Puzzle Corner

INTRODUCTION

Since this is the first issue of a new academic year, let me once again review the ground rules under which this column is conducted.

In each issue, I present three regular problems (the first of which is often chess, bridge, go or computer-related) and one "speed" problem. Readers are invited to submit solutions to the regular problems, and two issues later, one submitted solution is printed for each regular problem; I also list other readers who responded. For example, solutions to the problems you see below will appear in the January/February 2000 issue of *Technology Review* and the current issue contains solutions to the problems posed in the May/June issue.

The January/February 2000 column will be due in early November. Please try to send your solutions early to ensure that they arrive before my submission deadline. Late solutions, as well as comments on published solutions, are acknowledged in subsequent issues in the "Other Responders" section. Major corrections or additions to published solutions are sometimes printed in the "Better Late Than Never" section, as are solutions to previously unsolved problems.

For speed problems the procedure is quite different. Often whimsical, these problems should not be taken too seriously. If the proposer submits a solution with the problem, that solution appears at the end of the same column in which the problem is published. For example, the solution to this issue's speed problem is given below. Only rarely are comments on speed problems published.

There is also an annual problem, published in the Jan/Feb issue of each year, and sometimes I go back into history to republish problems that remained unsolved after their first appearance.

PROBLEMS

S/O 1. Larry Kells has a three-part problem entitled "War Returns" that once again involves our poor husband who keeps facing tough luck at the table. I am presenting Part I this issue. Kells writes:

Sometime later I saw the man from the bridge club sitting on a park bench again, sobbing. I asked him what the matter was. He said his wife had just thrown him out of the house for good. During a club session that I had missed, he had had three high-level doubled contracts made against him. In each case, he had dealt and opened the bidding with sound values for his bid, but in the end "even God couldn't sink those contracts!"

"First, I held the Q108654 of hearts, AK of spades and 13 points overall. I opened one heart, my wife responded one spade, and I rebid two hearts. Suddenly, the opponents jumped in and the bidding did not end until it reached six hearts doubled."

"So you didn't have the values to warrant bidding that high."

"You don't understand, it was the opponents who bid six hearts, I doubled, and they made it!"

"Wow! Your wife must have made some stupid mistake in the play."

"No, that contract was impregnable! My wife glowered daggers at me when it was over."

What deal produced this suprising result?

S/O 2. John Prussing has a problem that I can use when I next want to go bowling with one of the blown glass balls we have around the house.

The moment of inertia of a homogeneous sphere about an axis through its center is $I = {}^2/_5 MR^2$, where M is the mass of the sphere and R is the radius. The moment of inertia of a (hollow) homogeneous spherical shell can be obtained by subtraction to be $I = {}^2/_5(M_1R_1^2 - M_2R_2^2)$. Determine the moment of inertia of a thin homogeneous spherical shell of mass M and radius R. The thickness of the shell is negligible compared to the radius and so all the mass may be considered at a distance R from the center.

S/O 3. Our last regular problem is from David Brahm, who believes it is originally from Yoshiyuki Kotani. An ant travels only along the floor, walls and ceiling of a 1x1x2 room. If he starts in a corner, what is the furthest away point he can reach? Measure distance as the ant travels (rather than as the crow flies).

SPEED DEPARTMENT

Michael Foster remarks an old "Puzzle Corner" problem of finding an English word containing a given pattern was popular at Bell Labs in the 1970s (I believe the original pattern was "ookkee" and one possible answer "bookkeeper"). Foster offers us three more patterns to try: "hipe," "hcr" and "ufa."

SOLUTIONS

M/J 1. We begin with a bridge problem from Larry Kells, who wonders about the difference between facing North or South (besides not getting sun in your eyes).

What is the largest possible variation between the number of tricks that South as declarer can take at a given suit contract, and the number of tricks that North would take in the same contract, assuming best play by both sides?

Robert Bishop found a seven-trick difference. I remember there being late-night bridge activity at Baker House (and elsewhere too, I imagine). Perhaps Professor Bishop was a participant.

South, who hates to be dummy, insists on a spade contract, which yields a seven-trick difference depending on which opponent makes the opening lead.

In each case, South wins his four high trumps. He wins nothing else when West leads; but he wins all of North's seven hearts when East leads (out of turn, but accepted by declarer).

West	North	East
	♠ x	
	♥ AKQJ10xx	
	♦ Kxx	
♠ 10987	♣ Kx	♠ xxxx
♥ xxxxx		♥
♦ xx	**South**	♦ AQxx
♣ xx	♠ AKQJ	♣ AQJxx
	♥ x	
	♦ xxxx	
	♣ xxxx	

With West on lead, the defense scores two high cards and a ruff in each minor suit, followed by a heart ruff and another diamond ruff. Shut out of dummy, declarer has to yield a ninth trick to East's high club at the end.

When East leads, he wins only his two aces—either right away or, after a trump lead, at the end.

M/J 2. Here is one from Terry Langerdoen, who must work for a company with a very restrictive holiday policy.

Allyson's first job after graduation in 1996 is with a company whose paydays occur every other Friday, except when a payday Friday is a holiday (Independence Day, Christmas and New Year's Day), in which case, it is the immediately preceding Thursday. Her last payday in 1996 is Friday, Dec. 20, Assuming she remains employed by this company and it does not alter its payday arrangements, what is the first year in which she will have 27 paydays? Similarly, if her last payday in 1996 is Friday, Dec. 27, what is the first year in which she will have 27 paydays?

The solution below is from Jørgen Harmse. Steve Feldman notes that the vacation policy is not as restrictive as I suggested since the holidays listed are the only national holidays that do not fall on fixed days of the week.

Harmse writes:

There will be 27 paydays in a non-leap year if and only if the first payday is the 2nd of January (and the last is Thursday, the 31st of December). A leap year will produce 27 paydays if, and only if, the first payday is the 2nd or 3rd of January. The first payday precesses to the 2nd or 3rd and then jumps to the middle of January.

The first payday in 1997 is the 3rd of January. Payday moves up one day in 1998, producing 27 paydays.

If instead the last payday of 1996 is the 27th of December, then the first payday in 1997 is the 10th of January. The first payday precesses to the 2nd of January 2004, producing 27 paydays.

M/J 3. Perhaps others have seen this one before or will find some quick solution. I, however, was amazed when I peeked at William Pulver's answer.

What 16-digit number, when multiplied by any single digit, will give a product that contains those same 16 digits? (A trivial solution is 0000000000000000. Pulver has a solution with considerably fewer leading zeros—EDITOR).

Leonard Nissim makes it all clear:

The 16-digit number is 0588235294117647. It is the first 16 digits of the decimal representation of $^1/_{17}$. Multiplied by any digit from 1 to 9 (or up to 16), it will yield the same cycle of 16 digits, beginning at a different spot.

Explanation: Except for the primes 2 and 5, factors of 10, the decimal representation of $^1/p$ for any prime p is periodic. Its period is the multiplicative order of 10 in the finite field with p elements. This must be a *factor* of $p-1$, by Lagrange's theorem. In the cases where it has maximal order, $p-1$, then the behavior noted by Pulver is present.

The smallest such case is $p = 7$; I had previously noted that 142857 can be multiplied by 1, 2, 3, 4, 5 or 6 to produce the same six-digit cycle with a different beginning.

BETTER LATE THAN NEVER

J/F 2. Eugene Sard sent us a beautiful solution to the one rope problem, along with a proof of correctness. It is long, but I will send a copy to anyone who requests it. Please include either a postal or fax address; e-mail is not possible as the solution is a hard copy. Sard conjectures that the largest number of ropes will be three and has found some such solutions. Stan LaVallee also believes three is the maximum and sent us a solution.

OTHER RESPONDERS

Responses have also been received from R. D'Angelo, L. Iori, M. Boas, R. Sinclair and C. Wiegert.

PROPOSER'S SOLUTION TO SPEED PROBLEM

Archipelago, witchraft and manufacture.

Send problems, solutions and comments to: Allan Gottlieb, New York University, 715 Broadway, 10th floor, New York, NY 10012, or to gottlieb@nyu.edu.

Edited by Owen W. Ozier '98

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