1. If the pattern continues, how many squares would comprise Figure 500?

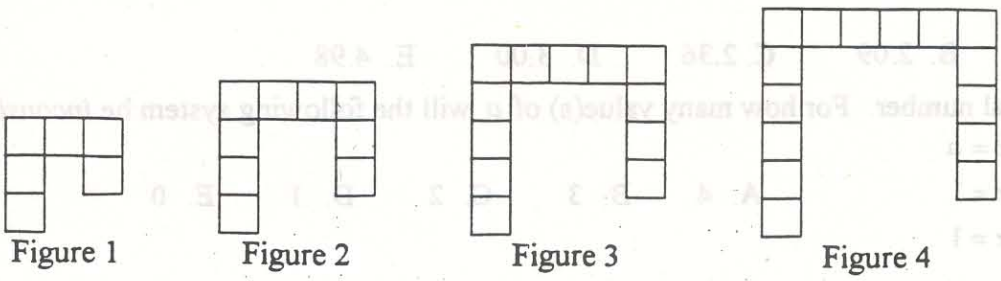

Figure 1 Figure 2 Figure 3 Figure 4

A. 1497 B. 1500 C. 1503 D. 1506 E. 1509

2. If $5x+3y=6$ and $7x+4y=7$, then $x^3+y^3=$

A. -370 B. 64 C. 316 D. 370 E. none of these

3. If the roots of a quadratic equation of the form $x^2+bx+c=0$ are $5\pm 4i$, then $bc=$

A. -410 B. -64 C. 64 D. 410 E. none of these

4. The approximate number of seconds in the American average life span is

A. 2^{30} B. 2^{31} C. 2^{32} D. 2^{33} E. 2^{34}

5. Which of the following is tangent to $x^2+y^2=169$ at (12,5)?

A. $12x-5y=119$ B. $5x-12y=0$ C. $5x+12y=120$ D. $12x+5y=169$ E. none of these

6. Let T be the triangle whose vertices are at (0,0), (1,1), and (2,0). Find m so that $y=mx$ divides T into two triangles of equal area.

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

7. A house is 70 ft by 30 ft (rectangular). A dog is tied on a 75 ft leash at the center of one of the long sides of the house. Assuming there are no constraints on the dog's movement other than the leash and the house itself, what is the area to the nearest square foot of the space the dog can reach?

A. 5,753 sq ft B. 8,836 sq ft C. 11,329 sq ft D. 11,506 sq ft E. 17,671 sq ft

8. What is the remainder when 1999^{1999} is divided by 7?

A. 1 B. 2 C. 3 D. 4 E. 5

9. Let $P(x)=\left\{\left[(x+1)^3+1\right]^5+1\right\}^7$. Which statement is NOT true?

A. The degree of P is 105.

B. $P(-2)=1$

C. $P\left(-1-\sqrt[3]{2}\right)=0$

D. P has only one real zero.

E. $P\left(x^2-1\right)=P\left(-x^2-1\right)$ for all x.

10. $\sum_{n=1}^{\infty} 5^{1-n}2^{2n}=$

A. 10 B. 15 C. 20 D. 25 E. ∞

11. Find the area to the nearest hundredth of a square unit of the region described by $x \geq 0$, $y \geq 2x$, and $y \leq \sqrt{9-x^2}$.

A 2.01 B. 2.09 C. 2.36 D. 3.00 E. 4.98

12. Let a be a real number. For how many value(s) of a will the following system be *inconsistent*?

$$\begin{cases} ax - y + z = a \\ x - ay + z = 1 \\ x - y + az = 1 \end{cases}$$

A. 4 B. 3 C. 2 D. 1 E. 0

13. If A is an acute angle whose sine is s, then $\sin 4A =$

A. $4s(1-2s^2)\sqrt{1-s^2}$ B. $2(1-2s^2)\sqrt{1-s^2}$ C. $\frac{4}{3}(1-s^2)^{3/2}$ D. $4s\sqrt{1-s^2}$

E. $4s(1-2s^2)^{3/2}$

14. Which of the following intervals contains the sum of the squares of the solutions for $2(3)^t = 5t + 1$?

A. $\left(-\infty, -\frac{\pi}{3}\right)$ B. $\left[-\frac{\pi}{3}, \frac{\pi}{3}\right]$ C. $\left(\frac{\pi}{3}, \sqrt{2}\right)$ D. $\left[\sqrt{2}, 2\right]$ E. $(2, +\infty)$

15. For an arbitrary function f with domain $(-\infty, +\infty)$, define $F(x) = f(x) + f(-x)$ and $G(x) = f(x) - f(-x)$. Which of the following MUST be an even function?

A. $F+G$ B. FG C. F/G D. $F \circ G$ E. $G \circ G$

16. If $\frac{(x-3)^2}{100} + \frac{(y-1)^2}{48} = 1$ and $6x - 5y = 13$, then $x^2 - 6x =$

A. -2 B. 7 C. 8 D. 16 E. none of these

17. How far out at sea will a ship be when it can first be seen by a person standing on the shore if the highest point of the ship is 50 ft above sea level and the observer's eyes are 5 ft above sea level? Use 3960 miles as the radius of the earth. Round final result to the nearest mile. Assume perfect visibility, calm seas, and that the observer has as good a telescope as is necessary.

A. 8 mi B. 11 mi C. 16 mi D. 48 mi E. 52 mi

18. Suppose $\frac{x}{y} = 2^z$, $\frac{y^2}{z} = x$, and $\frac{yz}{\sqrt{x}} = 8$. Find $\log_2(xyz)$.

A. 2 B. 6 C. 10 D. 16 E. 18

19. Find the radius r of the inscribed circle in a right triangle having hypotenuse equal to L and one acute angle equal to θ. $r =$

A. $\frac{L\cos\theta\tan\left(\frac{\theta}{2}\right)}{1+\tan\left(\frac{\theta}{2}\right)}$ B. $\frac{L\cos\left(\frac{\theta}{2}\right)\tan\left(\frac{\theta}{2}\right)}{1+\tan\left(\frac{\theta}{2}\right)}$ C. $\frac{L\sin\left(\frac{\theta}{2}\right)\tan\left(\frac{\theta}{2}\right)}{1+\tan\left(\frac{\theta}{2}\right)}$ D. $\frac{L\sin\left(\frac{\theta}{2}\right)\tan(\theta)}{1+\tan(\theta)}$

E. none of these

20. Let p be the probability that a positive score is obtained on this exam when a student randomly selects for each of the 20 questions from the choices A, B, C, D, and E. Which of the following is closest to p?

A. 0.005 B. 0.01 C. 0.13 D. 0.22 E. 0.37