Mπ The Mathematics and Physics Institute NEWSLETTER

Director: Richard Waring
Mathematics Coordinator: Richard Delaware

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FIRST SEMESTER -- TOP TEN

By taking the mean of their college Calculus and Physics grades for the first semester, we have determined our current Top Ten MPI students. We congratulate them all. Alphabetically by schools, they are:

Derek Olson	(Fort Osage)
Rebecca Schwietz	(Fort Osage)
David Visnich	(Fort Osage)
Amy Bentz	(Truman)
Eric Huss	(Truman)
James McIntosh	(Truman)
Jennifer Musil	(Truman)
Rachel Roberts	(Truman)
Pamela Moseley	(Wm Chrisman)
Brian Stuck	(Wm Chrisman)

RECRUITMENT DAY -- FEB. 14

On Tuesday Feb. 14, we are inviting for a visit interested juniors and their teachers from the high schools involved in the MPI program. (Last year we hosted about 150 students.) They will arrive between 8 and 8:15 am and, with MPI student tour guides, take a short tour of the MPI classrooms. There will be MPI students at work on Calculus in our computer lab, a Physics lab set-up for viewing, and lectures or problem-solving sessions in action. Following the tour, everyone will be led to Rm. 207, to receive an MPI brochure, this issue of the Newsletter, a <u>new</u> sheet containing information about the Calculus Readiness Test and MPI Mathematics Technology, a donut (!), and be seated for our slide show, along with computer, calculator, and physics demonstrations. Afterward, several MPI students will be asked to share their thoughts about being in the program, and we'll all take questions from the audience.

TO ALL MPI ALUMNI:

HAVE YOU GRADUATED FROM COLLEGE?

IF SO:
PLEASE CONSIDER BEING
AN ENRICHMENT SPEAKER!

CALL (816) 235-1272

MATHEMATICS TECHNOLOGY REPORT

1. In December, the first version of the 71 page MPI "Green" PC Lab book, written by the mathematics coordinator, was printed, containing all Calculus II computer labs in one place, and in one format. This complements the 101 page "Red" book of Calculus I PC labs produced last summer, and used all of Fall semester. Next year there will be a similar book (maybe "Orange"?) for the 5 MPI Physics labs we have created for use with computers.

2. On Jan. 20, we gave a graphics calculator survey to all MPI students. We learned that of those who have rented the SHARP EL-9300C from us, possibly 25 plan to buy the calculator at the end of the year (similar to last year), and interestingly, 13 still regularly use a plain scientific calculator in addition to their graphics calculator, claiming that for elementary calculations it is faster, and that they are used to it. Some other survey questions, and selected student responses follow:

"Do you feel comfortable with your graphics calculator? Has it been easy to use? Have you had any general problems, etc?"

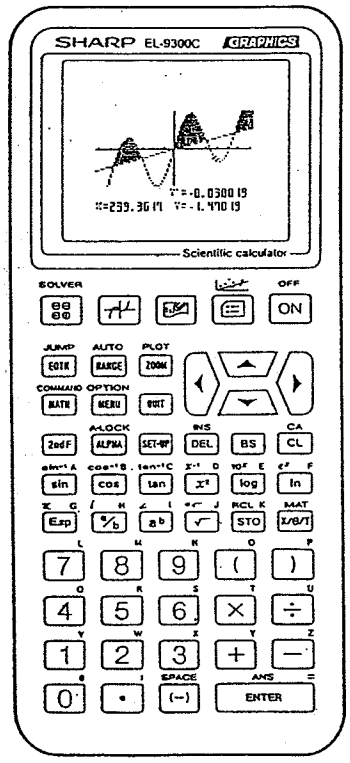
-- In fact it has been one of the most useful tools used on the tests for both Physics and Calculus.

--I feel very comfortable with this graphics calculator. I haven't had any big problems but I have had a lot of little ones.

--Yes - it is easier to use than the TI-82. I like how when you have fractions the calculator shows them in fraction form.

--I feel comfortable with my graphics calculator, it was not easy in the beginning of the year but it is now.

--Problems - battery runs out quick. Slides off of desks.



"What features of your graphics calculator do you like most, in comparison to any other graphics calculator you may be familiar with?"

--I'm a personal fan of the 2nd Jump button.

--I like to be able to write out my equations as I would on paper.

--a) Being able to program formulas into your calculator.
b) Being able to enter in fractions to obtain answers in fractions and as decimal numbers.
c) The calculator can almost do some of the same things that the Derive program can. So whenever I don't have time to use Derive I find out the answers by using my calculator.

--Comparing the graphs of this calculator to some others, this one proves to be the best.

"Describe <u>in what places</u> outside the MPI classrooms, and <u>at what times</u> you find yourself using your graphics calculator:"

--When doing my homework and balancing my checkbook, letting friends check their graph work.

--I use it for finding percents on high school work.

--Other classes and doing taxes.

--Usually in my bedroom during the night or sometime during school.

--I use my graphing calculator in Analytic Geometry (when allowed) and on various mathematics examinations or competitions.

--In my trig class.

--At home for bills and checkbooks.

--I use my graphics calculator mostly in my car when I'm trying to get most of my regular school work done.

--When I use the phone, because I have a couple of phone numbers in it.

--In drafting class.

--I use it at school, home, and at my boyfriend's house when doing my homework.

--While walking through the grocery store... trying to find the best bargain!!

--In chemistry class doing stoichiometry and formula problems; at home figuring problems to facilitate programming.

--To figure out grades & percentages at school; to figure out $ made at work.

"How do you use your graphics calculator in MPI Calculus?"

--In radian mode.

--To check derivatives and integrals by NDER and NINT; to graph curves and learn stuff about the curves graphically. Sometimes to compute long and detailed calculations in one line of typing.

--Mainly to see the graphs of different functions. I also like to work out problems and then go to my calculator programs and double check myself.

--To draw pictures, remember formulas, I like to take notes and make charts to help me get good grades.

--Wisely and graphically.

--I use my calculator in calculus the most in order to get an idea of what a function looks like. It seems to be easier to work a problem once you have a pictorial idea of the function you are working with.

--To put it simply, without that calculator I would be in a world of hurt. I use it constantly to graph things, to check my work, etc.

--I use my calculator when doing my PC Lab reports, usually if I don't finish my lab on time. In calculus when finding an numeric answer for an unknown in an equation, I find the value first then graph it to see if it's right.

"How do you use your graphics calculator in MPI Physics?"

--In degree mode.

--Mainly just for basic calculations, occasionally for conversion factors.

--For solving the equations, to store equations when I can't remember them all.

--I don't use it that much, in fact most calculations we encounter in physics are more easily done on a regular calculator.

--I only use a calculator in physics for "formula memorization". Other than that, I only use it for calculations.

ODDS AND ENDS

On Dec. 1, our new blue MPI brochures were finally printed, with new photographs of current students.

Since Dec. 19, as an experiment in both Calculus and Physics, we have added 10 min. to the normal 50 min. time we have previously allowed for exams. This does pose some logistic problems, but takes into account that using graphics calculators often requires time, and gives students more time to fully answer our many "free-response" type questions. We'll be re-examining this idea at year's end.

On Jan. 6, Sheri Adams attended a conference at the Learning Exchange on Assessment called: Writing Rubrics.

On Jan. 13, Tina Knutson attended a conference at the University of Missouri in Columbia, MO, to discuss with other state educators how Teacher Education programs need to be changed.

As Fall semester ended on Jan. 18, our temporary 5th section E was dissolved, and students were spread among the remaining Calculus I sections A, B, and D, which with the usual attrition had grown smaller over the semester. As a result, we say "Goodbye" once again to Calvin Nelson, who emerged to help teach Physics this Fall semester, as he slips once more into retirement. [Although, it appears his talents have just been snapped up by Truman High School to teach a one semester Physics course!] Al Morse, who had been team-teaching Calculus in both sections B and E, now can devote himself entirely to B.

We are currently talking about possibly replacing all the "tablet armchair" traditional student desks in three of the classrooms we use with, say, 5'x 30" tables, and chairs. One other classroom and our MPI PC lab already have them, and both students and faculty over-whelmingly prefer that setup. [If nothing else, the percussive sound of graphics calculators sliding off the tilted "tablet" desks to strike the floor would diminish!]

Finally, at semester we decided to use the capability of our new grading software to remove the "most damaging" score from a student's first semester record, instead of our past method of just dropping the lowest exam score. [For those

wondering, even though exams are weighted more than any other assessment, it is mathematically possible (and not unusual) that a low score in some other category can be more damaging than a lowest exam score.]

ENRICHMENTS

FOLLOW UP

On Dec. 9, Frank Booth again brought to us his captivating talk: **SCIENCE IN THE CRIME LAB.** This was Frank's 6th year as a speaker, and so we presented him with an MPI sweat-shirt and a pie (π?) as some measure of our appreciation for his excellent talks. Here's a sample of what our students had to say this year:

--Mr. Booth described the different procedures detectives go through in determining what happened at the scene of a crime. He discussed the role of fingerprints, blood, and hair as they relate to the crime scene. I was surprised at how important the crime lab is. A lot of unseen evidence can be left at a crime site.

--Some techniques include determining the approximate place from which a bullet was fired through the size and shape of the burn pattern left. The bullet can also be matched up to the gun through the marks (unique to each gun) made on the bullet by the barrel. More interesting than this was the calculation of the angle at which blood strikes any surface according to the length and width of the drops. With these angles then it is possible to discover the source from which each drop traveled (this being done to show the placement of the victim when struck, etc.).

--I didn't get bored or drift off. Time flew. It was a swell enrichment.

--Mr. Booth talked to us about how science is used in a forensics lab. He showed us how physics (blood splatters from hand-body impacts can be used to trace the point of impact), chemistry (luminal attaches to the iron (II) in blood and makes it glow in the dark), and other sciences. He showed us how sensitive fingerprinting techniques are, as well as foot printing! (And plastic printing, hair printing, etc.) With people like this, it's a surprise more criminals aren't caught (like all of 'em!). This was great!

--WOW!! What can I say but - WOW! That was a really neat presentation. I really enjoyed this enrichment. I found the differences in the separate hairs fascinating. I had no idea as to how remarkable luminal was or what it looked like.

--Criminals leave many subtle identifying clues, such as shoe prints, fingerprints, and hairs. High-contrast black-and-white photographic film, UV light-sensitive film, and lasers are used to increase the quality of samples. If enough distinguishing characteristics of the sample match the suspect's characteristics, the suspect may be convicted... Very interesting, clear relation to science.

--Mr. Booth demonstrated how obviously small details transform into solid evidence. Hair follicles, blood traces, clothes or carpet fibers, shoe prints, etc. New procedures help direct police towards the rightful criminal and protect us. It was great! The way he kept referring to cases really brought it to our level.

--Fascinating! Absolutely fascinating! I had no idea there were so many different ways to identify individual differences in so many different items. I also had no idea how stupid criminals can be. The slides were great. I was impressed by the variations in hair. The amount of information that can be obtained from a crime scene from hair, fingerprints, blood patterns, etc., is phenomenal. Cancel both classes and give this guy more time. I want to learn more. This was awesome.

--Another interesting thing Mr. Booth told us is that every gun barrel inside is different. The drill bit used in making the barrel changes slightly after each drilling so the tiny markings on the inside of the barrel are different.

--He spoke on how chemistry and mathematics aids in investigating crimes. His specialty was examining hair samples and blood stains. He showed that using math and blood stains he determines where the blow was administered. The subject matter was very interesting. He had some

good displays that made it worthwhile!

Our 10th Annual **PANEL DISCUSSION** on Jan. 3 was again held in Rm. 207, and moderated by Sheri Adams and Al Morse. As usual, each of the 4 panelists discussed their college experience, their major, and/or work experience.

The alumni panelists this year were:

Seth McMenemy **(88-89)**
BS Electrical Engineering
Pritchard Corp./Black and Veatch

Kendra Van Tuyl **(90-91)**
Washington University
French and Business Major

Sam Dorton **(93-94)**
University of Pennsylvania
Engineering Major

Jenna Medina **(93-94)**
Brigham Young University
Microbiology Major

Their presentations were witty and perceptive. In all, 10 former MPI students appeared. Some specific current MPI student comments were:

--The best advice given by a student was don't spend your scholarship money on going to the movies. This session was very helpful and seemed to give me an extra push to try harder at MPI. Good job on choosing panel. There was quite a variety of students.

--This was a great way to ease us back into the routine after Christmas break. This was very informative. I'm glad the discussion was over a variety of subjects (as opposed to calculus and physics). All the information presented about college in general will be very helpful in planning my freshman year, and the years to follow. This was the kind of information I have been looking for. The speakers from BYU and Wash. U. were very good speakers and seemed comfortable.

--Although some of them aren't entering a math or physics field they didn't regret taking MPI. The donuts and orange juice was a wonderful surprise. Thank you!

--The four MPI alumni which presented their stories did well in presenting good and bad aspects of college life. Most of it I had heard before but it was good to hear from people closer to my age.

--One man from MU was an engineer and liked the head start on physics and calc classes. The other 3 liked that MPI teaches people how to study before having 18 or so credit hrs. and learning the hard way. They all agreed that freshman year should be spent in the dorms. I liked that 2 MPI teachers asked questions and brought out information that would not have been mentioned otherwise. All the alumni seemed as though they really wanted to give advice to help us.

--The panel idea really gets the discussions going.

--It was good to see and hear from friends who had graduated in the past. They gave some helpful advice, some more entertaining than helpful, and some both (don't take 18 credit hours your freshman year as Jenna said). And, of course, afterwards we had doughnuts and juice--this saved many of us a stop at Poppy's, and money.

--The four members represented a diverse group: one was a graduate already in a career, one a senior who majors in non-math related subjects, one a freshman who majored in chemistry, and one a freshman who took a heavy load in microbiology at a large school. I think they were very entertaining, as well as being very informative.

--They discussed how MPI helped them prepare for college and that we should not blow-off MPI. They described what it was like living in a dorm and how tough it is to adjust to college. I thought that this provided an insight to life in college.

--The one thing said that has most stuck in my mind was the comparison of a large school to a place like Independence.

--Most of the alumni students echoed what I'm already learning at MPI: you must study. Although my grades here are lower than I'm used to getting, I know that its better to learn the hard way here, than to mess up my college record learning to study more

effectively.

On Jan. 13 David Wieliczka from the UMKC Physics Dept. gave his **LASERS AND HOLOGRAMS** talk. He brought with him not only a 15 milliwatt helium-neon (red) laser, but also a much more powerful 20-25 milliwatt argon (green) laser. Some student comments were:

--This was probably the most interesting speaker we've had all year. He explained to us in great detail but without using large complicated words, what lasers are, what they are used for and how holograms are made. I personally liked the hologram of the chess board best, being a chess player myself.

--I was surprised to learn that the word laser was an acronym. The demonstrations with the laser were intriguing, and I particularly enjoyed the one that tested if you were near or far sighted. I also liked learning some of the uses for lasers and holograms in technology.

--He told us of the history and development of lasers along with uses. The coolest was checking our vision by seeing whether the spot pattern moved. This was a good one.

--He told us about how holograms are used to check for faults in the manufacturing industry. How lasers are being used in surgery and how it makes it more cost effective.

--This enrichment on lasers and holograms is the best enrichment to have kept my attention so far. A laser is a small band of very concentrated light. They can travel for hundreds of thousands of miles before spreading out. Depending on the intensity of the laser, they can either cut through metal or just make a spot. However, all intensities are dangerous to the eyes.

--This was very interesting. The speaker is obviously very knowledgeable. He conveyed the information very well without confusing us. I loved the 30 second eye test. That was fascinating. The demonstrations with the different apertures with the lasers was great. The argon laser was really neat. I had no idea there were so many applications of lasers in industry, medicine, entertainment, etc.

--This was one of the most interesting enrichments we've had. I thoroughly enjoyed every aspect of this presentation. I only wish we had had more time to hear more. This presentation caused me to want to go into the laser field.

On Jan. 27th we had Anthony Hancock, a British chemist, and science administrator at Marion, Merrill, Dow, Inc. back to speak on **AGING: IT'S HAPPENING TO US!** [Student comments were compiled too late for this Newsletter. They'll be in the April issue.]

UPCOMING

On Feb 10, Lori Hill, Senior Software Engineer at Wilcox Electric Inc. just back from Paris, France, will return to speak on **LANDING PLANES USING SATELLITES: THE GLOBAL POSITIONING SYSTEM.**

On Feb. 24, Ed Kiker, a Harvard graduate who majored in Lunar Geology, and a member of both the National Space Society and the Space Studies Institute will return to speak on **ENERGY FROM SPACE.**

On Mar. 17 we are planning a Field Trip to the **UMKC PHYSICS DEPT.** to tour their laboratories in: **Surface Physics** (Dave Wieliczka), **High Pressure Physics with Diamond Anvil Cells** (Michael Kruger), **Atomic Force Microscopy and Scanning-Tunnelling Electron Microscopy** (Da-Ming Dhu), and **Photo-Luminescence** (Jerzy Wrobel).

Finally, on March 24, nurses Beth Rice and Kim Moehle, with Physicist Stephen Slack, from the Midwest Gamma Knife Center at Research Medical Center in Kansas City will join us to speak on **NEUROSURGERY FOR THE 21ST CENTURY: THE GAMMA KNIFE.**

MPI E-MAIL ADDRESS:

rdelaware@cctr.umkc.edu

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

NEW (OR CHANGED) E-MAIL ADDRESSES

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

**** NEW ****

(91-92) Yan Pei Chao
yc31@cornell.edu
CORNELL UNIV.

(91-92) Jason Van Natta
c650078@mizzou1.missouri.edu
UM-COLUMBIA

(93-94) Matt Barrows
mbarrows@umr.edu
UM-ROLLA

(93-94) Rachel Hayes
rrh180s@nic.smsu.edu
SMSU

(93-94) Jenna Medina
medinaj@yvax.byu.edu
BRIGHAM YOUNG UNIV.

**** CHANGED ****

*** The MPI E-MAIL ADDRESS has changed! (See Box Above)**

(90-91) Matt Roberds
mroberds@cstp.umkc.edu
UM-KANSAS CITY

(91-92) Kristi (Lynn) Puder
kpuder@umr.edu
UM-ROLLA

(92-93) Kristi Bass
st063017@rckhrst1.bitnet
ROCKHURST

WE HEAR FROM PAST STUDENTS

PAM (DETERS) KOOP (84-85)
(BS, Computer Science)

and

STEVEN KOOP (84-85)
(BS, Aerospace Engineering)

Letter received 12-27-94:

"MERRY CHRISTMAS AND HAPPY NEW YEAR

Konnichiwa! That's "Hello!" in Japanese. Wow! Has it been a busy year or what? It seemed especially exciting for the two of us with all the changes that have been going on in our lives. What with us quitting our jobs in Washington, D.C. (it was time for a change), vacationing in Italy (Pamela's first trip outside of the United States), moving overseas to Japan (talk about a stressful situation--packing up everything we own and moving to a foreign country), Steven starting his new job with the Navy (new people, new places, new expectations), Pamela getting adjusted to being at home without a job (there has to be more to life than cleaning), making new friends (we've been very lucky to find some close friends over here), and exploring Japan (strange mix of western and eastern influences). We've had more than enough to keep us busy.

We have a wonderful home here in Japan. It's an older, two-story Japanese house with three bedrooms, one and a half bathrooms, closet space, and a lovely little garden that blooms all year round. We are very fortunate. We are about 16 kilometers from the Yokosuka Navy Base, where Steven works. It takes Steven anywhere from 35 to 50 minutes to get into work each day. It takes so long and varies so much because of all the stop and go traffic. This is because of tons of traffic lights, train track crossings, motor-scooters and millions of crazy pedestrians. They like to walk on the road in **front** of your car instead of on the sidewalks. Ughh! It also takes a little getting used to driving on the left side of the road. It's hard to remember sometimes that there is a legal lane of traffic on the left side near the curb for motorcycles (they are everywhere in Japan). So each time we turn left, we have to make sure that there isn't one trying to go straight through the intersection. Otherwise we would be cutting them off in their rightful lane and any resulting accident would be our, the baka gaijin's (crazy foreigner's), fault. Driving can be very frustrating.

So far we haven't been hit by any of the typhoons thank goodness. They've all managed to veer away from this area. We do have some very serious winds on occasion though. We have to bring inside anything from the outside that might blow away; like tables, chairs, and even our heavy potted plants. We then put these big wooden shutters over all the windows to protect them against any airborne objects. We do have a

decent supply of canned food and water set aside for emergencies, which thankfully we haven't had to use.

We've only felt one major earthquake since we've been here. There have been little ones, but mainly at night when we were asleep. The biggest one so far happened in the evening as we were watching TV. The doors started to shake as well as the overhead light fixture. Actually, we both really enjoyed the experience, which lasted for over 50 seconds! We found it incredibly fascinating to feel the Earth rumble beneath us. We hope we'll never have to experience a quake more severe than that one. Experts say we are past due for a BIG ONE. The last big earthquake was in 1923 and the trend is to have one every seventy years or so. We both would feel better about the situation if we felt more small tremors, hopefully relieving some of the strain so the big one would not be as BIG. As for driving anywhere to evacuate, forget it. The roads are the worst place to be, even if there isn't an emergency!

[**EDITOR'S NOTE:** On 12-28-94 Hachinohe in Northern Japan was hit by a 7.5 earthquake, and of course as we have all heard now, on 1-16-95 Kobe, very close to where Pam and Steve live, was hit by a 7.2 quake, the largest in 100 years!]

The weather here is pretty pleasant as a whole. Summers are a little hot, but the real problem is the humidity--as high as 99% quite a bit of the time. The rest of the time in the summer it seems to be raining. Then the humidity is 100%. So, we have to run air conditioners or dehumidifiers in the rooms where we have our clothes so they won't mold. We've also stopped using metal clothes hangers because they rust, even with the dehumidifiers running. The winters here are mild, with the temperatures hardly ever dropping below freezing. Consequently, we have very little snow. Yeah! However, we did have a storm last winter that left 10 inches of snow on our door step in just one day. Our Japanese neighbors Mari and Toshiko, who are also our landlords, told us this was very unusual and that they only get this much snow about once every ten years.

The ironic part is that even though it doesn't get that cold here, we tend to **FREEZE** in our house anyway. They don't put insulation in these houses like back in the States and we don't think they've ever heard of central heating and air conditioning (each room has its own air conditioner and separate heater, if it has one at all). Actually some of the new houses being built have insulation and are rumored to have double paned windows and central climate control, but that may just be a passing trend. After all, Japan is really big on tradition! Furthermore heating costs are outrageous here. So we keep warm by piling blankets over ourselves, drinking hot Japanese green tea (Pamela only, she thinks it is excellent!), pointing our space heater directly at our toes, and cuddling up together to watch videotapes of American shows sent to us from the States. Ahh! The joys of living in Japan!

Pamela has been volunteering for the Girl Scouts and the Boy Scouts. She is currently the Publicity Chairman for Girl Scouts which means she takes pictures at all the events and writes articles and advertisements to put in the local base paper. She also is an Assistant Scoutmaster for the Yokosuka Boy Scout Troop 35. She's been doing lots of camping with both organizations and loves it. She's really turning into a little camping monster. Steven's been working a lot of hours recently, he's turning into a regular Japanese salaryman. So far work has taken him to Hong Kong, Bangkok, and Kuala Lumpur. We're so glad the Holidays are here and we can spend some time together again.

It's been very interesting, sometimes frustrating, but certainly never boring here in Japan!"

JEFF PETERSON (89-90)
(Pre-Med Major)

"I entered UMKC's 6 year medicine program straight out of high school in Aug. '90. I have done extremely well in my studies. I attribute some of my success to being prepared for college level work straight out of high school because of my experience with college level work in high school itself. I will graduate in May of '96 and plan on entering a residency specializing in

Radiology, which is one of the top five most competitive specialties to apply for. The physics course I completed through the MPI will be extremely valuable since many of the basic premises of radiology are based in physics and chemistry. I can say to those currently enrolled, or planning to enroll in MPI courses, strive for excellence in your MPI courses for they will prove invaluable in your future endeavors!"

KENDRA VANTUYL (90-91)
(French and Business Major)

"MPI professors were as, if not more, qualified as other professors of math and physics courses. However, MPI professors were always more clear in presenting material than were my college professors.

More than anything, MPI helped me in the areas of self-discipline, motivation, and time management. These are skills that I use everyday and will continue to use for the rest of my life.

Last year I studied abroad in Paris, France where I attended an international school of business for a semester. I spent my second semester as an intern at Exxon, France where I worked in the Communications, Human Resources, and Public Relations departments. I am currently teaching French at Washington University. As for my future, I'm looking at two options. I plan on either teaching French in a private high school, or working in international business.

Keep up the good work! You've got a great program!"

MARK MATSON (91-92)
(Mathematics & Computer Science Major)

"When I went to MPI, the calc tests were 10 problems. I thought that they were hard and that Mr. Delaware just made them hard to challenge us. When I got to college, the calc tests were 10 questions and they were hard. I thought that maybe Delaware had transferred to MU to make my life hell. I discovered, however, that all math teachers think about the same. So, all of you who are still at MPI, take advantage of it while you still can."

JASON VanNATTA (91-92)
(Nursing/Pre-Med Major)

"I'm sure you have heard this many times before but it (the MPI) definitely gives you the edge on those who go to college straight out of high school.

Your cover letter said something about this questionnaire's purpose was to see if the (MPI) program warranted future funding?!? I can't believe someone is questioning that fact! Of course it does! I think most past and current students will say the same. Just keep making the program available to future students!"

LESLIE (FARROW) BAY (91-92)
(Accounting Major)

"I've taken Calculus II and then went back and took Business Calculus. MPI Calculus I was great. It was far better than any of the other classes I've had. I don't think I could have made it through those two classes if I hadn't had the terrific instruction from the MPI staff.

MPI was a great learning experience which helped bridge the gap between high school and a four year college. MPI helped me to learn the study skills I needed to handle the pressure and stress of college classes.

I highly recommend MPI for any high school Senior, even if they are not planning a career in the math or science fields. It provides a head start on other freshmen entering college and a great background for learning."

KRISTI BASS (92-93)
(Biology/Physical Therapy Major)

"The credit from MPI helped tremendously in taking care of my general requirements (most of them anyway) for math and physics. But, more importantly, I learned that it's okay to make a B or C in a course.

It's not shameful to receive those kind of grades, provided you have put forth your best effort and hard work. Some things come more easily to others, you just have to find what works for you. I definitely learned that physics wasn't my greatest subject and neither was calculus, therefore I knew not to major in either of those two areas. MPI gave me the study skills I needed to make it through college and it served as a sort of transition from high school courses to those of the college level."

STACIE COLE (92-93)
(Chemistry/Biology Major)

"I felt that (the MPI) prepared me very well. I took calculus last year, and I know that I was able to do so well because I retained a lot of what I learned at MPI. I took Physics I this past semester. I know that I would have been totally lost if I hadn't learned physics at MPI.

MPI taught me the need to study more than the day before the test. It was a good glimpse of college. I think I was more ready for the college classes that I am taking."

JESSIE NOLLE (92-93)
(Civil Engineering Major)

"Whatever it costs to keep MPI running, it should be spent. There aren't enough programs for students that are capable of a faster-than-average pace. I think the people that can handle being challenged need to be."

RACHEL HAYES (93-94)
(Psychology/Dietetics Major)

"Basically, the MPI taught me how to study--I had never had to before. I learned to manage time more effectively and how to stick with something until I felt truly prepared.

Whole new doors were opened up in my mind--I can interrelate worlds of physics, chemistry, calculus, trigonometry, etc. I also believe that the MPI sharpened my skills in logic and reasoning which carries through into every subject.

I learned how to get to know new people in a classroom setting, I made several very close friends that are some of my best today, and I learned to take responsibilities like studying seriously. I learned to work for what I wanted. I also gained a sense of pride in my accomplishments at the MPI.

Even beyond the free credit (which helped tremendously), I gained a lot from the MPI. Obviously the knowledge of calculus, physics, and computers, the "college" atmosphere introduction, and being able to grow out of high school were very important. However, I would have to say that the best part was the true friendships that I developed there. I love the way that all of the high schools could get together to share the experience."

MATT BARROWS (93-94)
(Engineering Major)

"MPI helped me understand what college would be like. It showed me the differences between high school and college in a very sheltered way and... helped me change myself into a more college ready person, to avoid the initial shock.

I really enjoyed meeting all of the (MPI) students. I have made friends that I will remember the rest of my life."

MATT ROBERDS (90-91)
(Computer Science Major)

"As I advance in the CS department (junior/senior level courses), some of the classes are even starting to approach the MPI standard (a high one).

Do the homework! Delaware's calc taught me that. Even in classes where it is collected and graded, do it ASAP! That way you have plenty of time to ask the prof if you haven't a clue.

Experience with Derive led me to be not scared of Maple (another computer math package). Maple is used in some upper-level CS classes at UMKC.

I am applying for a summer

internship at Argonne Labs, IL and/or any other summer jobs I can find. Will let you know..."

TODD JOHANN (92-93)
(Undecided Major)

"Because of MPI, I have decided to enroll in further calculus courses next term. Because of my success at MPI, I am now not sure that I don't want to go into math, physics, or engineering. I don't know whether to hate MPI or thank you all. ☺

MPI was one of the best opportunities I had in high school."

JENNA MEDINA (93-94)
(Microbiology Major)

"I got used to bigger assignments, papers/essays in calculus so I wasn't surprised by my papers in science classes.

Being with other smart people gave me the best challenge of my high school career. I needed that. I would highly recommend it."

KRISTI (LYNN) PUDER (91-92)
(Mechanical Engineering Major)

"The MPI gave me a wake up call for college. It was a good transition between regular high school courses and college courses. I have never been sorry that I participated in the MPI. Keep it going!!"

JOSHUA SMALL (93-94)
(Engineering Major)

"The classes at MPI are just like the classes here and I learned that I need to study and do the suggested questions every night, or at least do them sometime.

MPI taught me to break problems down and solve it in steps, if the problems were complex. It also taught me to approach the problems from different angles until I find a solution.

MPI forced me to develop college level study skills, which involves doing problems everyday a little at a time, that gave me a distinct advantage over most other students. It also introduced me to the idea of group study, which is very valuable."

MORE 1994-95 STUDENT IMPRESSIONS

"I am very appreciative of the opportunity that I have to particpate in MPI. It has given me a chance to have to have a couple of college classes while still in high school. These classes are more difficult than any other courses I have taken. It has given me the opportunity to see what it will take to succeed in college. MPI has already helped to improve my previously non-existent study habits. Another great aspect of MPI is that it gets me out of morning wrestling practice."

David Visnich
Ft. Osage High School
Ft. Osage School District

"To everyone else, MPI stands for Math Physics Institute. But to me, it stands for much more than that. Academically, it represents the biggest challenge I have ever faced. I knew it was going to be difficult from the very beginning. Little did I know how much it would actually change my life. Absolutely ALL of my spare time is devoted to studying. Just staying caught up requires so many hours of reading and problem solving. It's to the point where my boss at work schedules my hours around Calculus and Physics tests. I must admit, that is out of control.

I sometimes feel like all of this hard work is for nothing. I mean, I want to major in English and be a teacher. I have no business learning about derivatives and torques.

So what am I doing here? Good question. No—honestly, I'm here because I'm being prepared for college. I'm here because I have the opportunity to learn more than the average student. I'm here because I love the challenge."

Rachael Gard
Truman High School
Independence School District

"If f(x) is positive on the

interval between a and b...", Mr. Delaware says, going into great detail of some mathematical function of one kind or another. I think it was integration. I'm not sure.

"Not one of you is stupid. You can achieve anything you want." Mr. Waring says breaking into his motivating speech on Stonewall Jackson. It always ends with "... and he would have been first if he would have been given more time." It's so uplifting to know that teachers care so much for us. I wish all teachers were as kind and considerate as the MPI teaching staff. (Now, I don't know if this made any difference, but I do hope that I can get a twenty on my next physics lab!)"

Joe Dee Haney
Wm. Chrisman High School
Independence School District

"I feel that MPI is a great experience for those who can do this level of math. The physics is not bad. If you made a high grade in any other lab science you'll do well here. The study guide outlines everything, great for last minute reference. Know your trig. Become familiar with your calculator early on, and study, then you'll probably do well. The PC labs are great. They're easy to learn from."

Hattie Williams
Van Horn High School
Kansas City MO School District

A SOLUTION TO MATHEMATICS CHALLENGE #36

Recall the problem statement:

THE STEEPEST PARABOLA

Find the smallest positive number "h" such that

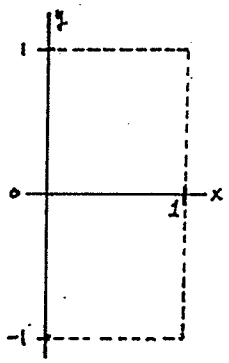
IF $f(x) = ax^2+bx+c$ is a quadratic function satisfying $|f(x)| \le 1$ whenever $0 \le x \le 1$,

THEN the inequality $|f'(x)| \le h$ holds.

[Calculus Note: f'(x) is the first derivative of f(x).]

Since the graph of a quadratic function is just a parabola, another way to state this question is:

Find the absolute value of the steepest (positive or negative) slope that a line tangent to a parabola can have if whenever $0 \le x \le 1$, that part of the parabola lies entirely between $y = -1$ and $y = 1$:



SOLUTION:

Suppose we have a quadratic function $f(x) = ax^2+bx+c$ $(a \neq 0)$ satisfying $|f(x)| \le 1$ whenever $0 \le x \le 1$. So the graph of f(x), which is a parabola, lies within the "box" shown above in the statement of the problem whenever $0 \le x \le 1$.

Noting that $f'(x) = 2ax+b$, we want to find the smallest positive number "h" so that $|f'(x)| = |2ax+b| \le h$ holds, for all $0 \le x \le 1$. But $2ax+b$ for $0 \le x \le 1$ is just a (non-horizontal) line segment, which can only take on its maximum at one of its endpoints, meaning at either $f'(1)$ or $f'(0)$. We restrict ourselves to the $f'(1)$ case. [The argument is similar for $f'(0)$.] In short, it is enough for us to find the smallest positive number "h" so that $|f'(1)| = |2a+b| \le h$ holds.

Now, it is well known that a polynomial of degree "n" is uniquely determined by its values at exactly n+1 points. Here, our quadratic polynomial f(x) (degree n=2) requires only 2+1 = 3 points to be uniquely determined, say x = 0, x = 1/2, and x = 1. These yield f(0) = c, f(1/2) = a/4 + b/2 + c, and f(1) = a + b + c. Of course, once the quadratic is determined, its derivative is likewise determined; in fact, notice that we can write:

$$3\cdot f(1)-4\cdot f(1/2)+f(0) = 3(a+b+c)-4(a/4+b/2+c)+c$$
$$= 3a+3b+3c-a-2b-4c+c$$

$= 2a+b$
$= f'(1).$

Thus, using the triangle inequality,

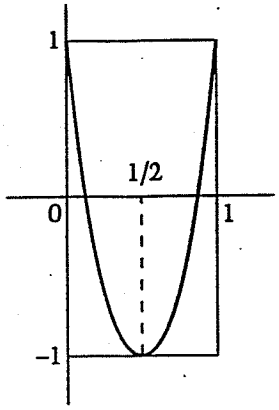
$$|f'(1)| = |2a+b| = |3\cdot f(1)-4\cdot f(1/2)+f(0)|$$
$$\leq 3\cdot|f(1)| + 4\cdot|f(1/2)| + |f(0)|$$

and, since $|f(x)| \leq 1$ is assumed for all $0 \leq x \leq 1$, continuing,

$\leq 3\cdot 1 + 4\cdot 1 + 1$
$= 8.$

So in <u>all</u> cases of f(x), $|f'(1)| \leq 8$. [The smallest "h" is no <u>larger</u> than 8.]

On the other hand, in the specific case $g(x) = 8x^2-8x+1$, seen below, in which a=8, b=-8, and c=1, we have $|g'(1)| = |16\cdot 1-8| = 8$:



So, it can happen that $|f'(1)| \geq 8$. [The smallest "h" is no <u>smaller</u> than 8.]

Therefore, in all cases the smallest "h" = 8.

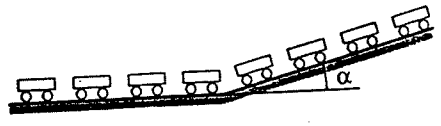
[From: Quantum Magazine, July/August 1994, p.31.]

A SOLUTION TO PHYSICS CHALLENGE #27

Recall the problem statement:

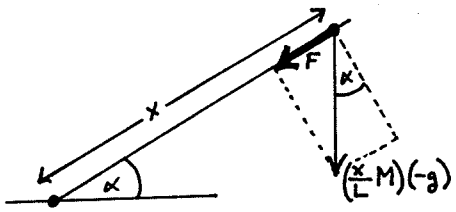
LONG TRAIN

A train moving under its own momentum goes up an incline of angle α. When the train stops, one half of its length is on the incline. What time elapses from the moment the train begins to go up the incline until the moment it stops? The length of the train is L. Disregard the friction between the train's wheels and the incline.



SOLUTION:

From the statement of the problem above, the angle of the incline is "α", and the total length of the train is "L". Recall that "g" stands for the constant acceleration due to gravity. Now, let "M" be the total mass of the train, and let "x" be the length of the part of the train on the incline. So, the proportion of the train's total weight which is on the incline is just $(x/L)\cdot M\cdot(-g)$. Consider the diagram below:



The net force "F" acting down the incline is the component of the train's weight <u>parallel</u> to the incline, meaning: $F = (x/L)\cdot M\cdot(-g)\cdot\sin(\alpha)$. Substituting this into Newton's 2nd Law F = Ma (mass times acceleration) gives:

$$Ma = \left(\frac{x}{L}\right)M(-g)\sin\alpha \quad , \text{ so}$$

$$a = -\left(\frac{g\sin\alpha}{L}\right)x \quad .$$

This means the acceleration "a" is a negative constant multiple of the position "x". [In calculus, instead of "a" we would use the notation x", the second derivative of x.] So we recognize this as the (differential) equation of simple harmonic (oscillating) motion, whose period "T" is known to be given by:

$$T = 2\pi\sqrt{\frac{L}{g\cdot\sin\alpha}} \quad .$$

Since a full period would consist of the train moving entirely onto the incline then back off again, and a half period would consist of the train just moving entirely onto the incline, it follows that one <u>quarter</u> of a period corresponds to the train

moving only one half of its length onto the incline. The time "t" required for this movement is:

$$t = \frac{T}{4} = \frac{\pi}{2}\sqrt{\frac{L}{g \cdot \sin\alpha}} \ .$$

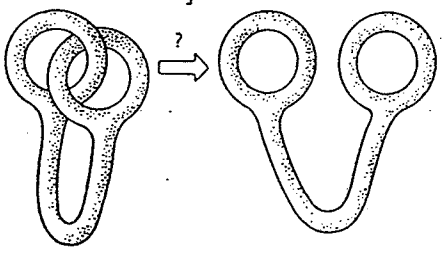
This solves our problem.

But, notice also that since neither "M" nor "x" appear in this solution, the time "t" does not depend on either the mass "M" of the train, or how much "x" of it goes up the incline; the time is the same for any "M" or "x"! [Likewise, the period of a pendulum, swinging under simple harmonic motion, is independent of either the swinging mass "M", or the amplitude "x" of the swing.]

[From: Quantum Magazine, Nov./Dec. 1994, p.23]

MATHEMATICS CHALLENGE #37

Imagine that figure (i) shown below on the left is made of perfectly stretchable, elastic material. Can you deform it into figure (ii), the one on the right, by stretching and manipulation but without cutting or tearing it? [Either show how it can be done, or prove it can't.]



(i) (ii)

[From: All The Math That's Fit To Print, by Keith Devlin]

PHYSICS CHALLENGE #28

SATELLITE OF THE SUN

Calculate the minimum period of revolution of a spaceship around the Sun, given that the angular size of the Sun as seen from the Earth is $\alpha = 9.3 \times 10^{-3}$ radians.

[From: Quantum Magazine, Jan./Feb. 1995, p. 23]

Editor/Writer: **Richard Delaware**

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Mathematics and Physics Institute
600 W. Mechanic, Room 224
Independence, Missouri 64050-1799

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