Important Instructions For This Test: Good luck, have fun, and as always: "NOTA" stands for "None of These Answers is correct."

1. Max's function is $f(x) = (x-2)^2 + 1$. Evaluate $f(f(4))$.

(A) 5 **(B)** 7 **(C)** 10 **(D)** 14 **(E)** NOTA

2. θ is $-\frac{\pi}{4}$. Find the value of $\sin\theta + \cos\theta$.

(A) $-\frac{\sqrt{2}}{2}$ **(B)** 0 **(C)** $\frac{\sqrt{2}}{2}$ **(D)** $\sqrt{2}$ **(E)** NOTA

3. The monthly rent for an apartment in Atlanta is \$2600 less than the cost of renting the apartment for 3 months. How much does it cost to rent the apartment for a year?

(A) \$1300 **(B)** \$2600 **(C)** \$14400 **(D)** \$15600 **(E)** NOTA

4. Evaluate $\cos^{-1}\left(\cos\left(-\frac{11\pi}{12}\right)\right)$

(A) $-\frac{5\pi}{6}$ **(B)** $\frac{\pi}{3}$ **(C)** $\frac{7\pi}{12}$ **(D)** $\frac{11\pi}{12}$ **(E)** NOTA

5. Two sequences are given below with sums of A and B. What is the value of $A - B$?

$$2 + 4 + 6 + 8 + 10 + \ldots + 198 + 200 = A$$

$$1 + 2 + 3 + 4 + 5 + \ldots + 99 + 100 = B$$

(A) 5000 **(B)** 5050 **(C)** 10100 **(D)** 20200 **(E)** NOTA

6. Which is an angle that is coterminal with $-\frac{\pi}{6}$?

(A) $-\frac{433\pi}{6}$ **(B)** $\frac{103\pi}{6}$ **(C)** $\frac{67\pi}{3}$ **(D)** $-\frac{383\pi}{6}$ **(E)** NOTA

7. Vector $\vec{v}$ is $\begin{bmatrix} 4 \\ 5 \\ -6 \end{bmatrix}$ and vector $\vec{u}$ is $\begin{bmatrix} -3 \\ 2 \\ 1 \end{bmatrix}$. Evaluate $(\vec{v}\cdot\vec{v})(\vec{u}\cdot\vec{u})$

(A) 546 **(B)** 933 **(C)** 1024 **(D)** 1078 **(E)** NOTA

8. Evaluate $(-\frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2}i)^3$

(A) -1 **(B)** 1 **(C)** $-i$ **(D)** i **(E)** NOTA

Questions 9 and 10 are about the results of a recent survey. The survey of 120 people found:
60 people think their job will be replaced by A.I.
50 people think their job will be replaced by robots
20 people think their job will be replaced by both A.I. and robots

9. Find the probability that a person who thinks their job will be replaced by A.I. also thinks their job will be replaced by robots.

(A) $\frac{2}{3}$ **(B)** $\frac{3}{5}$ **(C)** $\frac{1}{2}$ **(D)** $\frac{1}{3}$ **(E)** NOTA

10. Find the probability that a randomly selected person thinks that their job will be replaced by neither A.I. nor robots..

(A) $\frac{1}{3}$ **(B)** $\frac{2}{5}$ **(C)** $\frac{1}{2}$ **(D)** $\frac{3}{4}$ **(E)** NOTA

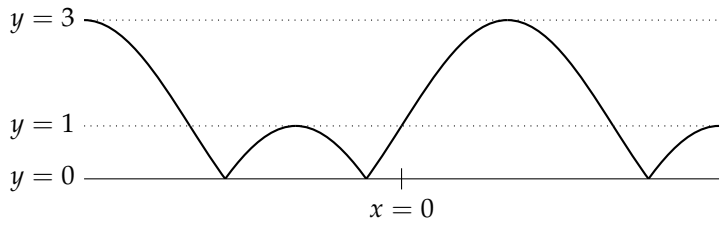
11. Find the coefficient of the x term in the expansion of $\left(x^3 + \frac{2}{x}\right)^7$.

(A) 32 **(B)** 336 **(C)** 672 **(D)** 1120 **(E)** NOTA

12. Find the domain of $f(g(x))$ if $f(x) = \sqrt{x^2 - 64}$ and $g(x) = \ln(x - 2)$.

(A) $(\infty, -2 + e^{-8}) \cup (2, 2 + e^8]$ **(C)** $(2, 2 + e^{-8}] \cup [2 + e^8, \infty)$ **(E)** NOTA
(B) $(2, e^8]$ **(D)** $[2 + e^{-8}, \infty)$

13. Which of the following could be the equation for the graph shown?



(A) $|2\cos x + 1|$ **(B)** $|2\sin x + 1|$ **(C)** $|3\sin x - 1|$ **(D)** $|2\sin x - 1|$ **(E)** NOTA

For questions 14 and 15 consider triangle XYZ with sides $XY = 8$, $XZ = 6$, and $m\angle X = 120^\circ$

14. What is the length of side YZ?

(A) $2\sqrt{37}$ **(B)** $2\sqrt{38}$ **(C)** $2\sqrt{39}$ **(D)** $2\sqrt{41}$ **(E)** NOTA

15. What is the area of triangle XYZ?

(A) $10\sqrt{3}$ **(B)** $12\sqrt{3}$ **(C)** $12\sqrt{2}$ **(D)** $14\sqrt{3}$ **(E)** NOTA

16. Which of the following is the oblique asymptote of $\frac{2x^3 - 14x^2 + 3x - 5}{x^2 + 6}$?

(A) $-9x + 79$ **(B)** $-4x - 8$ **(C)** $x + 48$ **(D)** $2x - 14$ **(E)** NOTA

For questions 17 and 18 consider the function $f(x) = x^3 - 4x$:

17. On which of the following domains is the function odd?

(A) $(-1, 6)$ **(B)** $(-8, 8)$ **(C)** $(2, 43)$ **(D)** $(-\infty, 500)$ **(E)** NOTA

18. It is known that the "vertices" (points where the graph changes direction) of $f(x)$ occur at $x = \pm\frac{2}{\sqrt{3}}$. On which of the following domains is the function monotonically decreasing?

(A) $(-1, 0)$ **(B)** $(0, 2)$ **(C)** $(2, \infty)$ **(D)** $(-\sqrt{2}, 500)$ **(E)** NOTA

19. Let H be the area in the Cartesian plane bounded by the lines $y = 2x + 2$, $y = -2x + 2$ and the x-axis. H is then rotated about the y-axis to create a 3D shape. What is the volume of the shape?

(A) $\frac{\pi}{3}$ **(B)** $\frac{2\pi}{3}$ **(C)** π **(D)** $\frac{4\pi}{3}$ **(E)** NOTA

20. Find the smallest value of x such that $(x^2 + 4x - 14)^2 - (x - 4)^2 = 0$.

(A) -5 **(B)** 2 **(C)** $\frac{-5+\sqrt{97}}{2}$ **(D)** $\frac{-5-\sqrt{97}}{2}$ **(E)** NOTA

21. Which of the following sets of vectors are linearly independent?

(A) $\begin{bmatrix}1\\2\\3\end{bmatrix}, \begin{bmatrix}2\\4\\6\end{bmatrix}$ **(C)** $\begin{bmatrix}4\\9\\-3\end{bmatrix}, \begin{bmatrix}-1\\2\\3\end{bmatrix}, \begin{bmatrix}3\\11\\0\end{bmatrix}$ **(E)** NOTA

(B) $\begin{bmatrix}6\\2\\8\end{bmatrix}, \begin{bmatrix}0\\0\\0\end{bmatrix}$ **(D)** $\begin{bmatrix}1\\0\\0\end{bmatrix}, \begin{bmatrix}1\\1\\0\end{bmatrix}, \begin{bmatrix}1\\1\\1\end{bmatrix}$

22. Victor the alien drops in on a Ferris wheel pod at the wheel's peak height of 168 feet. The height that Victor is at can be modeled with a sinusoidal function with amplitude A and period T seconds. 118 seconds later, Victor's pod is at the trough at a height of 20 feet. What is the sum of A and all possible integer values of T?

(A) 310 **(B)** 314 **(C)** 388 **(D)** 434 **(E)** NOTA

23. What type of limaçon is the graph of $r = 7 + 4\sin\theta + 6\cos\theta$?

(A) Convex **(B)** Dimpled **(C)** Cardioid **(D)** Inner loop **(E)** NOTA

24. Evaluate $\cos(3x)$.

(A) $-3\cos x - 4\cos^3 x$ **(C)** $3\cos x - 4\cos^3 x$ **(E)** NOTA
(B) $-3\cos x + 4\cos^3 x$ **(D)** $-3\cos x - 4\cos^3 x$

25. Jalen and Jaylen are playing monopoly with only 2 people. In order to increase the pace, They use 4 dice instead of just 2. However, there is a rule in monopoly where if a person rolls a double (both dice have the same number), they are awarded a second roll. In order to adjust this rule under 4 dice, they change it to a person needs to roll at least 3 of the 4 dice to be the same number. How much lower is the probability that a player gets a second roll under this new rule?

(A) $\frac{1}{36}$ **(B)** $\frac{5}{72}$ **(C)** $\frac{2}{27}$ **(D)** $\frac{5}{36}$ **(E)** NOTA

26. A cup of mass 30g is thrown with the velocity vector $\vec{v} = \langle 4, 2\rangle$. It hits the floor and breaks into 3 pieces of equal mass. One piece has the velocity vector $\vec{v}_1 = \langle -6, 3\rangle$, and another piece has the velocity vector $\vec{v}_2 = \langle 5, 0\rangle$. Assuming momentum is conserved, what is velocity vector of that last piece? (Hint: the value of $m\vec{v}$ is equal before and after the break.)

(A) $\langle 1, 3\rangle$ **(B)** $\langle 13, 1\rangle$ **(C)** $\langle -2, -7\rangle$ **(D)** $\langle 4, -6\rangle$ **(E)** NOTA

27. A projectile is fired at 40m/s at an angle of 15° above the horizon. What is the horizontal range, in meters, the projectile will achieve? Assume $g = 10m/s^2$.

(A) 160 **(B)** 120 **(C)** 80 **(D)** 40 **(E)** NOTA

28. Jaden brings in one complete cake. He then brings in 2 half cakes. He then brings in 3 quarter cakes. He continues to bring in cakes increasing in quantity by one but decreasing in size by a half. What is the total amount of cake he brings in?

(A) 4 **(B)** 10 **(C)** 42 **(D)** ∞ **(E)** NOTA

29. Which of the following is a rotation of the conic $7x^2 + 6\sqrt{3}xy + 13y^2 = 16$ so that it no longer has a xy term?

(A) $\frac{x^2}{4} - y^2 = 1$ **(B)** $x^2 + y^2 = 4$ **(C)** $x^2 - \frac{y^2}{4} = 1$ **(D)** $x^2 + \frac{y^2}{4} = 1$ **(E)** NOTA

30. Evaluate

$$\lim_{x\to 2} \frac{x^3 - 8}{x^2 - 4}$$

(A) $\frac{5}{13}$ **(B)** 2 **(C)** 3 **(D)** 16 **(E)** NOTA