

M π

The Mathematics and Physics Institute NEWSLETTER

Director: Richard Waring
Mathematics Coordinator: Richard Delaware

October 1, 1995

Vol. 10, No. 2

YEAR 12 - WE BEGIN

Currently enrolled at the MPI are 63 students, from Fort Osage (11), Lutheran (1), Northeast (14), St. Mary's (2), Truman (16), Van Horn (15), and Wm. Chrisman (4) high schools. Of these, 30 (48%) are female, and 23 (37%) are minorities. As you can see we do not have students from the 12 high schools mentioned in the August issue, since the Kansas City Missouri School District, due to severe curtailment of funds, chose not to allow students from Lincoln, Metro, Paseo, or Southeast to attend this year. But, we are hoping to once more open up to these schools next year.

We have had our usual battles with busses getting students here on time, and the loss of several students already, but nothing that is unusual, although on the third day of class, Sept. 8, our 9 new inkjet printers (finally) arrived, replacing the noisy dot-matrix printers in our computer lab. The atmosphere in lab is now much improved.

! MPI OPEN HOUSE !

Sunday Nov. 5, 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 graphics 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. 5, 1995, 2-4 PM

SOME STATISTICS FROM OUR 94-95 ANNUAL REPORT

536 students have completed the MPI program (Years 1-11, Sept. 1984 - May 1995); 335 (62.5%) of these were male, and 201 (37.5%) female.

It is still true that, on average, 75% of all MPI students who start the program actually finish.

Of the 294 MPI Alumni from Years 1-6 (1984-90) (excluding foreign-exchange students), 277 (94%) entered college, receiving 210 college degrees (to the best of our knowledge), including at least 135 degrees in Science, Mathematics, or Engineering, and 6 Medical Doctors.

TO ALL MPI ALUMNI:

**HAVE YOU GRADUATED
FROM COLLEGE?**

IF SO:

**PLEASE CONSIDER BEING
AN ENRICHMENT SPEAKER
OR JOINING OUR
PANEL DISCUSSION!**

[Wed. Jan 3, 1996]

CALL (816) 235-1272

MPI E-MAIL ADDRESS:

rdelaware@cctr.umkc.edu

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

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

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

**** CHANGES ****

- (84-85) Doug Bullock, Asst. Professor
bullock@diamond.idbsu.edu
BOISE STATE UNIVERSITY
- (85-86) Sarah Littlewood
srl@math.wustl.edu
WASHINGTON UNIVERSITY
ST. LOUIS, MO
- (85-86) Melissa Steffens
msteffei@cyclops.pei.edu
TRUMAN HIGH SCHOOL
INDEPENDENCE, MO
- (86-87) Tim Bacchus
bacchus@cclink.tfn.com
- (86-87) C. Alan Canfield
alan_canfield@ccmail.aleg.
tyndall.af.mil
TYNDALL AIR FORCE BASE
PANAMA CITY, FL
- (86-87) Pat Liang, MD
pwliang@aol.com
SHAWNEE MISSION, KS
- (88-89) Seth McMenemy
asm5494@kcpl.com
KANSAS CITY POWER & LIGHT CO

**** NEW ****

- (94-95) Derek Olson
dao@umr.edu
UNIV OF MO - ROLLA
- (94-95) Rebecca Schwietz
schwietz@fas.harvard.edu
HARVARD UNIVERSITY

(94-95) Sam Young
c672741@showme.
missouri.edu
UNIV OF MO - COLUMBIA

ODDS AND ENDS

On Sept. 14, Phyllis Chase, the Director of Curriculum and Instruction for the Kansas City Missouri School District, and Earl Jones, their Mathematics Instructional Specialist, visited us to see the MPI program in action. Later on Sept. 20, Isabelle Nash, the Gifted and Talented Coordinator for the District, also visited, bringing with her a photographer to take pictures for her report.

On Sept. 22, Sheri Adams attended a workshop on cooperative learning at CMSU.

Sept. 28-29, the Director attended a meeting of the Sigma Pi Sigma Diamond Jubilee Committee in Baltimore, MD.

On Oct. 4-7 Jim Graczyk will be presenting Ceramics Engineering from a technical viewpoint at the National Technical Preparation Conference in Atlanta, GA.

On Oct. 6-7 the Mathematics Coordinator will attend and be a speaker at the 5th Annual Greater Kansas City Area Mathematics Technology EXPO.

Finally, on Oct. 19, the Director and the Mathematics Coordinator will attend the MPI's annual luncheon meeting with the UMKC administrators overseeing the MPI program, and the three superintendents (or their representatives) of the Ft. Osage, Independence, and Kansas City, MO School Districts.

ENRICHMENTS

FOLLOW UP

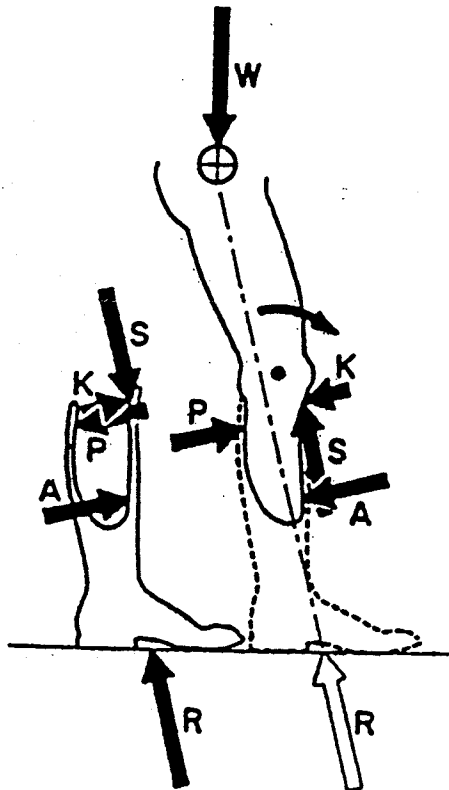
On Sept. 29, Mitch Dobson (MPI 89-90), currently the resident Prosthetist/Orthotist at Certified Orthotics and Prosthetics Associates in Lenexa, KS, spoke on **PRINCIPLES AND ADVANCEMENTS IN PROSTHETIC TECHNOLOGY.**

Some specific student comments were:

--The lecture was upbeat and to the point, which is a plus at 8:00 in the morning. I felt that Mr. Dobson knew what he was doing. He had an interesting point that caught my attention. He said that most of the people that needed prosthetics didn't worry much about what it looked like but how it felt and how mobile they could be. This surprised me because I thought that it would be an easier transition for people if they had a limb that looked as normal as possible.

--I thought that the presentation was very interesting. I'm planning on going into the medical field and I enjoyed seeing aspects of other fields of medicine. I was really impressed with the runner in the video. I also thought that the hand movement was really fascinating.

--This looks like a challenging and interesting job. The part that I thought was best, was the arm with motion control. After seeing this, I don't think it would be that bad to lose a part of my body. It was really neat to play with the examples he brought with him!



--He told about the new components on the market, such as hydraulic limbs, special knees, and carbon fiber/epoxy materials. He also told us about the big influence CAD/CAM has on the design of prosthetics.

--New technology in prosthetics allows amputees to walk up and down inclines, something that could not be done before. This invention is called the seven bar knee. Other advancements allow sensations to be felt through the prosthesis.

--I learned about the different kinds of pieces and even the different forces on your leg when walking. The knee joint was very impressive as well as the moveable arm. I thought he did an excellent job. The slides, video, and the actual prosthetics were great. He kept us all interested and I enjoyed his presentation. People usually don't hear much about prosthetics but I thought it was quite interesting.

--He talked about the four main reasons for needing prosthetic limbs. He mentioned the six types of amputations on extremities: above the knee, below the knee, partial foot, bilateral, above the elbow, and below the elbow. Towards the end, he showed how they use the computer to get the exact shape for the prosthetic limb. I liked the fact that he had so many prosthetic limbs there for us to look at.

--I enjoyed the footage used in this enrichment, and I especially thought that the lecture was quite interesting. The prosthetics on display were also a plus, since most of us have never really been in such close contact with prosthetics before. I know that I have never even touched an artificial limb or actually seen how it works. ...I thoroughly enjoyed listening to the speaker.

UPCOMING

On Oct. 13, we welcome for the first time Gisela Dreschhoff, a German Geophysicist, working with the Space Technology Center at the University of Kansas, who will speak on: **A PALEO-ASTROPHYSICAL RECORD IN ICE CORES: NITRATES IN POLAR SNOW.**

On Oct. 27, Kathleen Fuller, a Physical Anthropologist, also from

the University of Kansas, making her second appearance as an MPI speaker, will discuss: **OUR SISTER TAXON: THE CHIMPANZEE.**

Finally, on Friday, Nov. 10, we'll make our annual all-day field trip to the **NUCLEAR RESEARCH REACTOR** at the University of Missouri-Columbia campus.

WE HEAR FROM PAST STUDENTS

SETH McMENEMY (88-89)
(BS, Electrical Engineering)

E-mail received 8-15-95:

"I am currently serving as the KCPL Northland Distribution Engineer. I plan new circuits, upgrades, system improvements, etc. for our distribution facilities up north. If you guys need me for anything just let me know. KCPL gives plant tours, usually of Hawthorn which is the power station with the big red and white striped stack just over the hill from you guys. If you are interested let me know and I will find out more information.

Sounds like the building tenancy is holding up fine. I am happy to see the growth of the MPI. It's an excellent one of a kind program.

Say hi to Sheri for me.
Thanks!

DEREK OLSON (94-95)
(Engineering Major)

E-mail received 8-22-95:

"Hello! I just started classes at UMR yesterday and am looking forward to a busy year. I HAVE been getting the "Scientific American" magazine every month.

Well, I received the Newsletter and thumbed through it. I wish everyone the best this year! I must go but will most likely keep in touch!"

SAM YOUNG (94-95)
(Engineering Major)

E-mail received 9-5-95:

"Hello. How was the first day

of MPI? Hopefully everything went smoothly. Though I am sure this new bunch probably won't compare to Us.

Well, I'm down here at MU having fun. Actually it isn't all that fun. Homework is starting to pile up and the classes are really kickin' in. I'm taking Calculus I (Math 80) down here. So far it has been really easy. Thank goodness I had you (Delaware) and Mrs. Knutson as teachers before coming here. My professor is from Russia and is hard to understand. Last Friday he tried to explain limits, woe be to the student who had never had calculus before. He may know his subject but he can't teach worth spit.

My class numbers around 250 with my lab group around 30. But that still doesn't help because the TA's first language isn't English. I don't mind too much. It is just frustrating trying to explain your problem.

Tell Tina hi, and that she should have named her kid Sam."

DOUG BULLOCK (84-85)
(PhD Mathematics)

E-mail received 9-7-95:

"I'm living in Boise, Idaho now. I am an assistant professor finally, and somewhat nostalgic for the lazy days of graduate school. Work load is tremendous, though I can't see exactly where all the time evaporates to. I'm only teaching two classes, but it seems to take me all day every day just to get ready for tomorrow's lectures. Even the thought of research is far in the distance."

REBECCA SCHWIETZ (94-95)
(Undecided Major)

E-mail received 9-16-95:

"Hi! I took the math placement exam and placed into Math 1b (Calc 2). I didn't figure that was too terrible considering that I've spent all summer going over problem sets from my many calculus books that I keep at home. (A little sarcasm goes a long way, eh?) I also plan to take writing (requirement), Econ 10, and either Polish, French, or Latin.

Pretty decisive for me. I'll shop the languages next week and figure them out. No problems.

Harvard seems like a great place so far. The people are great and my dorm is even nice (three of us have our own common room complete with desks, table and chairs, and window seat). We don't do too bad for freshman.

Well, I'll let you go. Just thought I'd drop a quick note. Feel free to write back. I love mail"

E-mail received 9-22-95:

"Do widzenia! Still no Boston winters to contend with, it was at least 70 degrees here today. And we've only had one day of rain. Not too bad when I hear people in MO are combating 40 deg. weather and a friend in MN said it snowed yesterday.

I just had my first Calc class today. We start with integration, do differential equations, and end with series and Taylor polynomials. So basically it's stuff I've done, but maybe a little more in-depth (especially with diff. equations). The book was written by the head of the department, but amazingly enough, seems easy to read. It does seem long on theory and short on practice, though. (Not a good sign for me.)

Polish seems very cool. The class consists of 5 grad students and 4 undergrads. All of them speak another slavic language (i.e. Czech or Russian) except one, but the professor was quick to announce that that was fine. I have no real reason to take Polish, but I thought I'd enjoy it a lot and it was something other than French, so I took it. A little thing just for me."

1995-96 STUDENT FIRST IMPRESSIONS

"Beginning MPI was an adventure. I didn't know what to expect. The beginning review was somewhat misleading, but now I am realizing that the work will truly be taxing. The challenge is there, it just took a while to expose itself."

Sierra McDaniel
Truman High School
Independence School District

"My first impression of MPI was unexpected. I was expecting to be in a place with a bunch of students with taped glasses and pocket protectors, and teachers that thrived on making students work to death, literally. But in actuality, it is the challenge that I was looking for and just the right experience that I need to get ready for college. I appreciate the chance and experience that MPI provides and I hope I make it through, positively ☺. I am really looking forward to a great challenge!"

Risala Allen
Van Horn High School
Kansas City, MO School District

"The experience of MPI has been quite extraordinary. Near-death experiences due to fatigue, assignments that spin a person's head as though they were possessed, and the constant reminder that Mr. Delaware has staplers for \$2.00 have all become common. Of course we all were prepared for this, or did you not get the memo? The best part of this program is the break with high school; this is a college program. We are not children. We have taken on the responsibilities of the program and we will reap the rewards only if we fulfill those responsibilities. Good luck!"

Don Vaught
Ft. Osage High School
Ft. Osage School District

"Before the end of school last year, I had a lot of options. I could have taken the easy way out of my senior year and filled my schedule with the figurative "blowoff" classes, but that isn't really what I wanted. I decided to fill my schedule with challenging classes, including Calculus and Physics at MPI. Out of this unique experience, I expect to acquire study skills that will help me succeed as I head into college. Already, we have started to form study groups, realizing that two (or three, or four, ...) heads are better than one. MPI also gives us the chance to sample the subject matter of college level courses without college level pressure. I expect that everyone in "Year 12"

will benefit from their MPI experience in some way or another."

Scott Preston
Wm. Chrisman High School
Independence School District

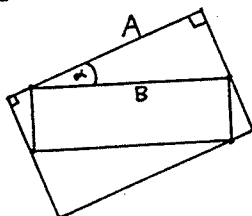
A SOLUTION TO MATHEMATICS CHALLENGE #39

Recall the problem statement:

For any rectangle, let's define the "Eccentricity" of the rectangle to be the ratio of its larger side to its smaller. [So squares have Eccentricity = 1, and all other rectangles have Eccentricity > 1.]

Show that if rectangle B is inscribed inside rectangle A, so that each vertex of B is on a different side of A, then the inequality below holds:

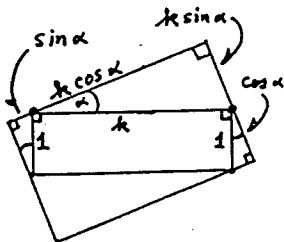
Eccentricity of A \leq Eccentricity of B.



[From: Quantum Magazine, May/June 1995, p. 19]

SOLUTION:

As shown in the figure above, let α be the angle between the longer sides of the rectangles A and B. Label the sides of the inner rectangle B as k and 1 , where $k \geq 1$ is the longer side. Now, from the figure below,



since the long side of the outer rectangle A is greater than or equal to its short side, we see that

$$k \cdot \cos \alpha + \sin \alpha \geq \cos \alpha + k \cdot \sin \alpha$$

$$\sin \alpha - \cos \alpha \geq k(\sin \alpha - \cos \alpha).$$

If it were true that $\alpha > \pi/4$, we would have $\sin \alpha > \cos \alpha$, meaning $\sin \alpha - \cos \alpha > 0$, so that the last inequality above would hold only if $k \leq 1$. But, we have assumed above that $k \geq 1$. This forces $k = 1$, so that in the figure above $\alpha = \pi/4$, a contradiction. Thus, we may assume that $\alpha \leq \pi/4$.

Now, the Eccentricity of B (as defined in the statement of the problem, above) is the ratio $k/1 = k$, and the Eccentricity of A, because $\alpha \leq \pi/4$ means $\cos \alpha \geq \sin \alpha$, is the ratio

$$\frac{k \cdot \cos \alpha + \sin \alpha}{\cos \alpha + k \cdot \sin \alpha}$$

Finally, since $k \geq 1$, it follows that $k^2 \cdot \sin \alpha \geq 1 \cdot \sin \alpha$, and hence,

The Eccentricity of A

$$\begin{aligned} & \frac{k \cdot \cos \alpha + \sin \alpha}{\cos \alpha + k \cdot \sin \alpha} \\ &= \frac{k \cdot \cos \alpha + k^2 \cdot \sin \alpha}{\cos \alpha + k \cdot \sin \alpha} \\ &\leq \frac{k(\cos \alpha + k \cdot \sin \alpha)}{\cos \alpha + k \cdot \sin \alpha} = k \end{aligned}$$

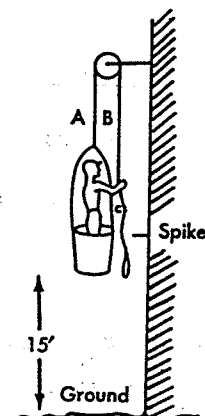
= The Eccentricity of B,
as desired.

A SOLUTION TO PHYSICS CHALLENGE #30

Recall the problem statement:

A man is standing in a bucket that is attached to the end of a rope, A, which goes over a pulley, and he holds the other part, B. In front of him is a wall. The part of the rope, C, that is below his hand is 5 feet long, and has a loop on its end. He wants his lunch. He is tired of holding that rope. He lets himself down until he is holding the loop, which he slips over a convenient spike in the wall. The whole rope is 25 feet long and is slightly elastic, so that at the first stage (shown here) the A and B part of the rope is stretched to its maximum extent - and to within 90% of breaking point - and he is 15 feet from the ground. The rope stretches

one inch per foot. How far is he from the ground after he hooks the rope over the spike? (Ignore the loop.) Give your answer to the nearest half inch.



[From: Intriguing Puzzles in Math & Logic by Stephen Barr.]

SOLUTION:

After hooking the rope over the spike, the man is zero inches from the ground! The rope breaks the moment he lets go of the loop and the spike holds it, because when this happens the stress is doubled - and, as we said, the rope was already at 90% of its breaking point!

MATHEMATICS CHALLENGE #40

A computer printed out two numbers, 2^{1995} and 5^{1995} , completely multiplied out.

How many digits in all were printed?

[From: Quantum Magazine, Sept./Oct. 1995, p. 19.]

PHYSICS CHALLENGE #31

A ping-pong ball is tossed into the air. Will it take longer for it to go up, or to come back down?

[From: Quantum Magazine, Sept./Oct. 1995, p. 19.]

Editor/Writer: Richard Delaware

The $M\pi$ 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 'M π Newsletter'.

Mathematics and Physics
Institute

600 W. Mechanic, Room 224
Independence, Missouri 64050-1799

UMKC