

SIAM ANNOUNCES THE FIRST-EVER



Moody's Mega Math Challenge

2006



A contest for high school students in the NYC metropolitan area

Challenge weekend:
March 4–5, 2006

TEACHER- COACH GUIDE

siam

Organized by SIAM
Society for Industrial and Applied Mathematics

The **M**oody's Foundation

Funded by The Moody's Foundation



THE PLAYING FIELD

for the 2006 M³ Challenge

Eligibility

The M³ Challenge is open to teams of 11th- and 12th-grade students attending high schools in the New York metropolitan area. For purposes of the Challenge, this area is defined as the five boroughs of New York City; Nassau, Rockland, Suffolk, and Westchester Counties in New York; Bergen, Essex, Hudson, Mercer, Middlesex, Monmouth, Passaic, Somerset, and Union Counties in New Jersey; and Fairfield County in Connecticut. Each school may enter up to two teams, and each team must consist of three to five students.

Faculty Coach

The coach is responsible for making students aware of the contest, organizing and registering teams of three to five students, and keeping and safeguarding the team's unique ID# and password (received at registration). The coach is encouraged to prepare teams for the contest. The coach of each team that submits a viable solution paper within the contest time frame will receive an honorarium.

Registration

Go to M3Challenge.siam.org and click on "register to participate."

The Challenge Problem

Teams will be presented with one open-ended, realistic and challenging modeling problem. The problem is unlikely to have a definitive correct solution. Attention should be paid to creative problem solving and originality in quantitative and qualitative reasoning. Partial solutions are acceptable. Teams will have a choice of working on the problem on either Saturday or Sunday of the Challenge weekend. Coaches must indicate the Challenge weekend day on which their team will work when they register. The Challenge problem will be available to teams on the M³ Challenge web site at either 7:00 AM EST on Saturday, March 4, or at 7:00 AM EST on Sunday, March 5, depending on the date chosen. Each team will receive a password that is valid only on that day and which will correlate with their deadline time.

After downloading the Challenge problem, the team will have until 9:00 PM EST to complete the formal write-up of its solution and upload it to the SIAM offices. Teams should devote their Challenge time to understanding and completing the problem, not to cosmetic supplemental material for the formal narrative solution. Teams will be given an additional 24 hours if needed to priority mail graphics or visuals to SIAM to support their work. Team members may not discuss any aspect of the problem with, or seek help from, the coach or anyone other than their teammates. A team may use computers, software packages, books, reference works, or any inanimate source, all of which must be properly referenced. Each team member and coach will be required to attest to his or her acceptance of and adherence to these rules of integrity for the contest.

Sample Problems

The sample problems that follow give a general idea of the type of realistic and open-ended problem that the student teams will be asked to solve. Additional sample problems will be available on the web site on January 23 to help prepare teams for the contest.

Rules and Guidelines Recognition

Contest information, including guidelines, format, requirements, certification and consent forms, and complete rules, will be posted on the M³ Challenge web site.

Student participants who submit a viable solution paper within the contest time frame will receive a certificate. Press releases will be prepared and distributed to appropriate media.

Judging

Solution papers will be judged in March. In the final phase of judging, top teams must be interviewed by or make a brief presentation of their paper to a panel of judges. Coaches and teams will be notified of the results of the M³ Challenge in April. Teams selected for prizes will be invited to an awards ceremony. News releases will provide recognition for winning teams and coaches.

Prizes

Teams that are judged to have submitted the best solution papers will receive tuition scholarships for college education. Each scholarship will be shared equally among the members of a team.

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|-----------------------------|----------|-------------------------|--------|
| Summa Cum Laude Team Prize: | \$20,000 | Meritorious Team Prize: | \$7500 |
| Magna Cum Laude Team Prize: | \$15,000 | Exemplary Team Prize: | \$5000 |
| Cum Laude Team Prize: | \$10,000 | Honorable Mention: | \$1000 |

SAMPLE PROBLEMS



Sample #1: Safe Passage

The table gives north (N) and east (E) coordinates (in feet) of a 50-ft by 140-ft channel, which runs east and west. The depth d at low tide of the corresponding coordinates is given in feet.

(a) Indicate the safe regions of the channel for a ship with a five-foot draft.

(b) Turbulent weather can cause the ship to rise or sink an extra half-foot. Indicate the safe region in the case of turbulent weather.

(c) Create a one-page advisory for the captain.

| | | | | | | | | | | | | | | | |
|-----------------------|----|----|-----|----|----|----|----|----|----|-----|----|----|----|----|-----|
| N | 0 | 5 | 10 | 15 | 20 | 25 | 30 | 30 | 35 | 35 | 40 | 40 | 45 | 50 | 50 |
| E | 25 | 75 | 130 | 90 | 50 | 15 | 40 | 70 | 30 | 105 | 55 | 95 | 65 | 20 | 120 |
| d | 8 | 8 | 8 | 8 | 6 | 9 | 4 | 5 | 5 | 9 | 4 | 9 | 6 | 7 | 8 |

Sample #2: Anytown's Site Selection for an Emergency Care Facility

A sleepy suburb for many years, Anytown has grown dramatically during the past 20 years, introducing corresponding needs, one of which is an emergency care facility. During this time, the need for other municipal services, especially schools, has caused property taxes, the principal source of revenue for the town, to increase substantially, resulting in a taxpayer backlash focused on restraining spending for new projects. The town council has asked you to present an analysis of the situation at the next meeting along with a recommendation for the best location for the facility.

A map of the town is shown on an insert. The main shopping district is largely confined to Main Street and the first block on either side of it. The residents in these blocks generally live in apartments above the stores, which occupy the first floor. One complex of large apartment buildings is located at the west end of town, and another is located north and east of the shopping area. Single-family homes dominate the housing stock for most of the remaining developed areas, with much of the development clustered around the two freeway exits and lower-density housing in the low hills to the southeast. A senior citizen residence is located southwest of the town center.

Comments for the Map

The town is nearly bisected north to south by the Meander River. Between Interstate Highway 103 and Main Street, there is only one street that crosses the river east-to-west, as shown. Within each residential area, the road structure can be assumed to be rectangular and fairly dense.

Most of the town is zoned for homes 4 to an acre (Residence A). Some of the town is zoned for homes 3 to an acre (Residence B). The Ritz development is zoned for homes with a minimum lot size of 1 acre (Residence C). The only access to homes in the Ritz parcel is through the south end of East Street.

Determine the best location(s) for the new emergency care facility and document your findings in a concise report to the Town Council. Explain and justify your analysis in a full-page article intended for broad distribution to the citizenry in the *Anytown Times*, a weekly newspaper with broad circulation throughout the city.

Suggestions for Getting Started:

Compared to the "Safe Passage" Problem, the "Anytown" problem is intended to be light on numerical data. It requires the teams to look up data, figure out data, or theorize about what kind of data makes sense. All of this is applied mathematics modeling and problem solving in the best sense. For example, when teams read "4 houses to the acre," the students need to calculate the area of the land to which this applies, then convert that to acres. They can then multiply by something less than 4 (probably about 2), because zoning would apply to the buildings and lots, and does not include the streets, sidewalks, open-space land set-asides, etc. Thus, before students can get started, they need to do some work in interpreting the given data and converting it to a form that is useful for the actual problem. To calculate the number of people involved, they might "guesstimate" an average family size and multiply. The problem also requires students to make some assumptions about usage of the emergency facility. Some of this might be available by searching public hospital reports on the web. The relative usage for a senior center might also be a look-up item. The main point is that the student teams should exhibit creativity and initiative in attacking the problem.

Moody's Mega Math Challenge is organized by SIAM and funded by The Moody's Foundation.

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SIAM, headquartered in Philadelphia, PA, is an international community of over 10,000 individual members, including applied and computational mathematicians, computer scientists, and other scientists and engineers. With over 500 academic and corporate institutional members, SIAM serves the disciplines of applied mathematics and computational science by publishing a variety of books and prestigious peer-reviewed research journals, by conducting conferences, and by hosting activity groups in various areas of mathematics. SIAM supports regional sections and student chapters that provide many opportunities for students. One of the primary goals of the organization is to increase the pipeline of students into applied math studies and careers. More information about SIAM is available at www.siam.org.

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