1. What is an equation of the circle whose diameter has endpoints (1, 2) and (5, 6)?
   
   (A) $(x + 3)^2 + (y - 2)^2 = 20$
   (B) $(x - 3)^2 + (y + 2)^2 = 20$
   (C) $(x - 3)^2 - (y + 2)^2 = 20$
   (D) $(x - 3)^2 + (y + 2)^2 = 80$
   (E) $(x + 3)^2 - (y - 2)^2 = 80$
2. A frequency distribution for the ages of 50 men in a certain association is given. What is the approximate mean age of the men?

(A) 35.7
(B) 35.9
(C) 36.3
(D) 36.5
(E) 37.1

3. What is the period of \( f(x) = \sin(3x) \cos(4x) \)?

(A) \( \frac{\pi}{3} \)
(B) \( \frac{\pi}{2} \)
(C) \( \frac{2\pi}{3} \)
(D) \( \pi \)
(E) 2\( \pi \)

4. A pyramid and a box share a base and have the same volume. What is the ratio of the height of the pyramid to the height of the box?

(A) 1 : 3
(B) 1 : 3
(C) 1 : 1
(D) 2 : 1
(E) 3 : 1

5. If a loan is compounded continuously at a rate of 5% per year, approximately how many years will it take for the loan amount to triple?

(A) 20
(B) 21
(C) 22
(D) 24
(E) 25
6. The graph of the polar function \( r = 2\theta \) is a(n) 
(A) spiral  
(B) circle  
(C) ellipse  
(D) cardioid  
(E) lemniscate

7. The area of circle \( x^2 + y^2 + 6x + 4 = 0 \) is 
(A) \( 4\pi \)  
(B) \( 5\pi \)  
(C) \( 6\pi \)  
(D) \( 8\pi \)  
(E) \( 12\pi \)

8. Evaluate \( \lim_{x \to -2^-} \frac{|x - 2|}{x - 2} \). 
(A) Does not exist  
(B) \(-2\)  
(C) \(-1\)  
(D) \(1\)  
(E) \(2\)

9. Given the piecewise function 
\[
f(x) = \begin{cases} 
3x, & \text{if } x < 0 \\
\tan x, & \text{if } 0 \leq x \leq \pi \\
x + 1, & \text{if } x > \pi
\end{cases}
\]
where \( x \) is in radians, what are the values of \( x \) for which \( f(x) \) is discontinuous?
(A) 0 and \( \frac{\pi}{2} \)  
(B) 0, \( \frac{\pi}{2} \), and \( \pi \)  
(C) 0 and \( \pi \)  
(D) \( \frac{\pi}{2} \) and \( \pi \)  
(E) \( \frac{\pi}{2} \), \( \pi \), and \( \frac{3\pi}{2} \)
10. If \((-3, y)\) is a point on the graph of the inverse of \(f(x) = 2x^5 + 5x^3 + 6x + 10\), then \(y = \)?

(A) \(-626\)
(B) \(-3\)
(C) \(-1\)
(D) 3
(E) 626

11. A triangle has sides of length 2, 3, and 4. What is the approximate measure of the smallest angle?

(A) 26°
(B) 27°
(C) 28°
(D) 29°
(E) 30°

12. The graph of \(h(x)\) is a line. If \(h(1) = 3\) and \(h(5) = 9\), then an equation of \(h(x)\) is

(A) \(h(x) = \frac{-2}{3}x + \frac{5}{3}\)
(B) \(h(x) = \frac{2}{3}x + \frac{1}{3}\)
(C) \(h(x) = \frac{2}{3}x + \frac{5}{3}\)
(D) \(h(x) = \frac{-3}{2}x + \frac{3}{2}\)
(E) \(h(x) = \frac{3}{2}x + \frac{3}{2}\)

13. Which of the labeled sections represent \((A \cup B) \cap C\)?

(A) I, II, III, IV, V, VI, and VII
(B) I, II, III, IV, V, and VI
(C) II, IV, V, VI, and VII
(D) II, IV, V, and VI
(E) IV, V, and VI
14. The graph of \( g(x) = \frac{(x + 2)(x + 3)(x + 4)}{(x + 2)(x - 3)} \) has the following asymptotes.

(A) no horizontal or vertical asymptotes
(B) no horizontal and one vertical asymptote
(C) no horizontal and two vertical asymptotes
(D) one horizontal and one vertical asymptote
(E) one horizontal and two vertical asymptotes

15. Evaluate \( \tan(\cos^{-1}\left(\frac{3}{8}\right)) \).

(A) \( \frac{3\sqrt{55}}{55} \)
(B) \( \frac{8\sqrt{55}}{55} \)
(C) \( \frac{\sqrt{55}}{8} \)
(D) \( \frac{\sqrt{55}}{3} \)
(E) \( \frac{\sqrt{73}}{3} \)

16. If \( f(x) = x^2 + 2x \) then \( \frac{f(x + h) - f(x)}{h} = \)

(A) 1
(B) \( 2x + 2 \)
(C) \( 2x + 2 + h \)
(D) \( 1 + \frac{4x}{h} \)
(E) \( 2x + 2 + h + \frac{4x}{h} \)

17. What is the probability of rolling two regular 6-sided dice and getting a sum of 10 or higher?

(A) \( \frac{1}{10} \)
(B) \( \frac{1}{6} \)
(C) \( \frac{7}{36} \)
(D) \( \frac{5}{18} \)
(E) \( \frac{1}{2} \)
18. If $9.26^y = 3.26^x$, then $x = \frac{y}{\log 3.26}$.
   
   (A) 0.35y  
   (B) 0.53y  
   (C) 1.88y  
   (D) 2.84y  
   (E) 3.00y

19. A cone shares its base with a cylinder and is inscribed inside the cylinder. If the volume of the cone is 24 cubic units, what is the volume in cubic units of the cylinder?
   
   (A) 8  
   (B) 24  
   (C) 48  
   (D) 72  
   (E) Cannot be determined

20. Evaluate $(2 + 2i\sqrt{3})^3$.
   
   (A) $-64$  
   (B) $8 - 24\sqrt{3}$  
   (C) $8 + 24\sqrt{3}$  
   (D) $8 - 24i\sqrt{3}$  
   (E) $8 + 24i\sqrt{3}$

21. If the points $(-1, -2), (1, 6),$ and $(2, 1)$ all lie on the graph of $f(x) = ax^2 + bx + c$, then respectively $a, b,$ and $c =$
   
   (A) $-3, -4, \text{ and } -5$  
   (B) $-3, -4, \text{ and } 5$  
   (C) $-3, 4, \text{ and } 5$  
   (D) $3, -4, \text{ and } 5$  
   (E) $3, 5, \text{ and } 5$
22. The statement “If it is expensive, then it is a car” is true. Which of the following statement(s) is (are) also true?

I. If it is not expensive, then it is not a car.
II. If it is not a car, then it is not expensive.
III. If it is a car, then it is expensive.

(A) I
(B) II
(C) III
(D) I and II
(E) I, II, and III

23. If the median of the data 2, 6, 3, 6, 4, x is 4.5, then x =

(A) 1
(B) 4.5
(C) 5
(D) 6
(E) 7

24. Use the parametric equations y = −10t + 4 and x = 5t + 1 to find y in terms of x.

(A) y = −50x − 6
(B) y = −10x + 4
(C) y = −2x + 6
(D) y = 2x + 4
(E) y = 10x − 6

25. The variable x varies inversely with the cube of y and directly with the square of z. If y is tripled and z is quadrupled, then x is multiplied by

(A) \(\frac{1}{432}\)
(B) \(\frac{8}{27}\)
(C) \(\frac{15}{27}\)
(D) \(\frac{16}{27}\)
(E) 432
26. What is the sum of the three smallest non-negative solutions to $x \cos(10x) = 0$?

(A) $\frac{\pi}{5}$

(B) $\frac{9\pi}{20}$

(C) $\frac{4\pi}{5}$

(D) $2\pi$

(E) $\frac{9\pi}{2}$

27. If the graph of $x^2 + y^2 + 2x + 6y + a = 0$ is a point, then $a =$

(A) $-10$

(B) $-1$

(C) $1$

(D) $9$

(E) $10$

28. If $f(x) = \ln x^a$, then $f(be^c) =$

(A) $c \cdot b^a$

(B) $b^{(ac)}$

(C) $(bc)^a$

(D) $ac + \ln(ba)$

(E) $a(c + \ln b)$

29. The operation @ is defined by $x @ y = y - \frac{x}{y}$.

For what value(s) of $m$ does $3 @ m = 2$?

(A) $-1$ and $3$

(B) $1$

(C) $1$ and $2$

(D) $2$

(E) $2$ and $3$
30. \[
\sum_{k=3}^{7} c =
\]
(A) \(c\)
(B) \(2c\)
(C) \(3c\)
(D) \(4c\)
(E) \(5c\)

31. The radius of the circle shown is 9 units. If the area of the shaded sector is \(9\pi\) square units, what is the length of \(\overline{ACB}\)?
(A) \(3\pi\)
(B) \(15\pi\)
(C) \(16\pi\)
(D) \(18\pi\)
(E) \(27\pi\)

32. The vertex of the graph of the parabola \(x^2 + ax - y + b = 0\) is \(\left(\frac{5}{2}, -\frac{1}{4}\right)\).
What is the sum of \(a\) and \(b\)?
(A) \(-2.75\)
(B) \(2.25\)
(C) \(5.25\)
(D) \(7.75\)
(E) \(11.00\)

33. The region bounded by the \(x\)-axis, the \(y\)-axis, \(x = 2\), and \(y = 3\) is revolved about the \(x\)-axis. What is the approximate volume of the solid generated?
(A) \(37.7\)
(B) \(43.5\)
(C) \(47.1\)
(D) \(51.3\)
(E) \(56.5\)
34. If the zeros of \( f(x) \) are 1, 2, and 3, then the zeros of \( f(x^2) \) are
   (A) 1, 2, and 3
   (B) \( \pm 1, \pm 4, \) and \( \pm 9 \)
   (C) 1, 4, and 9
   (D) 1, \( \sqrt{2} \), and \( \sqrt{3} \)
   (E) \( \pm 1, \pm \sqrt{2}, \) and \( \pm \sqrt{3} \)

35. If \( A \) is in radians, \( \sin A = 0.2588 \), and \( \tan A = -0.2679 \), then \( A \) is approximately
   (A) \(-0.26\)
   (B) 0.26
   (C) 2.88
   (D) 6.02
   (E) 6.28

36. If \((a, b)\) is the point on the line \(2x + 3y = 7\) that is closest to the origin, then \( a = \)
   (A) \(\frac{13}{12}\)
   (B) \(\frac{14}{13}\)
   (C) \(\frac{15}{14}\)
   (D) \(\frac{16}{15}\)
   (E) \(\frac{17}{16}\)

37. If \( f(x) = e^x \), then \( \frac{f^{-1}(1)}{f(1)} = \)
   (A) 0
   (B) 0.18
   (C) 0.37
   (D) 0.74
   (E) 2.71
38. If \( x_3 = 11 \) and \( x_{n+1} = 2x_n + 1 \), then \( x_1 = \) USE THIS SPACE FOR SCRATCH WORK.

(A) 2  
(B) 5  
(C) 9  
(D) 23  
(E) 47  

39. If \( \log_3 x = \log_2 x \), then \( x = \)

(A) \(-\frac{3}{2}\)  
(B) \(-1\)  
(C) 0  
(D) 1  
(E) 2  

40. If \( \sin(Ax) = \sin(2Ax) \), then which of the following could be the value of \( x \)?

I. \( x = \frac{\pi}{3A} \)  
II. \( x = \frac{\pi}{A} \)  
III. \( x = \frac{2\pi}{A} \)

(A) II  
(B) III  
(C) I and II  
(D) II and III  
(E) I, II, and III

41. If \( c = e^{a+b} \), then which of the following is (are) true?

I. \( a = \ln\left(\frac{c}{e^b}\right) \)  
II. \( a = \ln c - b \)  
III. \( a = \ln\left(\frac{c}{b}\right) \)

(A) I  
(B) II  
(C) III  
(D) I and II  
(E) I, II, and III
42. If \( f(x) = 3x^2 + 1 \) and \( g(x) = 2x + 3 \), then \( f(g(x)) = g(g(x)) \) when \( x = \)
   (A) \(-1.86 \) and \(-0.81\)
   (B) \(-1.77 \) and \(-0.89\)
   (C) \(-1.50 \) and \(-1.17\)
   (D) \(-0.55 \) and \(1.22\)
   (E) At no values

43. A sphere is cut through its center vertically and half the sphere is discarded. The remaining semi-sphere is then cut horizontally through its original center and the bottom half is discarded. The remaining piece is then placed on a table and is cut vertically through the original center so that one of the pieces has a corner whose angle measures 30°. What is the ratio of the volume of the piece with the 30° angle to the volume of the original sphere?
   (A) \(\frac{1}{36}\)
   (B) \(\frac{1}{24}\)
   (C) \(\frac{1}{12}\)
   (D) \(\frac{1}{6}\)
   (E) \(\frac{1}{4}\)

44. How many different ways can the letters in the word ERASER be arranged so that there is a vowel on each end?
   (A) 36
   (B) 72
   (C) 144
   (D) 180
   (E) 720
45. For which of the following is \( \frac{x}{y} - \frac{y}{x} < 0 \)?

(A) \( x < y \)
(B) \( y > x \)
(C) \( x < y < 0 \)
(D) No values of \( x \) and \( y \)
(E) All values of \( x \) and \( y \)

46. Which of the following is part of the domain written in interval notation of

\[ f(x) = \log(\cos(\frac{ax}{b} + \pi)) \]

(A) \( \left( -\frac{2b\pi}{a}, -\frac{b\pi}{a} \right) \)
(B) \( \left( -\frac{2a\pi}{b}, 0 \right) \)
(C) \( \left( -\frac{3b\pi}{2a}, -\frac{b\pi}{2a} \right) \)
(D) \( \left( -\frac{a\pi}{b}, -\frac{a\pi}{2b} \right) \)
(E) \( \left( -\frac{b\pi}{a}, 0 \right) \)

47. The expression \( \frac{\tan^2 x + 1}{\sec^2 x - 1} \) is equivalent to

(A) \( \sin^2 x \)
(B) \( \cos^2 x \)
(C) \( \tan^2 x \)
(D) \( \csc^2 x \)
(E) \( \sec^2 x \)

48. If \( f(x) = x^2 \), \( g(x) = \sin x \), \( h(x) = \cos x \), and \( j(x) = 2x + 1 \), then which of the following is an even function?

(A) \( h(j(x)) \)
(B) \( f(j(x)) \)
(C) \( g(h(x)) \)
(D) \( g(j(x)) \)
(E) \( j(g(x)) \)
49. If the graph of
\[ 2x^2 + 6y^2 + 4x + 12y - 46 = 0 \]
is inscribed inside a rectangle, the area of the rectangle is
(A) \(18\sqrt{2}\)
(B) \(18\sqrt{3}\)
(C) 36
(D) \(27\sqrt{3}\)
(E) \(36\sqrt{3}\)

50. What is the amplitude of the graph of
\[ y = 3\sin(ax)\cos(bx) + 3\sin(bx)\cos(ax) \]?
(A) 3
(B) 6
(C) \(3ab\)
(D) \(3(a + b)\)
(E) \(6(a + b)\)