There are 71 questions and you should do this exam in two and a half hours. Do not use any books, calculators, or computers.

1. If \( x - 1 = 2 \), then \( x + 1 = \)
   (A) 1  (B) 2  (C) 3  (D) 4  (E) –2

2. A cylinder has a circular cross section of diameter 4 cm (centimeters) and length 5 cm. The volume is approximately
   (A) 600 cm\(^3\)  (B) 60 cm\(^3\)  (C) 6,000 cm\(^3\)  (D) 0.6 cm\(^3\)  (E) 6 cm\(^3\)

3. If \( x = 3 \), then \( x^2 + 3 = \)
   (A) 6  (B) 9  (C) 12  (D) 27  (E) 3

4. The area under this line between \( x = 1 \) and \( x = 5 \) is about
   (A) 15
   (B) 5
   (C) 55
   (D) 25
   (E) 155
5. \( \frac{(-2)(-6)}{-4} = \)

(A) -3  (B) -2  (C) 2  (D) 3  (E) -12

6. \((2xy^3)^3 = \)

(A) \(6x^3y^9\)  (B) \(8x^4y^6\)  (C) \(8x^4y^6\)  (D) \(8x^3y^9\)  (E) \(6x^3y^9\)

7. \((2x - 1)(4x + 1) = \)

(A) \(8x^2 - 2x - 1\)  (B) \(8x^2 - 6x - 1\)  (C) \(8x^2 - 1\)  (D) \(6x\)  (E) \(-6x\)

8. \(\frac{4 \times 10^{-15}}{8 \times 10^{-12}} = \)

(A) \(5 \times 10^{-4}\)  (B) \(2 \times 10^{-4}\)  (C) \(5 \times 10^{-28}\)  (D) \(5 \times 10^4\)  (E) \(2 \times 10^{-27}\)

9. \(A_{13}. \left( \frac{x^2}{y} \right) + \left( \frac{x}{y^2} \right) = \)

(A) \(\frac{x}{y}\)  (B) \(\frac{y}{x}\)  (C) \(xy\)  (D) \(\frac{x^2y + x}{y^2}\)  (E) \(\frac{x^2y^2 + xy^2}{x^2y^2}\)

10. \(x^2 - 100 = \)

(A) \((x + 10)^2\)  (B) \((x - 10)^2\)  (C) \((x + 10)(x - 10)\)

(D) \((x - 50)(x - 50)\)  (E) \((x - 2)(x - 50)\)

11. \((5 \times 10^8)(6 \times 10^{-12}) = \)

(A) \(3 \times 10^{-3}\)  (B) \(3 \times 10^{-19}\)  (C) \(3 \times 10^{-4}\)  (D) \(3 \times 10^4\)  (E) \(2 \times 10^{-27}\)
12. \((2x + 3) - (x - 2) =\)

(A) \(x + 5\)  (B) \(x + 1\)  (C) 3  (D) 7  (E) \(3x + 5\)

13. If \(A = \sqrt{3}\) and \(B = 1\) in the following triangle, then \(C =\)

\[\triangle ABC\]

\(A = 30\)  \(C = ?\)  \(B = 90\)  \(a = ?\)

(A) \(\frac{1}{\sqrt{3}}\)  (B) \(\frac{1}{2}\)  (C) 2  (D) \(\sqrt{2}\)  (E) \(\sqrt{5}\)

14. If \(\frac{1}{3}\) of a number is 8, then what is \(\frac{1}{4}\) of the number?

(A) \(\frac{1}{12}\)  (B) \(\frac{1}{6}\)  (C) 6  (D) 12  (E) 24

15. If \(x = -2\) and \(y = 5\), then \(x^3y =\)

(A) \(-40\)  (B) \(-30\)  (C) 30  (D) 40  (E) 12

16. If there are about three feet in a meter, 25 meters is about

(A) 8 feet  (B) 75 feet  (C) 450 feet  (D) 4.5 feet  (E) 0.45 feet

17. \((x^2 - 3x + 2) - (3x^2 - 5x - 1) =\)

(A) \(4x^2 - 8x + 1\)  (B) \(2x^2 + 2x + 3\)  (C) \(-2x^2 + 2x + 3\)

(D) \(-2x^2 - 2x + 1\)  (E) \(2x^2 + 2x + 3\)
18. \( \frac{2x}{3y} \cdot \frac{9y}{4x^2} = \)

(A) 6xy  (B) \( \frac{3y}{2x} \)  (C) \( \frac{8x^3}{9y^2} \)  (D) \( \frac{3}{2x} \)  (E) \( \frac{8x^3}{9y^2} \)

19. \( 2x^2 + 5x - 3 = \)

(A) \( (2x-3)(x+1) \)  (B) \( (2x-3)(x-1) \)  (C) \( (2x-1)(x+3) \)  (D) \( (2x+1)(x-3) \)  (E) \( (2x-1)(x-1) \)

20. \( \ln(ab) = \)

(A) \( 10^{ab} \)  (B) \( e^{ab} \)  (C) \( e^{(a+b)} \)  (D) \( \ln(a) + \ln(b) \)  (E) \( a \ln(b) \)

21. \( |3-8| = \)

(A) -11  (B) -5  (C) 5  (D) 11  (E) 12

22. \( \frac{2}{x} + \frac{5}{y} = \)

(A) \( \frac{2y+5x}{xy} \)  (B) \( \frac{2x+5y}{xy} \)  (C) \( -\frac{7}{x+y} \)  (D) \( \frac{7}{xy} \)  (E) \( \frac{-7}{x+y} \)

23. The box pictured below has a square base and a closed top. Express its surface area in terms of \( x \) and \( h \).

\[ \text{(A) } x^2 + 4xh \]
\[ \text{(B) } 8x + 4h \]
\[ \text{(C) } 4x + h \]
\[ \text{(D) } hx^2 \]
\[ \text{(E) } 2x^2 + 4xh \]
24. If \( x = -4 \) and \( y = -7 \), then \( x - y = \)

(A) \(-11\)   (B) \(-3\)   (C) \(3\)   (D) \(11\)   (E) \(28\)

25. If \( f(x) \) is a function whose graph is the parabola sketched below, then \( f(x) < 0 \) whenever

\[
\begin{array}{c}
\text{(A) } x < 0 \\
\text{(B) } x < 3 \\
\text{(C) } x > 1 \\
\text{(D) } x < -1 \text{ or } x > 3 \\
\text{(E) } -1 < x < 3 \\
\end{array}
\]

26. If money in a bank doubles every 5 years, then by what factor does it increase over a 20 year period?

(A) \(4\)   (B) \(8\)   (C) \(12\)   (D) \(16\)   (E) \(20\)

27. Definition: A function is even if \( f(-x) = f(x) \) for each \( x \) in the domain of \( f \). Which of the functions whose graphs are shown is even?
28. If \( 7y - 4 = 16 + 3y \), then \( y = \)
(A) \( \frac{6}{5} \)  \( \) (B) \( 2 \)  \( \) (C) \( 3 \)  \( \) (D) \( 5 \)  \( \) (E) \( -5 \)

29. \( (10)(-1/5)(-2)(3) = \)
(A) \( -12 \)  \( \) (B) \( -3 \)  \( \) (C) \( 10 \)  \( \) (D) \( 12 \)  \( \) (E) \( -10 \)

30. The y-coordinate of the intersection of the graphs of \( x - 2y = 6 \) and \( x + y = -3 \) is
(A) \( -3 \)  \( \) (B) \( -2 \)  \( \) (C) \( -1 \)  \( \) (D) \( 1 \)  \( \) (E) \( 3 \)

31. \( 8^{-1/3}9^{1/2} = \)
(A) \( 6 \)  \( \) (B) \( -6 \)  \( \) (C) \( \frac{1}{6} \)  \( \) (D) \( \frac{2}{3} \)  \( \) (E) \( \frac{3}{2} \)

32. \( \sqrt[3]{-27} = \)
(A) \( -9 \)  \( \) (B) \( -3 \)  \( \) (C) \( 3 \)  \( \) (D) \( 9 \)  \( \) (E) \( 54 \)

33. Which of the following best resembles the graph of \( y = \frac{1}{2}x^2 - 3x + 1 \)?
(A)  \( \) (B)  \( \) (C)  \( \) (D)  \( \) (E)

34. If \( \log_3(x + 1) = 2 \), then \( x = \)
(A) \( 5 \)  \( \) (B) \( 6 \)  \( \) (C) \( 7 \)  \( \) (D) \( 8 \)  \( \) (E) \( \frac{2}{\log_3} - 1 \)
35. \((-2x^2)(3x^2y)(-y) = \)

(A) \(-6x^2y\) \hspace{1cm} (B) \(-x^2\) \hspace{1cm} (C) \(6x^4y\) \hspace{1cm} (D) \(6x^4y^2\) \hspace{1cm} (E) \(-x^2\)

36. Which of the following curves best resembles the graph of \(f(x) = 3^x\)?

(A) \hspace{1cm} (B) \hspace{1cm} (C) \hspace{1cm} (D) \hspace{1cm} (E)

37. If \(\frac{(2x+1)(x-1)}{(x+1)} = 0\), then \(x = \)

(A) \(-1\) or 1 \hspace{1cm} (B) \(-\frac{1}{2}\) or 1 \hspace{1cm} (C) \(-\frac{1}{2}, 1, \) or \(-1\) \hspace{1cm} (D) \(\frac{1}{2}\) or \(-1\) \hspace{1cm} (E) \(\frac{1}{2}, 1, \) or \(-1\)

38. \(13a - 15b - a + 2b = \)

(A) \(13 - 13b\) \hspace{1cm} (B) \(12a - 13b\) \hspace{1cm} (C) \(14a - 17b\) \hspace{1cm} (D) \(12a^2 - 13b^2\) \hspace{1cm} (E) \(13a + 13b\)

39. The symbol "\(\cong\)" means "is approximately equal to." Given that \(3^7 \cong 2000\), then \(3^{14} \approx \)

(A) 4,000 \hspace{1cm} (B) 40,000 \hspace{1cm} (C) 400,000 \hspace{1cm} (D) 4,000,000 \hspace{1cm} (E) 2,000^8
40. In the given figure, the distance between points \( A \) and \( C \) is

(A) 8  
(B) 10  
(C) 12  
(D) 14  
(E) 16

41. If \( f(x) = \frac{2x + 6}{x + 2} \), then \( f(a + 2) = \)

(A) \( \frac{5}{2} \)  
(B) \( \frac{2a + 8}{a + 4} \)  
(C) \( \frac{2a + 10}{a + 4} \)  
(D) \( \frac{2a + 6}{a + 2} \)  
(E) \( \frac{2a + 6}{a + 4} \)

42. The graph of the equation \( y = -5x + 3 \) is

(A) a horizontal line  
(B) a line rising to the right  
(C) a vertical line  
(D) a line falling to the right  
(E) not a line

43. If \( ax + b = 3 \) and \( a \neq 0 \), then \( x = \)

(A) \( \frac{b + 3}{a} \)  
(B) \( \frac{3 - b}{a} \)  
(C) \( \frac{b - 3}{a} \)  
(D) \( b - 3 \)  
(E) \( 3 - b \)

44. The quantity \( a + b \) is a factor of how many of the following:

\[ a^2 - b^2 \quad a^2 + b^2 \quad a^3 - b^3 \quad a^3 + b^3 \]

(A) 0  
(B) 1  
(C) 2  
(D) 3  
(E) 4

45. \( 3p > p + 12 \) is equivalent to

(A) \( p > 1 \)  
(B) \( p > 3 \)  
(C) \( p > 4 \)  
(D) \( p > 6 \)  
(E) \( p > 15 \)
46. In the triangle shown, $\tan(a) =$

\[
\begin{array}{c}
\text{(A) } A/B \\
\text{(B) } B/A \\
\text{(C) } B/C \\
\text{(D) } A/C \\
\text{(E) } C/A
\end{array}
\]

47. $A^{ab} =$

\[
\begin{array}{c}
\text{(A) } A^{a+b} \\
\text{(B) } bA^a \\
\text{(C) } \frac{A^a}{A^b} \\
\text{(D) } (A^a)^b \\
\text{(E) } A^aA^b
\end{array}
\]

48. The area of the rectangle pictured below is

\[
\begin{array}{c}
\text{(A) } 0.015 \\
\text{(B) } 0.15 \\
\text{(C) } 0.2 \\
\text{(D) } 0.35 \\
\text{(E) } 0.75
\end{array}
\]

49. Suppose the sides of a rectangle with length $x$ and width $y$ are each doubled. The area of the rectangle now is

\[
\begin{array}{c}
\text{(A) } xy \\
\text{(B) } 2xy \\
\text{(C) } 3xy \\
\text{(D) } 4xy \\
\text{(E) } x^2y^2
\end{array}
\]

50. $4^0$ (4 raised to the zeroth power) =

\[
\begin{array}{c}
\text{(A) } 2 \\
\text{(B) } 0 \\
\text{(C) } 4 \\
\text{(D) } 1 \\
\text{(E) } 0.25
\end{array}
\]
51. \(4 - (-2 + 5) = \)

(A) 11  (B) 7  (C) 1  (D) –3  (E) –1

52. In the triangle shown, \(\sin(b) = \)

\[
\begin{array}{c}
\text{D} \\
\text{b} \\
4 \\
\text{c} \\
\text{d} \\
3
\end{array}
\]

(A) 1.2  (B) 1.33  (C) 0.75  (D) 0.8  (E) 0.6

53. \(|x - 2| \leq 1\) is equivalent to

(A) \(x \geq 3\)  (B) \(x \leq 1\)  (C) \(-3 \leq x \leq -1\)  (D) \(1 \leq x \leq 3\)  (E) \(-3 \leq x \leq 3\)

54. \(\frac{3/2}{2/3} = \)

(A) 0  (B) 4/9  (C) 9/4  (D) 1  (E) 6

55. The length of a certain rectangle is 3 meters more than twice its width. If the perimeter of the rectangle is 90 meters, then the width of the rectangle is

(A) 6 m  (B) 12 m  (C) 14 m  (D) 16 m  (E) 29 m

56. \(4(s + 2) = \)

(A) 4s + 8  (B) 4s + 6  (C) 4s + 2  (D) s + 8  (E) \(\frac{1}{4}(s + 2)\)

57. \(\frac{3}{4} - \frac{1}{7} = \)

(A) 17/28  (B) 25/28  (C) 1/14  (D) 2/47  (E) 3/14
58. If \( 1 - 5x < 3 \), then
\[
\begin{align*}
&\text{(A)} \ x < -\frac{2}{5} \quad \text{(B)} \ x > -\frac{2}{5} \quad \text{(C)} \ x < \frac{2}{5} \quad \text{(D)} \ x > \frac{5}{2} \quad \text{(E)} \ x > \frac{5}{2}
\end{align*}
\]

59. Definition: A function \( f(x) \) has a minimum value at the number \( c \) if \( f(c) \leq f(x) \) for every \( x \) in the domain of \( f(x) \). If the domain of the function whose graph appears on the right is \([0,4]\), at which number does the function have a minimum value?

\[
\begin{align*}
&\text{(A)} \ 0 \\
&\text{(B)} \ 1 \\
&\text{(C)} \ 2 \\
&\text{(D)} \ 3 \\
&\text{(E)} \ 4
\end{align*}
\]

60. The side \( D \) in this triangle is
\[
\begin{align*}
&\text{(A)} \ 5 \\
&\text{(B)} \ 25 \\
&\text{(C)} \ \sqrt{12} \\
&\text{(D)} \ \sqrt{5} \\
&\text{(E)} \ \sqrt{7}
\end{align*}
\]

61. \( (2\sqrt{3})(3\sqrt{6}) = \)
\[
\begin{align*}
&\text{(A)} \ 18 \\
&\text{(B)} \ 18\sqrt{2} \\
&\text{(C)} \ 108 \\
&\text{(D)} \ \sqrt{108} \\
&\text{(E)} \ 6\sqrt{108}
\end{align*}
\]

62. \( 1 - \sin^2 \theta = \)
\[
\begin{align*}
&\text{(A)} \ -\cos^2 \theta \\
&\text{(B)} \ \cos^2 \theta \\
&\text{(C)} \ \cos \theta \\
&\text{(D)} \ \csc^2 \theta \\
&\text{(E)} \ -\cos(2\theta)
\end{align*}
\]

63. If \( f(x) = \cos(3x) \), then \( f(\pi/6) = \)
64. The circumference of a circle of radius R is
   (A) $2\pi R$       (B) $R^2$       (C) $\pi^2 R$       (D) $\pi^2 R^2$       (E) $\pi R^2$

65. Which of the following best represents the graph of $y = \sin x$ for $x$ between $-\frac{\pi}{2}$ and $\frac{\pi}{2}$

66. $\sin \theta \tan \theta \csc^2 \theta =$
   (A) $\tan \theta \sin^2 \theta$       (B) $\cos \theta$       (C) $\sin \theta$       (D) $\tan \theta$       (E) $\sec \theta$

67. For which value of $x$ is $\tan x$ not defined?
   (A) $-\pi$       (B) $-\frac{\pi}{2}$       (C) 0       (D) $\frac{\pi}{4}$       (E) $\frac{\pi}{3}$
68. The area of a circle of radius $R$ is

(A) $2\pi R$  (B) $R^2$  (C) $\pi R$  (D) $\pi^2 R^2$  (E) $\pi R^2$

69. The angle $a$ in this triangle is

(A) 45  (B) 60  (C) 120  (D) 30  (E) 90

70. The slope of line $A$ is

(A) 4.0  (B) 3.3  (C) 3.0  (D) 0.25

71. If there are $(5/8)$ mile per km (kilometer) and 60 seconds in a minute, then 100 km/minute is about

(A) 3 miles/second  (B) 4,000 miles/second  (C) 6 miles/second
(D) 0.1 miles/second  (E) 1 mile/second