

- Find the number of ordered pairs of real numbers  $(a, b)$  such that  $(a + bi)^{2009} = a - bi$ .  
A: 1005  
B: 2008  
C: 2009  
D: 2010  
E: none of the above
- A ball is thrust up vertically from the ground into the air and hits the ground 2.5 seconds later. What is the maximum height of the ball in feet?. Assume that air resistance is negligible. The acceleration due to gravity is  $-32 \text{ ft/sec}^2$ .  
A: 50  
B: 30  
C: 100  
D: 75  
E: none of the above
- If the geometric series  $a + ar + ar^2 + \dots$  has a sum of 7, and the terms involving odd powers of  $r$  have a sum of 3. What is  $a + r$ ?  
A:  $4/3$   
B:  $12/7$   
C:  $3/2$   
D:  $5/2$   
E: none of the above
- If  $y$  is a continuous function and  $y' = |1 - x|$  and  $y(0) = 1$ , what is  $y(3)$ ?  
A.  $-3/2$   
B.  $3/2$   
C.  $5/2$   
D. 2  
E. none of the above
- If the graph of  $y = x^3 + ax^2 + bx - 4$  has a point of inflection at  $(1, -6)$ , what is the value of  $b$ ?  
A. -3  
B. 0  
C. 1  
D. 3  
E. none of the above

6. How many different points in 3-dimensional space have 3 positive integral coordinates whose sum is 100?  
A:  $98^3$   
B: 9702  
C: 4851  
D: 9506  
E: none of the above
7. Given that  $x^2 + y^2 = xy$ , find  $\frac{dy}{dx}$ .  
A:  $2x + 2y$   
B:  $x + y$   
C:  $\frac{y-2x}{x-2y}$   
D:  $\frac{y-2x}{2y-x}$   
E: none of the above
8. Find this limit.  $\lim_{x \rightarrow (\pi/2)^-} \frac{4 \tan x}{1 + \sec x}$   
A: 0  
B: 4  
C: 2  
D: -4  
E: none of the above
9. I drove at a constant speed for 3 hours and traveled  $x$  km. If I had driven each kilometer one minute faster, I would have driven 30 km. further in the 3 hours. What is the value of  $x$ ?  
A: 40  
B: 50  
C: 60  
D: 30  
E: none of the above
10. Find all  $k$  so that  $(1, 2k)$ ,  $(3k, 4)$ , and  $(5, 6k)$  cannot determine 3 points on a circle.  
A: 2,  $-2/3$   
B:  $2/3$ ,  $3/5$   
C: 1,  $-4/3$   
D:  $2/3$ ,  $6/5$   
E: none of the above

11. Water is poured into a conical cup at the rate of  $\frac{2}{3}$  cubic inches per second. If the cup is 6 inches tall and the top of the cup has a radius of 2 inches, how fast does the water level rise when the water is 4 inches deep? (in inches per second)
- A:  $\frac{3}{8\pi}$   
B:  $\frac{3\pi}{8}$   
C:  $\frac{8}{3\pi}$   
D:  $\frac{2\pi}{3}$   
E: none of the above
12. What is the base of the system in which 121 represents the same number as the decimal number 324?
- A: 15  
B: 9  
C: 12  
D: 17  
E: none of the above
13. On what open interval is  $f(x) = (x^2 - 3)e^x$  decreasing?
- A:  $-3 < x < 1$   
B:  $x < -3$  or  $x > 1$   
C:  $x < -1$  or  $x > 3$   
D:  $x < -3$   
E: none of the above.
14. Calculate  $\lim_{n \rightarrow \infty} (1 + \frac{1}{n^2})^{\sqrt{n}}$ .
- A: 0  
B: 1  
C:  $e$   
D:  $\sqrt{e}$   
E: None of the Above
15. Evaluate  $\int_1^4 e^{\sqrt{x}} dx$ .
- A.  $e^4$   
B.  $6e^4$   
C.  $2e^2$   
D.  $e^2 - e$   
E. none of the above

16. The region bounded by the curve  $f(x) = 2\sqrt{x}$ , the x-axis, and the lines  $x = 4$  and  $x = 9$ , is revolved about the x-axis. Find the volume of the resulting solid.
- $42\pi$
  - $\frac{1436\pi}{3}$
  - $130\pi$
  - $\frac{175\pi}{4}$
  - none of the above
17.  $A = \sqrt{6 + \sqrt{6 + \sqrt{6 + \dots}}}$  and  $B = \sqrt{9 - \sqrt{9 - \sqrt{9 - \dots}}}$ . Find  $AB$ .
- $3\sqrt{6}$
  - $3(\sqrt{26} - 2)/2$
  - $3(\sqrt{37} - 1)/2$
  - $4\sqrt{5} - 2\sqrt{2}$
  - none of the above
18. A sphere is inscribed in a cube. The cube has a surface area of 36 square meters. A second cube is then inscribed in the sphere. What is the surface area of the inner cube in square meters?
- 12
  - $9\sqrt{3}$
  - 9
  - 18
  - none of the above
19. Find the value of  $a + b + c + d$  so that the graph of  $y = ax^3 + bx^2 + cx + d$  has a local minimum at  $(0,0)$  and a local maximum at  $(3,4)$ .
- 1
  - $\frac{28}{27}$
  - $\frac{5}{2}$
  - $\frac{26}{3}$
  - none of the above
20.  $f(x) = \int_1^{3x} \sqrt{t^2 - t} dt$  for all  $x > 1$ . Find  $f'(5)$ .
- $6\sqrt{53}$
  - $3\sqrt{70}$
  - $3\sqrt{210}$
  - $\sqrt{210}$
  - none of the above

21. Find  $\lim_{x \rightarrow -\infty} (\sqrt{x^2 + 4x + 7} + x)$ .
- A. 0
  - B.  $-\infty$
  - C. 1
  - D. 2
  - E. none of the above
22. An open box with a rectangular base is to be constructed from a rectangular piece of cardboard 16 inches wide and 21 inches long by cutting out a square from each corner and then bending up the resulting sides. Find the size of the corner square that will produce a box having the largest possible volume.
- A. 2
  - B. 4
  - C.  $2/5$
  - D. 3.5
  - E. none of the above
23. If an arc of  $45^\circ$  on a circle A has the same length as an arc of  $30^\circ$  on circle B, then the ratio of the area of circle A to the area of circle B is :
- A:  $4/9$
  - B:  $2/3$
  - C:  $5/6$
  - D:  $3/2$
  - E: none of the above
24. Evaluate  $\int_2^3 \frac{4x^2 + 13x - 9}{x^3 + 2x^2 - 3x} dx$ .
- A.  $\ln(15/2)$
  - B.  $\ln(45/4)$
  - C.  $\ln(15/4)$
  - D.  $\ln(24/5)$
  - E. none of the above
25. Assign an area to the region that lies under the graph of  $y = e^{2x}$ , over the x-axis and to the left of  $x = 1$ .
- A. 1
  - B.  $e^2$
  - C.  $e/2$
  - D.  $\frac{e^2}{2}$
  - E. none of the above

26. A particle travels along the x-axis with velocity given by  $v(t) = 4 - 3t - t^2$ . If the particle is at position 2 on the x-axis at  $t = 0$ , then where is the particle at  $t = 2$ ?
- A.  $-2/3$
  - B.  $2/3$
  - C.  $4/3$
  - D.  $13/3$
  - E. none of the above
27. Calculate  $\sum_{n=1}^{\infty} \left[ \frac{7}{n(n+1)} + \frac{2}{3^{n-1}} \right]$
- A: 9
  - B: 1
  - C:  $23/3$
  - D: Series diverges
  - E: None of the above
28. Find the slope of the polar graph  $r = \sin(2\theta)$ , when  $\theta = \pi/6$ .
- A.  $\sqrt{3}$
  - B. 0
  - C. 1
  - D.  $\sqrt{3}/2$
  - E. none of the above
29. Find the cosine of the acute angle between the lines tangent to the curves  $f(x) = -\ln(\cos(x))$  and  $g(x) = \ln(\sin(x))$  at  $\pi/3$ .
- A:  $1/2$
  - B:  $\sqrt{2}/2$
  - C:  $\sqrt{3}/2$
  - D: 1
  - E: none of the above
30. Solve for  $y(3)$ , such that  $y' = \frac{2xy}{1+x^2}$  and  $y(2) = 5$ .
- A:  $41/5$
  - B: 8
  - C:  $42/5$
  - D: 10
  - E: none of the above