64 B) -266.17 C) -44.36 D) -5.55 E) NOTA
22. Given A(2, 4, 2), B(-2, -4, 1), C(5, -2, -3), and D(-3, 4, 2), what is the volume of the parallelepiped with vector edges \overline{AB} , \overline{AC} , and \overline{AD} ?
 A) $28\frac{1}{3}$ B) 156 C) 170 D) 256 E) NOTA
23. $\vec{u} = 3\vec{i} - \vec{j} + 2\vec{k}$ and $\vec{v} = \vec{i} + 2\vec{j} + 3\vec{k}$, $\vec{u}\vec{v} =$
 A) 4 B) 5 C) 6 D) 7 E) NOTA
24. What is the area enclosed by $x = \frac{2}{127} + \frac{37}{4}\cos\theta$ and $y = \frac{11}{9} - \frac{311}{16}\sin\theta$, to the nearest square unit?
 A) 565 B) 0 C) 101558 D) 575 E) NOTA
25. Find the constant term in the expansion of $\left(4x^5 + \frac{1}{2}x^{-3}\right)^{16}$.
 A) 1024 B) 4096 C) 8008 D) 32032 E) NOTA
26. In a 34, 40, 71 triangle, find the smallest angle (nearest second).
 A) $147^\circ 8' 52''$ B) $15^\circ 3' 25''$ C) $15^\circ 3' 24''$ D) $147^\circ 8' 53''$ E) NOTA
27. Find the tangent line to $y = x^4 - x^3 + \frac{7}{2}x^2 - 5x + 49.2$ when $x = 2$. This line can be used to approximate values of the polynomial near $x = 2$. Find the absolute value of the difference between the true y -value at $x = 2.1$ and the tangent line's y -value at $x = 2.1$.
 A) .0619 B) .2221 C) 30.6479 D) .222 E) NOTA
28. The probability that Kory beats Hayley is .4. What is the probability that Kory beats Hayley at the next 6 out of 10 competitions (round to the nearest thousandth)?
 A) .250 B) .251 C) .111 D) .112 E) NOTA
29. $\cot A = -\frac{4}{3}$, where A is in quadrant II, and $\csc B = -\frac{41}{40}$, where B is in quadrant IV. Find $\cos(A+B)$, to the nearest thousandth.
 A) .589 B) .590 C) .409 D) .410 E) NOTA
30. $f(x) = x^2 - 2x + 4$, $f(1) =$
 A) 2 B) 3 C) 4 D) 5 E) NOTA