M π   The Mathematics and Physics Institute NEWSLETTER

YEAR 13 - WE BEGIN

Currently enrolled at the MPI are 67 students, from Center Place Restoration (2), Central (2), Fort Osage (11), Lincoln (1), Metro (2), Northeast (7), Paseo (4), Truman (20), Van Horn (6), and Wm. Chrisman (12) high schools. Of these, 35 (52%) are female, and 11 (16%) are minorities. We have students from more high schools, 10 in all, than ever before.

! MPI OPEN HOUSE !

Sunday, Nov. 3, 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 and HP 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!

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!! MPI OPEN HOUSE !!
SUNDAY NOV 3, 1996, 2-4 PM
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SOME STATISTICS FROM OUR 95-96 ANNUAL REPORT

583 students have completed the MPI program (Years 1-12, Sept. 1984 - May 1996); 358 (61%) of these were male, and 225 (39%) female.

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

Of the 337 MPI Alumni from Years 1-7 (1984-91) (excluding foreign-exchange students), 319 (95%) entered college, receiving 236 college degrees (to the best of our knowledge), including at least 157 degrees in Science, Mathematics, or Engineering, and 7 Medical Doctors.

On average, 26% of MPI Alumni attend UMKC, 15% attend UM-Columbia, and 10% attend UM-Rolla.

TO ALL MPI ALUMNI:

HAVE YOU GRADUATED FROM COLLEGE?
IF SO:
PLEASE CONSIDER BEING AN ENRICHMENT SPEAKER OR JOINING OUR PANEL DISCUSSION!
[Fri. Jan 3, 1997]

CALL (816) 235-1272

MATHEMATICS TECHNOLOGY REPORT

1. This is the 7th year since we first tentatively began using a computer lab in one section of calculus, the 6th year since we fully integrated such a lab into calculus, the 4th year using the SHARP EL-9300C graphics calculator in all our classes, and our 1st year using the HP 38G graphics calculator in one

test section of students, for possible full adoption next year. We have tried to keep abreast of the best of these innovations, remembering that it is always the mathematics and the physics that must come first.

2. As of this summer, the MPI now has an internet connection, using Netscape, in all its offices, and in the student computer lab, through the UMKCnet. With this access, as the year continues we'll learn just how it can enrich our courses, and by the end of the year we should have our own MPI web page.

ODDS AND ENDS

On Sept. 25, Sheri Adams attended the Missouri Dept. of Elementary and Secondary Education Regional Conference, and was group facilitator for "A Sampler of the New Mathematics Assessment for the State of Missouri."

On Oct 3, the Mathematics Coordinator will host the MATH MANIA mathematics event being held at Kansas City Kansas Community College for students, both high school and college. He organized this full day event sponsored by the MAA (Mathematical Association of America) and the Mary P. Dolciani Halloran Foundation.

Oct. 4-5, the Mathematics Coordinator will attend, moderate one discussion, "What Will We Do With the TI-92?", and give three talks at the 6th Annual Greater Kansas City Mathematics Technology EXPO, also held at Kansas City Kansas Community College: "EXPO Showcase: A Comparison of Derive for Windows with Classic Derive, "A Newly Discovered Property of Ellipses: Is Star Trek's PHASER Imminent?"; a WORKSHOP, "Interactive Notebooks on a Graphics Calculator! The New HP 38G and Aplets".

On Oct. 10, the Mathematics Coordinator will give a talk entitled "Derive Visualizations: What You Might Not Know You Can Do!" at the Central Regional NCTM (National Council of Teachers of Mathematics) Conference, held in Kansas City, MO. On the same day, at the same conference, Sheri Adams will give a talk entitled "Block Scheduling and the Mathematics Classroom".

From Nov. 6-10, the Mathematics Coordinator will attend the 9th Annual ICTCM (International Conference on Technology in Collegiate Mathematics) in Reno, NV, as a member of its Executive Steering Committee.

On Nov. 13, Jim Graczyk will take Van Horn students to compete in KU's "Engineering Day".

Nov. 18-19, Jim Graczyk will attend the Tech Prep Conference at Tan Tara, and give a talk entitled "Is It Physics, or Just P.T.?"

ENRICHMENTS

FOLLOW UP

On Sept. 27, Mitch Dobson (MPI 89-90), currently the resident Prosthetist/Orthotist at Certified Orthotics and Prosthetics Associates (COPA) in Lenexa, KS, spoke on **PRINCIPLES AND ADVANCEMENTS IN PROSTHETIC TECHNOLOGY.**

Some student comments were:

--Mitch described what the process of making a prosthesis was, what all was involved. He talked about the reasons people needed prosthetics, about the biomechanical principles and the technological advancements. Was neat to have an MPI graduate here to talk because he knew what it was all about and could kid around about it.
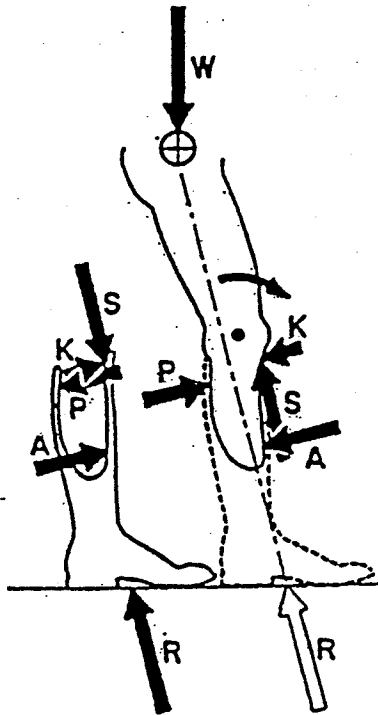
--I think that Mr. Dobson did an excellent job of presenting his subject. Prosthetic limbs does not sound like an interesting topic to listen to, but he really held my attention.

--We learned that balancing prosthetics to support different people's weights involves a lot of vector problem solving.

--Discussion of how physics provides for the precise development of prosthetic limbs. He told us how the weight is distributed so the pressure of the limb wouldn't be on the amputated end of the bone. He gave us "advice" for college.

--I would suggest that he bring a demonstration of the CAD/CAM technology, if possible. It would have been easier to visualize. Overall, I though the presentation was very exciting and interesting. Mr. Dobson is an excellent speaker who is conscientious of his audience and their interests.

--He talked about prosthetics (the branch of medicine dealing with any artificial device attached to the body for aid), and its new technological advancements. People need artificial limbs because they may have lost them in an accident, through disease or cancer, or they may have been born that way. Technological advancements have been the hydraulic knee that takes kinetic energy and converts it into potential energy and vice-versa, and also the CAD/CAM, which helps speed up the process of creating limbs tremendously.

--He pointed out that he works with extremities only (arms, legs ...). Apparently there's a lot of advancement being made in his field and this is an exciting time to be part of it.

--This speaker was very good actually. He joked enough to be informal but was serious enough to be interesting. He kept the attention and had a well laid out explanation with good visual models.

--My favorite part of the enrichment was playing with the electric arm and legs.

--This was more interesting than I expected. He was a good speaker who presented the material well. I was surprised by how much I learned because I had never thought very much about this before.

--Although the subject of prosthetic limbs wasn't of much interest to me, I did, however, enjoy seeing how physics relates to a real world situation.

--Mitch talked about the process and steps to make prosthetics. He also stressed the point that we need to pay attention in physics because in most technologies today physics is a good subject to know. It was good!! Very, very interesting!

--It was a very good presentation. I would like it better if he would talk a little bit more about his schooling. Maybe next time he could discuss neurology of the appendages, natural gravitational forces on the body, and anatomy of the joints. I would have also liked to have seen more types of artificial appendages (either slides or real ones). He could also explain in more detail the adaptation of the individual person to their new appendage.

UPCOMING

Oct. 11, Seth McMenemy (MPI 88-89) an electrical engineer with Kansas City Power and Light, working as a distribution engineer, will speak to our students on **ELECTRICITY: POWER, TECHNOLOGY, AND ENGINEERING.**

On **Oct 25**, John Renner, MD of the Consumer Health Information Research Institute and on the board of the National Council Against Health Fraud will speak on **HEALTH, MISINFORMATION, AND JUNK SCIENCE: HOW TO EVALUATE IT.**

Ron Schuchard, Professor of Ophthalmology and Physics at UMKC, joins us on **Nov. 8** to speak on **VISUAL INFORMATION PROCESSING: HOW DOES THE BRAIN SEE?**

Finally, on Friday, **Nov. 22,** 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.]

** CHANGES **

(90-91) Jill Blake
jblake@swri.edu
SOUTHWEST RESEARCH INSTITUTE

** NEW **

(95-96) Robert Davis
wild5@microlink.net
UNIV MO-ROLLA

WE HEAR FROM PAST STUDENTS

JILL BLAKE (90-91)
(BS, Chemistry)

E-mail received 8-26-96:

"Hello... I got your e-mail about Paul Grutter and I looked up his e-mail address on the internet. I just e-mailed him but I am positive that it is the same Paul I know.

Well, I just wanted to give you an update on my new mailing address. I just graduated in May from Wash. U. and now I am working in Research and Product Development for Southwest Research Institute in San Antonio, TX... There has been a massive drought down here and so now it is pouring rain and I have no umbrella. I hope I can leave work sometime soon. I am in the Applied Chemistry and Chemical Engineering department here working in Microencapsulation. It is really interesting. Well, thanks for the info on Paul Grutter."

ROBERT DAVIS (95-96)
(Engineering Major)

E-mail received 8-26-96:

"Well, I am receiving my formal education from Longview Community College. After two years of attending Longview, I am planning to transfer down to the University of Missouri-Rolla.

This semester classes include the following: Calculus I, Chemistry, History, English, and Introduction to the Profession of Engineering. A total of 17 hours.

Although we are not allowed to use calculators on any of our math tests, I could use the (SHARP) graphics calculator as a checking system on homework problems, and it might prove helpful in other math based classes.

Would it be possible to buy a Sharp calculator from MPI? If so, e-mail me and we can go from there. Thanks"

MPI E-MAIL ADDRESS:

rdelaware@cctr.umkc.edu

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

1996-97 STUDENT FIRST IMPRESSIONS

"My first impression of MPI is that it is very demanding. The work, so far, has not been extremely difficult but has required a lot of time. I found that study groups can be very beneficial. The overall experience should be extremely helpful in my preparation for the future."

Stephanie Farnan
Ft. Osage High School
Ft. Osage School District

"My first few weeks of MPI was not a surprise to me because I knew what challenge I had to face and I was willing to. MPI has taught me to become self-oriented and do my school assignments at a steady pace. MPI will give me and others the better advantage of life."

Linda Nguyen
Northeast High School
Kansas City, MO School District

"My impression of MPI so far has been a good one. I think it is a challenging experience, but at the

same time, it is a rewarding one. The things I am learning here will eventually lead to an easier time in college. Over the summer, I was a bit worried about how I would like it, but now I am glad I am taking MPI."

Omer Choudhary
Truman High School
Independence School District

"My first impression of MPI was that it was still dark when I got there in the morning. I was expecting a high school type class, but much to my surprise, things moved QUITE a bit more quickly... and you don't have to raise your hand to seek permission to use the restroom. ☺"

Sarah Crow
Paseo Academy
Kansas City, MO School District

A SOLUTION TO
MATHEMATICS CHALLENGE #44

Recall the problem statement:

Two identical coins touch the sides of a rectangle at the same point, one from the inside and one from the outside, as shown below:
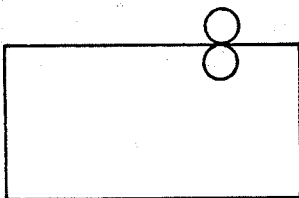
The coins are rolled (in the plane) along the perimeter of the rectangle until they come back to their initial positions.

Suppose these identical coins each have circumference "c", and that the height of the rectangle is twice the circumference of the coins, while its width is twice its height.

How many complete revolutions will each coin make during its journey?

[From: Quantum Magazine, July/August 1996, Brainteaser B178, p.15.]

SOLUTION:

Note that as a coin rolls a distance equal to its circumference "c", it makes one full revolution. Now, we are given that the height of the rectangle is $2c$, its width is $4c$, so that its perimeter must be $2(2c+4c) = 12c$.

First, this means that the outside coin will make at least 12 revolutions as it rolls along the rectangle's sides. But, we also see in the picture below (illustrated at the upper left) that at each outer corner of the rectangle it rolls an additional 1/4 turn. So, the total number of revolutions for the outside coin is $12 + 4(1/4) = 13$.
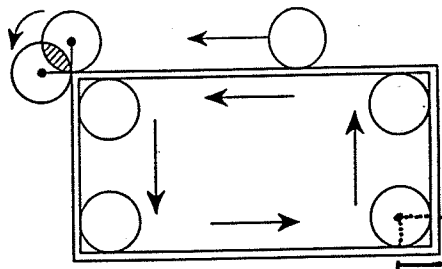
Second, let "r" be the radius of either coin. By the definition of circumference we know that $c = 2\pi r$, meaning $r = c/2\pi$. Now, we see in the picture above (illustrated at the lower right) that at each inner corner of the rectangle, the inside coin fails to roll a distance equal to twice its radius, specifically $2r = 2(c/2\pi) = c/\pi$. So, it rolls a total inner distance of $12c - 4(c/\pi) = (12 - 4/\pi)c$, meaning the total number of revolutions for the inside coin is $12 - 4/\pi \approx 10.72$.

A SOLUTION TO
PHYSICS CHALLENGE #35

Recall the problem statement:

No doubt you've noticed how an effervescent tablet (for instance, Alka-Seltzer™) dropped into water first sinks to the bottom, giving off lots of bubbles, but soon floats to the surface, continuing to release bubbles of gas.

Why does the tablet rise?

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SOLUTION:

The bubbles envelop the tablet
with a layer of practically constant
thickness.   Since   the   tablet
dissolves <u>uniformly</u> over its entire
surface, its diameter shrinks very
slowly, while in comparison its
thickness shrinks quickly. So, the
surface area of the tablet and the
volume of the bubble layer remain
virtually constant, while the mass of
the   tablet   decreases   rapidly.
Therefore, at some point, the buoyant
force of the bubble layer exceeds the
weight of the tablet, and it rises to
the surface of the water.

MATHEMATICS CHALLENGE #45

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Let the function "f" be defined
on positive integers n as:

$$f(3n) = \begin{cases} 1 & \text{, for } n = 1 \\ n + f(3n-3) & \text{, for } n > 1 \end{cases}$$

Find the value of f(12).

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PHYSICS CHALLENGE #36

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There was a pile of books on a
table.   I cautiously pulled a book
from the middle of the pile.   The
books on top of the book I was taking
moved along with it, but the books
under it stayed in place. Why?

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Editor/Writer: **Richard Delaware**

UMKC