1. Given the following set \( \{-\pi, 0, 1, 0.9, \sqrt{36}, \frac{30}{7}, \sqrt{15}, -\frac{8}{2}\} \), list all elements that belong to the set of:
   a) Natural Numbers  
   b) Whole Numbers  
   c) Integers  
   d) Rational Numbers  
   e) Irrational Numbers  
   f) Real Numbers

2. Find the equation of the line passing through the point \((8, -4)\) and the midpoint of the line segment with endpoints \((-5, -2)\) and \((3, 6)\). Write the equation in slope intercept form.

3. State the domain and range of the given relation and decide whether or not the relations are functions, or one-to one. Assume that \(Xscl = Yscl = 1\) and that all boundary points are included.
   a) \(\{(5, -1), (2, 2), (-1, 3), (4, 2), (6, 1)\}\)

4. Refer to the graph of the linear function \(y = f(x)\) and answer the following.
   a) \(f(x) = 0\)  
   b) \(f(x) < 0\)  
   c) \(f(x) > 0\)  
   d) \(f(x) \leq 0\)  
   e) \(f(x) \geq 0\)

5. Refer to the graph of the quadratic function \(y = f(x)\) and answer the following.
   a) \(f(x) = 0\)  
   b) \(f(x) < 0\)  
   c) \(f(x) \geq 0\)

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6. Refer to the graph of the polynomial function \( y = f(x) \) and answer the following.
   a) \( f(x) = 0 \) 
   b) \( f(x) \leq 0 \) 
   c) \( f(x) > 0 \)

   \[ x = -7 \quad y = 0 \]

7. George runs a copying service, and he charges 5 cents per copy. The cost of the copy machine is $3600, the cost of a life time maintenance service is $1500, and the cost of making a single copy is 2 cents. Find the cost function, the revenue function, the profit function, and the break-even point.

8. Write the function \( g \) whose graph can be obtained from the graph of the function \( f \) by performing the transformations in the given order. Then graph the function \( g \).
   a) \( f(x) = |x| \); reflect the graph about the y-axis, then vertically shrink it by a factor of 0.5.
   b) \( f(x) = x^2 \); shift the graph 3 units to the left, then vertically stretch it by a factor of 4.
   c) \( f(x) = \sqrt{x} \); reflect the graph about the x-axis, then shift it vertically downward 4 units.
   d) \( f(x) = x^2 - 7 \); shift the graph right 2 units, then shift it vertically upward 3 units.

9. The graph of the function \( f(x) = |x| \) is shifted 3 units to the right, then vertically shrunk by a factor of \( \frac{1}{2} \), then reflected about the y-axis, and finally shifted down 5 units. Write the final translated function \( g(x) \) and sketch its final graph.

10. Evaluate the following function at the given values.
   \[
   f(x) =\begin{cases} 
   x - 5 & \text{if } x \leq -1 \\
   x^2 & \text{if } -1 < x < 2 \\
   9 - x & \text{if } x \geq 2 
   \end{cases}
   ; \quad f(0), \ f(-1), \ f(2), \ f(-3), \ f(4).
   \]

11. If \( g(x) = [x-4] \), find \( g(-2.3), \ g(-5), \ g(4.1), \ g(3), \ g(5.1) \).
12. Let \( f(x) = x^2 - 5 \) and \( g(x) = 4x + 1 \). Find the following. Simplify the answer completely.
   a) \((f \circ g)(x)\)
   b) \((g \circ f)(x)\)

13. Use the **Sign Analysis Method** to solve the following inequalities and write your answers in interval notation.
   a) \( x^2 - 5x > 36 \)
   b) \( x^2 - 5x \leq 36 \)

14. A box with no top is to be made from a 25 inch by 50 inch rectangular piece of cardboard by cutting equal size squares from each corner and folding up the sides. Let \( x \) represent the length of a side of the square to be cut from each corner.
   Include a sketch of your calculator graph if you solved this problem graphically.
   a) What are the restrictions on \( x \)?
   b) Find the value of \( x \) that will maximize the volume of the box.
   c) Find the value of \( x \) at which the volume of the box will be greater than 200 cubic inches.

15. Use a graphing calculator to find a complete graph of the given function. Determine all local extrema. Give the ordered pair \((x, y)\) for the local extrema. **Round to two decimal places if necessary. You do not need to sketch the graph.**
   \[ f(x) = -x^3 + 37x^2 - 50x - 70 \]

16. For the following polynomial function, \( P(x) = -x^5 - 2x^4 + 14x^3 - 8x^2 + x - 27 \),
   a) The maximum number of roots is ________.
   b) The endpoint behavior of the function can be described as ________________________.
   c) The possibilities for number of local extrema are ________________________________.
   d) List all possible rational roots.

17. Use synthetic division to show that 2 is a zero of \( P(x) = 2x^3 + x^2 - 13x + 6 \).
   Then factor \( P(x) \) completely.

18. Factor \( P(x) \) into linear factors. \( P(x) = 4x^3 - x^2 - 83x - 60 \); and \( P(-4) = 0 \)

19. For the following polynomial function, \( P(x) = 2x^4 + 5x^3 - 10x^2 - 20x - 6 \),
   a) List all possible rational roots.
   b) Determine all roots.
20. Find the vertical and horizontal asymptote(s) of the following rational functions.

a) \( f(x) = \frac{x^2 - 36}{2x^2 - 2x - 4} \)

b) \( f(x) = \frac{x}{x^3 - 25x} \)

c) \( f(x) = \frac{9x^2}{x - 1} \)

21. Find the \( x \)-intercept(s) (if any) and the \( y \)-intercept of \( f(x) = \frac{36 - x^2}{x^2 + 4x - 5} \).

22. Solve the following rational inequalities \textit{analytically}. Write your answers in interval notation.

a) \( \frac{5x + 2}{2x - 5} < 2 \)

b) \( \frac{5x + 2}{2x - 5} \geq 2 \)

c) \( \frac{(x-1)(x+4)}{x+3} \leq 0 \)

d) \( \frac{(x-1)(x+4)}{x+3} > 0 \)

Solve the following graphically or analytically. For the inequalities, if a solution exists, write your answers in interval notation.

\textit{Show all important work for the particular method chosen to receive credit.}

23. \( 8^{2x-3} = 32^{x+1} \)

24. \( \sqrt{3x+4} > x - 2 \)

25. \( |7x + 2| \geq 0 \)

26. \( |x - 1| + |x + 3| \geq 12 \)

27. \( |-3x - 9| + 4 = 10 \)

28. \( |x - 5| + 8 < 2 \)

29. \( 4x^2 + 12x - 9 = 0 \)

30. \( \log_7 x + \log_3 (x - 3) = \log_7 9 + \log_3 2 \)

31. \( 6x^2 - 11x = 7 \)

32. \( 6^{x+3} = 4^x \)

33. \( \log (7 - 3x) - \log (x + 2) = 1 \)

34. Solve the given radical equation and its related inequalities \textit{graphically}.

\textit{Round to 4 decimal places if necessary.} For the inequalities, write your answer in interval notation.

a) \( x - 9 = \sqrt{x - 8} \)

b) \( x - 9 \leq \sqrt{x - 8} \)

c) \( x - 9 \geq \sqrt{x - 8} \)

35. Find the inverse of the following functions.

a) \( f(x) = \frac{5x - 7}{3} \)

b) \( f(x) = \sqrt[3]{x - 7} \)
FORMULAS: \[ R = \log \frac{I}{I_0} \quad A = P \left( \frac{1}{2} \right)^{\frac{t}{h}} \quad A = Pe^{kt} \quad F = P \left( 1 + \frac{r}{n} \right)^{nt} \quad F = Pe^{-rt} \]

36. How long will it take an investment of $5000 to double if it is invested at 3.4% compounded semiannually? What will the future value be after 10 years?

37. How much money should be invested today at 5% interest, compounded continuously, so that in 10 years the investment will be worth $12,000?

38. How old is a mummy that has lost 70% of its carbon 14? Use \( h = 5700 \) years.

Graph the following conic sections accurately.

39. \( \frac{(x+3)^2}{16} - \frac{(y-2)^2}{36} = 1 \)

40. \( 25x^2 + 9y^2 = 225 \)

41. Complete the square to find the center and radius of the following circle. Graph the circle.
\( x^2 + y^2 + 8x - 6y + 16 = 0 \)

42. Use a graphing calculator to solve the nonlinear system of equations. Include a sketch of your calculator graph. Round your answers to the nearest hundredth.

\[ \begin{align*}
4x + 5y &= 7 \\
x &= y^2 + 1
\end{align*} \]

43. Graph the following system of inequalities.
\[ \begin{align*}
y &> x^2 - 3 \\
x^2 + y^2 &\leq 25
\end{align*} \]

44. Let \( A = \begin{bmatrix} 7 & 3 \\ -5 & 0 \\ -9 & -1 \end{bmatrix} \), \( B = \begin{bmatrix} 2 & 1 & -1 \\ 0 & 4 & 5 \end{bmatrix} \), \( C = \begin{bmatrix} 5 & -8 \\ 4 & -5 \\ 7 & 2 \end{bmatrix} \), and \( D = \begin{bmatrix} -6 & 4 & 7 \\ 0 & -2 & 8 \end{bmatrix} \).

Find the following (if the answer exists):

a) \(3A - 2C\)  \hspace{1cm} b) \(AD\)  \hspace{1cm} c) \(DA\)  \hspace{1cm} d) \(C^2\)

45. Consider the following augmented matrix:
\[ \begin{bmatrix}
3 & -1 & 4 & -13 \\
1 & 2 & -1 & 12 \\
4 & -1 & 3 & -7
\end{bmatrix} \]

a) Write the Row Echelon Form of the augmented matrix.

b) Write the Reduced Row Echelon Form of the augmented matrix.
46. Use any method to solve the following system of equations:
   \[ 3x - y + 4z = -13 \]
   \[ x + 2y - z = 12 \]
   \[ 4x - y + 3z = -7 \]

47. If \( a_n = \frac{(-1)^n}{n^2} \), find \( a_{45} \)

48. Evaluate the sum. \textit{Round to 4 decimal places if necessary.}
   \[ \sum_{n=1}^{20} \frac{2n}{n + 1} \]

49. Expand the binomial expression and simplify completely.
   a) \( (x - 3y)^4 \)
   b) \( (x + y)^7 \)

50. Evaluate the following expressions.
   a) \( \binom{13}{5} \)
   b) \( _{13}P_5 \)
   c) \( \frac{7!}{2!5!} \)
ANSWERS FOR PRACTICE FINAL

1. a) \( \{1, \sqrt{36}\} \)  b) \( \{0, 1, \sqrt{36}\} \)  c) \( \left\{-\frac{8}{2}, 0, 1, \sqrt{36}\right\} \)  d) \( \left\{0, 1, 0.9, \sqrt{36}, \frac{30}{7}, -\frac{8}{2}\right\} \)  e) \( \left\{-\pi, \sqrt{15}\right\} \)
   f) \( \left\{-\pi, 0, 1, 0.9, \sqrt{36}, \frac{30}{7}, \sqrt{15}, -\frac{8}{2}\right\} \)

2. \( y = -\frac{2}{3}x + \frac{4}{3} \)

3. a) domain: \( \{-5, -2, -1, 4, 6\} \); range: \( \{-1, 1, 2, 3\} \); function: yes; one-to-one: no
   b) domain: \( (-\infty, 4] \); range: \( (-\infty, \infty) \); function: no; one-to-one: no
   c) domain: \( (-\infty, \infty) \); range: \( [-6, \infty) \); function: yes; one-to-one: no
   d) domain: \( [-6, \infty) \); range: \( [0, \infty) \); function: yes; one-to-one: yes

4. a) \( x = -4 \)  b) \( -4, \infty \)  c) \( -\infty, -4 \)  d) \( [-4, \infty) \)  e) \( (-\infty, -4] \)

5. a) \( \{-7, -1\} \)  b) \( (-\infty, -7) \cup (-1, \infty) \)  c) \( [-7, -1] \)

6. a) \( \{-4, -2, 2\} \)  b) \( (-\infty, -4] \cup [-2, 2] \)  c) \( (-4, -2) \cup (2, \infty) \)

7. \( C(x) = 5100 + 0.02x \), \( R(x) = 0.05x \), \( P(x) = 0.03x - 5100 \), break-even point: 170,000 copies

8. a) \( g(x) = \frac{1}{2}|x| \)  b) \( g(x) = 4(x + 3)^2 \)  c) \( g(x) = -\sqrt{x - 4} \)  d) \( g(x) = (x - 2)^2 - 4 \)

9. \( g(x) = \frac{1}{2}|x - 3| - 5 \); graph:

10. \( f(0) = 0 \)  
    \( f(-1) = -6 \)  
    \( f(2) = 7 \)  
    \( f(-3) = -8 \)  
    \( f(4) = 5 \)

11. \( g(-2.3) = -7 \)  
    \( g(-5) = -9 \)  
    \( g(4.1) = 0 \)  
    \( g(3) = -1 \)  
    \( g(5.1) = 1 \)

12. a) \( 16x^2 + 8x - 4 \)  
    b) \( 4x^2 - 19 \)

13. a) \( (-\infty, -4) \cup (9, \infty) \)  
    b) \( [-4, 9] \)

14. a) \( 0 < x < 12.5 \) in  
    b) \( 5.28 \) in  
    c) \( 0.16 \) in < \( x < 12.18 \) in

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15. Minimum: \((0.69, -87.21)\) Maximum: \((23.97, 6218.03)\)

16. a) 15 b) up then down c) 14, 12, 10, 8, 6, 4, 2, or 0 d) \(\pm \{1, 3, 9, 27\}\)

\[
\begin{vmatrix}
2 & 1 & -13 & 6 \\
4 & 10 & -6 \\
2 & 5 & -3 & 0
\end{vmatrix}
; \quad P(x) = (x - 2)(x + 3)(2x - 1)
\]

18. \(P(x) = (x + 4)(x - 5)(4x + 3)\)

19. a) \(\pm \left\{1, \frac{1}{2}, 2, \frac{3}{2}, 3, 6\right\}\) b) \(-3.18, -1.12, -0.39, 2.18\)

20. a) Vertical Asymptotes: \(x = 2, x = -1\) Horizontal Asymptote: \(y = \frac{1}{2}\)
   b) Vertical Asymptote: \(x = 0, x = 25\) Horizontal Asymptote: \(y = 0\)
   c) Vertical Asymptote: \(x = 1\) Horizontal Asymptote: \(\text{none}\)

21. \(x\)-intercepts: \(x = \pm 6\) \(y\)-intercept: \(y = -\frac{36}{5}\)

22. a) \([-12, \frac{5}{2}]\) b) \((\infty, -12] \cup \left[\frac{5}{2}, \infty\right)\) c) \((\infty, -4] \cup (-3, 1]\) d) \((-4, -3) \cup (1, \infty)\)

23. \(\{14\}\)

24. \(\left[-\frac{4}{3}, 7\right]\)

25. \((\infty, \infty)\)

26. \((\infty, -7] \cup [5, \infty)\)

27. \(\{-5, -1\}\)

28. \(\emptyset\)

29. \(\left\{-\frac{3 \pm 3\sqrt{2}}{2}\right\}\)

30. \(\{6\}\)

31. \(\left\{-\frac{1}{2}, \frac{7}{3}\right\}\)

32. \(x = \frac{3\ln 6}{\ln 4 - \ln 6} \approx -13.2571\)

33. \(\{-1\}\)

34. a) 10.6180 b) \([8, 10.6180]\) c) \([10.6180, \infty)\)

35. a) \(f^{-1}(x) = \frac{3x + 7}{5}\) b) \(f^{-1}(x) = x^3 + 7\)

36. \(t \approx 20.56\) \(F \approx \$7004.69\)

37. \(P \approx \$7278.37\)
38. \( t \approx 9900.7 \) years

39. 

41. Standard Form: \((x + 4)^2 + (y - 3)^2 = 9\)
   Center: \((-4, 3)\)
   Radius: 3

42. \((1.20, 0.44)\) and \((3.87, -1.69)\)

43. See 7.6 #26 for solution

44. a) \[
\begin{bmatrix}
11 & 25 \\
-23 & 10 \\
-41 & -7
\end{bmatrix}
\]
b) \[
\begin{bmatrix}
-42 & 22 & 73 \\
30 & -20 & -35 \\
54 & -34 & -71
\end{bmatrix}
\]
c) \[
\begin{bmatrix}
-125 & -25 \\
-62 & -8
\end{bmatrix}
\]
d) not possible

45. a) \[
\begin{bmatrix}
1 & -1 & 3 & -7 \\
4 & 4 & 4 & 4
\end{bmatrix}
\]
b) \[
\begin{bmatrix}
1 & 0 & 0 & 2 \\
0 & 1 & 0 & 3 \\
0 & 0 & 1 & -4
\end{bmatrix}
\]

46. \((2, 3, -4)\)

47. \(a_{45} = -\frac{1}{2025}\)

48. 34.7093

49. a) \(x^4 - 12x^3y + 54x^2y^2 - 108xy^3 + 81y^4\)

   b) \(x^7 + 7x^6y + 21x^5y^2 + 35x^4y^3 + 35x^3y^4 + 21x^2y^5 + 7xy^6 + y^7\)

50. a) 1287 \hspace{1cm} b) 154,440 \hspace{1cm} c) 21

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