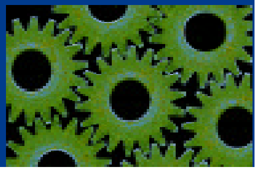


Brain Ticklers

RESULTS FROM SUMMER 2003

Perfect

Biggadike, Robert H.	AR	A	'58
Creutz, Michael J.	CA	B	'66
Creutz, Edward C.	PA	Γ	'36
Galer, Craig K.	MI	A	'77
* Garnett, James M.	MS	A	'65
Kay, Nathaniel E.	OH	Λ	'01
* Kimsey, David B.	AL	A	'71
Schmidt, V. Hugo	WA	B	'51
Snelling, William E.	GA	A	'79
Strong, Michael D.	PA	A	'84

Other

Akridge, G. Russell	GA	A	'62
Alderson, William S.	MI	E	'43
Alexander, Jay A.	IL	Γ	'86
Anidi, Chibueze E.	Non-member		
Atobatele, Timothy A.	NV	B	'02
Baines, Elliot A., Jr.	NY	Δ	'78
Baxter, Denmer D.	MO	Γ	'54
Brule, John D.	MI	B	'49
Cameron, Charles M.	OH	Γ	'01
Caputo, William R.	NJ	Γ	'55
de Nobel, Richard W.	OH	A	'52
Erwin, Grant W., Jr.	Father		
Freese, Herbert A.	Non-member		
Garside, Jeffrey J.	WI	E	'90
Johnson, Roger W.	MN	A	'79
Jones, Donlan F.	CA	Z	'52
Kern, Peter L.	NY	Λ	'62
Koo, John S.	NY	P	'03
Marks, Laurence B.	NY	I	'81
Marrone, James D.	IN	A	'87
Mazeika, Daniel F.	PA	B	'55
McGrath, Brian P.	IN	A	'04
Mitchell, Donald B.	CA	Γ	'59
Nabutovsky, Joseph	Father		
Post, Irving G.	PA	E	'58
Quintana, Juan S.	OH	Θ	'62
Rentz, Peter E.	IN	A	'55
Piersol, Allan G.	Non-member		
Reyes, Albert J.	Non-member		
Routh, Andre G.	FL	B	'89
Skorina, Frank K.	NY	M	'83
Small, Mitchell J.	NY	Γ	'61
Snyder, M. Duane	IA	B	'63
Spong, Robert N.	UT	A	'58
Stone, Laurence D.	MA	Θ	'86
Musbach, Avery	Son		
Stribling, Jeffrey R.	CA	A	'92
Summerfield, Steven L.	MO	Γ	'85
Valko, Andrew G.	PA	Λ	'80
VanShaar, Steven R.	UT	Γ	'00
Wan, Yew Kong Mark	CA	A	'03
Watkins, Matthew A.	NY	N	'05
Wechsler, Lawrence D.	NY	E	'55
Wolff, Nicholas L.	NE	A	'00

*Denotes correct bonus solution

SUMMER REVIEW

The most difficult problem was the Bonus, about mailing a cone, with only two correct answers. The shortest line connecting two points on a surface, a geodesic, on a cone is a straight line when the cone is flattened. Problem 1 about a pile of cannonballs in the shape of a tetrahedron was also difficult. Many entries gave a square-base solution, whereas a tetrahedron has a triangular base.

FALL ANSWERS

Here are the solutions to the Fall Brain Ticklers. Fall entries will be acknowledged in the Spring issue.

1. Doyle is the ornithologist, and he earned only one point. For final totals of A>B>C>D, the only possibilities for (A,B,C,D) are (6,5,1,0), (6,4,2,0), (6,3,2,1), (5,4,3,0), and (5,4,2,1). So, A either wins all three matches or wins two and ties one, and D either loses all three matches or loses two and ties one. Investigation of the possible outcomes with these restraints gives multiple possible outcomes with one or two ties, no possible outcomes for four or more ties, and only one possible outcome for three ties. Namely, A and B tie, C and D tie, A beats C, A beats D, B and C tie, B beats D, and C and D tie. So, the first round was A vs. D and B vs. C, and A is the lion tamer and B or C is the musician. The last round was A vs. C and B vs. D, and B is the neurologist. So, Doyle is the ornithologist and managed only a tie.

2. It is Betty's birthday. $A + B + C = 80$, $A = 2C$, $A + T = 2(B + T)$, and $(A + T) + (B + T) + (C + T) = 1.5(80) = 120$. Combining the first and last equations yields $T = 40/3$. This reduces the third equation to $2B = A - 40/3$ which can be solved simultaneously with the first two equations to yield $A = 130/3$, $B = 15$, and $C = 65/3$.

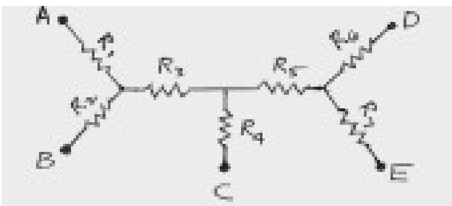
3. Ben's probability of winning is 7/8 if he chooses THH. Of the eight possible initial sequences of three coin tosses, Al wins if HHH occurs, but Ben will eventually win with the other seven possible sequences.

4. At what spin rate of the Earth would loose mass lift off at the equator? Lift off occurs when gravitational acceleration g equals radial acceleration of v^2/r where v is the tangential velocity and r is the radius of the Earth. Solving this equation yields a tangential velocity of about 7,909 meters per second at the equator, which is about 6,228 rotations per year or about 17 rotations per 24 hours. Note that the mass of the person was not a factor in the solution.

5. The cone will revolve $\sqrt{[1 + (H/R)^2]}$ times about its axis in order to generate a full circle as it rolls on a plane. The slant height of a right circular cone of height H and radius R is $\sqrt{(H^2 + R^2)}$. So the circumference of the generated circle on the plane is $2\pi\sqrt{(H^2 + R^2)}$, and the circumference of the cone's base is $2\pi R$. The ratio of these two values is the desired answer.

BONUS. For a black box with n terminals, the number of different connections to pairs of terminals is $n(n - 1)/2$. Therefore, five terminals yield 10 different connections. We have found seven configurations, ignoring reflections, for a black box with five external terminals to permit integral resistance measurements from 1 through 10 ohms by proper choice of two terminals. The key is to recognize that the solution requires the use of 0.5 ohm resistances, which can be produced by wiring two one-ohm resistors in parallel. Then you must visualize possible configurations and try different resistor values. We awarded credit if you found only one solution!

Shown below are our generalized configuration and the seven solutions we found.



R_1	R_2	R_3	R_4	R_5	R_6	R_7	Total Used
0	1	0	2	0.5	3.5	6.5	18
0	1	0	2	2.5	1.5	5.5	17
0	1	0	2	4.5	0.5	3.5	16
0	1	1.5	0.5	0	3.5	6.5	19
0	1	1.5	0.5	2	1.5	5.5	18
0	1	1.5	0.5	4	0.5	3.5	17
0	1	5	0	1.5	0.5	2.5	15

COMPUTER BONUS. The last non-zero digit is 4. The factorial 1,000,000! ends in …58412544 followed by 249,998 zeros. You have to be careful in your computer programming in how you handle factors ending in 5 to be sure you carry enough places.

NEW WINTER PROBLEMS

1. Find the largest integer such that each pair of consecutive digits is a different prime.

—*Penguin Dictionary of Curious and Interesting Numbers*

2. Solve the following cryptic multiplication, which is also correct in Spanish. Please don't use a computer on this one!

DOS × DOS = CUATRO

—**Alfredo J. Peralta,** *MA* B *'54*

3. Consider a series of five real numbers, such that $n_{i+1}/n_i = Q$ for i = 1, 2, 3, or 4. For what values of Q do the sum of the first three terms in the series equal the sum of the last two terms?

—**Craig K. Galer,** *MI* A *'77*

4. Place 16 non-zero digits in the squares of a 4 × 4 grid such that each row, from left to right, and each column, from top to bottom, is a perfect square. The square numbers do not all have to be different from each other.

—**Richard I. Hess,** *CA* B *'62*

5. Assume the Pentagon building, near Washington, DC, is situated on a flat plane with no restrictions in visibility. If you are situated at a random point at ground level exactly 6 km from the center of the Pentagon, what is the probability that you can see three sides of the building? Assume the length of a side of the Pentagon is 281 m.

—**Paul A. Sabatino,** *NY* M *'83*

BONUS. Craps is played with a pair of standard dice. If a player first rolls a 2, 3, or 12, he loses. And, if he first rolls a 7 or 11, he wins. Otherwise, he continues rolling until he matches the original number, in which case he wins, or he rolls a 7, in which case he loses. Assume an unethical gambler can load one face of one die so the probability of that face coming up is 1/3 while the probability of any of the other faces coming up is reduced to 2/15. Which face should he load to maximize his probability of winning? And, what is that probability expressed as a rational number?

—**Howard G. McIlvried III,** *PA* Γ *'53*

COMPUTER BONUS. Let us define a *maxdigital* number as a 10-digit number with no leading zero that contains the digits 0 through 9 each exactly once. The largest such number is 9,876,543,210, which is obviously divisible by 2 and 5. When we perform these divisions, we get two other maxdigital numbers, 4,938,271,605 and 1,975,308,642. It is easy to find the largest maxdigital numbers which are 4 and 8 times other maxdigital numbers. But what are the largest maxdigital numbers which are exactly 3, 6, 7, and 9 times other maxdigital numbers?

— Colin Singleton in *New Scientist*

By the way, if you are rusty on writing computer programs to solve repetitive math calculations, such as is needed to solve the Computer Bonus, please email me at *dondechman@aol.com* and I will get you started. And I'll write a Math Corner article on the subject if there is enough interest.

Send your answers to any or all of the Winter Brain Ticklers to:

Jim Froula
Tau Beta Pi
P. O. Box 2697
Knoxville, TN 37901-2697

The cutoff date is the appearance of the Spring issue in early April, and acknowledgments will be made in the Summer column.

If your answers are text only, they may be emailed to *Brainticklers@tbp.org.*

The details of your calculations are not required, and the Computer Bonus is not graded.

Jim will forward your entries to the judges: Howard G. McIlvried III, *PA* Γ *'53;* Fred J. Tydeman, *CA* Δ *'73;* John L. Bradshaw, *PA* A *'82;* and the columnist for this issue,

—**Don A. Dechman,** *TX* A *'57.*

40 TBΠ SCHOLARSHIPS

The Tau Beta Pi Association Scholarship Program for senior-year study during the 2004-05 academic year will close March 1, 2004, when applications must be in the hands of Director of Fellowships D. Stephen Pierre Jr., P.E., Alabama Power Company, P.O. Box 2247, Mobile, AL 36652-2247.

A record total of up to 40 cash awards, each worth $2,000, will be given in our fantastic, expanding program. Winners will be notified in early April. Junior members of TBΠ are eligible to apply. Applications are available at *www.tbp.org.*