PRACTICE PROBLEMS FOR FINAL

(1) Function or not (vertical line test or \( y = x \) expression)

1. Find all relations which are functions.
   - (A) \( x^2 + y^2 = 4 \)
   - (B) \( y = \frac{3x-1}{x+2} \)
   - (C) \( |y| = x - 3 \)
   - (D) \( y = x^5 - 3x \)

(2) One to one function (Horizontal line test)

2. Find all one to one functions.
   - (A) \( f(x) = x^2 - 4x \)
   - (B) \( f(x) = \frac{x}{x-1} \)
   - (C) \( f(x) = |x + 5| \)
   - (D) \( f(x) = x^3 - 4 \)

(3) Three symmetry
   - y-axis: even
   - Origin: odd

3. Which of the following function is symmetric with respect to the origin?
   - (A) \( f(x) = x^3 + 4 \)
   - (B) \( f(x) = x^4 - 1 \)
   - (C) \( f(x) = x^3 - 4x \)
   - (D) \( f(x) = x^2 + 2x \)

4. Which of the following function is symmetric with respect to the y-axis?
   - (A) \( f(x) = x^3 - 9x \)
   - (B) \( f(x) = x^4 - 1 \)
   - (C) \( f(x) = \frac{3x}{x^2+9} \)
   - (D) \( f(x) = x^2 + 2x \)

(4) Find the value of a function.

5. Evaluate \( f(-3) \) if \( f(x) = 3x^2 - 2x + 1 \)
   - (A) 22
   - (B) 34
   - (C) -20
   - (D) -34

6. Evaluate \( f(-2) \) if \( f(x) = \frac{x-3}{x^2+1} \)
   - (A) -1
   - (B) -\frac{5}{6}
   - (C) \frac{5}{3}
   - (D) 1

7. Evaluate \( f(2) \) if \( f(x) = \begin{cases} x^2, & x < 0 \\ 1, & x = 0 \\ 2x + 1, & x > 0 \end{cases} \)
   - (A) 4
   - (B) 10
   - (C) 1
   - (D) 5

(5) Domain of a function.

8. Find the domain of the following function \( f(x) = \frac{2x}{x^2-4} \)
   - (A) \((-\infty, -2) \cup (-2, 2) \cup (2, \infty)\)
   - (B) \((-2, 2)\)
   - (C) \((-\infty, -2) \cup (2, \infty)\)
   - (D) \((-\infty, -2] \cup [2, \infty)\)

9. Find the domain of the following function \( f(x) = \sqrt{3x - 12} \)
   - (A) \((-\infty, 4]\)
   - (B) \([4, \infty)\)
   - (C) \((-\infty, -4] \cup [4, \infty)\)
   - (D) \((-\infty, \infty)\)

10. Find the domain of \( (f + g)(x) \) where \( f(x) = 1 + \frac{1}{x} \) and \( g(x) = \frac{1}{x} \)
    - (A) \((-\infty, 0)\)
    - (B) \((0, \infty)\)
    - (C) \((-\infty, 0) \cup (0, \infty)\)
    - (D) \((-\infty, \infty)\)
(6) Find the intercepts

11. Identify the intercepts of the following function: \( f(x) = \frac{2x+6}{x+2} \)
   (A) x-int: (-3,0) ; y-int: (0,-2)  
   (B) x-int: (-3,0) ; y-int: (0,3)  
   (C) x-int: (0,-3) ; y-int: (-2,0)  
   (D) x-int: (0,-3) ; y-int: (3,0)

12. Identify the intercepts of the following function: \( f(x) = x^2 + x - 12 \)
   (A) x-int: (-3,0), (-4,0); y-int: (0, -12)  
   (B) x-int: (-12,0) ; y-int: (0,3)  
   (C) x-int: (-3,0), (4,0) ; y-int: (0, -12)  
   (D) x-int: (3,0), (-4,0); y-int: (0, -12)

(7) Factor and x-intercept

13. Which of following is a factor of a polynomial \( f(x) = 6x^3 - 35x^2 + 19x + 30 \)?
   (A) \( x + 5 \)  
   (B) \( 2x + 3 \)  
   (C) \( 3x + 2 \)  
   (D) \( x + 6 \)

14. Which of following is a factor of \( f(x) = 2x^4 - 7x^3 - 2x^2 + 13x + 6 \)?
   (A) \( x - 5 \)  
   (B) \( x + 2 \)  
   (C) \( 2x + 1 \)  
   (D) \( x + 3 \)

(8) Operations of functions

15. Let \( f(x) = x^2 - 6x \) and \( g(x) = \sqrt{x} + 9 \). Which of following is true?
   (A) \( (f + g)(-1) = 5 \)  
   (B) \( (f - g)(0) = -3 \)  
   (C) \( (f - g)(-5) = 53 \)  
   (D) \( \left( \frac{g}{f} \right)(7) = 1 \)  
   (E) None of the above

(9) Composition

16. Find the composite function \( (f \circ g)(x) \) if \( f(x) = 2x^2 - 4x - 1 \) and \( g(x) = 3x \)
   (A) \( 6x^3 - 12x^2 - 3x \)  
   (B) \( 36x^2 - 12x - 1 \)  
   (C) \( 6x^2 - 12x - 1 \)  
   (D) \( 18x^2 - 12x - 1 \)

17. Find the composite function \( (f \circ g)(x) \) if \( f(x) = x^2 - 3x + 7 \) and \( g(x) = 2x - 1 \)
   (A) \( 2x^3 - 7x^2 + 17x - 7 \)  
   (B) \( 4x^2 - 10x + 11 \)  
   (C) \( 4x^2 - 6x + 9 \)  
   (D) \( 4x^2 - 2x + 5 \)

(10) Inverse functions

18. Find the inverse of the function \( f(x) = \sqrt[3]{x + 8} \)
   (A) \( f^{-1}(x) = x^3 + 8 \)  
   (B) \( f^{-1}(x) = \frac{1}{\sqrt[3]{x + 8}} \)  
   (C) \( f^{-1}(x) = x^3 - 8 \)  
   (D) \( f^{-1}(x) = \sqrt[3]{x + 8} \)

19. Find the inverse of the function \( f(x) = \frac{2x - 3}{4x + 1} \)
   (A) \( f^{-1}(x) = \frac{4x+1}{2x-3} \)  
   (B) \( f^{-1}(x) = \frac{2x-3}{4x+1} \)  
   (C) \( f^{-1}(x) = \frac{-x-3}{4x-2} \)  
   (D) \( f^{-1}(x) = \frac{2x-3}{4x+3} \)

20. Describe in a sentence when \( y = x^3 - 3 \) is the inverse function of \( y = \sqrt[3]{x + 3} \)
   (A) Mirror image about x-axis  
   (B) Mirror image about y-axis  
   (C) Mirror image about the origin  
   (D) Mirror image about y = x
(11) Solve a polynomial

21. Solve the equation \( x(x + 6) = 3 \)
   \( (A) -6 \pm \sqrt{3} \) \( (B) -6 \pm 2\sqrt{3} \) \( (C) -3 \pm 2\sqrt{3} \) \( (D) 3 \pm 2\sqrt{3} \)

22. Solve the equation \( 2x^2 - 4x + 1 = 0 \)
   \( (A) \frac{-2 \pm \sqrt{2}}{2} \) \( (B) \frac{2 \pm \sqrt{2}}{2} \) \( (C) \frac{2 \pm i\sqrt{2}}{2} \) \( (D) 1 \pm \sqrt{2} \)

23. Solve the equation: \( (x - 2)^2 = 18 \)
   \( (A) -2 \pm 2\sqrt{3} \) \( (B) 2 \pm 2\sqrt{3} \) \( (C) 2 \pm 3\sqrt{2} \) \( (D) 3 \pm 2i\sqrt{3} \)

24. Solve the equation: \( 4x^2 - 2x + 3 = 0 \)
   \( (A) \frac{1 \pm i\sqrt{11}}{4} \) \( (B) \frac{1 \pm i2\sqrt{11}}{4} \) \( (C) \frac{-1 \pm i\sqrt{11}}{4} \) \( (D) \frac{-1 \pm i2\sqrt{11}}{4} \)

25. Solve the equation: \( 3x^3 - 5x^2 - 2x = 0 \)
   \( (A) -\frac{1}{3}, 0, 2 \) \( (B) -\frac{1}{3}, 2 \) \( (C) \frac{1}{3}, 0, -2 \) \( (D) \frac{1}{3}, -2 \)

26. Solve the equation: \( x^3 - 2x^2 - 9x + 18 = 0 \)
   \( (A) -2, 2, 9 \) \( (B) -3, -2, 3 \) \( (C) -3, 2, 3 \) \( (D) -9, -2, 2 \)

(12) Final all real/complex zeros

27. Find the real/complex zeros of the function.
   \( f(x) = x^4 + 2x^3 + 22x^2 + 50x - 75 \)
   \( (A) -3, 1, -5, 5 \) \( (B) -3, 1, -5i, 5i \) \( (C) 3, -1, -5, 5 \) \( (D) 3, -1, -5i, 5i \)

28. Find the real/complex zeros of the function and write it as factor form.
   \( f(x) = x^4 - 5x^3 + 2x^2 + 22x - 20 \)
   \( (A) -2, 1, 3 \pm i \) \( (B) 2, -1, 3 \pm i \) \( (C) -2, 1, -3 \pm i \) \( (D) 2, -1, -3 \pm i \)

29. Find the real/complex zeros of the function and write it as factor form.
   \( f(x) = 2x^4 + 7x^3 + x^2 - 7x - 3 \)
   \( (A) \) Zeros: \( -\frac{1}{2}, -3, -1, 1 \); \( f(x) = (x + \frac{1}{2})(x + 3)(x + 1)(x - 1) \)
   \( (B) \) Zeros: \( -\frac{1}{2}, -3, -1, 1 \); \( f(x) = (2x + 1)(x + 3)(x + 1)(x - 1) \)
   \( (C) \) Zeros: \( -\frac{1}{2}, -3, -1, 1 \); \( f(x) = (2x - 1)(x - 3)(x + 1)(x + 1) \)
   \( (D) \) Zeros: \( \frac{1}{2}, 3, -1, 1 \); \( f(x) = (2x + 1)(x + 3)(x - 1)(x + 1) \)

30. Form a polynomial of degree 3 with zeros: \(-2\) with multiplicity 2 and 4 with multiplicity 1.
   \( (A) (x - 2)^2(x + 4) \) \( (B) (x - 2)^2(x + 1)^4 \)
   \( (C) (x + 2)^2(x - 4) \) \( (D) (x + 2)^2(x + 1)^4 \)

31. Form a polynomial of degree 3 with zeros: \(2, 4 \pm i\)
   \( (A) x^3 - 10x^2 + 33x - 34 \) \( (B) x^3 - x^2 + 32x - 34 \)
   \( (C) x^3 - 10x^2 + 31x - 30 \) \( (D) x^3 + 10x^2 + 33x + 34 \)
32. Solve the equation: \( \sqrt{10x - 1} = x + 2 \)
   (A) Only 1  (B) Only 5  (C) 1, 5  (D) -1, -5

33. Solve the equation: \( \sqrt{x + 12} = x \)
   (A) Only 4  (B) Only -3  (C) 4, -3  (D) 3, -4

34. Solve the equation: \( \frac{5}{2x-3} = \frac{3}{x+5} \)
   (A) 16  (B) \( \frac{23}{2} \)  (C) \( \frac{61}{3} \)  (D) 34

35. Find the sum of all solutions: \( \frac{3}{x-3} + \frac{5}{x-4} = \frac{x^2-20}{x^2-7x+12} \)
   (A) -9  (B) -8  (C) 8  (D) 9

36. Find the equation of a straight line which contains two points (-3,5) and (0,1)
   (A) \( y = -\frac{4}{3}x + 1 \)  (B) \( y = \frac{4}{3}x + 1 \)
   (C) \( y = -\frac{2}{3}x + 1 \)  (D) \( y = -\frac{3}{4}x + \frac{11}{4} \)

37. Find the equation of a straight line which contains a point (2,4) and is parallel to \( 5x - y = 20 \).
   (A) \( y = 5x - 14 \)  (B) \( y = 5x - 6 \)
   (C) \( y = -5x + 14 \)  (D) \( y = \frac{1}{5}x + 4 \)

38. Find the equation of a straight line which contains a point (3,4) and is perpendicular to \( 3x - 8y = -23 \).
   (A) \( y = -\frac{8}{3}x + 12 \)  (B) \( y = -\frac{8}{3}x + 36 \)
   (C) \( y = \frac{8}{3}x - 12 \)  (D) \( y = \frac{8}{3}x - 4 \)

39. A truck rental company rents its trucks at a daily base price of $29 plus 39 cents for each mile the truck is driven. Mr. Park rented a truck for one day and was charged $165.5 when he returned the truck. How many miles did he drive?
   (A) 200 miles  (B) 250 miles  (C) 350 miles  (D) 450 miles

40. Find the value of \( y \) which satisfies the linear system of equations: \( 5x - y = 13 \)
   \( 2x + 3y = 12 \)
   (A) -1  (B) 0  (C) 2  (D) 3

41. A restaurant manager wants to purchase 200 sets of dishes. One design costs $25 per set, while another costs $45 per set. If she only has $7400 to spend, how many of the $25 design should she buy?
   (A) 75  (B) 80  (C) 112  (D) 120

42. A bank loaned out $12,000, part of it at the rate of 8% per year and the rest at the rate of 18% per year. If the interest received totaled $1000, how much was loaned at 8%?
   (A) $400  (B) $5500  (C) $6500  (D) $11,600
43. There were 436 people at a civic club fundraiser. Members paid $4.5 per ticket and nonmembers paid $8.25 per ticket. If total receipts amounted to $2562, how many members attended the fundraiser?

(A) 264  (B) 276  (C) 160  (D) 172

44. Find the vertex of \( y = 3x^2 - 12x + 3 \)

(A) \((2, -8)\)  (B) \((2, -9)\)  (C) \((-2, -9)\)  (D) \((2, -5)\)

45. Find the maximum/minimum of the quadratic function \( y = -2x^2 + 8x - 5 \)

(A) Maximum: \((2, -13)\)  (B) Maximum: \((2, 3)\)  (C) Minimum: \((-2, 3)\)  (D) Minimum: \((-2, -13)\)

46. Find the quadratic function such that its vertex is \((2, -1)\) and its \( y \)-intercept is 7.

(A) \( y = (x - 2)^2 - 1 \)  (B) \( y = \frac{3}{2}(x - 2)^2 - 1 \)
(C) \( y = 2(x - 2)^2 - 1 \)  (D) \( y = \frac{3}{2}(x + 2)^2 + 1 \)

47. The height, in feet, from the ground of a ball dropped from a 176-foot building \( t \) seconds after it is dropped is given by the formula \( H(t) = -16t^2 + 176 \). How long does it take the ball to hit the ground?

(A) 16 seconds  (B) 5.5 seconds  (C) 3.3 seconds  (D) 11 seconds

48. The area of the opening of a rectangular window is 143 cm\(^2\). If the length is 2 cm more than the width, what is the width of the window?

(A) 9 cm  (B) 11 cm  (C) 12 cm  (D) 13 cm

49. The profit that the vendor makes per day by selling \( x \) pretzels is given by the function \( P(x) = -0.004x^2 + 2.8x - 200 \). Find the number of pretzels that must be sold to maximize profit.

(A) 500  (B) 450  (C) 350  (D) 300

50. Beth has 3000 feet of fencing available to enclose a rectangular field. One side of the field lies along a river, so only three sides require fencing. Express the area \( A \) of the rectangle as a function of \( x \), where \( x \) is the length of the side parallel to the river. For what value of \( x \) is the area largest?

(A) 750 ft  (B) 1000 ft  (C) 1500 ft  (D) 2000 ft

51. Solve the inequality: \( x^2 \geq x + 6 \)

(A) \((-\infty, -2] \cup [3, \infty)\)  (B) \((-\infty, -3] \cup [2, \infty)\)
(C) \([-2, 3]\)  (D) \((-\infty, \infty)\)

52. Solve the inequality: \( x^2 - x - 12 < 0 \)

(A) \((-4, 3)\)  (B) \((-3, 4)\)
(C) \((-\infty, -3) \cup (4, \infty)\)  (D) \((-\infty, -4) \cup (3, \infty)\)

53. Solve the rational inequality: \( \frac{x-3}{x+2} \leq 0 \)

(A) \((-2, 3]\)  (B) \((-3, 2]\)
(C) \((-2, 3]\)  (D) \((-\infty, -2) \cup [3, \infty)\)
54. Solve the inequality: $\frac{x+1}{x-1} \leq 2$
   (A) $(-\infty, 1) \cup [3, \infty)$
   (B) $(-\infty, 1) \cup [5, \infty)$
   (C) $(1,3]$  
   (D) $(1,5]$

55. Find all vertical asymptotes for the function $f(x) = \frac{x^2-1}{x^2+4x+3}$
   (A) $x = -1, x = -3$
   (B) $y = -1, y = -3$
   (C) $x = 1$
   (D) $x = -3$

56. Find the horizontal asymptote for the function $f(x) = \frac{x-1}{x^2-5x+6}$
   (A) $y = 2$
   (B) $y = 1$
   (C) $y = 0$
   (D) No horizontal asymptote

57. Find the oblique asymptote for the function $f(x) = \frac{x^2+2x-3}{x+3}$
   (A) $y = x - 1$
   (B) $y = 1$
   (C) $y = 0$
   (D) No oblique asymptote

58. Find the remainder when $f(x) = x^3 + 2x - 1$ is divided by $x - 1$
   (A) 0
   (B) 1
   (C) 2
   (D) $-4$

59. Find the approximate of $\log_2(3)$. Round your answer to two decimal digits.
   (A) 5.88
   (B) 1.58
   (C) 1.10
   (D) 0.63

60. Rewrite the expression as a single logarithm form: $2 \ln(x) - \ln(x + 2) + 3 \ln(z)$
   (A) $\ln\left(\frac{x^2(x+2)}{z^3}\right)$
   (B) $\ln\left(x^2(\frac{x+2}{z^3})\right)$
   (C) $\ln\left(x^2z^3\right)$
   (D) $\ln(x - 2 + 3z)$

61. Write the exponential equation $2^a = x$ in the logarithmic form.
   (A) $a = \log_2(x)$
   (B) $2 = \log_x(a)$
   (C) $2 = \log_a(x)$
   (D) $a = \log_x(2)$

62. Solve the equation: $3^{x-3} = \left(\frac{1}{3}\right)^{-x}$
   (A) 6
   (B) 1
   (C) $-3$
   (D) $-1$

63. Solve the equation: $2^{2x+1} = 4^{-x+2}$
   (A) $-1$
   (B) $\frac{1}{4}$
   (C) $\frac{1}{2}$
   (D) $\frac{3}{4}$

64. Solve the equation: $\ln(x) + \ln(x - 1) = \ln(12)$
   (A) 4, −3
   (B) 3, −4
   (C) Only 3
   (D) Only 4

65. Solve the equation: $\log_2(x) + \log_2(x + 2) = 3$
   (A) −4, 2
   (B) Only −4
   (C) Only 2
   (D) Only 4
66. The number, $A$, of bacteria found in a culture is a function of time, $t$, in minutes and is given by the formula $A = 2500e^{0.5t}$ with the initial value $A_0 = 2500$. After how many minutes will there be double the initial amount of bacteria? Round to 2 decimal places.

(A) 1.39  
(B) 1.54  
(C) 2.34  
(D) 2.77

67. Find the distance between points $(-1,0)$ and $(2,4)$

(A) 4  
(B) $\sqrt{17}$  
(C) 5  
(D) $\sqrt{27}$

68. Find the center and radius of the circle: $x^2 + y^2 - 4x + 6y + 9 = 0$

(A) Center $(-2,3)$; radius 4  
(B) Center $(2, -3)$; radius 4  
(C) Center $(-2,3)$; radius 2  
(D) Center $(2, -3)$; radius 2

69. Find the equation of a circle whose two diameter end points are $(1, -5)$ and $(3,7)$.

(A) $(x - 2)^2 + (y - 1)^2 = 35$  
(B) $(x - 2)^2 + (y - 1)^2 = 37$  
(C) $(x + 2)^2 + (y - 1)^2 = 45$  
(D) $(x + 2)^2 + (y - 1)^2 = 61$

70. Find the accumulated value of an investment of $680 at 4\%$ compounded monthly for 17 years. Round your answer to the nearest cent.

(A) $1142.40$  
(B) $1340.72$  
(C) $1273.63$  
(D) $1324.57$

71. If $3600 is invested at 10\%$ compounded quarterly how many is in the account after 20 years? Round your answer to the nearest dollar.

(A) $27,345$  
(B) $23,596$  
(C) $25,954$  
(D) $10,804,500$

72. How long does it take money to triple if it is invested at 15\% compounded continuous?

(A) 9.56 years  
(B) 9.86 years  
(C) 7.46 years  
(D) 7.32 years

73. The graph of $y = x^3$ is shifted right by 5 units, reflected across the $x$-axis, and shifted up 2 units. Write the resulting equation.

(A) $y = -(x + 5)^3 + 2$  
(B) $y = -(x^3 + 5) + 2$  
(C) $y = -(x - 5)^3 + 2$  
(D) $y = -(x - 5)^3 - 2$

74. The graph of the function $y = 4(x + 2)^3$ can be obtained from the graph of the function $y = x^3$ by which of the following transformations?

(A) Shift to the right by 2 units, then shift up by 4 units;  
(B) Shift to the left by 2 units, then stretch vertically by a factor of 4;  
(C) Shift to the right by 2 units, then stretch vertically by a factor of 4;  
(D) Shift to the left by 2 units, then stretch vertically by a factor of 4;  
(E) None of the above.
75. Simplify the following expression in the standard form $a + bi$
(A) $(2 - 3i)^2$  
(B) $\frac{3-i}{1+2i}$

76. Which of the following statements is NOT correct about the polynomial $f(x) = -3x^5 + 4x^3 + x^2 + ax + 3$ (where $a$ is some real number)?
(A) It may have five local maximums and local minimums.
(B) It may have up to five zeros.
(C) Its graph has no asymptotes.
(D) 3 is its y-intercept.
(E) The right end of its graph goes down (to negative infinity).

77. Find the coordinate of the midpoint $M$ of $A(1,2)$ and $B(-6,-3)$
(A) $\left(-\frac{7}{2}, -\frac{1}{2}\right)$  
(B) $(6,-1)$  
(C) $\left(-\frac{5}{2}, -\frac{1}{2}\right)$  
(D) $(1,1)$

78. Rationalize the denominator: $\frac{5\sqrt{7}}{\sqrt{1} + 1}$
(A) $\frac{5\sqrt{7}}{6}$  
(B) $\frac{5\sqrt{7} - 5}{6}$  
(C) $\frac{5\sqrt{7} - 1}{6}$  
(D) $\frac{\sqrt{7}}{6}$

79. Find the quotient when $x^3 + 2x^2 - 3x + 4$ is divided by $x^2 + x - 2$
(A) $x + 1$  
(B) $x - 1$  
(C) $-2x - 6$  
(D) $-5x + 3$

80. Find the remainder when $-2x^{40} + 5x^{20} + 4x^2 - 7x + 1$ is divided by $x + 1$ : Use the remainder theorem
(A) 15  
(B) 16  
(C) 1  
(D) 2

81. Which of the following is true?

(A) Its domain is $[-2,3]$  
(B) Its range is $[-2,3]$  
(C) It is only decreasing on the interval $(-2,3)$  
(D) It is only increasing on the interval $(-2,-3)$  
(E) The local max is $(3,5)$
SOLUTION:

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(A) $-5 - 12i$  (B) $\frac{1}{5} - \frac{7}{5}i$