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:

Kyle Langlands	(Fort Osage)
Tab Lawson	(Truman)
Jessie Nolle	(Truman)
Eric Swearingen	(Truman)
Tim Thacker	(Truman)
Brett Williams	(Truman)
Todd Johann	(Wm Chrisman)
Amanda Koster	(Wm Chrisman)
Andrea Slusser	(Wm Chrisman)
Ric Stuck	(Wm Chrisman)

RECRUITMENT DAY -- FEB. 17

On Wednesday Feb. 17, we are inviting interested juniors and their teachers from the six high schools involved in the MPI program for a visit. We usually host about 120 students each year. They will arrive between 8 and 8:15 am and, with MPI tour guides, take a short tour of the MPI classrooms. There will be MPI students at work on Calculus in our new 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, "The Loft", to receive an MPI brochure, this issue of the newsletter, a donut (!), and be seated for our slide show 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.

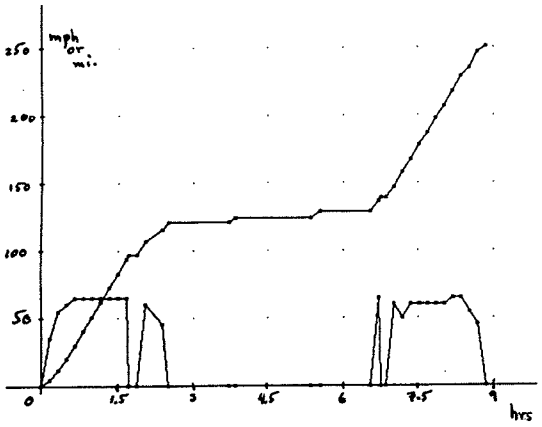
MPI E-MAIL ADDRESS:

rdelaware@vax1.umkc.edu

COMPUTER LABS REPORT

1) "POLY, SHE WROTE." We recently held a Calculus Lab using one of the little shareware programs from the Univ. of Arizona Mathematics Dept., called FINDPOLY, which runs as follows: After starting the program, you load a polynomial p(x) of degree ≤ 7, having integer coefficients, from an encrypted file within the program -- meaning, the program knows the polynomial, but you DON'T. The program then allows you to examine p(x), and its 1st and 2nd Derivatives, by Plotting any of the three, Evaluating any of the three at any point you wish, or, finding Roots for any of the three. (It uses Newton's Method). Using this data, and your knowledge of how polynomials act, you must discover the degree and all the coefficients of your 'mystery' polynomial, i.e., you want to Find Poly! This little game is a superb exercise in knowledge of derivatives and their graphs, the formal algebra of polynomials, deduction, educated guessing and verification, solving simultaneous linear equations, etc. Our students, after finding one or two polynomials, were asked to write out an effective procedure for QUICKLY discovering a polynomial, showing exactly HOW they elicited mathematically useful information. Next year we'll give this Findpoly lab more than just one hour, since it is clear that everyone loves a mystery!

2) Another new Calculus lab used MICROCALC and its ability to graph the integral of a function along with the function itself. After our students examined several examples, comparing the two graphs, we presented them with raw data gathered during our bus trip to the MU Nuclear Reactor earlier this year, consisting of time, speed, and distance traveled. The graphs for one of the two busses appear below:



They were first to mark on the horizontal axis when Rest Stops, the Reactor Visit, the MU Physics Dept. Visit, Lunchtime, and a Gas Stop took place. (Can you?) They were then asked to compare the two graphs, and with luck realize that this is a nice, natural example of the relationship between a function (speed) and its integral (distance traveled).

3) A PEDAGOGICAL NOTE: We have found that if we place students directly into the PC lab with an assignment, they will often immediately begin using the computer, even though the best way to proceed may be to set up the problem and do some work first by hand. The lure of the PC and Derive is too great. So, we are beginning to realize that to effectively teach the different values of hand work and computer work, we must first have a period outside the PC lab to work on the lab materials, going as far as possible without computational or graphical aid. The lesson must be: To Each Tool Its Own Place!

CONFERENCES YET AGAIN

On Feb. 12-13, the mathematics coordinator will attend a small conference at Oklahoma State University on the exciting reformed Calculus text produced by the Harvard Consortium. We may well adopt this as the new MPI text next year.

From Mar. 30 - Apr. 4, Joe Kaifes and the mathematics coordinator will attend the Annual Meeting of the NCTM (National Council of Teachers of Mathematics) in Seattle.

Over the same period, from Apr.1 - Apr. 4, several of the Physics instructors will attend the Annual NSTA (National Science Teachers Association) conference here in Kansas City.

ENRICHMENTS

FOLLOW UP

Here are some student comments on Quinton Bowles' **TOUR OF UMKC MECHANICAL ENGINEERING LABS** on Dec. 11, 1992:

-- Dr. Bowles was very nice for explaining to our group about the elasticity of a spring material used in building such things as the floor of an airplane in such a sincere manner. The labs we toured were very informative.

-- One lab was a mechanical test lab, which of all places was in a garage. There, they tested the malleability of metals and tested different types of welds by stretching them. Next, we saw a scanning electron microscope. They were using a fly as a specimen. At 600X we were able to see the compound lens in the fly's eye. Last, we visited the broken metals lab, where they test broken metals such as torsion bars, train wheels, etc. to see why they broke.

Our 8th Annual **PANEL DISCUSSION** on Jan. 5 was held again in Rm. 207, "The Loft", and moderated by Sheri Adams and Al Morse. As usual, each of the 7 panelists discussed their college experience, their major, and for one, her professional life after college.

The alumni panelists this year were:

Robin (Steen) Crick **84-85**
BS Accounting (UMC)
Accountant/Quality Facilitator

Jon Fox **88-89**
University of MO - Rolla
Physics

Seth McMenemy **88-89**
University of MO - Columbia
Electrical & Computer Engineering

Rana Barber **89-90**
Baker University
Veterinary Medicine/Computer Science

Mitch Dobson **89-90**
University of Texas - Dallas
Prosthetics/Orthotics

Jeff Hoskins **90-91**
University of MO - Columbia

Leslie Farrow **91-92**
University of Mo - Kansas City

Their presentations were generally well-received. Some specific MPI student comments were:

-- Some of the comments were pretty funny. Like some of the greatest shocks of college: coed bathrooms (a joke), and culturally "different" people. I really liked what Mitch did when he knew he wanted to go to Texas, but went to Kirksville (Northeast MO State Univ.) first to make the big move away from home easier. That was smart and was something that everyone should consider before they move out and go far away. They all said some good things that I will remember.

-- It was good to hear some real talk about college. People were forward about their problems in college. Some people were helpful with their opinions about advisors and classes. What not to do and what to do.

After the panel, orange juice and donuts were available, and we broke into small groups to visit. In all, 15 former MPI students appeared.

UMKC Physicist Dave Wieliczka's **LASERS AND HOLOGRAMS** talk on Jan. 15 was again a favorite, with his 15 milliwatt helium-neon laser, illustrative software, and several holograms. One student summed it up: "Terrific!"

On Jan. 29 we were treated to a new speaker, Peter McCann, a molecular biologist working at Marion-Merrill-Dow, and speaking on **DIFLUOROMETHYLORNITHINE AND AFRICAN SLEEPING SICKNESS.** He presented a wonderful story of scientific discovery and even serendipity, telling how he and his colleagues in Strasbourg, France worked with the afore-mentioned compound in cancer research, were contacted by a doctor in Africa wanting to try it on Sleeping Sickness, who then discovered that it yielded a complete cure! An exciting scientific success story.

UPCOMING

On Feb. 12, Peter Nemechek, a medical doctor, will discuss **AIDS.**

For Feb. 26 we are talking to Rona Hirschberg (a UMKC Biologist).

On Mar. 12, David Frayer a physical paleoanthropologist at KU will discuss **HOW TO RECOGNIZE THE EARLIEST HUMANS.**

On Mar. 26, we will make a **KC MUSEUM FIELD TRIP** to tour the traveling NASA mockup of the inside of Space Station Freedom, temporarily in town, and then visit the museum exhibit: Mirror, Mirror On The Wall.

WE HEAR FROM PAST STUDENTS

KEN HILL (86-87)
(Mathematics Major)

"I enjoy receiving the regular MPI newsletters; my favorite part is the letters from alumni. I just received the December newsletter and read about Cindy Gillespie (MPI 86-87). I am glad to see that I am not the only one from my class that has not graduated from college.

I am currently enrolled at UMKC majoring in Mathematics. I have majored in Electrical Engineering, Computer Science, Education (Mathematics), and finally settled on Mathematics. I believe my time at MPI was perhaps the most valuable of my life. It was there that I learned that Mathematics is not a dead science! I have, ever since, been excited about Mathematics. Keeping every Mathematics text I ever used in school and buying other texts as I found them at bookstores, flea markets, auctions, and garage sales, I have amassed a collection of over 100 math books alone. I always encourage people I meet to take all the Mathematics classes they can. My overall educational goals are to have an MS Mathematics and an MS Computer Science. I someday hope to teach Mathematics. However, a graduation date for my BS Mathematics is still floating somewhere in the indeterminate future.

Often, I have allowed work to interfere with school. This has not only cost a lot of money, and a lot of time, but also it has adversely affected my GPA. I can now state, however, that I am profitably self-employed and the only immediate plan that I have is to attend school. There is nothing more gratifying than knowing that you are the boss. I am

planning on taking one more semester (WS '93) as a part time student and then will attack my education with full vigor and resolve -- remember U. Grant! I have a giant banner with his words stretched across my office (as everybody should)!

P.S. To those that do not know yet, the USMC was not one of the brighter decisions I ever made. My father, an ex-Marine, and I are both very pleased to state that I NEVER became a Marine."

VANESSA (WHITE) KEMPER (87-88)
(Mathematics Major)

"Sorry, (I can't be a panelist) but school starts January 4th for me. (I'm sure you wouldn't want me to miss THAT!) I should be graduating in mid-June this year. I'll be getting a math BS with an emphasis in secondary education. I hope you have happy holidays."

HIEN TRAN (87-88)
(BA Chemistry; Medical School)

"I thought that I should let you know that I'm going to KU Medical Center now. I have just finished the first semester. I'm doing OK there. Anyway, Merry Christmas and have a joyous New Year."

PAT LIANG (86-87)
(BS Biochemistry; Medical School)

"I believe I cannot say any negative comments toward MPI due to its vital role in building my academic and professional character. The attention to the student in the initial adjustment stage in the high school to college transition is what impressed me most about MPI. In my first year in Bloomington, Indiana, I found myself as one person amongst 36,000. My first true college lecture has 863 people in it-a rather intimidating journey indeed. Believing in the tactics of notetaking and time-management learned at MPI, I forged on in my studies.

Even now, nearly a full six years after high school graduation, I feel that skills learned at MPI have grown and are still in active use during my term now in academic medicine. Soon I will progress toward clinical medicine and married life and I feel that again, skills learned at MPI will be used in varying degrees and manners, from time-management to social skills and interactions. MPI has helped me grow and I feel that the experience is more than words can fully describe, within the confines of any printed page."

TINA JENKINS (89-90)
(Medical Technology Major)

"The instructors at MPI were very helpful-always there to help after class or whenever was convenient. At UMKC, the faculty is helpful, yet their capabilities of teaching are limited. The professors are nice, yet they simply are not good teachers. They are either impossible to comprehend (many are foreign) or there due to tenure and never really learned to teach, and thus a waste.

Keep up the good work! Mr. Morse was the best instructor I ever had-he puts many of the UMKC faculty to shame. Delaware brought a lot to lecture as well through his light heartedness-it was easy to approach him. This quality is very rare-both were excellent instructors."

JOHN BUCKLEY (86-87)
(BS Physics & Mathematics;
Graduate Student - Physics)

"I am currently working in the field of space physics. The KU space physics department is one of the central data processors for the ULYSSES spacecraft that orbits the sun right now. I work with certain aspects of one instrument aboard the craft -- lots of computer work. I would strongly suggest a visitation to the facility...I feel its computer-oriented research program is a 'must' to see by MPI students. (They) also handle data from other spacecraft -- including VOYAGER, GALILEO, and IMP8.

Before attending KU, I had no conception of how we obtained information from our space probes. Now I have had 'hands-on' experience that is important for people younger than I to experience. Probably the most shocking thing I've discovered is how dependent everyone here is on the computer. I feel it is important for students at the MPI to see how this fits into the research-oriented world...

In the long term, I will probably NOT pursue a career in space physics. Why? Too much computer, too little physics. It's a harsh reality that I'm only beginning to realize! This is very important for MPI students to be aware of. (I'm sure that computer-nuts would love my job.) Chances are I will end up teaching physics and math at either the high school or junior college level -- I will keep you informed.

The MPI program was very important for me. It was the start of important career decisions -- I have no doubt of this now."

EUGENE BAE (86-87)
(BS Electrical Engineering;
Graduate Student at MIT)

"I hope the New Year brings good and glad tidings to everyone! I regret being unable to attend the MPI reunion earlier this month, but my work called me back to Boston immediately after the holidays. I hope things are going well for all the faculty and staff. I enjoy reading the newsletter, and I hope you will continue to provide that service so that alumni may keep in touch with the program and each other.

This will be just a brief hello, as I plan to write more often once things get settled down. I am in the midst of a final in a course I'm taking at the Kennedy School of Government... Just briefly, I plan to graduate this May with my Master's degree in Technology and Policy, and I am seeking an internship/position in Washington D.C. for a period of 1-2 years before I continue my studies and eventual Phd.

And of course! Eric Butkovich (MPI 86-87) and Maria Aguilera (MPI 86-87) are engaged to be married this coming year. Since this is their story to tell, you may want to reach them yourselves.

OK... that's enough for now...I hope to be in touch with you again soon."

DANIELLE GLOSSIP (89-90)
(Physical Anthropology Major)

"I haven't taken any more math & physics, but the courses at MPI were much better than the chemistry courses I have taken (Gen I & II & Organic I).

A terrific program for getting ready for college. Keep up the GREAT WORK (and try to keep Al Morse!)"

CHRISTINA KETCHUM (90-91)
(Mathematics Elem. Ed. Major)

"Teacher to student ratio at MPI was a lot lower than at K-State even lower than in recitations. Teacher availability was a lot better, teachers at MPI were always there when I needed help, at the college I'm in now it takes longer to get problems solved.

I would recommend to anyone interested in going on to college to go to MPI and get some of the basics out of the way. It's a lot easier and teachers are more helpful than what you'll find at any other institution of higher education."

LLOYD WILLIAMSON (87-88)
(Corporal US Marine Corps)

"I am currently serving my second four year tour with the Marine Corps. As a non-commissioned officer I'm responsible for the morale and welfare of my subordinates. In my leadership position I must develop them professionally, physically and mentally. The classes I took at the MPI during my senior year in high school taught me how to study a problem and solve it through logical steps. The steps needed to solve most problems are similar to the troop-leading steps I have learned in the Corps.

The first task is to begin the plan or, in other words, find out what the problem is. The next two steps, arrange reconnaissance and make reconnaissance, are just like looking at the problem and figuring out where you're going and how to get there. Completing the plan is tantamount to merely deciding your course of action. The last two steps, issue orders and supervise, are doing the job and ensure it's done correctly.

As you can see I was being taught how to solve almost any task put before me without even realizing it. Even though I don't use anything more than simple mathematics most of the time, what I learned at the MPI has made me a more capable leader."

92-93 STUDENT IMPRESSIONS AGAIN

"MPI has become my #1 motivator. Not only has it expanded my mathematics horizon, but it has also provided me with my own MPI family.

When my brother attended MPI, I always thought he had no life because he was always doing homework, but now that I'm at MPI, I've decided it must be hereditary because I no longer have a social life either."

Amy Fox
Fort Osage High School
Fort Osage School District

"Although MPI is hard, once you've conquered the first semester you feel like you could conquer anything, so stick with it."

Shelly Carter
Northeast High School
Kansas City, MO School District

"If I understand the material the day before the test, that's good, and I don't need to study. If I don't understand it by then, there's no way I can learn it in one night, and there's no need to study."

Jessie Nolle
Truman High School
Independence School District

A SOLUTION TO MATHEMATICS CHALLENGE #26

Recall the problem statement:

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?

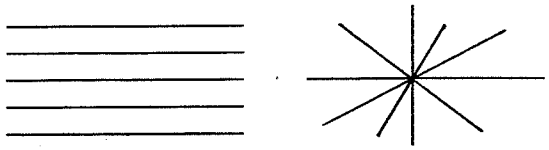
For instance, if all 5 lines are parallel, there are $k = 0$ points of intersection. If all 5 lines meet in one point, there is $k = 1$ point of intersection. How many other values of k can be attained, and why?

[From the AMP-Line Fall 1991 Newsletter.]

SOLUTION:

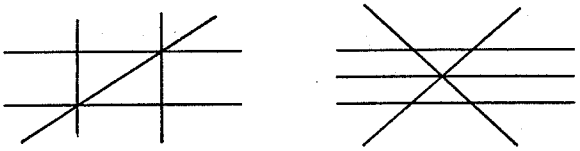
Using 5 lines, all values of k = 0 to k = 10 can be attained EXCEPT k = 2 or 3. Constructions and reasons are given below:

k = 0: 5 parallel lines.
k = 1: 5 lines meet in one point.

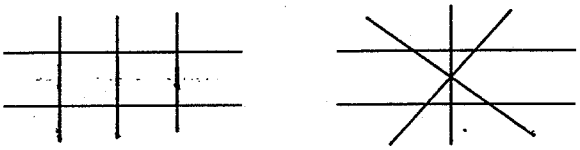


k = 2 and k = 3: Except for the k = 1 case above where all 5 lines meet in one point, if there are NO parallel lines among our 5 lines we will always get k > 5 intersections. (Just examine the constructions below.) If there are exactly 2 parallel lines among the 5 lines, then the smallest number of intersections occurs when the 3 non-parallel lines all intersect on a point of one of the 2 parallel lines, in which case k = 4. If there are either exactly 3 parallel lines, two distinct pairs of parallel lines, or exactly 4 parallel lines we will always get either k = 4 or k > 4 intersections. (Again, just see the constructions below.)

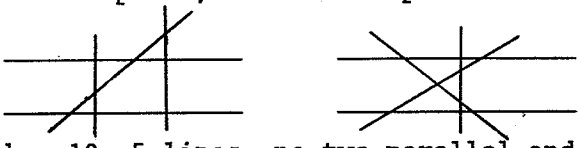
k = 4: A square and one diagonal.
k = 5: 3 parallel lines and 2 others intersecting on one of them.



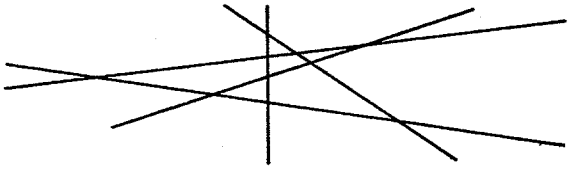
k = 6: 3 parallel lines and 2 other parallel lines intersecting all 3.
k = 7: 2 parallel lines and 3 others intersecting in one point between the 2 parallels.



k = 8: A square and a non-diagonal line cutting off a corner.
k = 9: 2 parallel lines, and 3 other lines, not all meeting in one point, and no two parallel.



k = 10: 5 lines, no two parallel and no three meeting in a point.



A SOLUTION TO PHYSICS CHALLENGE #17

Recall the problem statement:

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

SOLUTION:

We can start by comparing the size of adult lungs to 1 liter (1/2 of a 2 liter pop container). Will the adult lungs hold nearly 1/10 (10^{-1}) liter, 1 (10^{0}) liter, or 10 (10^{1}) liters? The answer is certainly much more than 1/10 liter, and much less than 10 liters. So the choice, to the nearest power of ten, is 1 (10^{0}) liter/breath. Next, ask how many times an adult breathes per minute. Is it nearest to 1 (10^{0}), 10 (10^{1}), or 100 (10^{2}) times? Certainly it is much more than once, and much less than 100 times. The choice is therefore 10 (10^{1}) breaths/minute. Now we estimate to the nearest power of 10 the number of minutes in a 24 hour day. Certainly there is much more than 100 (10^{2}), and much less than 10,000 (10^{4}), so the choice here is 1000 (10^{3}) minutes/24 hours. Putting these three conclusions together we have the correct answer, to the nearest power of ten (Here L = liters, and B = breaths):

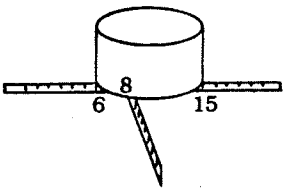
$(10^{0}\ L/B)(10^{1}\ B/min.)(10^{3}\ min./24\ hrs)$

$= 10^{4}$ liters/24 hrs.

MATHEMATICS CHALLENGE #27

A large cylindrical pot has been set over an open fire on crosspieces of metal bars at right angles and with sharp upper edges marked in inches out from the center, for some forgotten reason.

The pot has been pushed to a precarious position, and from where we are we can see that the circular bottom just intersects the bars at 6, 8, and 15 inch marks, as indicated below:



What is the DIAMETER of the pot?

[From: Mathematical Brain Benders by Stephen Barr.]

PHYSICS CHALLENGE #18

Estimate to the nearest power of ten how many home runs were hit in all regular season major league baseball games last year.

Editor/Writer: **Richard Delaware**

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