A One-Cup-of-Coffee Solution: the Coffee’s Still Warm

This being the first issue of another year, we again offer a “yearly problem” in which you are to express small integers in terms of the digits of the new year (1, 9, 8, and 8) and the arithmetic operators +, −, × (multiplication), / (division), and exponentiation. We desire solutions containing the minimum number of operators; and, among solutions having a given number of operators, those using the digits in the order 1, 9, 8, and 8 are preferred. Parentheses may be used for grouping; they do not count as operators. A leading minus sign does count as an operator.

JAN 1. We next offer a bridge problem that Douglas Van Patter noticed in the 1986 summer nationals:

**Dummy**
- 5
- A K 8
- Q 9 3
- A K 8 6 5 3

**Declarer**
- A K 10 9 8 7 2
- 6
- J 10 8 6
- Q

You are in a four-spade contract and take the opening lead of ♥2 in dummy. Assuming rubber bridge with neither side vulnerable, how do you play the trump? What if match points are being used?

JAN 2. Jim Landau asks us a non-computer problem. Compute the natural logarithms of the integers from 2 to 10, using pencil and paper only (no calculators, computers, or numeric tables), to four decimal places of accuracy.

JAN 3. The following problem, from Ahmad Khan and Rao Yelamarty, first appeared in the October 1986 issue of IEEE Potentials. It is possible to obtain all the integers from 1 to 40 by adding and subtracting various combinations of only four different integers. What are these four integers?

JAN 4. Our last regular problem, entitled “The 20th Anniversary Party,” is from Richard Hess:

The hostess told me the youngest of her three children likes her to pose this problem, and proceeded to explain, “I normally ask guests to determine the ages of my three children, given the sum and product of their ages. Since Smith missed the problem tonight and Jones missed it at the party two years ago, I’ll let you off the hook.” Your response is “No need to tell me more, their ages are…”

**Speed Department**

SD 1. Our first speed problem is from Bonnie Dalzell and Jim Saklad. The “17-year cicada” (Magicicada Septendecim) is so-called because it spends 17 years underground before emerging as a winged adult. What survival-of-the-fittest advantage does this unusual life span offer?

SD 2. Greg Huber wants to know the next number in the sequence 10^2, 10^3, 10^4, 10^5, 0...
lution was impossible, tried to get three digits in
order, etc.

1.1
2 81 - 79
2 81 - [0.9 + 7/8]
4 91 - 87
5 9(17) - 8
6 7 - 1
7 71 x 7
8 17 + 7
9 17 + 8
10 71 (79, 98)
11 1 + 9 + 8 - 7
12 19 (71) - 78
13 19 - 87
14 (1 x 9)7
15 1 + 9(78)
16 97 - 87
17 27 x (9 - 8)
18 89 - 71
19 19 x (8 - 7)
20 19 + 8 - 7
21 (917) - 87
22
23 29 + 8 + 7 - 1
24 (1 x 9) + 8 + 7
25 1 + 9 x 8 + 7
26
27 98 - 71
28 (897] - 1
29
30
31
32
33
34 19 + 8 + 7
35 91 - (8 x 7)
36 (9 - 7) x 18
37 (7 x 19 - 81
38
39 (8 x 7) - 1
40 (7 x 8 - 9)
41
42
43
44
45 (9 x 7) - 18
46 (8 x 7) - 1 x 9
47 (8 x 7 x 1) - 9
48 1 - 9
49 (9 x 7) x 9

50 - 100

Also solved by Allen Tracht, A. Holt, Naomi Mar-
kowski, Mark Spraudlin, Raymond Kinseley, Steve Feldman, Avi Ornstein, Harry Zare-
emba, and Alan Foonberg.

A/S 1. How can West make a contract of 6 hearts
against any defense?

The following solution is from Edgar Rose:
If North leads a A, draw trumps, and using a Q as en-
try, discard the closed hand's losing diamonds on
the two high clubs in dummy. This will provide
declarer with an over-trick. With any other lead,
win in hand playing low from dummy and play all
trumps, drawing low diamonds and a low club
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declarer with an over-trick. With any other lead,
win in hand playing low from dummy and play all
trumps, drawing low diamonds and a low club
dummy. Next play remaining high cards from
close hand except a A, always playing low from
dummy. At this point the closed hand has
a A, a 2, and two low diamonds with a black
suit card.

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His solution is:
\[ a(t) = 0.6 \times t \]
\[ v(t) = 0.3 \times t^2 \] (initial \( v = 0 \))
\[ d(t) = 0.1 \times t^3 + h \] (\( h = \) initial separation)
\[ a(m) = 1 \] (max.)
\[ v(m) = t \] (max., initial \( v = 0 \))
\[ d(m) = 0.5 \times t^4 \] (max., initial \( d = 0 \))

Note 1: Use maximum acceleration to catch fly at largest initial separation.
Note 2: Man and fly have the same velocity at \( t = 0 \) (both at rest) and \( t = 103 \) (\( v = 103/5 \)). Between \( t = 0 \) and \( t = 103 \) the man is moving faster than (catching up to) the fly; after \( t = 103 \) the fly is moving faster and the man cannot catch it.

Note 3: At \( t = 103 \), \( d(m) = 0.5 \times (103)^3/3 = 0.5 \times 100009 = 50005 \), and \( d(f) = 0.1 \times (103)^3 + h = 0.1 \times (1000007) + h = (1000007)/10 \). Equating the two (split): \( h = 50007/2 \). Coffee's still warm.


A85. Find integral values for the lengths \( a, b, c, d, e, \) and \( f \) in the following diagram.

[Diagram with points A, B, C, D, E, and F labeled with their respective distances.] Harry Zaremba found a solution that depends on two assumptions:

- It is assumed all the lengths are to be unequal, and
- that the extension of line CE is perpendicular to the line AB at the point D.

One solution involving Pythagorean triples is indicated in the figure in which the required integral lengths are:

- \( AC = a = 164 \)
- \( AE = e = 45 \)
- \( BC = b = 200 \)
- \( BE = f = 123 \)
- \( AB = c = 156 \)
- \( CE = e = 133 \)

Also solved by Avi Ornstein, Bill Huntington, Dudley Church, Edward Dawson, Garshad Zamanian, Joe Neuendorfer, Ken Rosato, Mark Foster, Mary Lindenberg, Robert Bart, Scott Berkenblit, Tom Harriman, Yamaji, William Strauss, and Winslow Hartford.

Better Late Than Never

APR 1. Robert Bart does not consider the solution "an entirely different approach."

APR 2. Unfortunately, either I misplaced Robert Bart's solution or it was lost in transit. Mr. Bart had recognized that APR 2 is the famous "Problem of Apollonius," which admits eight exact solutions. Stanley Zisk also found eight solutions and writes:

One way to describe the eight solutions would be as follows. With your numbers 1, 2, and 3 as the original circles, imagine a circle "O" drawn through their centers. Then let us define that a solution circle "contains" one of the original circles when its tangent point lies outside the circle "O." Now we see that your number 4 is the solution that "contains" none of the originals; number 5 contains all three of the originals; and numbers 6, 7, and 8 each contain two of the originals. It is easy to see that there are three more circles that each contain only one of the originals. This definition for "contains" will not always be strictly accurate for all combinations of sizes and arrangements. Another way to describe the solutions would be to start with the inscribed circle, number 4. Keeping it tangent to numbers 1 and 2, allow it to enlarge and intersect with number 3. Continue to enlarge it until it has entirely swelled and is again tangent to number 3, on the other side. This could also be done for numbers 1 and 2, yielding a total of three new solutions. Now going back to the first of the new solutions, keeping it tangent to number 2 (on the outside) and to number 3, allow it to enlarge and intersect number 1 until it is again tangent to number 1 on the outside. This results in your number 8, and so forth. So, I suggest that the general number of solutions is, in fact, eight: three each containing one and two circles, and one each containing zero and all three circles.

APR 5. William Strauss found an alternative solution that he believes is easier to do in your head.

MJ 1. MJ 4. Tom Harriman has responded.

JUL 2. Naomi Markovitz and Tom Harriman have responded.

JUL 3. Michael Jung, Dave McNally, Tom Harriman, and Alan Taylor have responded.

JUL 4. Naomi Markovitz, Tom Harriman, and Norman Wickstrand have responded.

JUL 5. Michael Jung and Tom Harriman have responded.

A8 SDJ. Dudley Church notes that it takes training to tie a bowline with one hand.

Proponents' Solutions to Speed Problems

SD 1. All predators of the cicada must have a generation length that is relatively prime to the cicada's. Hence if the predator has a population increase due to a good supply of cicadas, the next swarm of cicadas will emerge out of sync with the predators, reproductive cycle. (If the predator has a one-year cycle it will need to wait 16 generations for cicadas, and no predators have life spans of 34, 51, etc., years.)

SD 2. The ith term of the sequence is the smallest non-negative integer whose name contains the ith letter of the alphabet, i.e., thousAnd, Billion, ocCillation, . . .

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