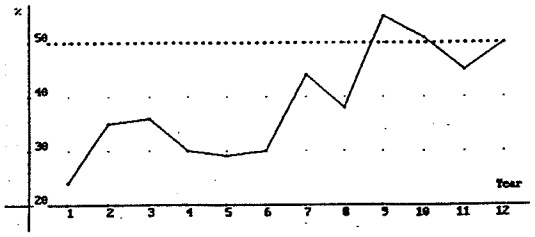
Mπ The Mathematics and Physics Institute NEWSLETTER

Director: Richard Waring
Mathematics Coordinator: Richard Delaware

April 1, 1996 Vol. 10, No. 5

YEAR 12 - OUR FIRST DOZEN

We arrive at the end of this year with 48 students (of which 24 are female), having begun with 71. The percentage of females finishing over these 12 years is shown below:



Next year we expect larger numbers of students, since once again the Kansas City, MO District has opened the MPI program to all high schools in the district. So, we hope to see students from additional schools such as Central, Lincoln College Prep, Metro, Paseo, Southeast, and Westport.

To prepare for our 13th year, in the last month we have re-written our statement of General Policies to account for new decisions we've made about everything from probation and dismissal, and the fact that two schools have gone to a 6 week grading schedule, to what we'll do if there are excessive "snow days". The mathematics coordinator has also sent a letter to all those high school "mentors" now helping our MPI students in Calculus outside of MPI classes, to establish guidelines for that help which will allow us to work in tandem.

Finally, as we all think about the Olympics in Atlanta this summer, and the many years of intense effort put in by all the participating young athletes, we remind our students, both this year and next, that merely having potential is no guarantee of success. Olympians, however evidently great their potential, would not be where they are without years of practice. The same is true of academic subjects, particularly Calculus and Physics. To the upcoming class of 1996-97 we say: Come to us determined to work, and we'll help you fulfill some of that potential.

MPI ON THE WEB?

Before next year, the MPI offices and computer lab will have an ethernet connection to the UMKCnet, and hence have Internet access. We hope this will help us explore useful mathematics and physics web sites, and eventually use what we find in our courses. Since one of the connected locations will be the computer lab, we may give students restricted access for particular MPI projects.

Being connected to the Internet also raises the possibility of creating our own MPI Home Page soon, which could contain a wealth of information for MPI Alumni wanting to keep in touch, and for others to learn about the program. These details we haven't yet discussed. Of course, we already have an MPI e-mail address, but for those further interested, we now have a brief one-page description of the MPI at the following URL address: http://cei.haag.umkc.edu/math/mpi.htm, which is linked to the UMKC Dept. of Mathematics and Statistics home page. It's a start!

CALCULUS READINESS EXAMS

During the last two weeks of April, the Mathematics Coordinator will travel to most of the high schools participating in the MPI to administer the MAA Calculus Readiness Test, a 25 question diagnostic test designed to determine roughly how

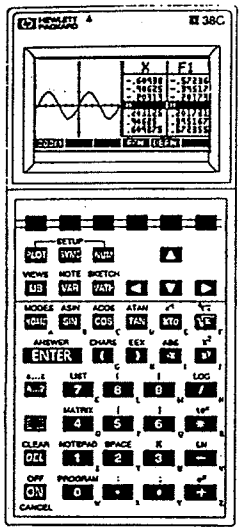
prepared a student is to take calculus. It covers analytic geometry, algebra, and some trigonometry. A score of 12 or above is required to attend the MPI, although occasionally lower scores are accepted provided a transcript and two recommendations are received, and a personal letter is written to the Director by June 1.

Of course, this little test is by no means definitive, and in fact, a student's commitment more often determines his or her success at the MPI than a score on one introductory test. However, this test has proved to be effective as long as it is complemented by CAREFUL SCREENING done at individual high schools by counselors and teachers who know the students in question. Let us be clear on this: students who have all the prerequisite classes and score 12 or more on the test, but who possess no maturity or commitment to hard work will not succeed at the MPI.

We hope that many of the approximately 165 students who visited us on our Recruitment Day Feb. 13 will decide to take the test.

MATHEMATICS TECHNOLOGY REPORT

1. This is the third year we have used the SHARP EL-9300C graphics calculators in all of our classes, creating in that time an MPI SHARP Manual of programs and other useful tips, but after next year we may well switch to another graphics calculator. The most likely candidate now is the new Hewlett-Packard HP 38G, which first appeared on the market in August 1995.



The reasons for the switch are not merely due to trendiness, but reflect real, pedagogically useful, improvements in calculator design from the industry. Although the SHARP continues to have the clearest LCD display, is easy to learn, and allows mathematical expressions to be entered exactly as you would write them, there have been no other models from the company since 1993, and there is little educational support. Also, the SHARP does not link to a computer to store images or programs, and its LCD face-plates tend to fall off. On the other hand, both TI (Texas Instruments) and HP have introduced several new models since that time, designed in response to mathematical and educational community requests. For instance, some of the new features that put the HP 38G in first place for us are:

The only attached hard cover on the market; more pixels for a finer LCD screen resolution (131x64 instead of only 95x64); an LCD face-plate that cannot come off; infra-red link between calculators - no cords; 3 AAA instead of 4 AAA batteries; nearly the same price as the SHARP; connects to a computer; 3 keys conforming to the Calculus Reform ideas of Graphical (PLOT), Symbolic (SYMB), and Numerical (NUM) viewpoints; tables feature; split-screen feature; more functions built-in; some symbolic calculations possible; targeted applications known as "Aplets"; extensive educational support.

2. This summer both Derive and Recordbreaker!, our grading program, will have Windows versions out. The latter should be the most immediately useful, while the former will require that our computers have 8 MB RAM, an upgrade for most of them.

TO ALL MPI ALUMNI:

HAVE YOU GRADUATED FROM COLLEGE?

IF SO:
PLEASE CONSIDER BEING
AN **ENRICHMENT SPEAKER**

CALL (816) 235-1272

ODDS AND ENDS

On Feb. 13, our Recruitment Day, we hosted 165 high school juniors, with about 20 other teachers and counselors, from 10 different high schools: East, Fort Osage, Lincoln College Prep, Metro, Northeast, St. Mary's, Southeast, Truman, Van Horn, and Wm. Chrisman. This total of 185 is once again the largest number of guests yet, topping the 157 who attended last year. Among the additional teachers were 14 members of the Gifted and Talented Dept. of the Kansas City MO School District.

This has been the second worst winter for cancellation of MPI classes due to bad weather, as can be seen in the table below:

NUMBER OF MPI "SNOW DAYS"

3 - Year 1 (84-85)
2 - Year 2 (85-86)
0 - Year 3 (86-87)
2 - Year 4 (87-88)
0 - Year 5 (88-89)
0 - Year 6 (89-90)
0 - Year 7 (90-91)
0 - Year 8 (91-92)
5 - Year 9 (92-93)
1 - Year 10 (93-94)
0 - Year 11 (94-95)
4 - Year 12 (95-96)

Blackout curtains have been ordered for Rm. 207 where we host our Enrichment Speakers every two weeks. Projections should now be bright and clear, undimmed by the morning sun.

On Friday Mar. 15, tables and chairs replaced the tablet armchairs in Rm. 204! Now, on to Rm. 203.

THE AUGUST 1996 ISSUE

The August 1 Mπ Newsletter will list the top ten MPI students for 95-96 and all those receiving awards at our May 16 Awards Presentation.

There will also be IMPORTANT INFORMATION and advice for the YEAR 13 class of 96-97. TAKE NOTE!

ENRICHMENTS

FOLLOW UP

Jan. 12, Seth McMenemy (MPI 88-89) an electrical engineer with Kansas City Power and Light, spoke to our students on **ELECTRICITY: POWER, TECHNOLOGY, AND ENGINEERING.** Seth responded to the student comments that appeared in the last issue of this newsletter.

E-mail received 2-21-96:

"I just wanted to thank you guys for letting me come talk. I really enjoyed the experience. I also want to thank the students for being a good audience and for giving me their comments.

I thought I would follow up on a couple of the student comments:

1. One person asked if overhead power lines generate ozone gas that replaces the ozone layer. The concern was that placing more power lines underground may hurt the ozone layer. First, ozone at our level in the atmosphere is a pollutant. It is difficult for ozone generated at ground level to find its way to the ozone layer. Second, the overhead power lines do not generate ozone. Any component that breaks or makes electrical contact while energized (example: switches) can spark and thus generate some ozone. The amount of ozone generated during these switching operations is miniscule compared to other sources of ground level ozone, like lightning for example.

2. One person expressed dislike in the idea of time-of-use pricing for electricity. This will save customers money. The pricing schemes will encourage customers to cut back electric usage during peak times (the late afternoons of hot summer days). Our demand last summer hit a peak of 2,909 MW. We have about 3700 MW of installed generating capacity. Once our peak demands start going over 80% of our installed capacity we must either pay governmental fines or install new generation capacity. Either option is expensive and costs the customers money in the long run. By making it economically attractive for customers to reduce electric usage during this peak time it is possible for us to eliminate or defer our needs to build new capacity and thus save our customers hundreds of millions of dollars in the long run.

Also, providing cheaper night time power will result in increased

night time usage of our system. The system generates and distributes electricity approximately 15% to 25% more efficiently with more load on it. This results in more energy used by the consumer per unit of fuel purchased by the power company. Another savings that can be passed along to the customer.

3. There were a few comments made about electric vehicles. I just want to follow up what I presented in January and also offer some additional points for consideration. a) Electric vehicles (EVs) eliminate pollution caused by vehicles. However, they do increase pollution generated at electric power plants. Hopefully, the pollution is more controllable at the few power plants compared with the many vehicles. b) EV efficiency is not much better than traditional internal combustion engines (ICEs) when considering the whole fuel to energy usage process. Both EVs and ICEs have fuel-to-energy usage efficiencies in the range of 40% to 60%. c) EVs will probably result in an increased number of batteries that we will have to dispose of some day.

If there are any more questions or comments feel free to e-mail. If Ed Kiker needs any volunteers for the Mars expedition be sure to sign me up! Thanks again."

On **Feb. 9**, UMKC Physics professor David Wieliczka brought back his popular talk **LASERS AND HOLOGRAMS**. Students responded:

■ Holograms are truly 3-D. His presentation was fun. I especially liked the chess hologram that he brought. I also liked how he mentioned some of the lasers we use in everyday life, such as the grocery store (I knew that), CD players, and in many types of communication.

■ Lasers can be made out of solids, liquids, and gas. We also took an eye test and I found out that I am nearsighted. I didn't realize that there was a laser in every compact disk. In holograms you don't transmit light through openings, you transmit by reflecting it off a surface.

■ We should definitely have more enrichments like this one.

■ He hopes someday we will be able to watch movies in holographic form. This way it would be 3-D instead of just being projected onto a flat screen. An advantage of holograms over pictures is that it is possible to look around objects to see what is behind them and be able to see depth more clearly.

■ In a laser, the waves add together as the particles decay to a lower state – light plus light = dark? Yes, if the crest of one wave meets the trough of another – 1st LASERS were MASERS/M stood for microwave. Dave Wieliczka was full of facts such as these as he presented lasers and holograms. Using his own computer program, he showed us the basics to waves, especially types of interference. The lasers weren't even the best part – it was definitely the holograms. It was a surprise to me that if you cut up a hologram, you will have two exactly alike – not just two halves. This was the year's best – by far.

■ I have 2 questions I forgot to ask at the time: What company is on the leading edge of the hologram industry? What is the derivation of the word hologram?

■ He brought a five milliwatt laser to show to us. It is amazing how useful such a low-power laser can be; it is strong enough to be directed onto the surface of the moon.

Kay Weiss, an astronomer from Kansas City Kansas Community College, joined us on **Feb. 23** to speak on **STELLAR EVOLUTION**. Some student comments were:

■ She was a pretty good speaker. I was interested in the material that she presented. I think this one was cool.

■ I really enjoyed it. I never knew about the dying star. I knew that they died but I never knew when.

■ Weiss said that the stars are like a Rosetta stone for astronomers, a scientist can tell how old a star is by looking at the color of a star through timed-exposure pictures. There are many things we can learn from the stars.

■ Stellar evolution is the study of the life and death of stars.

Everything is made of star dust, even us. When a star burns hydrogen in space, it is changed to helium. When the star burns out it changes to other elements such as the ones found on earth. Hydrogen is the most abundant material in the universe, then helium, and other elements only make up about 2%. As a star gets older, the center compresses inward and the outside moves further away. Our own sun will eventually expand past the earth's orbit, but not for a few billion years. Stellar evolution is such a deep subject.

■ Nebulas are "baby star nurseries." Huge gas clouds form. When these clouds collapse because of gravity, star cores are formed and glow. Gas clouds cocoon a star core until the star glows with enough energy to blow the cloud off. Sometimes, stars are born prematurely when another star blows off the gas clouds surrounding them. When stars die, a gas ring expands around the star to a sphere around the star. The cloud of gas keeps expanding until it dissipates into interstellar space, enriched with carbon and oxygen and ready to contribute to the making of another star.

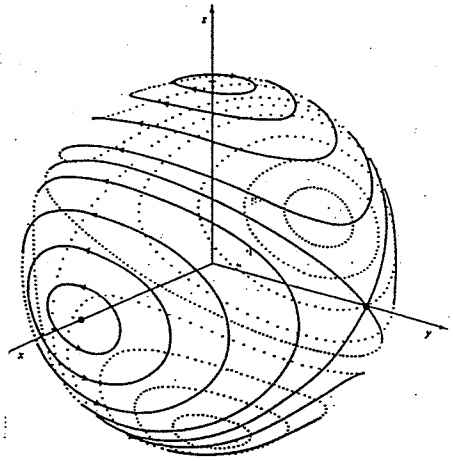
■ Every element in our body came from a star. It will take approximately 150 billion years to go through all of the hydrogen in the universe, when it's gone, there will be no more. This was another good one — I again can't think of a way to improve it.

■ She told us about some of the stars in Orion and about magnitude (the smaller the number, the brighter the star). She told us there was a way you could predict the changes in a star, just like you can predict a person's growth. I thought it was interesting. I liked the mix of visual aids — video, slides, and overheads. She was a good speaker and she was good at comparing and relating stars to more familiar concepts (the growth chart, etc.).

■ I found the discussion intriguing. She used multimedia techniques in a proficient manner. The speaker answered my high school "don't ask, don't tell question" about cosmology that the inquisition that is high school science refuses to answer, due to incompetence (or a secret government plot).

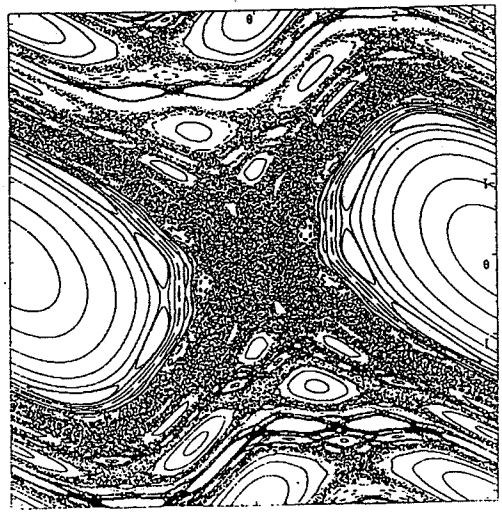
■ She did a good job presenting the material in an interesting manner. The video and slides were great.

On Mar. 8 we made our second annual Field Trip to the **UMKC PHYSICS DEPT.** This year we toured laboratories in:



1. Computational Physics
(James Phillips)

"The application of contemporary mathematics to modern physics and engineering problems has experienced a revolution because of the advances in computers. Demonstrations and hands-on computer experiments are available. A brief discussion covers developments in nonlinear systems and chaos."



2. Low Temperature Physics
(Da-Ming Dhu)

"Here we measure the thermodynamic and electrical

properties of different materials from below 1 K to 300 K.

Scanning tunneling and atomic force microscopies: We try to observe the configuration of single molecules absorbed on a substance. We measure surface forces with a sensitivity of 10^{-12} Newton."

3. Photoluminescence
(Jerzy Wrobel)

"Studies of optical properties of matter allow the scientist to predict the applicability of various materials for electronics (diodes, transistors, integrated circuits, ...), opto-electronics (lasers, light-emitting diodes, light detectors, ...) and optical devices (dye and solid state lasers, optical memory, optical processors, ...). Generally, a branch of science called optical spectroscopy is used to study optical properties. It includes measurements of absorption, reflection and emission of light by substances. In the photoluminescence lab you see the equipment required to perform spectroscopic studies at temperature ranging from 2 K (liquid helium) to 300 K (room temperature). You see luminescence of a semi-conductor (CdMnTe) at liquid nitrogen temperature and the spectrum of a mercury lamp."

4. Surface Physics
(Dave Wieliczka)

"The biological materials being studied have applications in the areas of restorative dentistry, implants, and bone growth. The field of dentistry is constantly trying to improve the materials used for restorative work. The development of a material to produce a stronger bond between the restorative and the tooth surface would provide a stronger and longer lasting restorative. The use of implants is becoming more common in both dentistry and orthopedics. Current implants are roughened surfaces of titanium which have been shown to not be incorporated into the body. Research is active in trying to coat the surface of the implant such that bone grows on the surface and incorporates the implant more intimately to the body. In all of these areas the chemistry at the surface is crucial in understanding the success and failures of the materials used for the various procedures."

5. High Pressure Physics
(Michael Kruger)

"The high pressure laboratory ... is capable of applying pressures greater than 1 million atmospheres on samples of interest ... There are 3 motivations for our work. The first is purely curiosity driven, to understand why and how matter reacts under such extreme compression. In the past this type of research has proven valuable in obtaining both a basic understanding of Nature as well as eventually resulting in technologically useful products. The second reason is applied, to try and synthesize novel and useful materials under high pressure. The third reason is to better understand the workings of the planets. Most of the material in planets is subjected to extreme pressure (for example, the pressure at the center of the Earth is at 3.6 million atmospheres) and behaves far differently from matter under ambient conditions. Thus, in order to understand the dynamics of planets, it is first necessary to understand the material properties of the matter within the planets.

High pressures may be achieved by using a device known as the Diamond Anvil Cell (DAC). Material is placed between 2 diamonds and a force is applied to both of the diamonds. Extremely high pressure may be achieved because diamond is very hard, and the samples that we study are very small. Remember that pressure = force per unit area (P = F/A). For extremely small samples, A is very small and the result is that the pressure P is very large, even for moderate forces. Through the use of the DAC, pressures of 5.5 million atmospheres have been achieved. Since diamond is transparent, we can visually study the samples as pressure is applied."

Student observations were:

- One of the more interesting pieces of equipment (for me) was the diamond anvil cell, where two diamonds are pressed together to create very high pressure (up to 5.5 million atmospheres). We visited a computer lab as well, in which we looked at various trajectory curves. We also learned about atomic emissions spectra for various elements. Would it be possible to see some of this equipment in action? I liked the handouts we got from two of the labs,

maybe the other labs could give us handouts.

■ I really enjoyed the computer simulation, and also the presentation on the conductivity of materials using white light. I didn't realize that some materials conduct more light than others. I also liked the presentation on the material that freezes instantly when in contact with a magnetic field.

■ Each speaker explained what he did, and how the results he acquired were beneficial to society. Overall, we could see the enthusiasm each speaker had for his experiments.

■ The subject matter for each was interesting and seemed to be up-to-date. Not to mention the money they spend in diamonds for high pressure and gold for microscopy. All in all, it was informative and interesting.

■ I enjoyed the trip – I like the demonstrations better than the ones at MU. The professors who spoke on low temperature labs and high pressure research were very informative. I liked the practical applications provided – especially the research on tooth work. Someday I hope to do research also – maybe.

■ It allowed us to look at a "real" physics department. We had a chance to ask questions and learn hands-on information.

■ What could be better than seeing chaos unravel? Seeing a vacuum 10^{12} times more powerful than atmospheric pressure? Or maybe making temperatures of almost 1½ x the temperature at the center of the Earth with your hand!? This was a great field trip.

■ They explained how each machine and all the equipment worked. I really liked the black light lamp thing. It made my socks glow! We learned how an electron microscope worked and the importance of magnets. The fluid of iron filings and oil was fascinating. It was grreat!

Mar. 22, Ron Schuchard, a professor of ophthalmology and physics at UMKC spoke on **VISUAL INFORMATION PROCESSING: HOW DOES THE BRAIN SEE?** Student comments on this talk will appear in the August issue.

UPCOMING

Apr. 12 will bring us a new speaker, Rhonda Strickland from the Cash Services Dept. of the Federal Reserve Bank of Kansas City, to speak on **AN OVERVIEW OF SERIES 1996 U.S. CURRENCY.**

We hope to have an engineer speak on **April 26,** but this is not yet confirmed.

Sun. **May 5** will be our annual **WORLDS OF FUN PHYSICS DAY.**

Finally, we'll hold our annual **PICNIC/BREAKFAST** at McCoy Park on Wed. **May 15,** and our **AWARDS PRESENTATION** on Thurs. **May 16,** the last day of the MPI this year.

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 **

(90-91) Matt Roberds
mroberds@sky.net
WILCOX ELECTRIC

(91-92) Tony Prettejohn
c593863@mizzou1.missouri.edu
UNIV. OF MO - COLUMBIA

(92-93) Kristi Bass
st063017@vax1.rckhrst.edu
ROCKHURST COLLEGE

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

** NEW **

(90-91) Stephanie (McGuire) Zech
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CENTRAL MO STATE UNIV.

(92-93) Brett Williams
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UNIV. OF MO - ROLLA

(93-94) Jesse Skinner
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UNIV. OF MO. - KANSAS CITY

(94-95) Amy Bentz
bentza@wm.jewell.edu
WM JEWELL COLLEGE

WE HEAR FROM PAST STUDENTS

PHÚC M. ĐÕ (85-86)
(BS, Electrical Engineering)

Letter received c. 2-8-96:

"This letter is in regards to the student impression section of your Mπ Newsletter dated February 1, 1996. The impression of Tien Nguyen certainly brought back my memory of MPI eleven years ago.

It was 1985. Like Tien, I was shocked and frustrated with the language and culture differences. I was about giving up too, but I didn't. Would you please tell Tien to hang in there and remind her of the Vietnamese Proverb **"Có Chí Thì Nên*."** English translation means **"Where There Is A Will There Is A Way"**. (Sorry, the tape and video "Where There Is a Will There Is An A" were not available at that time.) It has been my experience that patience and hard work are the key ingredients of success. It still works for me now. Sunwa (Gina) Kim is another example. She could not speak English when she attended MPI. She is now an electrical engineer. I believe MPI is a good testing ground to obtain college experience. Realistically, it trains you to become a disciplined and responsible individual.

Up-to-date about my employment status, I am currently training to become one of the lead engineers in the Engineering Division of the Kansas City Missouri Water Services Department.

Finally, I would like to say "Hello" to everybody at MPI, especially Mr. Nelson of Northeast High School.

Sincerely yours,
Phúc M. Đõ"

MATT ROBERDS (90-91)
(BS, Computer Science)

"Yes, I actually am working now. I thought all the math would go away. Ha! I am working for Wilcox Electric in KCMO on the Wide Area Augmentation System (WAAS) for the Global Positioning System (GPS). The WAAS provides a very accurate (± a few meters) position based on 'civilian' GPS data (± 100m). Eventually this will be used for aircraft approach, landing, and en route navigation. Basically, the system works by receiving GPS signals, processing, and transmitting corrections to a satellite. Did I mention that the processing step involves math? Lots and lots of math! We got sums! We got integrals! We got mind-bending matrix manipulation! We have RS/6000 servers to handle ALL THE MATH! So far I have not dealt with a lot of the math, but I probably will at some point – so I'll be hoping the MPI knowledge will kick back in. I think it will. As a note, I know you are using Derive (and Mathematica)? The math types at work use MathCAD a lot to prototype the formulae. (Either that or Excel, ick.) So keep showing them students how to use the PC's, it'll help. Life is different – there are assignments, deadlines, "professors" – but not much homework. Just 8a to 5p, 5 days a week, FOR THE NEXT 50 YEARS!! Ummm ... OK. Also as part of my job I get sent to sunny CA for 12-15 mos, starting in March/April 1996. Yes ... right after this, I'm going to Disneyland. Anyway, I know this is a bit late but I hope it still helps. Later!"

SHERI HARRISON-SMITH (90-91)
(Undecided Major)

"Again, I am sorry for taking so long to get back to you all. It has been a busy year. We have been in England now almost a year. I don't like it as well as I did Germany, but we're getting used to it. I need a favor, please. Since

we have moved I have lost Shalom Barber's address. So, if you could either print this so she can read it or send me her last known address, I'd appreciate it.

I hope this year is as good as the rest have been for you all. If you're ever in England, look me up!"

MATT BARROWS (93-94)
(Civil Engineering Major)

E-mail received 2-7-96:

"After having completed almost two years of college (seems like I just started yesterday), I thought that I might check in to let any one that cared know that I was alive. Right now I'm studying to become a civil engineer at the University of Missouri at Rolla. For anyone that comes to UMR, MPI will prove to be a great help. The last three semesters here have just been used to build on top of the foundation that I created at MPI. Another good foundation that I created at MPI was one of friends. You have the opportunity to meet many new and wonderful people, be sure to take advantage of it. While MPI did help me prepare for college, there were a few things that it didn't help me prepare for. One of which is the lack of teachers that truly care and are devoted to the teaching of students. Be glad that you are in a physics class of around 25 and not one of 200 where the teacher doesn't even have a clue what your name is. I recommend that you use MPI to its fullest extent. No matter what major you are going into it will help.

Best of luck to everyone that is going to school in the Fall. If there is anyone who is coming to Rolla and has questions, or wants help picking teachers (which I highly recommend) feel free to contact me via e-mail, call me at 573-364-9783, or if in Rolla stop by the Sigma Pi house.

Matt"

AMANDA KOSTER (92-93)
(English and German Major)

E-mail received 2-25-96:

"Hello!

It's been quite some time since you've heard from me, but I hope you haven't forgotten me. I am still reading the newsletters (thanks, by the way) and keeping up on things there. In case you were wondering, there have been a few changes here with me. First of all, I now live in Nebraska, which means I can't make it to any of the reunion type events over the holidays, unfortunately. Also, I have a double major in German and English now, which means the MPI courses I had don't really apply to my majors. However, they are helping out in many ways I hadn't considered. I am taking the GRE (General Records Exam), NMSU's general graduation test, this April, and my MPI training in using math and science is giving me a real edge in the practice exams I have been taking. There isn't any calculus, but the knowledge I need is the type of information I had to really "know" to do well in calc and physics. My instructor in the Princeton Review prep course said I am the only English major to get 700 of 800 in Quantitative (math) he has met in 9 years of teaching the course. Thanks for the solid math and science background!

Oh, and on a personal note, I am heading off to study abroad in Australia in July, returning in December. My math and science background has given me an edge with the application and acceptance process, too. My transcript, etc. show a rounded development in education and interests.

And yes, I still have that survey sitting here in my room waiting to be filled out and returned. I promise to get it in the mail soon! Well, after mid-term exams this week anyway...

Oh, and if anyone out there that actually knows me feels like emailing me, I'd love to hear from you. I check my email regularly...

Amanda Koster
Class of '93 at MPI

Please pass on my greetings to Mr. Morse, and if he is still at Chrisman, could he tell Ms. Negaard she was right... I ended up in English. And Mr. Hile would have predicted I'd end up with a German degree probably. Thanks! Amanda"

JESSE SKINNER (93-94)
(Civil Engineering Major)

"I feel that MPI was an important step in going from high school to higher education. I have wholeheartedly recommended it to students that I know who are eligible. My MPI classes were some of the most valuable of my public school career."

BRETT WILLIAMS (92-93)
(Mechanical Engineering Major)

"MPI is an excellent program in that it allows motivated students to pursue their first taste of college while still in high school. In fact, the more emphasis and effort that is made to give the students a full-fledged university experience, the better. The quality of instruction already exists at that level. Perhaps the difficulty of the material or setting higher expectations would make it even more so.

Many thanks to all those at MPI who invested in my education and best of luck to the current benefactors."

JENNA MEDINA (93-94)
(Microbiology Major)

E-mail received 3-7-96:

"Hello. Sorry I didn't tell you of my address change. Actually there is more to it than that. Here at BYU we have to pay for email, and so while I am not here if I don't want to have to keep paying I have to totally close my account, and then find time when I get back to go to the computer science building and open it back up. This year I had no time until a couple of weeks ago.

Things are going pretty well here. I think I might change my major. If I do it will not be drastic. Right now I am a Microbiology Major with minors in Chemistry and English. If I change it will be to the Biology/Secondary Education program in the Micro Department, I would drop my Chem minor, and I am supposed to talk to the head of the English/Secondary Ed composite program about what I would need to take to qualify to teach English as well. We'll see what actually happens. I just don't know what I want. Besides that I am very busy with classes, and on the stressed side of life (always). I have to get to class now, and today Margaret Thatcher is speaking at our University Forum (we have guest lecturers every Tuesday for the whole campus to go hear.) I am pretty excited to go hear her this morning. Well I hope all is well with you. Bye.

Jenna"

FINAL 1995-96 STUDENT IMPRESSIONS

"MPI is a different experience than what I've experienced before. If you like getting up early, staying up late doing my homework, and working more than ever before, you will love MPI. Although, it has prepared me better for college."

Alex Bates
Ft. Osage High School
Ft. Osage School District

"I always told myself that although at this time I am not getting the grades that I want, I will never give up because I have noticed that grades are important, but not more important than what I learn and gain for my future. The MPI program is a great opportunity for any student who will be going to college. It will develop your work habits and study habits. The MPI program has been excellent training for my future as a college student and for my future career."

Phuong B. Nguyen
Northeast High School
Kansas City, MO School District

"I'm used to getting A's in school without really trying, so MPI was a wake-up call for me. I still get the grades I want, but it's a lot more work. I'll admit there have been certain nights before tests in Calculus (II, especially) or Physics where I have been up until way after midnight, but that's probably due to my own procrastination problems.

I would encourage juniors to come here next year. It's a good experience (and not as hard as it

sounds, if you keep on task and don't put the homework off until the last minute).

Ragan Buckley
Truman High School
Independence School District

"With only two months left, we can say the year is close to being over. At the beginning of the year it was not that difficult to make it to school by 7:00 am, however, now it seems to be a struggle to be there by 7:10! So far it has been a hard and treacherous year but we have almost made it. If we can just hang in there for another two months, with the many hours of studying and the few hours of sleep, we will be able to look back on the year as an enjoyable memory."

Jennifer Watts
Truman High School
Independence School District

A SOLUTION TO MATHEMATICS CHALLENGE #42

Recall the problem statement:

A café is furnished with round (circular) tables and square tables. [Tables of the same shape are the same size.] Each round table is completely covered by 4 equal square napkins, and each square table is completely covered by 4 equal round napkins. Show that:

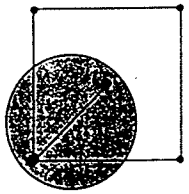
a. The diameter of a round napkin is ≥ half the diagonal of a square table, and

b. The side of a square napkin is ≥ the radius of a round table.

[From: V. Proizvolov in Quantum Magazine, Jan./Feb. 1996, p. 15.]

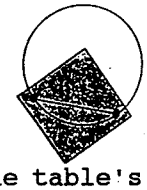
SOLUTION:

a. In the case of the square table and 4 equal round napkins, consider the 5 points which are the center and four corners of the table. Since a square table is completely covered by 4 equal round napkins, at least <u>two</u> of these 5 points must be covered by the <u>same</u> round napkin:

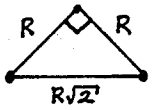


So the diameter of the napkin can't be smaller than the smallest distance between any two of these 5 points. Since the smallest such distance is that between the center and a corner, which equals half the diagonal of the square table, we see that the diameter of a round napkin is ≥ half the diagonal of a square table, as desired.

b. In the other case, if 4 equal square napkins cover a round table, they cover its circumference, so at least one of them covers an arc equal to 1/4 of this circumference (90 degrees):



If we call the table's radius R, then the distance between the two endpoints of this 90 degree arc is $R\sqrt{2}$, as shown:



If we call the square napkin's side length A, then the largest distance between points on such a napkin is along its diagonal, which has length $A\sqrt{2}$. Hence, since this napkin covers the arc, we have $A\sqrt{2} \geq R\sqrt{2}$, so $A \geq R$, meaning the side length of a square napkin is ≥ the radius of a round table, as desired.

A SOLUTION TO PHYSICS CHALLENGE #33

Recall the problem statement:

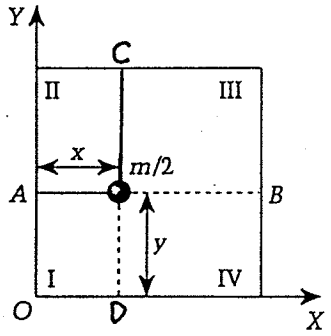
When the mass of a body placed in the center of a <u>square</u> table exceeds a certain value m, the table's legs break.

Find the regions on the table's surface where a body of mass m/2 can be placed <u>without</u> breaking the table's legs.

[From: O. Batishchev in Quantum Magazine, Jan/Feb. 1996, p. 19]

SOLUTION:

This is an equilibrium problem so we must apply the conditions of equilibrium; namely, the algebraic sum of the force components along any axis must be zero and the algebraic sum of the torques about any axis must also be zero. We must assume the mass of the table top is so small it can be neglected. Let the object of mass m/2 be placed on the table at point (x,y). Let f_1, f_2, f_3 and f_4 be the forces exerted upward on the table top by the legs located at I, II, III, and IV in the figure below.



From the first equilibrium condition,

$$f_1+f_2+f_3+f_4 = \frac{mg}{2} \qquad (1)$$

From the second equilibrium condition, taking the algebraic sum of the torques about the axis CD (taking torques producing counter-clockwise rotation to be (+) and torques producing clockwise rotation to be (-), we get:

$$-f_1x - f_2x + f_3(s-x) + f_4(s-x) = 0, \qquad (2)$$

where s is the side length of the table. Rearranging equation (2) we get

$$f_1+f_2=\frac{(f_3+f_4)(s-x)}{x} \qquad (2a)$$

solving equation (1) for $f_3 + f_4$ and substituting in equation (2a) we get,

$$f_1+f_2=\frac{[mg/2-(f_1+f_2)](s-x)}{x}.$$

Solving for $f_1 + f_2$ we get,

$$f_1+f_2=\frac{mg}{2}\left(\frac{s-x}{s}\right). \qquad (2b)$$

Similarly, taking the algebraic sum of the torques about the axis AB we get,

$$-f_1y + f_2(s-y) + f_3(s-y) - f_4y = 0. \qquad (3)$$

[NOTE: At this point the solution published in Quantum magazine becomes suspect. The author of the magazine solution has assumed the torques given by the first two terms and the second two terms of equation 3 are separately equal to zero. The author should have given some justification of this assumption. Otherwise we have only three independent equations (1), (2) and (3) and four unknowns. Thus a solution cannot be found.]

Given the questionable assumption mentioned above

$$-f_1y + f_2(s - y) = 0 \qquad (4)$$

so $$f_2 = \frac{f_1y}{s-y}.$$

Substituting this value of f_2 in equation (2b) and solving for f_1 we get,

$$f_1 = \frac{mg}{2}\frac{(s-x)(s-y)}{s^2}.$$

In order that leg I not be broken, we must have

$$f_1 < \frac{mg}{4}$$

meaning $$\frac{mg}{2}\frac{(s-x)(s-y)}{s^2} < \frac{mg}{4},$$

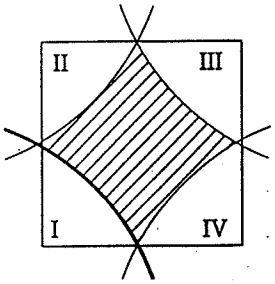
so that $$y > s\left(1-\frac{s}{2(s-x)}\right).$$

Thus a mass m/2 can be placed at any point characterized by the last inequality above.

The graph of the function

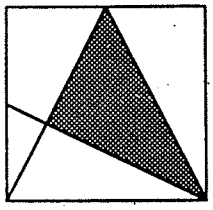
$$y(x) = s\left(1-\frac{s}{2(s-x)}\right)$$

is shown by the thick line in the figure below. From symmetry the set of "safety" points is thus the shaded region shown:



MATHEMATICS CHALLENGE #43

The shaded triangle below is formed by drawing segments from corners of a square to the midpoints of opposite sides, as shown:



Show that this triangle is in fact a right triangle, with its sides in the proportion 3 to 4 to 5.

[From: "A Round-Up of Square Problems", Duane Detemple & Sonia Harold, Mathematics Magazine, Feb. 1996, p.16.]

PHYSICS CHALLENGE #34

A beach ball can be suspended by blowing air from a fan upward on it. If the ball is pushed aside a small distance in any direction it will return to its original position when released. Why?

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