

M π

The Mathematics and Physics Institute NEWSLETTER

Director: Elizabeth Roth
Associate Director: Richard Delaware

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YEAR 18 – WE BEGIN

Currently 35 students are enrolled at the MPI, consisting of 3 from Center Place Restoration, 1 from Central, 8 from Fort Osage, 5 from Northeast, 1 from Paseo, 3 from Southeast, 9 from Truman, 5 from William Chrisman High Schools. Of these 9 are females and 26 are males.

!! MPI OPEN HOUSE !!

Sunday, Nov. 4, from 1-3 p.m., the MPI will hold its annual Open House for parents, teachers, counselors, administrators, and anyone else interested in talking to the faculty, staff or students of the MPI.

We'll be in the Truman Campus Building of UMKC behind the Truman Library, just north off of Hwy. 24 in Independence. There will be:

- 1) Physics demonstrations and laboratory set-ups.
- 2) Mathematics demonstration problems on chalkboards with SHARP graphing calculators on display, and
- 3) the MPI Calculus Lab in Room 223 will be open with MPI student assistants ready to demonstrate mathematics software to our visitors.

In Room 207 at 1:30p.m., the MPI Director and Associate Director will make some brief remarks and introduce the MPI teachers. And of course, there will be refreshments. If you have any questions please call 235-1272. You're invited!

**!! MPI OPEN HOUSE !!
SUNDAY, NOV. 4, 2001, 1-3 P.M.**

OUR NEW DIRECTOR

I am glad to have this opportunity to introduce myself as the new director of the Mathematics and Physics Institute.

I come here from Washington University in Saint Louis, where I received my Ph.D. in the area of theoretical nuclear physics and where I have been teaching for the last two years. Before that, I attended William Jewell College after graduating from Liberty High School.

It is very nice to be back in Kansas City, and I am enjoying meeting the new class of MPI students and working with our wonderful faculty. While things have been hectic but thrilling for me lately with the new job, new house, and my upcoming wedding, I am most excited to be working in this great program and teaching these great kids!

Eliz Roth

Elizabeth Roth, Director

SOME STATISTICS FROM OUR 00-01 ANNUAL REPORT

- 795 students have completed the MPI program (Years 1-17, Sept. 1984 – May 2001); 475 (60%) of these were male and 320 (40%) female.
- On average, 75% of all MPI students who start the program actually finish
- Of the 579 MPI Alumni from Years 1-12 (1984-96) (excluding foreign-exchange students), 539 (93%) entered college, receiving 324 college degrees (to the best of our knowledge), including at least 210 degrees in Science, Mathematics, or Engineering, 9 Medical Doctors, and 3 Ph.D.'s.

■ Where 75% of MPI Alumni Go:

| | |
|-----|-----------------------------------|
| 25% | UMKC |
| 16% | UM-Columbia |
| 11% | UM-Rolla |
| 5% | Truman State Univ. (NEMSU) |
| 4% | University of Kansas |
| 3% | Central Missouri State University |
| 3% | Penn Valley Community College |
| 3% | Rockhurst |
| 2% | Northwest MO State University |
| 1% | William Jewell College |
| 2% | Washington University – St. Louis |

TO ALL MPI ALUMNI:

**HAVE YOU GRADUATED
FROM COLLEGE?**

IF SO:

PLEASE CONSIDER BEING AN
ENRICHMENT SPEAKER

CALL 816-235-1272

Or contact us at mpi@umkc.edu

MPI Alumni who have spoken:

| | |
|-------------------------|---------|
| Doug Bullock | (84-85) |
| Brent Harding | (84-85) |
| Pam Deters/Stephen Koop | (84-85) |
| Tony Thornton | (88-89) |
| Seth McMenemy | (88-89) |
| Mitch Dobson | (89-90) |
| Rachel Allen | (92-93) |

ODDS AND ENDS

On September 7, Richard Delaware spoke in the UMKC Department of Mathematics and Statistics Expository Talks Series on: The Tangential Triangle and Rectangle Problem: Erdős, Grünwald, & Polya.

Sheri Adams and Libbi Sparks will continue for two more years to administer a Missouri Incentive Grant for Truman and William Chrisman High Schools to improve student mathematics performance on Missouri State Assessment tests. Libbi Sparks is now Instructional Specialist for Mathematics at William Chrisman High School.

On October 5-6, Richard Delaware will attend the 11th Annual Kansas City Regional Mathematics Technology EXPO at Rockhurst University, and with Andy Bennett of Kansas State

University will moderate a discussion titled: "What Do We Need to Know About Online Teaching?" He has been a member of the EXPO Steering Committee since 1991.

ENRICHMENTS

FOLLOW UP

On Friday, September 14, Douglas Carroll from the Department of Basic Engineering at the University of Missouri – Rolla, spoke on "Power Management for Solar Cars." He has been the advisor for UMR Solar Car Team since 1992, and has done research on composite materials.

Students responded:

■ It's essentially about power management and efficiency in solar cars. You lose energy due to rolling resistance, aerodynamics, and parasitic losses. Rolling resistance is apparently due to the flexing of the tire rubber. It is extremely important to be energy efficient with solar cars. All of this has to be taken into account in designing a solar car; although, at the moment, it seems that the only practical application of solar cars is to race them.

■ Representative from UMR came and talked about solar powered cars. Gave a run through of a typical day. He also discussed formulas they use to make the car most efficient. Then, he gave away 2 t-shirts, and I got one because I am a lucky duck.

■ I was most interested in the equations that were used to determine the efficiency of the car. I would've liked to see, in more detail, how exactly those equations were used. I thought that using a national champion car was a nice touch.

■ Ask if he could explain further how the solar panels convert the sunlight into energy.

■ I thought that overall, the speaker was very polished and had a very good presentation. It would have been neat if he had brought in more solar car parts.

■ He was a very good speaker not monotone and very knowledgeable. Maybe he could bring someone that actually drove a car and their experience.

■ I think that the speaker did a terrific job. He explained each subject to the fullest and went over or broke it down to make it clear.

On Friday, September 28, Cory Beard, UMKC School of Interdisciplinary Computing and Engineering, spoke on "Engineering Challenges for the Internet."

Students responded:

■ The discussion topic was disasters (storms, bombings, etc.) and the effect it has on information networks (phone, Internet, etc.), and how these "stressed networks" affect emergency response time and effectiveness. Using weighted sum formulas to generate functions and graphs to represent network traffic situations, different models of traffic prioritizing were developed and discussed. Many aspects of these models were analyzed and "optimized" (or made most efficient), such as traffic time delay and profit. Statistics are studied and plotted on graphs to represent customer satisfaction and cost of reimbursement. A seemingly optimal system of "priority resource tickets servers" was eventually revealed and discussed.

■ I thought this was a good presentation given the current national situation. It was a topic that I never really thought of or considered during the time, and if something similar occurs in the future, I will remember this.

■ He did a nice job. The subject doesn't really allow for any other visual aids, so he did well for what he had to work with.

■ I think it was great. No changes.

■ I enjoyed this topic at this particular time of our lives; it has relevance to the present. I thought he did a good job to explain things and involve the class.

UPCOMING:

On October 12, Darrin Ingram, Project Manager and Senior Associate at Gould Evans Goodman Associates Architects, and member of the American Institute of Architects, will speak on, "ARCHITECTURE: DESIGNING THE ENVIRONMENT."

October 26 has not yet been scheduled.

On November 9, Paleontologist and dinosaur hunter Craig Sundell of KU will speak on, "THE REAL JURASSIC PARK: A WINDOW INTO PALEOECOLOGY."

2001-2002 STUDENT FIRST IMPRESSIONS

"My first impression of the MPI was that this institute would be one of the hardest places to stay on top of my math and science skills, but it isn't as hard as it seems. Although I'm the only student from my high school, it feels like I've known some of the other students for a long time. The class settings at the MPI are great and all the students are on the same page. One thing I especially like is the method of teaching the teachers use as they give you an easy example of a problem and leave it up to you to see how far you can take it. I believe this is going to be an interesting and exciting year at the MPI."

Kenneth Steward
Central High School
Kansas City School District

"After the initial shock of waking up before dawn, MPI kind of grew on me. I thought I would have long dreary lectures to look forward to, but was pleasantly surprised. Everyone is awesome. It is a nice contrast to "regular" school. A lot is expected from us, so everyone does their best. I think I like it here. While not looking forward to the tests, I look forward to seeing everyone's bright shining faces at 6:59 in the morning. Or in my case, normally 7:01!!"

Leslie Tiensvold
Truman High School
Independence School District

"My first impression of MPI scared me. I thought I was in way over my head. After the first week I started to realize all I had to do is pay attention. After doing that it became easier in the classes."

Devin Thompson
Ft. Osage High School
Ft. Osage School District

"MPI can be really tough. You start out really stressing and losing sleep, but after a while, you start to just forget about your assignments and go on with your life. In all seriousness though, MPI has been good so far and we have all enjoyed the new experience."

Aaron Scott
Center Place Restoration High School
Independence School District

“My first impression of MPI was that the teachers were nice, the people were quiet, and I was tired. I wanted to drop it, but I decided to give it a fair try and now it’s a lot of fun and everyone is nice, helpful, and talkative.”

Amanda DeBrot
William Chrisman High School
Independence School District

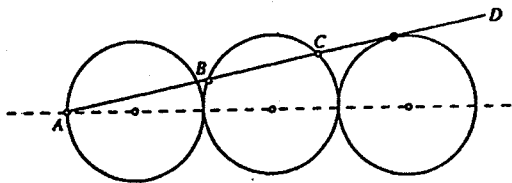
“Well, so far the MPI has been work, study, study, work. My brain is receiving a challenge, which hasn’t happened often enough during my school years and “I LOVE IT.” We’re still reviewing, but I’m learning lots of new things. I have gotten discouraged and will continue to, but I’m gonna continue to work, study, study, work, and study even more.”

Danielle Cole
Southeast High School
Kansas City School District

**A SOLUTION TO
MATHEMATICS CHALLENGE #69**

Recall the problem statement:

In the picture below, three circles of radius 5 are arranged side by side in a row. From the point A on the first circle, which is in line with all three centers, a line AD is drawn which is tangent to the third circle as shown.

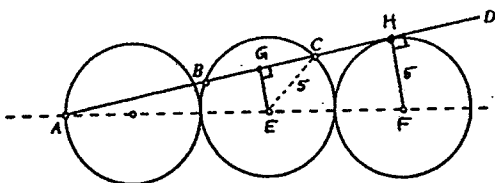


What is the length of the intersection BC of that tangent with the middle circle?

[From: The Mathematical Gazette, 1988, vol. 145, in a review of the book Mathematical Puzzling by Tony Gardiner, as quoted in Mathematical Chestnuts from Around the World, by Ross Honsberger, MAA, 2001, section 13, problem #2, p. 144.]

SOLUTION:

Let the center of the second circle be labeled E, and the center of the third circle be labeled F. Let the point of tangency on the third circle be labeled H. (See below.) Then as a radius, FH is perpendicular to the tangent line AD at H. Draw EG perpendicular to AD at G. Lastly, draw EC.



As notation, we will now let the symbol \overline{XY} represent the length of a line segment XY. Since the two right triangles EGB and EGC share side EG, and as radii $\overline{EB} = \overline{EC} = 5$, we conclude that these two right triangles are congruent. In particular $\overline{GB} = \overline{GC}$, meaning EG bisects BC at G.

Now, since triangle AEG is similar to triangle AFH, and the three circles each have radius 5, we have:

$$\frac{\overline{EG}}{5} = \frac{\overline{EG}}{\overline{FH}} = \frac{\overline{AE}}{\overline{AF}} = \frac{15}{25} = \frac{3}{5}$$

Thus, $\overline{EG} = 3$. Since as a radius $\overline{EC} = 5$, and triangle EGC is a right triangle, by the Pythagorean Theorem we conclude that $\overline{GC} = 4$. Hence, $\overline{BC} = 2 \cdot \overline{GC} = 8$, as desired.

NOTE: Current MPI students Dustin Sullivan and John Bender of Fort Osage High School submitted essentially the same solution.

**A SOLUTION TO
PHYSICS CHALLENGE #60**

Recall the problem statement:

Stuck on a windless day, a sailor decides to direct a powerful fan which he has on-board into the sail. If all the wind generated bounces backward off the sail, could this propel the sailor’s boat?

SOLUTION:

Yes, the craft moves forward! There are two impulses acting on the boat, one, backward from the fan recoiling from the wind it produces and the

second, forward from the air bouncing off the sail. These two are oppositely directed, but the wind bouncing off the sail can produce twice the impulse than if it just stopped at the sail, therefore, the boat receives forward momentum from this arrangement.

NOTE: This is the same effect as just turning the fan to face backward to propel the boat.

MATHEMATICS CHALLENGE #70

Suppose finite real numbers x , y , z , and t satisfy the following (simultaneous) system of equations:

$$x(yz + zt + ty) = 0$$

$$y(xz + xt - zt) = 0$$

$$z(xt + xy - ty) = 0$$

$$t(xy + xz - yz) = 0$$

PROVE that at least one of x , y , z , or t must equal 0. In fact, show that at least two of them must be 0.

[From: The Pi Mu Epsilon Journal as quoted in Mathematical Chestnuts from Around the World, by Ross Honsberger, MAA, 2001, Section 6, problem #11, p.50.]

PHYSICS CHALLENGE #61

In all collisions, linear momentum is conserved. Explain how linear momentum is conserved when you give a ball upward momentum, i.e. you throw it upward.

Then explain how linear momentum is conserved when a ball bounces from the floor.

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