

## THE ANATOMY OF A MATH COMPETITION

Joseph Petrillo  
Alfred University

### INTRODUCTION

It seems surprising that a university located in the village-speckled wilderness of Western New York would hold an annual high school mathematics competition. Or does it? Sure, the year-round residents of eastern Allegany County know that most of the finer things in life are acquired via the internet or the day-trip. A two-hour drive will get you from the Village of Alfred to Buffalo, Rochester, Ithaca, or Corning, and usually with time to spare. On the other hand, Alfred was settled by liberal thinkers who valued and supported education, and, according to many who live and work there, what could be a finer thing in life? A two-hour bus ride will get you to Alfred University from Buffalo, Rochester, Ithaca, or Corning, and usually with time to spare. So a math competition makes good sense to teenagers who are looking either to experience the intellectual challenge of their lives, or to have a Friday off from high school without it being a snow day.

On the first Friday in November, Alfred University's Division of Mathematics hosts over 350 area high-school students and their teachers who spend the day participating in the W. Varick Nevins III High School Mathematics Competition, a 40-year-old tradition with a simple mission: inspire and promote excellence in mathematics. It is almost certain that the Seventh Day Baptists who founded the Alfred Select School in 1836 would have approved of such a community-wide academic endeavor. Furthermore, two very special Alfred alumni, Varick Nevins and his wife, Lillian, would have been proud to know that their legacies live on.

The purpose of this article is not only to give a firsthand account of what goes into hosting a regional high school mathematics competition, and provide a basic template for other math departments across New York State and elsewhere, but also to suggest one way that colleges and area school districts can ally for the sake of young adults entering post-secondary education. Of course, the anatomy of a math competition need not include a historical Alfredian-like backdrop, but it does require dedicated and devoted participants and organizers, as the reader will see.

We shall next briefly introduce the Nevins, without whom the competition would not be, and track the course of the competition to the present day. Then we will present many of the details in planning, preparing, and executing a mathematics competition. The reader will be given a chance to work through some sample exam problems, and we will (re)announce all the first-place winners.

## A TRADITION IN THE MAKING

A Brooklyn native, William Varick Nevins III (1910-1967) made his way to Alfred by the late 1920's, earned a bachelor's degree from Alfred University in 1932, and earned a master's degree from Columbia University in 1937. Upon his return to Alfred in 1937, Varick was appointed a mathematics instructor (and eventually professor) and married AU graduate Lillian Texiere (1917-1985) shortly thereafter. Over the course of the next 30 years, Varick and Lillian lived rich lives rooted in dedication and devotion to their alma mater and community. Varick was best known for his sense of humor, Lillian for her knowledge of Alfred history and alumni. Together they started and ran the campus theater and opened their home to international students over semester breaks. Varick and Lillian served Alfred University and the village well until their deaths—his in 1967, hers 18 years later. The year after Varick's death, the W. Varick Nevins III High School Mathematics Competition was held for the first time in his honor, funded by an endowment established by family and friends. To this day, each member of the math faculty is expected to honor, respect, and nurture this event, as if it were part of the job description.

Summarized in Table 1 are the schedule and format changes that the competition has undergone since its inception, including one cancellation due to a late November blizzard. The most notable change was from a two-part multiple-choice/long-answer exam to a one-part exam. In the present format, students are given 75 minutes with which to solve 30 multiple-choice problems. Answers are recorded on an optical scan sheet and computer graded.

Year	Competition Day	Exam Format
1968 – 1992	2 <sup>nd</sup> or 3 <sup>rd</sup> Saturday in November	Multiple-Choice/Long-Answer
1993 – 1996	2 <sup>nd</sup> or 3 <sup>rd</sup> Friday in November	Multiple-Choice/Long-Answer
1997	3 <sup>rd</sup> Friday in November	CANCELLED
1998	1 <sup>st</sup> Friday in November	Multiple-Choice/Long-Answer
1999 – 2007	1 <sup>st</sup> Friday in November	Multiple-Choice

**Table 1.** Changes in the Nevins Competition.

In addition to the Nevins Mathematics Competition, Lillian and Varick have been and are still being honored by Alfred University in other ways. Upon the completion of the Powell Campus Center, the campus theater was moved from Alumni Hall and renamed the Nevins Theater. The Division of Mathematics awards its annual W. Varick Nevins III and Lillian Texiere Nevins Prize in Mathematics to students demonstrating excellence in the discipline. The Lillian T. Nevins Award for Lifetime Service to Alfred University is currently the Alumni Association's most prestigious award; Lillian was cited for distinguished service in 1977.

For more information on Varick and Lillian Nevins or the history of Alfred University the reader is urged to visit the archives at AU's Herrick Memorial Library either in person or on the web at <http://herrick.alfred.edu/special/archives/>.

## PLANNING AND PREPARATION

The Nevins Competition currently takes place on the first Friday in November and is organized and conducted by the faculty and staff of the Division of Mathematics. One member volunteers to act as the Exam Organizer, who collects and compiles problems and edits and formats the exam, while the division's administrative assistant corresponds with participants, makes room reservations, etc.

**August to Early October.** Fall semester at AU begins in late August, and over the next 6 weeks each of the 6 math faculty submits to the Exam Organizer 7 problems for consideration. The problems, which typically require creative thinking and problem solving rather than routine calculation, include topics from algebra to probability, logic to geometry. Most problems are made-up, but some are simplified versions of college-level competition problems, and others are taken directly from standard problem resources like textbooks and problem books. In the meantime, a formal invitation is sent to area high schools that have participated in the past; the competition, however, is open to any high school student. Pre-registration is required since arrangements must be made for examination room assignments, refreshments for a faculty-teacher social gathering, and lunch.

**Mid- to Late October.** The Exam Organizer distributes the 42 proposed exam problems to the mathematics faculty for review by mid-October. In late October, the faculty meets to vote on the 30 problems which will appear on the exam. After a final round of editing a week before the competition, the Exam Organizer prepares the final version of the exam for copying.

We include here a more detailed planning checklist, which is neither exhaustive, nor chronological.

- **Exam Materials**
  1. Write, submit, review, and choose exam problems.
  2. Prepare and photocopy finished exams.
  3. Order optical scan sheets and souvenir pencils.
- **Correspondence**
  1. Send invitations to area high schools.
  2. Send responses to teachers who register.
  3. Send thank-you notes to teachers who participate.
  4. Send final results to teachers.
- **Reservations and Facilities**
  1. Reserve rooms and necessary equipment.
  2. Notify food services for lunch and social gathering.

3. Notify computer center for computer grading.
- **People**
  1. Appoint people to work the sign-in and to deliver answer sheets to the computer center.
  2. Recruit student escorts/proctors.
  3. Arrange for photographer for awards ceremony.
- **Other**
  1. Provide name tags for adults and escorts/proctors.
  2. Assign and record a student number for each participant.
  3. Create student ID's and meal tickets.
  4. Obtain awards and escort/proctor compensation.
  5. Arrange for newspaper publicity.

## THE COMPETITION SCHEDULE

The schedule that follows allows time for students to travel to Alfred, participate in the competition, and return to their high schools in time to board their usual homebound school buses. The computer-graded, multiple-choice exam format is essential for an early afternoon departure.

### **9:00 – 9:45 Arrival and sign-in.**

A faculty member, with the registrant list, occupies a sign-in table set up at a predetermined location near where the participants arrive. Identification cards and meal tickets are distributed.

### **9:45 – 10:00 Settle in.**

Accompanying teachers, counselors, drivers, and parents are invited to attend a social gathering with the faculty. Students are escorted to testing sites by exam proctors.

### **10:00 – 10:10 On your marks—get set...**

At each testing site, a faculty member makes a few opening remarks and reviews the instructions. The student proctor helps with administering pencils, optical scan sheets, and exam copies.

### **10:10 – 11:25 Exam and social gathering.**

While student proctors remain at the testing site, the faculty attends the social gathering. Many of the accompanying adults take the exam and compare solutions with the math professors, who are not afraid to admit having trouble with one or two problems themselves.

### **11:30 – 12:30 Lunch.**

All guests are escorted to the dining hall where lunch is provided. Scan sheets are delivered for computer grading and results are returned.

### **12:30 – 1:00 Awards ceremony.**

The top 3 scores from 11<sup>th</sup> and 12<sup>th</sup> grade, the top 3 scores from 10<sup>th</sup> grade and lower, and the top team score are announced at the awards ceremony and awards are presented. Awards include partial scholarships to AU, monetary prizes, and a plaque. First place winners are listed at the end of the paper.

### **1:00 Departure.**

**THE NEVINS EXAM**

Talk to any faculty member in the Division of Mathematics at Alfred University and (s)he will say that one of the most enjoyable activities during the fall semester is the writing and reviewing of the Nevins exam. The goal is to create an exam which is both challenging and comprehensive. Here is a sample of exam problems which have appeared over the years, including the very first. The answers appear at the end of the article.

**1. [1968, Part I, Problem 1]** There are some children and some cows in the back of a Ford truck. There are 14 more legs than heads. The number of cows is

- A. 3      B. 7      C. 8      D. 14      E. 21

**2. [1974, Part I, Problem 1]** Given triangle ABC, let  $a$ ,  $b$ , and  $c$  be the midpoints of the sides. The area of triangle ABC is \_\_\_\_\_ times the area of triangle  $abc$ .

- A. 2      B. 3      C. 4      D.  $\pi/\sqrt{3}$       E. None of these

**3. [1979, Part II, Problem 2]** Suppose  $2x - 3y - z = 0$ ,  $x + 3y - 14z = 0$ , and  $z$  is nonzero. Evaluate  $\frac{x^2 + 3xy}{y^2 + z^2}$ . (Requires written solution.)

**4. [1983, Part I, Problem 15]** You are taking a trip from Alfred to Dinkeyville (between Alfred and Dinkeyville there is only 1 route and no one knows how far it is). Going to Dinkeyville you average 30 mph and returning to Alfred you average 60 mph. In miles per hour, what is your average speed for the whole trip?

- A. 35      B. 40      C. 45      D. 47.5      E. None of these

**5. [1996, Part I, Problem 14]** A certain three-digit number has the following property: If you place a 9 at the front of it you create a four-digit number that exceeds by 4428 the number you would get if you placed the 9 after the number. The sum of the digits of the original three-digit number is

- A. 5      B. 10      C. 12      D. 16      E. 20

**6. [2006, Problem 17]** A person begins with \$64 and successively bets one-half of her money. On each play she either gains that amount or loses that amount. How much money does she have after six plays if she wins three of those bets and loses three?

- A. \$8      B. \$16      C. \$27      D. \$64  
E. Depends on order in which wins and losses occur.

**AND THE WINNER IS...**

Table 2 lists every winner of the Nevins Competition through 2006. Perfect scores were earned in 1992 and 1999, and first-place ties occurred in 1991, 1999, and 2001.

1968	TIMOTHY FRAWLEY Corning-Painted Post East	1989	STEPHEN BREWSTER Hornell
1969	NORMAN CHAPMAN Wellsville	1990	CHRISTOPHER HYDE Livonia Central
1970	MICHAEL JAMESSON Cuba Central	1991	CHRISTOPHER HYDE Livonia Central ADAM MOLNAR Forest Hills, Salix, PA
1971	WILLIAM MCDANIELS Hornell		
1972	DOUGLAS PETRIE Corning-Painted Post East	1992	JIM RATH Fairfield, CT
1973	STEVEN STRATFORD Rushford	1993	MONICA BURDICK Livonia Central
1974	FRANCIS SHEFLIN Dansville	1994	KERI GINO Stuyvesant, Staten Island, NY
1975	DOUGLAS RONAN Pioneer, Arcade	1995	TIMOTHY WEIDNER Allegany-Limestone Central
1976	SUSAN WESTLAKE Alfred-Almond	1996	ETHAN FENN Corning-Painted Post West
1977	DAVID PLUMMER Corning-Painted Post West	1997	CANCELLED No Winner
1978	MARTIN NORDBERG Haverling, Bath	1998	MATT COSTANZA Livonia Central
1979	MARTIN NORDBERG Haverling, Bath	1999	JOHN ABBOTT Horseheads Central ETHAN FENN Corning-Painted Post West
1980	MICHAEL AMBROGI Corning-Painted Post East		
1981	JOHN BARTHOLOMEW Corning-Painted Post West	2000	DAN RICHARDS Corning-Painted Post East
1982	SCOTT GARMAN Notre Dame, Elmira	2001	JON BOROWIEC Livonia Central WILLIAM COOKE Corning-Painted Post West
1983	ROLF MUELLER Notre Dame, Elmira		
1984	KENNETH CHERKAUER Kenmore West	2002	DANIEL WAGNER Corning-Painted Post West
1985	WILLIAM NELSON Newfane Central	2003	DANIEL WAGNER Corning-Painted Post West
1986	AMY PANGBORN Kenmore West	2004	PETER SEMPOLINSKI Corning-Painted Post West
1987	MIKE BRADSHAW Cuba Central	2005	PETER WEISSIG Holland Central
1988	JEFFREY PETERSON Geneva-Romulus	2006	PETER FOSTER Corning-Painted Post East

**Table 2.** Nevins Competition Winners through 2006.

**ACKNOWLEDGEMENTS**

The author wishes to thank Laurie McFadden for help with gathering information for this article, and Eric Gaze, Lynn Petrillo, and Bob Rogers for their helpful suggestions.

**ANSWERS TO SAMPLE PROBLEMS**

1. A    2. C    3. 7    4. B    5. C    6. C