Welcome! The Math Department is so excited that you are taking on the challenge of a course in Precalculus! Precalculus is an in-depth focus on functions and introduction to new families of functions, including trigonometric and exponential. In order to jump into new material as soon as possible, you will need to review topics in the following packet.

A few guidelines:
- On this assignment, **you may use a calculator.** That said, try as much as you can without the calculator.
- If at any time, you need assistance with the topics included here, you may use online resources, such as Khan Academy. Any sources that you use should be cited.
- **This assignment will be due on the first full day of school.** There will be a **non-calculator, graded** assessment on these topics within the first two weeks of school.
- Below, you will find a suggested breakdown of the assignment into manageable pieces.
  - Week 1: June 22-June 26
    - Part One
  - Week 2: June 29-July 3
    - Part Two
  - Week 3: July 6-July 10
    - Part Three
  - Week 4: July 13-July 17
    - Part Four
  - Week 5: July 20-July 24
    - Part Five
  - Week 6: July 27-July 31
    - Project Week 1
  - Week 7: August 3-August 7
    - Project Week 2
- If you have any questions, you can reach me via email at mhain@stpaulsmd.org. Please note that it may take up to 48 hours to receive a response.
- Looking forward to a great year ahead!
PART ONE:

1. List $5, -1\frac{1}{5}, 3\frac{4}{5}, -\frac{3}{5}$, and $2\frac{2}{5}$ from least to greatest.

2. Simplify completely $[2^3 + 4(7 - 3)] \div 8$.

3. Evaluate $\frac{a^2 - b^2}{a - b} + \frac{bc}{a}$ if $a = 5, b = 3, c = 15$.

4. Simplify completely $\frac{-(7-9)(7+9)}{(2-6)4^2}$.

5. Simplify completely $\frac{16a^2 - 4a^2 + 64a + 36}{4}$.
6. Solve for \( x \) in the following equations.
   a. \( \frac{3}{5}x + 3 = 2x - 11 \)

   b. \( 2(x - 1) = 5 - (3 - 2x) \)

   c. \( 2(2x - 9) = 7x - 60 \)

   d. \( \frac{6x - 2(x - 4)}{3} = 8 \)

7. A theater has 600 tickets to sell for a show. Of these tickets, 225 sell for $2 a piece more than the others. If all tickets are sold at $2250 is taken for the show, which price is each type of ticket?

8. At 11:30 pm, two planes leave Chicago, one flying east at 450 km/hr and the other flying west at 620 km/hr. At what time will they be 1450 km apart?
PART TWO

9. Solve and graph each inequality.
   a. \(5x - 4 \geq 3x\)

   b. \(3(5t + 4) < 13t - 10\)

   c. \(-3 < 3 + 2w < 6\)

   d. \(2 > \frac{5}{t} \text{ or } 2t + 4 \leq -6\)
10. Solve the following absolute value equations.
   a. \(|4x - 10| = 12\)

   b. \(4|x - 7| = 2\)

   c. \(|2t + 5| \leq 7\)
PART THREE

11. True/False. If false, justify your answer with a counter-example.
   a. If $a \geq b$, then $a^2 \geq b^2$

   b. If $a < b$, then $\frac{1}{a} < \frac{1}{b}$.

   c. If $a < b$ and $c > 0$, then $\frac{a}{c} < \frac{b}{c}$.

   d. If $|a| > |b|$, then $a > b$.

12. Determine the constant $k$ so that $(-2, 5)$ will be a solution of $2x + ky = 3(k - 1)$. 

13. Graph each equation on the coordinate plane.
   a. \( y - 3 = 0 \)
   b. \( 3x - y = -5 \)
   c. \( \frac{x}{2} + \frac{y}{2} = 0 \)

14. Find the slope of the line that passes through (-2, -7), and (0, 9).

15. Find the slope of the line \( 3x + 4y = 9 \).
16. Find the equation in standard form of the line that passes through (2, 5) and has slope -2.

17. Find the equation in standard form of the line that passes through (-3, 0) and (0, 6).

18. Find the equation in standard form of the line through the point (4, -3) that is parallel to $3x - y = -5$.

19. Find the equation in standard form of the line through the point (4, -3) that is perpendicular to $3x - y = -5$. 
PART FOUR

20. Solve the following system of equations using any method.
   a. \[
   \begin{align*}
   3x + 4y &= 2 \\
   -5x + 4y &= -2
   \end{align*}
   \]
   b. \[
   \begin{align*}
   2x + 3y &= 4 \\
   5x + 4y &= 3
   \end{align*}
   \]

21. Graph the following inequalities, remembering to shade the appropriate area.
   a. \[x + 2y \leq 2\]
   b. \[2x - 3y < 6\]
22. Graph the system of inequalities on the coordinate plane. Be sure to shade accurately.
   a. \( x - 3y > 6 \)
   b. \( x + y \leq 2 \)

23. Find the following if \( f(x) = x^2 + 2 \) and \( g(x) = 2x - 1 \).
   a. \( f(g(2)) \)
   b. \( g(f(2)) \)
   c. \( f(g(x)) \)
   d. \( g(f(x)) \)
24. Simplify the following expressions completely.
   a. \(4(x^2 + 3) + 5(2 - 3x^2)\)
   c. \((2r - s)(3r + 2s)\)

   b. \((-6x^2r^2y)(5xr^3y^2)\)
   d. \(b^2x^2(2b + x^2)\)

25. Find the greatest common factor and least common multiple of the following.
   a. 420, 504

   b. 15\(y^2z^3\), 25\(yz\), 45\(y^2z\)

26. Factor each polynomial completely.
   a. \(6t^2 + 3ts + 10t + 5s\)
   c. \(9x^2 - 15x + 6\)

   b. \(a^2 + ab - 6b^2\)
   d. \(49x^2 - 16\)
PART FIVE

27. Solve the following quadratic equations.
   a. \((x + 5)(2x - 1) = 0\)

   b. \(x^2 - 12x - 10 = 0\)

   c. \(6t^2 - t - 2 = 0\)

28. Simplify each radical expression completely.
   a. \(\sqrt{224}\)

   b. \(\sqrt{324r^4s^7}\)

   c. \(\sqrt{3} \cdot 4\sqrt{3}\)

   d. \(-10\sqrt{18} - 5\sqrt{32}\)

   e. \(\frac{11\sqrt{6}}{\sqrt{98}}\)

   f. \((3\sqrt{5} + \sqrt{3})(3\sqrt{5} - \sqrt{3})\)
29. Solve the following radical equations.
   
   a. \( \sqrt{x + 1} = 4 \)
   
   b. \( \sqrt{2 - x} = x - 2 \)
   
   c. \( 3\sqrt{x} = 4 \)
   
   d. \( \sqrt{2 - \sqrt{x}} = \sqrt{x} \)
You have recently been hired as a civil engineer for the town of Brooklandville. Your first task is to analyze traffic patterns to determine what would be the best installation for a new intersection. Your boss has provided you with information regarding two different types of roundabouts, and two different types of intersections.

Directions: Complete each of the following pages showing all of your work. The Diving Deeper problems are intended to get you thinking more in depth about the problems. Try these problems! If you get stuck, explain your thinking and provide some predictions about where you would go next. Do this in complete sentences.
Problem #1

Directions
- Explain what must happen in the roundabout overall and at each of the four intersections over the course of an hour so that traffic doesn’t pile up.
- Find the value of the question mark. Explain your thinking.
- Guess what $w$, $x$, $y$ and $z$ represent, and find their values. Explain your thinking.
- Think of other questions to ask. Answer them.

Diving Deeper
- Suppose that traffic in the roundabout flowed clockwise. Predict how this would affect your answers to the questions. Use calculations to test your predictions.
Problem #2

Directions
• Figure out as much as you can about the traffic flow in this roundabout.
• Compare and contrast the situation and your answers with Problem #1.
• Explain what it might mean to exclude the variable \( a \) from this model.

Diving Deeper
• Suppose that all of the streets above were two-way. How many equations would there be? How many variables would each equation have? What additional information would you need in order to understand the traffic flow? How many path options would each driver have in and out of the roundabout?
Problem #3

Directions
- Figure out as much as you can about the traffic flow in this set of intersections.
- Compare and contrast the situation and your answers with Problems #1 and #2.
Problem #4

System 1
\[a - b + c = 19\]
\[-a - b - c = -23\]
\[a - 3b + c = 15\]

System 2
\[3a + b + c = 7\]
\[a + 2b - 4c = 14\]
\[-2a - b + c = -3\]

Directions

- Solve each system using methods of your choice. Explain your thinking.
- Describe the important features of each system, such as whether the equations are dependent or independent, the number of free variables, the number of solutions, etc.

Diving Deeper

- Can you create traffic scenarios that correspond to these systems? If so, show how to do it. If not, explain what makes it difficult or impossible.
Problem #5

Directions

• Find and describe all possible sets of values for the variables that might lead to smooth traffic flow. Include upper and lower bounds for each variable.
• Analyze the important features of the system of equations, such as the dependence or independence of the equations, the number of free variables, etc.

Diving Deeper

• How many solutions does this problem have?