Mπ The Mathematics and Physics Institute NEWSLETTER

Director: Richard Waring
Mathematics Coordinator: Richard Delaware

December 1, 1992 **Vol. 7, No. 3**

OPEN HOUSE THANK YOU LETTER

I want to thank all the 53 parents, family, school administrators, and board members, who took time from their busy schedules to attend the MPI Open House on Nov. 8. Your participation along with the efforts of 25 of our students and 7 of our faculty and staff all contributed to what I think was a successful event. The support and encouragement you give your children, our students, contributes immeasurably to their success in this challenging program.

I hope you had an enjoyable afternoon seeing our physics demonstrations, videos, and physics laboratory experiments. The new computers you saw being used as a teaching tool in calculus, and for data acquisition and analysis in physics experiments is truly "state of the art".

Thanks again for your participation. Your comments are always welcome.

Richard Waring
Director

TO ALL MPI ALUMNI:

HAVE YOU GRADUATED FROM COLLEGE?

IF SO:
PLEASE CONSIDER JOINING OUR PANEL DISCUSSION THIS YEAR!
Tues. Jan. 5, 1993

CALL (816) 235-1272

COMPUTER LABS REPORT

1) We've used several excellent calculus lab problems from two books: Exploring Calculus with Derive, by David Arney, and Student Research Problems in Calculus, published by the MAA.

For instance in an Arney problem about the straight-line motion of a robot along an assembly line, our students were forced to examine in great detail the intimate relationships among the position, velocity, and acceleration functions governing the motion of the robot. Careful attention to graphs, what the axes represent in different cases (What does the vertical axis represent THIS time? Doesn't it take on different meanings when the graphs of, say, a position and a velocity function are simultaneously present?), questions such as "What's the maximum speed in the forward direction? The backward direction? What is the range of accelerations?", and our demand that all conclusions be written out in detail made this a rich experience. And Derive was indispensable for everything.

2) For the first time we rolled the computers down to the Physics lab for two new experiments: Linear Velocity and Acceleration (using the new air-tracks and the software Precision Timer for data collection and analysis, along with Derive), and, Acceleration Due To Gravity (students dropped a ball onto a plate that recorded the time of the fall into Precision Timer, and then used this data and Derive to compute their own acceleration due to gravity, comparing it with the standard 9.8 meters/second squared.)

3) Early morning (6:15 - 7 am) usage of the Computer Lab is still brisk, and the high school teachers report that their MPI computers are also being heavily used throughout the

day. Our students are unquestionably much more comfortable with Derive this year, having used it not only in a larger number of scheduled Calculus labs and two new Physics labs, but for several longer-term Calculus project problems. And in an effort to encourage better writing, we have begun posting on the MPI bulletin board photocopies of well-written student calculus labs, hoping to inspire more of the same from others.

'LOST' MPI ALUMNI CAN YOU HELP US?

Can you provide ANY information about the following former MPI students? We particularly need to know whether they have graduated from college, which college, and with what degree. Any hint (phone number, address, college, parents' address, etc.) will be appreciated. We use this data to report to our sponsors on the impact of the MPI. Call our secretary Doris at (816) 235-1272 if you can help, or drop us a written note.

'LOST' ALUMNI

YEAR 1 - 1984-85

Paul Eaton	Ken Hylton
Matt Letourneau	Neal Malbaff
Debra Middleton	Thong Nguyen
Hung Pham	Kevin Prosser
James Sharp	Carla Shivers
Eugene Tiebout	James 'Curt' Wilson

YEAR 2 - 1985-86

Twana Jenkins	Felicia Knowles
Min Chi Ngo	Dan Sullivan
Bob Weinman	Latrice Williams

YEAR 3 - 1986-87

Amy Modrell	Sherry Dattoli
John Pritchett	

YEAR 4 - 1987-88

Jim Brown	John Carmack
Gary Carty	Dana Meade
Zina Mickles	Sean Mohn
Jamie Ryan	Desmond Wilkins

YEAR 5 - 1988-89

Michael Atty	Thaison Tran
Stephanie Young	

YEAR 6 - 1989-90

Efaraima Vele, Jr.	Chris Walker

AN EXPO, A FAIR, & CONFERENCES

It's been a busy semester of events for the MPI and its faculty:

On Oct. 16-17, the mathematics coordinator attended the 2nd Annual Greater Kansas City Mathematics Technology Expo in Kansas City, KS, as both a member of the planning committee, a panel moderator, and a speaker on Derive.

On Oct. 30, Richard Waring attended a gathering of past presidents at the National Sigma Pi Sigma (Physics Society) Congress in Dayton, OH.

The mathematics coordinator also attended the 5th Annual ICTCM (International Conference on Technology in Collegiate Mathematics) in the Chicago area, Nov. 12-15.

That same week, on Nov. 12-13, Al Morse attended the KCATM (Kansas City Area Teachers of Mathematics) Fall Math Conference in Overland Park, KS.

Tuesday evening Nov. 17, Richard Waring, the mathematics coordinator, and 5 Fort Osage MPI students manned a display of 5 MPI computer systems and 8 physics experiment set-ups for the Fort Osage District Technology Fair held in their Junior High. Over 600 people attended.

Finally, Sheri Adams will attend the MCTM (Missouri Council of Teachers of Mathematics) Conference on Dec. 4-5 in Columbia, MO.

ENRICHMENTS

FOLLOW UP

Ed Kiker's visit on Oct. 2 to discuss **RETURN TO THE MOON: WHEN AND WHY** was a highlight, both very informative and fun. For instance, to show how small vibrations (such as those in space and lunar habitats, etc.) can profoundly affect materials, he placed a heated piece of wire screen at the bottom of a wide and long hollow tube held just above the floor by one of our students, and suddenly a deep booming sound emerged as the heated air rose through the tube gently vibrating it. The effect was impressive.

Even more impressive is Ed's later letter to the MPI answering some of our students' questions gathered on enrichment reports after his talk. Here are some excerpts from Ed's thoughtful response:

"It was a pleasure to talk to your students again, and I hope that some of them begin to understand what a profound effect space research is having and will continue to have on all aspects of our lives. I shared the students' comments with the other members of our (National Space Society) Chapter, and would like to provide a little feedback from some of those comments.

One comment cut right to the heart of the whole reason I am interested in space: "I guess the big theme of it all was that space exploration is a vital and real part of our future if we want to survive in a polluted, overcrowded, industrial world." I would like to re-word that to: "The big theme of it all is that space exploration is a vital and real part of our future if we want to live in a world that is NOT polluted or overcrowded." I come to the space program from the environmental side of the house--for many years I was an environmental engineer, primarily in Alaska, until I came to see that space is the key to stopping and reversing pollution, moving major industries off the planet entirely, and bringing the world quality of life up to the point that populations are no longer expanding. A polluted world is absolutely unacceptable! We can and will clean it up. To myself and to virtually every member of the National Space Society, improving the quality of life is the whole reason for space exploration: clean up our homeworld, provide access to new worlds, diminish the possibilities of war while improving incentives for peace, and in general improving everyone's options for a decent life.

Several comments were related:

-What are we doing to keep the Moon from becoming a wasted rock after we suck everything of value from it?

-Some huge meteors have precious metal within them.

-The only change I would make would be him not telling us that the Moon will eventually be destroyed.

We will not destroy the Moon. Do not worry about that, we couldn't if we wanted to. The Moon is huge, and if we mined it for a thousand years we could not remove enough even to equal a small meteor crater. As to becoming a wasted rock--that is pretty much what the Moon is now. It is a dead world, with no water, no life, no air. It is bathed with heavy radiation from the Sun, and plowed to a depth of many meters by millions of years of meteorite bombardment, to the extent that it is essentially a great gravel pile. It has so many craters that even the dust particles have craters. It is far more desolate a wasteland than any desert on Earth. The process of mining for helium-three and other elements we need will merely smooth out some of the plains, erasing a few of the smaller craters for a few years until new meteorites add new craters. Lastly, when you think of precious metals, both on the Moon and asteroids, do not think so much of gold, silver, or platinum. The valuable metals are those we need for construction of solar power satellites, space station factories (remember, so we can remove some industries from the Earth), and Earth-observing stations. Thus, the truly valuable metals are aluminum, iron, chromium, nickel, molybdenum, and beryllium, along with oxygen, carbon dioxide, methane, calcium, nitrogen, glass, helium and hydrogen. These are the things truly valuable, and such items as gold, silver and platinum are unimportant side-lines. They may be useful, but not a reason for going.

The last comment which requires an answer I really liked: "Why does a guy from Harvard spend so much time playing with models like a 5 year old?" Let me put the answer to that this way: At the graveside is not the time for the design engineer to tell the widow of the test pilot "Gee, I guess I made the wings a little too small." That is harsh, but very much to the point... An engineer uses models of various types to cheaply replicate a thing he or she will design. A model is a very careful replica of a particular item, process, or concept, and it may be mathematical, a two-dimensional drawing on a computer of the back of an envelope, or a paper-mache or fiberglass three-dimensional scale or full size model. Believe me, an

engineer who does not understand and use models well does not have a job.

I hope that these replies are helpful, and that my presentation to you may have shown you how space can improve our future. I wish you the best in your academic and personal pursuits."

Here are some student comments on Frank Booth's talk **SCIENCE IN THE CRIME LAB** on Oct. 16:

- (It) was a fascinating lecture! The slides shown gave us a distinct impression on how important accuracy and efficiency is when dealing w/in-criminating evidence.

-The best part of Mr. Booth's presentation was his demonstration of how luminal works. Luminal is a chemical that is used to spray the area of a crime scene to detect blood that has been cleaned. It only works in the dark and illuminates with the slightest reaction of blood. He explained how bullet marks are recognized and how police can retrieve a serial number on a metal surface that has been etched off. It's very amazing.

-We learned that it is very hard to commit a crime without leaving some type of incriminating evidence. If you walk on a carpet, the police department using photography can actually make an imprint of your foot and compare it with your imprint and use this to convict the criminal.

-The speaker talked about the many different methods of identifying criminals such as shoe prints, fingerprints, tire prints, etc. They can tell if a hair has been dyed, cut and with what, and when their last hair cut was.

-My house was robbed a long time ago, it was during Christmas so the floors were muddy and everything, but they didn't do anything. I wonder what is the procedure of a robbed house. It was a very good presentation. Maybe have more time to talk more about it.

On Oct. 30, the day before Halloween, we were pleased to have Henry Mitchell back to discuss **BATS: STRANGE CREATURES OF THE NIGHT.** This time he even had some bat photographs to award to students asking good questions. Of course, vampire bats were a major topic of discussion, as the student comments reflect:

-He said that vampire bats do feed on humans, but they are much smaller than usually depicted. Good timing!

-I think he should come earlier in the year, so that he can bring a bat with him to show if possible. We also learned that someone who says they spotted a bat once a cold front moves in, is full of it. Bats migrate with the weather in Missouri, from the northern corner down to the lower southwest corner.

-Everything and anything you ever wanted to know about bats. Little known facts like the wings of a bat are only two cells thick and are actually adapted hands.

-I didn't know that vampire bats only existed in Central America and not in Europe. But that still does not exclude the existence of Dracula!! Dr. Mitchell was the most dramatic speaker that MPI has hosted thus far. He only spoke to our group for an hour but has already earned my admiration. I admired him because of his sincere devotion to his work of researching bats. I hope to one day be a professional as dedicated to my work as he is.

Finally, on Nov. 13 we made our annual trek to the **RESEARCH REACTOR** on the MU campus. In addition to the tours, this year a few students were assigned to record every 10 minutes or so both the odometer and speedometer readings on the two busses for a later exercise in calculus relating differentiation and integration. Here are some student comments:

-The spectroscopy stuff and the computer imaging of atoms were especially fascinating, as was the actual viewing of the reactor. Our tour guide also did some interesting demo's of radioactive common things.

-We got to go see the pretty blue glow in the reactor.

-A person could almost forget that they were in a potentially dangerous place, until the tour was over, when every person had to walk through a machine, that looked like an airport metal detector, and be checked for radiation.

UPCOMING

A speaker for Fri. Dec. 11 has not yet been confirmed.

On Tues. Jan. 5 we'll hold our annual Panel Discussion and Reunion when former MPI students visit and share their experiences with this year's class.

We have not yet confirmed speakers for Jan. 15 and Jan. 29, but David Wieliczka from the Physics Dept. has agreed to a laser and hologram talk, we have speakers from Marion-Merrill-Dow interested, as well as an associate dean of engineering at MU, and a NASA speaker is also likely in the Spring.

WE HEAR FROM PAST STUDENTS

CINDY GILLESPIE (86-87)
(Mechanical Engineering Major)

"As you may have guessed, I am finally graduating from UMR this December. However, I have been accepted to the EE graduate program and have decided to stay here for TWO MORE YEARS. I must be crazy, but I'm afraid if I don't do it now, I never will.

My field of interest is power, machines in particular. I hope to do a thesis on machine controls. My new expected date of graduation is December, 1994, but I may be able to move that up if I stay for summer school.

I hope to attain a research and development job in the area of machines when I graduate. I haven't really had to design anything or research anything as an undergraduate, so I think grad school will really help.

One of my professors talked me into going this summer,...and they say women aren't encouraged to go into engineering. I have received encouragement from my math and science teachers since junior high, and MPI convinced me that I had strong enough math skills to succeed. Everyone at MPI receives plenty of personal attention, males and females alike. If you want to use that as an endorsement you are welcome to. I have always felt that MPI was a great experience.

I read Kim Gallagher's (or whatever her new last name is) letter in the newsletter. I'm glad to hear she is doing so well. I bet she is a wonderful teacher. I hope she makes it out to the reunion this year. I'll be there. I'll tatoo the date to my forehead, so I won't forget.

Well, I have no more news. I hope to see you soon. I'm anxious to hear how you are doing."

Through the efforts of:
SETH McMENEMY (88-89)
(Electrical Engineering Major)

A letter from:

Paul W. Braisted, Associate Dean
College of Engineering
University of Missouri-Columbia

Oct. 29, 1992

"Seth McMenemy is one of our outstanding senior students in the Department of Electrical Engineering and was an earlier participant in your MPI program.

He came to see me a few days ago to tell me how important the MPI program had been for him and suggested that I write to you offering to be available as a speaker for MPI and to provide a tour of our new engineering facilities.

I am delighted to do both and am only embarrassed that I had not extended an invitation earlier. Although your speaker schedule may already be full for this year, I will be very pleased to serve as a substitute if that would be helpful to you. I could speak on the interaction of math, science and engineering or what we see as opportunities for the engineering profession in the future, or a variety of other topics.

As far as tours are concerned, the College of Engineering is in the very final stages of a $17,000,000 new building and renovation program which we will be delighted to show to your group. In addition, a new building for Agricultural Engineering was completed a few years ago and there are many interesting things to see there as well. The College of Engineering has also made spectacular progress in its engineering research developments program. This includes the Pipeline Transportation Project

which is one of the five new research centers established in the United States last year by NSF...

The welcome mat is always out in Columbia. Whenever your travels bring you this way I hope that you will have time to stop by for a visit."

MORE 92-93 STUDENT IMPRESSIONS

"I think that MPI is a complete reality check. I feel that most of us have realized that we can't function successfully in this program, without getting our study habits in order."

Christy Cramer
Northeast High School
Kansas City School District

"The MPI is a taste of next year, especially being in C-Section. [Calculus I, Calculus II, and Physics.] We're learning how to bear the grueling, fast-paced life of a college class without leaving high school. If this doesn't help to prepare us for what is ahead, I don't know what will."

Eric Swearingen
Truman High School
Independence School District

"When I first decided to attend MPI I just thought of it as something to make me look good to colleges. Now I realize how much more it is.

I'm around some pretty special people (teachers and students) that I wouldn't have met otherwise. We also have resources for labs and experiments that can't be found in high school. I've also discovered that I enjoy the class subjects, even though the work does get stressful now and then.

I'm glad I'm here."

Amanda Koster
Wm. Chrisman High School
Independence School District

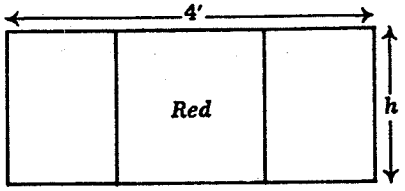
"I think MPI teaches a different lesson to everyone. To me, it taught the painful realization of one's own limitations in handling responsibility. Who knows, it may have even cursed me with a little maturity."

Carey Driscoll
Van Horn High School
Kansas City School District

A SOLUTION TO MATHEMATICS CHALLENGE #25

Recall the problem statement:

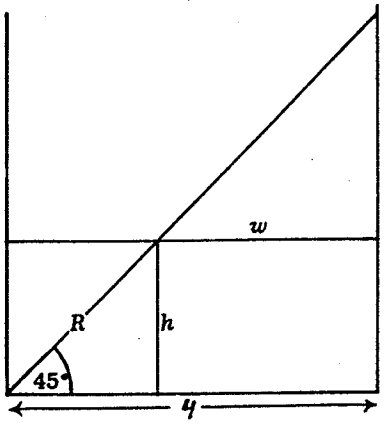
Stacie wants to design a flag to hang on her door. The door is 4 ft. wide, and the design will be a red square on a white background, but the white background will only appear at the sides, as in the figure below:



How big should the red square be to give the greatest area of white on the sides? (Remember, the width of the flag must be 4 ft.) In particular, WITHOUT using calculus, what value of h gives the maximum white area?

SOLUTION:

In the figure below we first push the red square R over to the left, so that on the right the rectangle of height h and width w encloses the total white area, which is hw. Notice that as we vary the height h, the upper left corner of the rectangle stays on the 45 degree line as shown, because R is always a square.



Now, when $h = w = 2$, the rectangle is also a square and the white area is $hw = 4$. As h moves away from $h = 2$, it either INcreases or DEcreases by some number n, and IN DIRECT

CORRESPONDENCE w either DEcreases or INcreases by the SAME value n, because that left corner is sliding along a 45 degree line! (Think of it as: For each horizontal RUN of distance n, there is an equal vertical RISE or FALL of distance n.) So, whether h is increasing or decreasing, the new area is

$$(2 - n)(2 + n) = 4 - n^2,$$

which is clearly an area LESS THAN 4. Hence, $h = 2$ gives the maximum white area.

[From: Mathematical Brain Benders by Stephen Barr]

A SOLUTION TO PHYSICS CHALLENGE #16

Recall the problem statement:

Medium Fast Physics

An object is in motion through a stationary medium. If the surrounding medium were absent, the object would continue moving indefinitely at the same speed. However, because of the energy lost due to friction with the medium, the object speeds up. How can this be possible?

SOLUTION:

The object is in ORBIT. As energy is lost to friction, the object drops to a lower orbit consistent with its new energy. At the lower orbit, the total energy of the object has DEcreased, but its kinetic energy has INcreased (i.e., the object speeds up).

[From: PASCO Scientific Lab Notes]

MATHEMATICS CHALLENGE #26

Draw 5 distinct lines on a blank sheet of paper. For which integers $k \geq 0$ is it possible to create exactly k points of intersection?

For instance, if all 5 lines are parallel, there are $k = 0$ points of intersection. If all 5 lines meet in one point, there is $k = 1$ point of intersection. How many other values of k can be attained, and why?

[From the AMP-Line Fall 1991 Newsletter.]

PHYSICS CHALLENGE #17

Use your reasoning skills to determine to the nearest power of 10, the number of liters of air an adult inhales in a 24-hour day.

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