# Mπ The Mathematics and Physics Institute NEWSLETTER

**Director: Richard Waring**
**Mathematics Coordinator: Richard Delaware**

**October 1, 1997** **Vol. 12, No. 2**


## YEAR 14 - WE BEGIN

Currently enrolled at the MPI are 52 students, from Central (1), Fort Osage (9), Lincoln (3), Northeast (7), Paseo (1), Truman (8), Van Horn (7), Westport (1), and Wm. Chrisman (15) high schools. Of these, 29 are male and 23 are female.

## ! MPI OPEN HOUSE !

**Sunday, Nov. 23, from 2-4 pm,** 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 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 2:30 pm,** the MPI 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 23, 1997, 2-4 PM

## SOME STATISTICS FROM OUR 96-97 ANNUAL REPORT

628 students have completed the MPI program (Years 1-13, Sept. 1984 - May 1997; 378 (60%) of these were male, and 250 (40%) female.

On average, 74% of all MPI students who start the program actually finish.

Of the 385 MPI Alumni from Years 1-8 (1984-92) (excluding foreign-exchange students), 363 (94%) entered college, receiving 269 college degrees (to the best of our knowledge), including at least 176 degrees in Science, Mathematics, or Engineering, and 8 Medical Doctors.

Where nearly 75% of MPI Alumni Go:

26% UMKC
16% UM-Columbia
10% UM-Rolla
4% CMSU
4% Truman State Univ. (NEMSU)
4% Univ. Kansas
3% Penn Valley Com. Col.
3% Rockhurst
2% NWMSU
2% Wm. Jewell College

Number of MPI Instructors 1984-1997:

| | Math | Physics |
|---|---|---|
| Year 1 | 7 | 5 |
| Year 2 | 4 | 4 |
| Year 3 | 5 | 3 |
| Year 4 | 5 | 3 |
| Year 5 | 4 | 3 |
| Year 6 | 4 | 3 |
| Year 7 | 4 | 3 |
| Year 8 | 4 | 3 |
| Year 9 | 4 | 3 |
| Year 10 | 4 | 3 |
| Year 11 | 4 | 4 (+1) |
| Year 12 | 4 | 3 (+1) |
| Year 13 | 3 | 3 (+1) |
| Year 14 | 3 | 3 (+1) |

(+1) = NE liaison, not an instructor.

## ODDS AND ENDS

On Oct. 3-4, the Mathematics Coordinator will attend, moderate one discussion, "Algebra Topics: What Do We Throw? What Do We Keep?", and give two EXPO Showcase talks at The 7th Annual Kansas City Regional Mathematics Technology EXPO held this year at Rockhurst College: "EXPO Showcase: Useful Mathematics Freeware/Shareware", and "EXPO Showcase: Comparison Between the New SHARP EL-9600 and the TI-83."

Oct. 29-31, **Sheri Adams** will attend an NSF conference for college instructors on Reform Calculus, at the Lake of the Ozarks.

From Nov. 5-9, the Mathematics Coordinator will attend the 10th Annual ICTCM (International Conference on Technology in Collegiate Mathematics) in Chicago, IL, as a member of its Executive Steering Committee.

Nov. 16-18, **Jim Graczyk** will attend the Tech Prep conference at Tan Tara, and give a talk on Physics.

**TO ALL MPI ALUMNI:**

**HAVE YOU GRADUATED FROM COLLEGE?**
IF SO:
PLEASE CONSIDER BEING
**AN ENRICHMENT SPEAKER**
OR JOINING OUR
**PANEL DISCUSSION!**
[Tues. Jan. 6, 1998]

CALL (816) 235-1272

## ENRICHMENTS

**FOLLOW UP**

On Sept. 26, Mitch Dobson (MPI 89-90), currently the resident Prosthetist/Orthotist at Rehab Designs of America in Lenexa, KS, joined us for the 4th time to speak on **PRINCIPLES AND ADVANCEMENTS IN PROSTHETIC TECHNOLOGY.**

Students responded:

■ He talked about the reasons for an amputation. And he talked about the factors that you must consider when constructing a limb... the separate physics of what you must do to make a limb as real as possible.

■ I wouldn't really alter very much about it. It would be interesting, however, to see diagrams of the interior parts of the spring-supported knee joint, and to hear an explanation of how the spring tension is measured precisely enough to not cause users to bounce off the ground with every step.

■ Diabetes is the leading cause of amputees. The goals a patient has are very important. They won't give a patient a prosthetic for an athlete, if all the person wants to do is go to work. Because of WW II and the Vietnam War, many advancements were made in the field of prosthetics. So much so that the world record for the ParaOlympics is 1 second off the Olympic world record. Another advancement is that a computer can now make the model for the prosthetic. I think Mitch had more to say and should have had longer to speak. I found what he had to say really interesting, and would have liked to hear what he had to say about the upper extremities.

■ This guy was cool. He made his field sound interesting.

■ Depending on a person's lifestyle, the prosthetist will make or design the artificial limb to fit it. The speaker was very interesting. He had a great personality and humor that kept the audience's attention.

■ This talk consisted of how a prosthetist evaluates if and how a person suffering amputation will replace what was amputated. During fabrication, a cast of the body part being replaced is made. After computing the pressure points on the cast, using principles of physics, fitting takes place. Alignment is also another important factor of fitting. Afterwards, to keep the replaced limb in working order, the prosthetist follows up on the patient.

■ Very Excellent!! He used diagrams and explained the area of prosthesis very well. He seemed very, very prepared for this lecture. He made the field of prosthetics seem

interesting. Definitely invite this speaker back next year!!

■ He continually mentioned the importance of physics, although he hadn't expected that much when he first got started. He brought many models and a few drawings to help describe the pressures and effects of the prosthetic limbs, and how it effected the amputated extremity. Mitch did an excellent job of balancing his information and entertainment. He knew his field very well, and was very excited about talking to us about it. He had great energy, and was able to hold our attention without even trying. Great lecture!

■ Patients must use their own weight and hip movements in order to bend the knee joint. The bending of the knee seems to be the biggest obstacle. Excellent job! Very interesting, relates good to students. Definitely invite back.

**UPCOMING**

**Oct. 10** brings us Gisela Dreschhoff, a German Geophysicist, working with the Space Technology Center at the University of Kansas, to speak on: **GEOPHYSICS RESEARCH IN THE POLAR REGIONS.**

We will have Craig Sundell of KU speak on **Oct. 24** about **THE REAL JURASSIC PARK: A WINDOW INTO PALEOECOLOGY.**

On **Nov. 7** Sam Gill, an instructor in Critical Thinking at Johnson County Community College, will return once more to talk about **UNSOLVED MYSTERIES.**

Finally, on Friday, **Nov. 21**, we'll make our annual all-day field trip to the **NUCLEAR RESEARCH REACTOR** at the University of Missouri-Columbia campus.

## NEW (OR CHANGED) MPI ALUMNI E-MAIL ADDRESSES

[A complete list of known MPI Alumni e-mail addresses is available on request.]

**** NEW ****

**(85-86) Phúc Đõ**
phuc_do@kcmo.org
KANSAS CITY, MO WATER DEPT.

**** CHANGES ****

**(91-92) Rodney Caudle**
rcaudle@ont.com
BDM INTERNATIONAL

## WE HEAR FROM PAST STUDENTS

**(85-86) Phúc Đõ**
(BS Electrical Engineering)

**E-mail** received 9-4-97:

"Finally, the City of Kansas City, Missouri Water Services Department has the internet on-line to communicate with the outside world on July, 1997.

If it is possible and at your earliest convenience, please send me the current list of MPI Alumni e-mail addresses. Thank you very much.

P.S. I passed the P.E. Examination and am currently registered as a Professional Engineer in the State of Missouri. Now I can stamp my own electrical designs."

**MPI E-MAIL ADDRESS:**

**rdelaware@cctr.umkc.edu**

**A list of known MPI Alumni e-mail addresses is available on request.**

## 1997-98 STUDENT FIRST IMPRESSIONS

"The first couple of weeks were very tough. I really was not used to doing work outside the school. I also had a hard time getting used to studying, or going over my notes in order to do an assignment. By now, it is getting easier to get my work done, but it still is pretty hard. Sometimes, particularly during calculus, I feel pretty lost. I hope I can get ahold of this before the exam. Other than that, I have had a pretty good time. I like the people that I work with, and hope that I

will be able to make it and finish the program."

**José Alcocer**
Van Horn High School
Kansas City, MO School District

---

"Before starting MPI I anticipated tons of work that I had no idea of how to begin and much needed tutoring with the teachers at MPI, but to my surprise we began reviewing algebra to make sure that all of us were equipped with the right tools to tackle the challenging work that lies ahead.

Also before starting I did not think I would have any fun because when I received the September Newsletter, I noticed that the three of us who attend Lincoln were all in different sections. However, the diversity of students at MPI is good to experience because it prepares you for college life. The schools represented here are Lincoln, Northeast, William Chrisman, Fort Osage, Truman, Van Horn, and Paseo. Before MPI I had never met anyone who attended three out of seven of these schools and if my best friend had been in my section, I probably would not have met many other people.

One of my first impressions that I still find kind of hard to believe was that my MPI classes would be my hardest classes hands down, (I was so very wrong). I am tackling a full schedule at Lincoln, have all but one new teacher, and the subjects that used to be easy, I now actually have to work hard.

In light of all my faulty first impressions I am still fortunate to have chosen to participate in MPI because I think I will learn a lot more than if I had just taken Advanced Physics and Calculus at my school, because of the difference in teaching styles and how the program is designed."

**Wilma Hines**
Lincoln High School
Kansas City, MO School District

---

"The classes at MPI require a lot more thinking than the math and science I'm used to, but overall the work isn't as hard as I was expecting. The homework is time-consuming but I was relieved to find that the teachers are very helpful, and can always answer our questions."

**Courtney Jones**
Truman High School
Independence School District

---

"My first impressions of M$\pi$? Early mornings and bad puns. I must say I have enjoyed both Calculus and Physics so far. I think it's because I still understand what the lessons are about, it's the best motivation. The best thing for me have been the lectures, because I feel all the pieces falling together and also the teachers can get into the material, which gives the lessons great energy! The worst things have been the early wake-up call and the fact that everyone seems so quiet (in my section). Altogether, I've been real excited about starting this and realizing that, yes, I can understand this math-stuff!"

**Richaela Riley**
Paseo High School
Kansas City, MO School District

---

## A SOLUTION TO MATHEMATICS CHALLENGE #49

Recall the problem statement:

---

Compare $\sqrt[9]{9!}$ with $\sqrt[10]{10!}$ .

Prove which one is larger.

---

[From: Challenging Problems in Algebra, by Posamentier & Salkind, 1970, Problem 11-10, p.156.]

---

**SOLUTION:**

The quickest way to compare these two positive numbers is to raise both to the $9 \cdot 10 = 90^{th}$ power, and compare the results. Recall that $10! = 1 \cdot 2 \cdot 3 \cdot \ldots \cdot 9 \cdot 10 = 9! \cdot 10$. So:

$$\sqrt[9]{9!} \;?\; \sqrt[10]{10!}$$
$$(\sqrt[9]{9!})^{90} \;?\; (\sqrt[10]{10!})^{90}$$
$$(9!)^{10} \;?\; (10!)^{9}$$
$$(9!)^{9} \cdot 9! \;?\; (9!)^{9} \cdot 10^{9}$$
$$9! \;?\; 10^{9}$$

But, clearly $9! = 1 \cdot 2 \cdot 3 \cdot \ldots \cdot 9$ is factor by factor less than a product of nine 10's, so

$$9! < 10^9 .$$

Retracing our steps backwards, we conclude:

$$\sqrt[9]{9!} < \sqrt[10]{10!} .$$

NOTE: In fact, you can prove that in general, for $n = 2,3,4, \ldots$ we have:

$$\sqrt[n]{n!} < \sqrt[n+1]{(n+1)!} .$$

## A SOLUTION TO PHYSICS CHALLENGE #40

Recall the problem statement:

Suppose you have two, large opaque vessels. One contains kerosene, the other contains kerosene and water.

How can you tell the one from the other using a spring scale and a weight on a string?

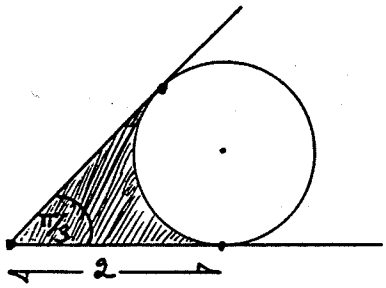
[From: Quantum Magazine, Sept/Oct 1996, p. 10, B183.]

**SOLUTION:**

Attach the string with the weight to the scale and lower the weight slowly into each of the vessels. In pure kerosene, the reading on the scale won't change as the weight goes down; but in the other vessel the reading will jump at the boundary between the two liquids: water is denser than kerosene, so the buoyant force increases abruptly at this point.

## MATHEMATICS CHALLENGE #50

Suppose a circle is lodged in a $\pi/3 = 60°$ angle corner as shown:




Find, both exactly, and approximately to 4 decimal places:

a. The radius "r" of the circle, &

b. The area of the shaded region.

## PHYSICS CHALLENGE #41

To the nearest power of ten, estimate the number of iron atoms in the head of a pin.

[From: Physics Olympics Handbook]

**Editor/Writer: Richard Delaware**

The Mπ Newsletter is typed in WordPerfect 5.1 with MoreFonts and published five times a year on the first of the month during the months of August, October, December, February, and April at the Mathematics and Physics Institute (MPI), 600 W. Mechanic, Room 224, Independence, MO 64050, phone (816) 235-1272, e-mail: rdelaware@cctr.umkc.edu. Please address all correspondence concerning this newsletter to 'Mπ Newsletter'.