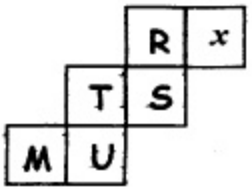
Theta Gemini
2000 Mu Alpha Theta National Convention

The abbreviation NOTA denotes "None of These Answers"

1. The figure shown can be folded into the shape of a cube. In the resulting cube, which of the lettered faces is opposite the face marked x ?



A. M
B. S
C. T
D. U
E. NOTA

2. Given that $\begin{bmatrix} 2 & -3 \\ 4 & 1 \end{bmatrix} \bullet \begin{bmatrix} 6 \\ x \end{bmatrix} = \begin{bmatrix} x \\ 3y \end{bmatrix}$

find the value of $x+y$.

A. 16 B. 15
C. 12 D. 9 E. NOTA

3. For $f(x) = |2+x| + |3x-6|$ when $-1 < x < 2$ choose the expression equivalent to f .

A. $4x-4$ B. $-2x+8$
C. $4x+8$ D. $x+4$
E. NOTA

4. I have won 30% of the games that I have played. If I have played 600 games, what is the least number of games that I now have to lose (with no wins or ties) to have won less than 28% of the games that I have played?

A. 12 B. 38
C. 43 D. 68 E. NOTA

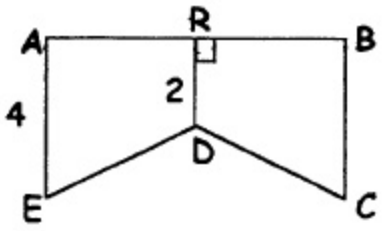
5. For $f(x) = 2x+1$ and $g(x) = x^2 + 3x$ let $4k+1 = g(f(2))$. What is the value of k ?

A. 85 B. 21
C. 9.75 D. 5 E. NOTA

6. If A and B are distinct members of the set { 9, 10, 20, 21 } and $P = \frac{A+B}{B}$ then which could <u>not</u> be a remainder of the quotient P ?

A. 5 B. 9 C. 3 D. 0 E. NOTA

7. Angles A and B in pentagon ABCDE are right angles, and ED=DC. If AB=6, AE=BC=4, RD=2 and R is the midpoint of $\overline{AB}$ then approximate the perimeter of ABCDE to the nearest hundredths place.



A. 22.90 B. 21.21
C. 14.90 D. 18.00 E. NOTA

8. If $f(x) = f(x-1) + 6$ and $f(2) = 1$ then give the value of $f(4)$.

A. 19 B. 13
C. 7 D. 1 E. NOTA

9. A solution is 30% acid, evenly distributed, and the rest is water. If 40 ounces of liquid are poured out and replaced by water, the remaining solution would contain 5 ounces of acid. How many ounces of acid did the solution have originally?

A. 17 B. $39.\overline{6}$
C. $56.\overline{6}$ D. 150 E. NOTA

10. If $\log a + \log b + \log c + \log d = 3$ and $\log b + \log c + \log d + \log e = 2$ then if $a = 10$ the value of e must be

A. 20 B. 10
C. $\frac{1}{10}$ D. $\frac{1}{20}$ E. NOTA

11. The lines given by $y = ax + 8$ for $a < 0$, $y = bx - 4$ for $b > 0$, and $x = 0$ enclose a triangular region. The region has area 24 for some values of a and b. Give the value of $b - a$.

A. 6 B. 4 C. 3 D. 1 E. NOTA

12. An object is dropped into a cylindrical vat with radius 6 feet and height 10 ft. It is half filled with water. The object completely submerges and raises the water level $\frac{1}{2}$ inch. Give the volume of the object in cubic feet.

A. 1.5π B. 1.8π
C. 15π D. 18π E. NOTA

13. Which expression is equivalent to $\sqrt{-2x} \bullet \sqrt{-2x}$ for all real values of x?

A. $2|x|$ B. $2x$
C. $-2|x|$ D. $-2x$ E. NOTA

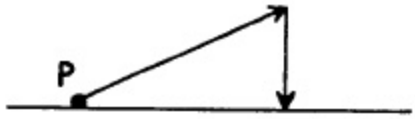
14. In one year, a man wears a green shirt every third day, beginning on his birthday, January 1, which is a Sunday. He wears brown shoes every second day beginning with the Monday after his birthday. He wears blue jeans every fourth day of the month, beginning on the Tuesday after his birthday. If we discount leap days, and assume that he wears other colors of clothes on days not mentioned here, on which day of the week will he wear a green shirt, brown shoes, and blue jeans?

A. Monday B. Wednesday
C. Thursday D. Saturday E. NOTA

15. If $\log_4(x+4) = \log_2(x)$ then give the val of $x^2 - x$.

A. 2 B. 3
C. 4 D. 8 E. NOTA

16. An airplane takes off in a linear path, 30 degre off horizontal from point P on the ground. It travels at 150 mph in a linear path for an amou of time then has a nonfatal accident. It drops vertically (but safely) to the ground. If it also drops at a constant 150 mph, and the total trip takes 2 hours, how far did it travel vertically?



A. 100 miles B. 200 miles
C. 300 miles D. $200\sqrt{3}$ miles
E. NOTA

17. If the natural numbers 1 through 100 are written, the how many times will the digit 5 be written?

A. 19 B. 20
C. 21 D. 22 E. NOTA

18. How many digits does the base ten expansion of 2^{2000} have?

A. 32 B. 64
C. 128 D. 603 E. NOTA

19. The circumference of a circle and the perimete of a square are each 20 cm. If the areas of the circle and square are A_1 and A_2, respectively, then find the value of $|A_2 - A_1|$.

A. $2\sqrt{5} - \frac{2\sqrt{5\pi}}{\pi}$ B. $16 - \frac{2\sqrt{5\pi}}{\pi}$
C. $\frac{100}{\pi} - 25$ D. $25 - \frac{100}{\pi^2}$
E. NOTA

20. If $\log_2(\log_3(\log_5(x))) = 2$ then how many positive integral factors does x have?

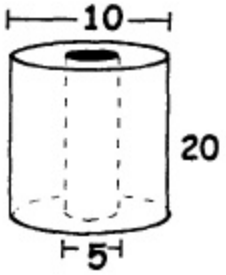
A. 2 B. 82
C. 405 D. 406 E. NOTA

21. The arithmetic mean of two numbers is 3 and the geometric mean of the same two numbers is 4. Find the sum of the squares of the same two numbers.

A. 4 B. 6
C. 16 D. 32 E. NOTA

22. A cylindrical can of diameter 10 cm and height 20 cm is made of solid metal. The center is drilled through and the "drilled out" piece is cylindrical with a diameter of 5 cm, and an axis that is the same as the original. What is the surface area of the resultant solid?

A. 1100π
B. 1060π
C. 943π
D. 337.5π
E. NOTA



23. For $x = 1000$ the value of the function $f(x) = \frac{(x+3)!}{(x+1)!}$ (f is defined for $x > 3$) is NOT evenly divisible by which integer?

A. 3 B. 50
C. 167 D. 1003 E. NOTA

24. Given parallelogram ABCD with BC=5, CD=6 and $m\angle C = 120$, give the area of ABCD.

A. 30 B. $15\sqrt{3}$
C. $12\sqrt{3}$ D. 24 E. NOTA

25. Let *a*, *b* and *c* be distinct members of the set S but *a* is not necessarily the first element of S. If S={ 1, 4, 9 } and $\frac{a+b}{c} > b$ then what is the least possible value of $\frac{a+b}{c} - b$?

A. 1 B. 1.5
C. 4 D. 6.5 E. NOTA

26. Given the equation $9^{1999} - 9^{1998} - 9^{1997} + 9^{1996} = k \cdot 9^{1996}$ then find the value of k.

A. 5760 B. 729
C. 640 D. 8 E. NOTA

27. If $y = e^x$ and $x = \ln z$ and $z = \frac{1}{m}$ then for $z > 0$, $xym \neq 0$ which is equivalent to m ?

A. y B. $-y$
C. $\frac{1}{y}$ D. $\frac{-1}{y}$ E. NOTA

28. A point P is on line L and L is defined by the equation $y = x + 2$. P is at (0, 2) at time t=0. P moves along L at a rate of 2 units per minute, increasing both x and y values. What is the x-coordinate after 5 minutes?

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

29. A paper measures 10 inches by 20 inches. It is to have printed matter on it, with a uniform border on all sides. What width border will give 40 square inches of printed matter? Approximate to the nearest hundredths of an inch.

A. 9.61 B. 4.81
C. 3.47 D. 1.74 E. NOTA

30. A regular triangle T_1 of side length 12 is drawn in a plane. From the midpoint of each side a second triangle T_2 is drawn with the midpoints of T_1 as vertices. From the midpoints of the sides of T_2 another triangle T_3 is formed, and so on. If the area of T_1 is A_1 and the area of T_2 is A_2, and so on, then find the summation of all areas: $A_1 + A_2 + A_{3+} \ldots$

A. $\frac{16}{3}\sqrt{3}$ B. $\frac{32}{3}\sqrt{3}$

C. $\frac{8}{3}\sqrt{3}$ D. $48\sqrt{3}$

E. NOTA