

# The Twenty-Ninth Annual Eastern Shore High School Mathematics Competition

November 8, 2012

## Team Contest Exam

### Instructions

Answer as many questions as possible in the time provided. To receive full credit for a correct solution, show all work and provide a clearly written explanation. Solutions will be judged based on correctness, completeness and clarity. (Little credit, if any, will be given for a solution consisting of just a number or a single sentence.)

All work and answers must be written on the provided sheets of plain white paper. Use only one side of each sheet of paper, and start each new problem on a new sheet of paper. Write your team name (that is, the name of the school which you are representing) at the top of each sheet that you turn in for scoring.

**At the start of the team round, your team will receive a copy of only Problem 1. Your team must submit a response to Problem 1 within the first 15 minutes of the team round time interval.**

**When you submit your response for Problem 1, you will receive a copy of Problem 2 and a copy of Problem 3. Your team will then have the time remaining in the team round to complete a response for each problem.**

Note: if your team completes Problem 1 before the end of the allotted time, you may submit it and receive copies of Problem 2 and Problem 3 in advance.

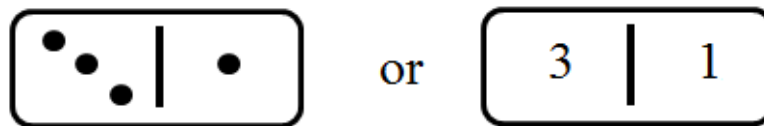
1. In a recent mathematics department meeting at WLM University, the 33 members present ranked who they thought had invented calculus. The members were all required to choose exactly one first place candidate, one second place candidate and one third place candidate. The three candidates to be voted upon were Leibniz, Newton, and the famous Jerk (otherwise known as the third derivative of position with respect to time).

(a) There are  $n$  ways that each voter can rank the candidates. Find  $n$ .

(b) Each member is given 3 points to distribute to the candidates (2 points for first choice and 1 point for second choice). Find the number of points Newton, Leibniz, and the Jerk each receive if the votes were distributed amongst three of the rankings as shown in the following table:

Rank	19 voters	10 voters	4 voters

2. Consider a set of "double- $N$  dominoes." Each domino has two regions separated by a bar. The dots which appear on dominoes are also called pips. Each region in a set of double- $N$  dominoes contains one of the numbers in  $\{0, 1, \dots, N\}$ . A domino may be referred to by the numbers in the respective regions. The domino shown below is a 3-1 (or 1-3) domino.



Note: you have been given a set of double-3 dominoes.

A double-0 set has 1 domino. i.e., the 0-0 domino.

3. (a) Find a 3-digit number with the following properties:
1. Each of the digits 1, 2, and 3 is used exactly once in the number.
  2. If we ignore all but the first  $n$