Mathworks Math Contest (MMC)
For Middle School Students
October 29, 2013

SCORE
(for Mathworks use)

STUDENT COVER SHEET

Please write in all information neatly and clearly to ensure proper grading. Thank you!

Student **First** Name:_____ **Last** Name:_____

Current Grade in School: _____

Home Address:_____

City:_____ State: _____ Zip: _____

Home Phone: (_____) _____

E-mail Address: _____

School Name: _____

Check Math Courses Taken:
☐Pre-Algebra ☐Algebra 1 ☐Algebra 2 ☐Geometry

Student Birth Date (MM/DD/YYYY): _____ / _____/ _____

Gender: ☐Male ☐Female

Are you a U.S. Citizen or Permanent Resident? ☐Yes ☐No

Return Completed Test by November 5th to:
Mathworks
601 University Dr., ASBS #110
Texas State University
San Marcos, TX 78666

2013 Mathworks Math Contest

Test Directions

- 15 problems
- 120 minutes (2 hours)
- **NO** calculators allowed
- Show all your work and how you obtained each answer
- Please mark final answer in box provided on test
- Use additional paper as needed.
- Do your best!

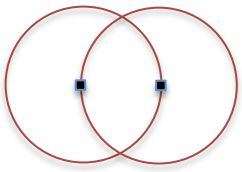
1. A committee on education of 5 is to be chosen from a class of 15, comprised of 9 females and 6 males. There must be at least 3 females on the committee. How many different committees are possible?

2. A bag contains 3 white marbles and 4 black marbles. Kim draws 2 marbles from the bag without replacement. If the second marble is white, what is the probability that the first marble was ***also*** white?

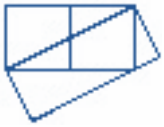
3. If x, y, and z are non-negative integers how many solutions does the equation $2x + 3y + 5z = 27$ have?

4. Eight students, numbered 1 to 8 in counter-clockwise order, are seated in a circle. A teacher has 2013 erasers, and he wants to distribute them to these students in the following way: starting with person 1 and proceeding counter-clockwise, the teacher gives i erasers to student i; for example, he gives 1 eraser to student 1, then 2 erasers to student 2, etc. When he is back at student 1 he again gives the student 1 eraser and continues around the circle until he does not have enough erasers to give to the next person. At this point, determine the number of erasers that the teacher has.

5. In the diagram below, the circles each have radius of 1 unit, and each goes through the center of the other. Find the area of the region common to both circles.



6. The two squares in the diagram below both have side lengths of 1. What is the area of the slanted rectangle?



7. Early in the morning when the air was cool
   John went fishing instead of to school.
   He caught a huge bunch, threw one fourth away,
   And saved twice the square root of his original bunch for another day.
   The remaining fifteen fed his family for lunch.
   So just how many fish were in his original bunch?

8. A triangle is drawn with vertices on a regular dodecagon (twelve sided figure). How many possibilities are there for the triangle if only non-congruent triangles are counted as different?
   For example, if we number the vertices 1 through 12, the triangle with vertices 1, 3, and 7 and the triangle with vertices 3, 5, and 9 are congruent so this only counts as one possibility.

9. Max assigns the 10 digits 0 – 9 to the 10 letters M, A, T, H, W, O, R, K, S, X so that different letters receive different digits. He observes the following equation:

$$\begin{array}{r} \quad M\ A\ T\ H \\ +\ W\ O\ R\ K\ S \\ \hline X\ 2\ 0\ 1\ 3 \end{array}$$

Find M+A+T+H+W+O+R+K+S, the sum of the 9 digits represented by the letters in MATHWORKS.

10. Let *ABCD* be a rectangle with perimeter 4026 cm and area 2013 cm^2. Equilateral triangles *ABP*, *BCQ*, *CDR*, and *DAS* are constructed outside the rectangle. Compute the ratio of the area of the quadrilateral *PQRS* to the area of the rectangle *ABCD.*

11. Let *ABCD* be a rectangle and *F* be a point on the side *AB*. The line segment *CF* and the diagonal *BD* intersect at point *E*. Extend *CF* and *DA* so that they intersect at point *G*. Suppose $|AFG| = 2013$ and $|BCE|:|BEF| = 10$. Find $|BEF|$, the area of the triangle *BEF*.

12. Billy is forming "code words" seven letters long using the letters *A*, *B*, and *C*. If each word is to include at least one of each letter, how many code words can he form?

13. Triangle *ABC* has $AB = 13$, $BC = 21$, and $AC = 20$. Point *D* lies on *BC* so that *AD* is an altitude of the triangle and point *E* lies on *AC* so that *BE* is an altitude of the triangle. Altitudes *AD* and *BE* intersect at *X*. What is the ratio *AX:XD*?

14. In rectangle *ABCD* points *E* and *F* are on *DC* so that *DF* = *FE* = *EC*. *AF* and *AE* intersect *BD* at *X* and *Y* respectively. What is the value of $\frac{XY}{BD}$?

15. What is the remainder when 2011^{2013} is divided by 100?