# Honors Geometry Students and Parents

The Harrison mathematics department would like to present the following letter to ALL math students. It was written for Honors Geometry students/parents, but could actually benefit all mathematics students. The letter was composed by Mr. Alan Whittemore, a STEMM graduate/retired engineer who lives in the Farmington area. Mr. Whittemore has helped many mathematics students at Harrison High School for the last several years. As a mathematics department, we hope you find the following information and suggested tips for improving success helpful.

# MATH TIPS AND INFORMATION

Congratulations! Your enrollment in Honors Geometry provides you with two big advantages:

1. You have the opportunity to optimize your math preparation for becoming a STEMM college graduate (Science, Technology, Engineering, Mathematics, and Medicine). STEMM college graduates earn 38% more than other college graduates.
2. You are taking the most important course for preparation for the math part of the ACT. The 60 questions on the math ACT are all word problems - 33 arithmetic and algebra, 23 geometry and graphing, and 4 trigonometry. Honors Geometry is proofs and word problems containing algebra, geometry, and graphing. This explains why there is a strong correlation between performance in Honors Geometry and performance on the math ACT.

ACT reports that in order for a student to have a 50% probability of scoring a B or better in first year college calculus the student needs to score a 27 or better on the math ACT. We find that a B+ in Honors Geometry will likely result in at least a 27 on the math ACT. Unfortunately, typically only about 40% of the students who take Honors Geometry score a B+ or better. Therefore, we have developed the following list of techniques for students who wish to increase the likelihood that they will score an A in Honors Geometry:

1. Use a loose leaf notebook with separate sections for class notes, quizzes and tests, and homework. The loose leaf notebook does several things. It allows every homework assignment to be easily removed and submitted to the teacher for critique. The notebook also creates the impression that the student needs to collect and retain the knowledge of the course in preparation for the final, for review for a subsequent course, and/or for ACT study.

2. Use light lined, square-ruled paper so that graph paper is always immediately available for sketches, tables, and graphs. An accurate sketch often provides a check of the answer.

3. Use a sharp pencil and a good, clean eraser.

4. Use broad, mechanical drafting quality numbers and letters in the same shape as the keyboard makes, such as: closed triangle 4's, broad 6's and 9's, snowman 8's, crossed z's to prevent confusion with 2's, etc.; so that your work can be easily read by anyone.

5. A few days after each test has been reviewed in class, retake the test to demonstrate to yourself that you now know how to do all the problems on the test. This is the best way to "study for the final" as you proceed through the course.

6. Learn to articulate in correct mathematical terminology each equation and algebraic step.

7. Use the 5-step algebraic process to solve word problems. (This is considered the most important item on this list).
   1) Read the problem carefully. List the known quantities. A labeled sketch may help. Choose a variable for one of the unknowns. Relate other unknowns to the chosen variable. This is the "Let x=" key.
   2) Reread the problem and write one or more general equations that correctly represent the relationships among the knowns and unknowns of the problem.
   3) Solve the equation to find the chosen variable.
   4) Reread the problem to assure that the problem request has been satisfied with the correct units and double underlined your answer.
   5) Check your results by considering if the answer is reasonable, and by substituting the answer back into the original equation.

8. Show all work neatly, step by step down the left and middle of your paper. Use the right side of your paper for calculations and checks.

9. Use lower case letters for line segments and upper case letters for areas and volumes.

10. Use subscripts to identify all quantities, such as:
    $A_{trap}$ for area of a trapezoid
    $x_{as}$ for x value of the axis of symmetry
    $y_{vtx}$ for y value at the vertex

10. Be able to derive many equations, such as:
    The area of a triangle from the area of a rectangle: $A_{\Delta} = bh/2$, where b is the length of the base and h is the height.
    The volume of a cylinder: $V_{Cyl} = Bh = \pi r^2 h$, where B is the area of the base, r is the radius of the cylinder, and h is the height.

12. Solve equations for the variable in question before substituting in numbers, such as:
    The area of a trapezoid: $A_{trap} = (b_1 + b_2)h/2$, where the b's are the length of the two bases and h is the height. If one of the bases is the unknown, this equation can be solved for $b_2 = 2A_{trap}/h - b_1$.

13. Use proportions whenever possible and solve by cross multiplying. Example:
    If the longer leg "b" of a 30/60/90 triangle is requested and the hypotenuse is given as 8, write the proportion: $\frac{b}{8} = \frac{\sqrt{3}}{2}$ becomes $b = \frac{8\sqrt{3}}{2} = 4\sqrt{3}$

14. When division by a fraction is indicated, invert the fraction and multiply. Example:
    $30/(1/2) + 10 = ?$ becomes $30 \times (2/1) + 10 = 60 + 10 = 70$.

15. Use dimensional analysis (cancellation of units). Example: How many minutes will it take to drive 60 miles at 90 mph?

$$t = \frac{d}{r} = \frac{60 \text{ mi}}{\frac{90 \text{ mi}}{\text{hr}}}$$ (the $\frac{90 \text{ mi}}{\text{hr}}$ is a fraction that should be inverted and mult)

$$t = \frac{60 \text{ mi}}{90 \text{ mi}} \cdot \frac{\text{hr}}{1 \text{ hr}} \cdot \frac{60 \text{ min}}{} = 40 \text{ min}$$ (Multiplying the numerator by 60 min and the denominator by 1 hr are equal and allow cancellation of the hrs and the answer in mins)

**After you fully understand and are comfortable using the rule, "Always do unto one side of the equation, whatever you do to the other side of the equation;"** learn to use several shortcuts, such as:

16. Instead of subtracting a factor from both sides of an equation, simply move the unwanted term(s) to the other side and change their sign. Example: The equation $6x + 4 = 2x + 12$ suggests that the student should subtract $2x + 4$ from both sides of the equation in either one or two steps. This involves a lot of writing and opportunities for mistakes. It is straight forward to move the 2x and the 4 to the other side of the equation and change their sign, to obtain: $6x - 2x = 12 - 4$

$$4x = 8$$
$$x = 2$$

17. Use cross multiply to simplify equations that have fractions. Example:
$x/8 = 2/1$, becomes $x = 16$.

18. Always use a horizontal line between the numerator and denominator when writing a fraction, instead of a "/" like I used in the previous example. This minimizes denominator to numerator mistakes.

19. Exchange the left and right side of any equation to get the variable of interest on the left side of the equation.

20. Change the sign of every term of the equation.

21. Multiply both the numerator and denominator of one side of an equation by any factor.

22. Find a common denominator for all terms of an equation and then eliminate the denominators. Example: $x/3 - 1 = -13/12$ becomes

$$4x/12 - 12/12 = -13/12$$ now eliminate the denominators (x12)
$$4x - 12 = -13$$
$$4x = -13 + 12$$
$$4x = -1$$
$$x = -\tfrac{1}{4}$$

Most all successful college math students and practicing engineers use the above techniques. By learning and using them now, you will improve your performance in Honors Geometry, other math and science courses, and on the math ACT.