

M π

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:

Mark Cleveland	(Fort Osage)
Aubrey Hanks	(Fort Osage)
Rachel Hayes	(Fort Osage)
Mike White, Jr.	(Fort Osage)
Jill Dawson	(Truman)
Sam Dorton	(Wm Chrisman)
Bobbi Hopkins	(Wm Chrisman)
Jenna Medina	(Wm Chrisman)
Josh Small	(Wm Chrisman)
Jennifer Yutzky	(Wm Chrisman)

Program moved to near the main Kansas City Volker Campus of UMKC (about 15 miles away), leaving our Independence building empty save for the MPI and a new tenant, the Independence campus of the Metropolitan Community Colleges (MCC). But UMKC, in cooperation with both the MCC and the Independence School District, announced on Jan. 24 plans to use the vast amount of space that still remains, changing the name of the building from the "UMKC Truman Campus" to the "Higher Education Center". A number of courses, special programs, etc. have already been proposed and only time will tell just what sort of new life the building will engender. But, in any case the MPI will definitely be a part of it.

RECRUITMENT DAY -- FEB. 15

On Tuesday Feb. 15, 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 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.

ENGINEERING IS GONE; BUT OUR BUILDING TAKES ON NEW LIFE

Over the 1993 Christmas vacation the entire UMKC Engineering

TO ALL MPI ALUMNI:

HAVE YOU GRADUATED
FROM COLLEGE?

IF SO:

PLEASE CONSIDER BEING
AN MPI ENRICHMENT SPEAKER!

CALL (816) 235-1272

MATHEMATICS TECHNOLOGY REPORT

1. After extensive rewriting by the mathematics coordinator last summer, the MPI calculus PC labs are now even more focused, and as a result have operated smoothly this year. There are now approximately 5 Pre-Calculus labs, 20 Calculus I labs, and 10 Calculus II labs, some of which were written by the mathematics coordinator, others culled and usually heavily modified from sources such as: Calculus Laboratories Using Derive, by Leinbach (1991); Calculus and the

Derive Program - Experiments with the Computer, by Gilligan and Marquardt (1991); Exploring Calculus with Derive, by Arney (1992); Discovering Calculus with Derive, by Johnson and Evans (1992); and, Student Research Projects in Calculus, by Cohen, et.al. (1991). All have been chosen to encourage strong analytical thinking, using Derive and other software ONLY where appropriate. None are routine, as our students will often attest.

2. We have also made frequent use of our new SHARP color LCD projection panel to augment lectures with PC demonstrations, such as for Newton's Method, to show videos more conveniently, such as calculus videos, and for enrichment speakers, such as with a Lasers program written and used by David Wieliczka in his recent Lasers and Holograms talk.

3. Our SHARP EL-9300C graphics calculators have become staples in the classroom, largely being used to produce graphs during problem solving, or even lectures. Students can convince themselves of what they are hearing, and so, we hope, remember better. We allow the use of these calculators in ALL exams in both courses, which has posed a challenge in the thoughtful design of these exams.

VISITS AND CONFERENCES

Fri. Dec. 3, before we broke for Christmas vacation, a television crew working for the Independence School District visited and videotaped MPI students in both a Physics Lab (uniform circular motion) and a Calculus PC Lab (Newton's Method for locating roots).

Jan. 3-8 both Larry Harding and Richard Waring attended the annual AAPT (American Association of Physics Teachers) conference in San Diego, CA.

On Jan. 24, two women from the Kansas City, MO District Talented and Gifted Program, Charlene Luster and Isabel Nash, visited the MPI to acquaint themselves with our program. They discussed the possible addition of one or two Kansas City schools (Lincoln and/or Central) to the MPI pool.

Feb. 22-25, Sheri Adams will attend an NSF-sponsored Task Force in Washington, D.C., to make recommendations on where mathematics and science education in the US should go.

MPI STATISTICS - FYI

On average over the last 9 years, 75% of students who start the MPI actually finish, as shown below:

	Start	Finish	Percentage
Year 1	73	55	75%
Year 2	73	57	78%
Year 3	57	45	79%
Year 4	63	42	67%
Year 5	58	48	83%
Year 6	66	50	76%
Year 7	60	43	72%
Year 8	70	48	69%
Year 9	51	40	78%

ENRICHMENTS

FOLLOW UP

On Dec. 10, Frank Booth again brought to us his captivating talk **SCIENCE IN THE CRIME LAB**, and here's a sample of what our students had to say:

--Mr. Booth talked about how Physics is used in forensics. He uses it to find suspects - ex: analyzing hair particles, using luminal to find blood, fingerprints, etc. We saw how chemistry, biology and physics are his entire job. An example of physics--how far away a suspect was from a shooting victim.

--Mr. Booth combined interesting stories with his informative slides to give a very enjoyable talk... Without visual aids this would have lost so much meaning.

--He shared with us a lot of information that I might of heard of but didn't realize worked. I knew that hairs were different from people to people, but not so different on the same head. I didn't know that if you sprayed luminal on blood that it would glow in the dark. He explained how every gun leaves a different mark on any given bullet, because of the way the grooves inside the gun were made. I like the fact that he brought props--blood stained carpet and bullets.

--They use super glue vapors to find fingerprints. * Very interesting.

--If you ever want to kill someone, don't do it on carpet--it's too easy to track down the blood. This was by far the most interesting and understandable enrichment yet!

--This week's enrichment speaker should be commended for his avoidance of technical jargon and presumptions of our previous knowledge. (His speech was easy to understand without a BS in Chemistry!) I enjoyed hearing the stories of particular crimes and the odd ways in which they were solved. The demonstration of blood detection on carpets was great, too!

Our 9th Annual **PANEL DISCUSSION** on Jan. 5 was again held in Rm. 207, "The Loft", and moderated by Sheri Adams and Al Morse. As usual, each of the 5 panelists discussed their college experience, and their major.

The alumni panelists this year were:

- | | |
|--|--------------|
| Pat Liang | 86-87 |
| BS Biochemistry (University of Indiana Medical School) | |
| Anthony Thornton | 88-89 |
| University of MO-Kansas City
Electrical Engineering Major | |
| Jason Anderson | 90-91 |
| Worcester Polytechnic Institute
Engineering Major | |
| Jeff Hoskins | 90-91 |
| University of MO-Columbia
Biology/Pre-Med Major | |
| Laura Dilley | 91-92 |
| Massachusetts Institute of Technology
Linguistics, Brain & Cognitive Sciences Major | |

Their presentations were generally well-received. In all, 11 former MPI students appeared. Some specific current MPI student comments were:

--They told us how they are doing and how they have to work more in college and have to budget their time wiser than ever before because they are out on their own and no one is there to watch over them.

--It was interesting to see how the

students who all came from around this area spread out to where they are now. It was good to see how the students chose different fields of study, and how the MPI helped them to pursue the area of study.

--The speaker who influenced me the most was the oldest guy who was in his 3rd year of medical school [Pat Liang]. Medicine is the direction that I am headed, but he filled me with fear of the next few years. I guess until yesterday, the realization never hit me of how much I need to learn (truly learn and comprehend), and how much money I will need in the next few years. I was floored when he said that he will be \$65,000 in debt at graduation.

--It was one of the more interesting enrichments we've had because of the variety of experiences and the fact that this specifically pertains to us. It was wonderful to know that some of the successful college students struggled a lot at MPI.

--It's okay if you are unsure of what you want to do for a job. With college you will get a variety of opportunities such as traveling to Bangkok and maybe publishing a paper. Honors programs really help a lot because you get experience on the job and get paid for it.

--MPI prepares you for college! Everyone on the panel said how the MPI helped them when they attended college the next fall. Anthony Thornton said, "If you make it here, you can make it in college." The importance of the MPI was also emphasized when Jason Anderson said, "Don't disregard the [MPI] because it can be very valuable. It saved me \$10,000 in tuition." The one thing that MPI helped them to become was a career student, which prepared them for their futures.

--I like how even at this stage of their college careers, only one or two had some specific idea of what they will be pursuing as a career. This was very encouraging for those who haven't even decided on a possible major yet.

--I feel that the more I heard alumni of MPI speak on surviving, the more encouragement I have. I've had severe problems here with physics and the more I heard, I knew that I'm not the first to fail.

--After the panel, there was food and refreshments for everyone. That time was ours to talk personally to the alumni. Excellent opportunity to hear about college from people who are experiencing it now.

On Jan. 14 when 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:

--He talked about holograms, which are 3-dimensional, and how it will be cheaper for car manufacturers to make a hologram of a new car rather than make different (clay) models. They have not perfected color in holograms yet.

--He brought in a few laser displays for us along with some interesting facts, one of those being that "laser" has only been a word for about five years. Before that it was an acronym. He showed us how the laser actually works: An atom is excited to the point that it decays, and once it decays it releases energy in the form of a wave. This wave then passes through other atoms causing them to decay and release more energy, which increases the amplitude of the wave so that by the time it is released it is very focused. All in all it was an excellent and enlightening lecture.

--The concept of a hologram was thought of as possible 100 years before it was even created.

--He began with a clear description of what a laser is and how it is different from regular light. He made good use of his instruments (computer and lasers) which made it easily understood and interesting. He then moved into holograms and stressed their usefulness in our world today and for tomorrow. I also enjoyed the explanations of how they work and what they are exactly. I always enjoy learning about things that are new and will be of the future.

--Since I am a future doctor, the part of his discussion that interested me the most was when he

described laser operations during surgical procedures.

Finally, Ed Kiker returned for a second time this year, to speak on **THE DESIGN PROCESS IN CYBERNETIC SYSTEMS**. Students responded as follows:

--He told us the process and everything involved with a project. He also went over all the steps needed and all the people necessary to make it work. He touched on the Delta Clipper and how UPS would like to use it to have your package anywhere around the world in one hour.

--Satellites must be autonomous, without maintenance. You must design for function maintenance, and actual use. Problems in space: corrosion, static buildup, meteorites, radiation. Models should be constructed to explain designs, like public relations, work tunnels, 2 and 3 dimensional mock-ups. I liked all the stuff he brought in to show us.

--He talked about the Delta Clipper and tentative plans for mining helium on the moon. His main objective, however, was talking about the importance of properly executing a project.

--He emphasized that lunar mining will take place and the importance of looking into the future and envisioning what will be taking place.

UPCOMING

On Feb. 11, we will welcome a new speaker, Michael Kruger, a recent addition to the UMKC Physics Dept. from U.C. Berkeley, whose field is the study of high pressure physics using diamond anvil cells. The title of his talk will be: **JOURNEY TO THE CENTER OF THE EARTH**.

We haven't scheduled a speaker for Feb. 25, but on Mar. 11, we'll welcome back to the MPI, this time as a speaker, one of our former physics tutors from 1985-86 (when we still had tutors). Lori Hill, now a Senior Software Engineer at Wilcox Electric, will discuss: **LANDING PLANES USING SATELLITES: THE GLOBAL POSITIONING SYSTEM**.

We have not yet confirmed a speaker for Mar. 25.

MPI E-MAIL ADDRESS:

rdelaware@vax1.umkc.edu

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

WE HEAR FROM PAST STUDENTS

REESE ISBELL (87-88)
(BA Sociology, UMKC)

"I will be going to grad school out of state in Political Science... I work part-time at Menorah Med. Ctr., but my occupation is with Planned Parenthood of Greater Kansas City. Outside work I am on the Board of Directors of the Human Rights Project, and a liaison to the GKC (Greater Kansas City) Choice Coalition, MO Alliance for Choice, and Harmony in a World of Difference. Sorry I won't be able to make the reunion."

TROY STOGSDILL (90-91)
(Biology Major)

"The instructors at MPI are maybe a little more friendly. MPI is on a more personal level and the professor-student interaction level is higher which makes things a little easier."

SCOTT HUMMEL (91-92)
(Biology/Pre-Med Major)

"I have not taken any physics yet. My physics at MPI transferred as 1st semester of my 2 semesters required physics at [Wm] Jewell [College]. In calculus, I felt well prepared. They were using the same book we used. I transferred with 1st sem. and took 2nd sem. We had covered a little more on 1st sem. [at the MPI] so I did not feel behind. In fact I felt a little ahead. I do not plan to take any more calculus.

I feel the taste of the college experience helped me in several

areas. I was more prepared for the change in study habits required. Also, for the change to classes geared toward lecture-type teaching. In addition, I liked the chance to meet new people and learn from others as to how different schools teach.

I would like to give the MPI a high recommendation. I feel it is an excellent program that offers many unique experiences to high school seniors. I would like to thank all the MPI professors for the fine job they did."

VALERIE SUMMERS (92-93)
(Veterinary Medicine Major)

"It gave me a taste of real college life and helped prepare me for what was ahead. I wish I would have taken the MPI courses more seriously and did what I was supposed to because now I have to go back and start all over again."

HANG DU (88-89)
(Elementary Education Major)

"I will be graduating this May with a bachelor's degree in Elementary Education. This [MPI] program was a great experience. You have all done a wonderful job."

RACHEL MACK (88-89)
(BS Mathematics)

"You finally were able to convince me to respond -- I am not lost! As I wrote above, I am currently working for Blue Cross and Blue Shield as a group auditor--it is new for me, as I just started Oct. 25, 1993. Although it is not what I want to do for "the rest of my life", I believe it is good experience; however, I look forward to the day when I am able to return to school. I am not sure what graduate degree I want to pursue, but I know that eventually I will go back. The MPI was a very "intellectually stimulating experience" for me--I believe it did prepare me for college as well as boost my self confidence--you were a great team of teachers with a lot of dedication to education as well as making education a "fun" experience! Hope everyone is doing

well! Especially Joe ... (Mr. Kaifes) he always made me smile! THANK YOU AND TAKE CARE."

TAMMY PHELPS (88-89)
(BS Biology/Pre-Med.)

"As I am getting "older & wiser" as you put it, I look back and realize that the best time to develop good study habits is ASAP! Even if you know the subject well already, learn it so that you could teach it blindfolded to someone else. No matter how trivial it seems, learn it. You'd be surprised when you need it or how often I say to myself, "I remember studying that", but that's all I remember. The best thing I've done is kept a balance between studies, family and activities I love to do. Make time. Even now that I am in medical school, I still take time to kick back and relax a bit. It's worth it."

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

"I actually thought MPI was more challenging because the material was the same as college level courses but we were just high school students who did not have fine-tuned study skills.

It prepared me for college and gave me a head start on everyone else in developing adequate study skills. It also allowed me to bypass some of the lower level classes that other freshmen have to take."

JACQUELYNNE MORRIS (90-91)
(Mechanical Engineering Major)

"The classes at MPI were smaller, so there was more personal attention. The teachers at MPI were better instructors. Quite a few of my teachers at UMC are, well, incompetent. I hate having to correct the teachers. The class knows more than the instructor does! I appreciate the self-confidence, and knowledge of the instructors at MPI. When they are sure of themselves and are secure in their knowledge--you feel more secure as a student. It [does] help at UMC that some of the instructors have been out in industry

and can give practical uses for what we're learning--it makes it seem worthwhile!

The MPI made me appreciate good teachers when I had them! While at the MPI, I also lost my fear to ask questions in class--in front of people I don't know. Remember--the only stupid questions are the ones you don't ask!! MPI also helped me learn to pace myself--work everyday on the problems--not just before the test. I remember the enrichment speakers that came to talk about time management--I really didn't appreciate it much then, but I do now.

I recommend [that] more enrichment speakers, like Shelley Wolff with the highway design project, come. I would've liked to do more design, or practical projects--perhaps in fields other than civil engineering. I did love the other enrichment speakers. I heard about the graphing calculators--a good idea because a lot of students at UMC have them and don't know how to use them."

TONY PRETTEJOHN (91-92)
(Industrial Engineering/Mathematics Major)

"The physics course at MPI was much easier than the Phys 175 course that I was required to take at MU. Every one of the problems was an applied problem requiring manipulation of formulas to get to the answer. At MPI it seemed as if we just memorized formulas and plugged numbers in. The mathematics courses have been about the same difficulty level, but more homework is required to be turned in.

I truly believe MPI made me realize what STUDYING is. All through high school I cruised through courses with easy A's. Then I found out through MPI that "smart" people have to study too. MU is a really competitive engineering school because many of the smarter high school students from the state attend there. It is very frustrating going from top of the class to somewhere in the middle. I think that this semester I finally stepped up to the challenge and I got a 3.13, so I was pleased.

Incorporate a lot of math on the computer because that is all I did in Calc II & III. MU seems really determined to teach math on the computer (I don't know if I agree)."

JASON VannATTA (91-92)
(Pre-Med Major)

"Actually, the courses at MPI were more personal due to the class size. The instruction was as good or better than what I have so far received.

I was better prepared for the "college" method of studying. It was a definite advantage to have attended MPI.

Just keep up the good work! After graduation I joined the military to go have an adventure. I got out after a year and now I'm back on track. I missed going to school and learning. I've been working full time and attending a community college at night. This coming August I plan to transfer to MU in Columbia to get my degree(s). MPI was a great experience and a major reason I'm returning to school. Thank you!"

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

"When in trouble, get help from other students, sit and do problems and don't give up until you understand completely.

Integrate what was previously learned with what is being learned.

I was given more responsibilities [at the MPI] and became more responsible because of it. I'm not one to ignore assigned homework, so when a ton was assigned, I made the time for it.

It was incredibly nice to have Calc I out of the way going into college. 1.) I didn't have to take a stupid math placement test. 2.) I didn't have to stay back; I'm ahead of everyone else.

Last year I thought I had a heavy load w/college prep English, Calc I, Physics, etc. That was nothing compared to what I've had to

do this year so far. I cannot believe I thought last year was hard."

ANDREA SLUSSER (92-93)
(Architecture Major)

"I believe [the MPI] better prepared me for college, forced me to accept responsibilities and mature much faster than some of my peers.

It is a wonderful opportunity that if it is available one should take advantage of it.

I believe MPI functions as it was meant to, it prepares students for what college is really like--the instructors were great--similar to what college professors are like. Although stressful at times it was a wise decision for me to go--even if the courses were redundant to my major. I was prepared for college more so than my peers and better adjusted to the demands college puts on you."

TODD JOHANN (92-93)
(Undecided Major)

"I do not plan to major in a science. This being the case I can not say with any certainty how MPI helped with courses. I can say however that the MPI is clearly the best opportunity students have in the area for studying calculus and physics and colleges frown upon a student who would pass up the opportunity."

HOLLY BUXTER (90-91)
(Mechanical Engineering Major)

"My experience at the MPI most closely resembles the later more specialized classes in my major. The classes are smaller, and the profs more approachable. The math and physics classes I have taken here have been nothing like the MPI, the classes are too big for the profs to even notice you--let alone know your name or offer extra help.

I wish I appreciated the MPI as much as I do now, when I was there. I look back and see so many opportunities I didn't take full advantage of. Now if I see such an opportunity--I jump at it!"

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

"I am taking a German language class through the University of Maryland Extension Center on Rhein Main Air Base, Germany where my husband is stationed, so to keep my schooling going.

The quality of teaching [at the MPI] was much better than some of the classes I have had. The teachers don't get to know their students, and many rarely take the time to help with materials covered in class. You all do those things, which helps immensely.

It gave me an early jump into the college way of doing things. The classes ease you into your advanced education, rather than suddenly waking up and finding yourself there."

MORE 93-94 STUDENT IMPRESSIONS

"So far, MPI has been of great value to me. Along with the regular studies of calculus and physics, MPI professors regularly employ labs which enables the students to relate their studies to the real world and see how they can be used. This, in conjunction with the more advanced learning rate, gives MPI students an extra step on other high school students."

Josh Small
Wm Chrisman High School
Independence School District

[In Vietnamese]

"Lo sợ và bồi rồi là những cảm giác của Dung đã có vào những ngày đầu học ở MPI. Nhưng với sự giúp đỡ của thầy cô và bạn bè, đã giúp Dung tự tin hơn, với Dung MPI là một cơ hội rất tốt để học hỏi và lấy kinh nghiệm. Là một người đi trước, Dung cũng có ít nhiều kinh nghiệm muốn chia sẻ cùng các bạn đó là, hãy dành một thời gian mỗi ngày cho MPI, đừng chán nản và bỏ cuộc và hãy cố gắng nhiều hơn nữa. Dung chắc chắn rằng các bạn sẽ đạt được nhiều kết quả tốt đẹp.

[English Translation]

I was nervous and kept wondering whether I could keep up

with the program on the first few days at MPI. But that feeling soon disappeared because of all the help and the concerns of the teachers and [my] friends. So I like to take this opportunity to share with you what I have learned through the program: Work hard, be punctual, take good notes, and work harder. And most important, if you spend a lot of time for something you care [about], the good results shall be on your side. I know it works because I worked for it."

Dung La
Northeast High School
Kansas City School District

"Sometimes I wonder how I handle the MPI, two part-time jobs, high school, other college classes and DECA (An Association of Marketing Students). It seems like a lot and it is, but I just set my priorities and go from there. I would not recommend trying to take on too much but if you do, take it easy and relax every once in a while. The MPI is not easy but it will prepare you for college. It has taught me that when I go to college not to take on too much and concentrate on my education."

Daisie Riley
Van Horn High School
Kansas City School District

"You must admit, it can be funny doing calculus at 7:00 A.M. Most people don't understand anything at 7:00 A.M., let alone calculus."

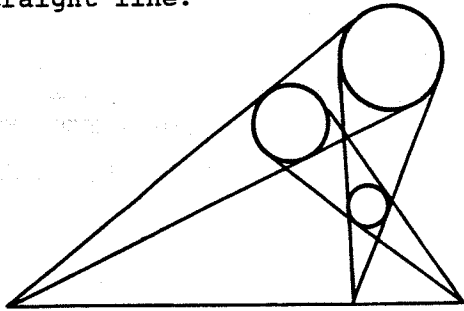
Chris Goldsmith
Truman High School
Independence School District

A SOLUTION TO MATHEMATICS CHALLENGE #31

Recall the problem statement:

Draw any 3 circles, no 2 of which are equal. There are then 3 PAIRS of circles. For each pair of circles, draw the 2 common outside tangent lines [see the sketch below] which of course, since the circles in the pair are not equal, must intersect somewhere in a point.

Show that the 3 intersection points so formed ALWAYS lie in a straight line.

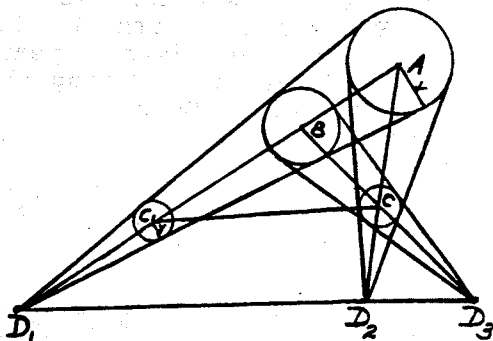


This problem is attributed to Prof. John Sweet, a famous engineer at Cornell University until his death in 1916.

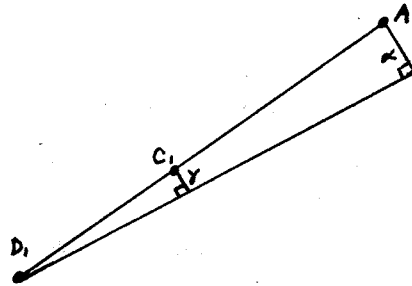
[From: Ingenious Mathematical Problems and Methods, by L.A. Graham]

SOLUTION:

We begin by modifying the figure in the statement of the problem. Suppose the 3 circles and their various common tangents have been drawn as above. Suppose further that we label the CENTERS of the circles from largest to smallest as A, B, and C, the radius of the largest circle as α , the radius of the smallest circle as γ , the 3 intersection points as D_1 , D_2 , and D_3 , and draw lines through the centers of the circles to these intersection points. Finally, we draw between the common tangents of the two largest circles (which have centers A and B), a fourth "auxiliary" circle, with center C_1 , identical to the smallest circle, whose center is C. These modifications are shown here:



Now, by examining the SIMILAR triangles isolated below, involving A,

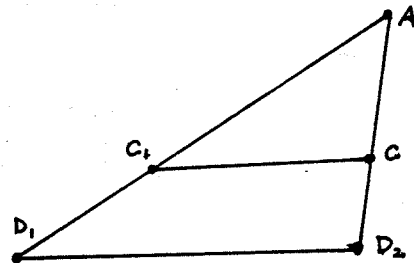


we see that the following ratios are equal: $\frac{\alpha}{\gamma} = \frac{AD_1}{C_1D_1} = \frac{AD_2}{CD_2}$. Then

rearranging the last equality with a little algebra, we have:

$$\frac{AD_1}{AD_2} = \frac{C_1D_1}{CD_2}, \text{ which implies that}$$

the following triangles are ALSO similar:



In particular, C_1C must be PARALLEL to D_1D_2 .

A similar argument using B shows that C_1C is also parallel to D_1D_3 . Thus, D_1 , D_2 , and D_3 are collinear, meaning $D_1D_2D_3$ is in fact a single straight line as desired.

It is reported that when Professor Sweet first heard this problem he said "Yes, that is perfectly self evident." He then explained his reasoning: "Instead of 3 circles in a plane, imagine 3 balls lying on a surface plate. Instead of drawing tangents, imagine a cone wrapped around each pair of balls. The apexes of the 3 cones will then lie on the surface plate. On the top of the balls lay another surface plate. It will rest on the 3 balls and will be necessarily tangent to each of the 3 cones, and will contain the apexes of the 3 cones. Thus the apexes of the 3 cones will lie in both of the surface plates, hence they must lie in the intersection of

the two plates, which is of course a straight line."

[From: Ingenious Mathematical Problems and Methods, by L.A. Graham]

A SOLUTION TO PHYSICS CHALLENGE #22

Recall the problem statement:

PHYSICS AT THE BAT

If a batter hits a baseball too close to the end of the bat or too close to the neck of the bat, the impact will sting the batter's hands. At what point along the bat should the ball be hit in order to minimize the sting?

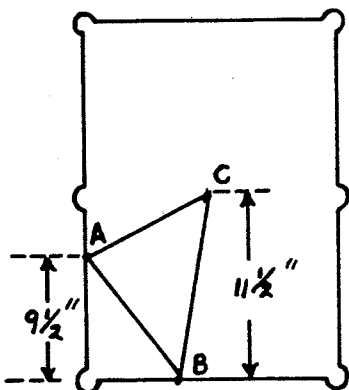
[From: Pasco Scientific Lab Notes]

SOLUTION:

If you approximate the bat as a uniform rod hinged at one end (the hands), then by considering the momentum change and the moments of inertia around the hinge, you will discover that the distance along the bat to the impact point should be the same as the length of the equivalent pendulum. Here, the point is $2/3$ of the distance along the bat. This point is often called the "center of percussion."

MATHEMATICS CHALLENGE #32

Suppose the (equilateral) triangle used to rack the balls for a game of pool is lying on the pool table as shown, where the measurements are given in inches:



How far is the point B from the nearest (lower left) pocket?

[From: Ingenious Mathematical Problems and Methods, by L.A. Graham]

PHYSICS CHALLENGE #23

SNOW CATCHER

A woman skiing across a field with a speed of $v = 20$ km/hour in a heavy snowfall observed that her mouth encountered $N_1 = 50$ snowflakes per minute. After turning back across the field, she noticed that only $N_2 = 30$ snowflakes hit her mouth per minute when skiing with the same speed. (A very observant woman indeed!) She also noticed that the wind velocity in her original direction was a constant w km/hour. [Assume $S = 24$ cm² is the area of the her mouth in the direction of travel.]

Estimate the Visibility during this time, where "Visibility" can be estimated as the average length L of a cylinder with cross-sectional area A equal to the area of 1 snowflake. [Assume that the average diameter of a snowflake is $d = 1$ cm.]

[From: M. Semyonov, Quantum Magazine, Nov/Dec 1993]

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