is cumbersome to use too frequently. A neater approach is to define a string as follows:-

```
DEF Z$(X) = RPT$("0",X)
```

Z$() can then be included in the character code string. For example:-

```
CALL CHAR (96,Z$(15)&"101" & Z$(28) & "808")
```

The same technique can be used in TI standard Basic by changing the definition of Z$(). Make sure that you put in enough zeros for your requirements.

```
DEF Z$ (X) = SEGS("00000000 0000000",1,X)
```

TI Display

One of the problems encountered with the standard TI-99/4A Basic is that there are no cursor control commands so that a PRINT statement invariably results in screen scrolling. This is often inconvenient especially when a screen layout has been produced for game playing.

The only way to overcome the problem is to position each character on the screen in turn using the HCHAR or VCHAR subprograms. The following subroutine can be used to print any string or number on the screen without screen scrolling:-

```
500 CALL HCHAR (R,C,32,L)
510 FOR I = 1 TO LEN(W$)
520 CALL HCHAR (R,C+I−1, ASC (SEG$(W$,I,1)))
530 NEXT I
540 RETURN
```

Before the subroutine is used, the row and column numbers R and C must be set and W$ must be assigned the string to be printed. If a number is to be printed assign STR$ (number).

Line 500 overcomes the remaining problem that if a short word overwrites a longer one, the end of the longer word remains on the screen. It blanks out a portion of the row starting at column C. Set L to equal the number of blanks required. If this feature is not required, use GOSUB 510.

Add the following lines and try running the test program.

```
100 CALL CLEAR
110 W$ = "TEXAS"
120 R = 4
130 L = 7
140 FOR C = 20 TO 8 STEP−2
150 GOSUB 500
160 NEXT C
170 FOR J = 1 TO 5
180 READ R,C,W$
190 GOSUB 510
200 NEXT J
210 GOTO 210
220 DATA 4,14,INSTRUMENTS
230 DATA 18,14,BASIC
240 DATA 12,11,TI BASIC OR
250 DATA 15,13,EXTENDED
260 DATA 7,7,THIS PROGRAM RUNS IN
```

If you prefer your words to be printed vertically on the screen just use VCHAR in line 500 and change the expressions in 520 to R+I−1 and C.

This approach to displaying information on the screen has another advantage over using the PRINT statement as it enables you to use the full 32 columns rather than the usual 28.

NUMBERS COUNT

THE PARTITIONS OF A POSITIVE INTEGER

More of Mike Mudge's mathematical problems.

Background

(i) Congruences: Given three integers a, b and c we say that a is congruent to b modulo c and write a≡b(modulo c) if and only if a−b is an integer multiple of c. Thus: 15≡1(modulo 7) because 15−1=14=7×2.
(ii) Partitions: A partition of a positive integer, n, is a non-increasing sequence of positive integers whose sum is n.
p(n) denotes the number of partitions of n. Thus: p(4)=5 because 4=4, 4=3+1, 4=2+2, 4=2+1+1, 4=1+1+1+1.

Problem

(a) (i) Calculate, as efficiently as possible, p(n), the number of partitions of a given n, verifying, if possible, the following results: p(10)=42, p(20)=627, p(50)=204226, p(100)=190569292.
(a) (ii) Factorise the calculated p(n) into prime factors.
(b) Verify the following observations of S Ramanujan:
(i)p(4),p(9),p(14),p(19),...
≡0(modulo 5)
(ii)p(5),p(12),p(19),p(26),...
≡0(modulo 7)
(iii)p(6),p(17),p(28),p(39),...
≡0(modulo 11)
(iv)p(24),p(49),p(74),p(99),...
≡0(modulo 25)
(v)p(19),p(54),p(89),p(124),...
≡0(modulo 35)
(vi)p(47),p(96),p(145),p(194),...
≡0(modulo 49)
(vii)p(39),p(94),p(149),..
≡0(modulo 55)
(viii(p(61),p(138),...
≡0(modulo 77)
(ix)p(116),..
≡0(modulo 121)
(x)p(99),...
≡0(modulo 125)

Now in 1919, S Ramanujan made the following remarkable conjecture, based upon empirical evidence, including the above results: 'If d = $5^a7^b11^c$ and 24k ≡1(modulo d), then: p(k),p(k+d),p(k+2d),...≡o(modulo d). This theorem is supported by all the available evidence, but I have not yet been able to find a general proof.'

Now c1930 S Chowla found a counter example to the Ramanujan conjecture; p(243)=133978259344888 $\not\equiv$ 0(modulo 7^3) however 24×243 ≡1(modulo 7^3)

Note: A fully modified conjecture was proved in 1967 by A O L Atkin; viz. If d = $5^a7^b11^c$ and 24k ≡ 1(modulo d), then: p(k) ≡ 0(modulo $5^a7^{[(b+c)/2]}11^c$) where [X] denotes the greatest integer not greater than X. We make no attempt to explore this brilliant result on this visit to the theory of partitions.

(c) Find other counter examples to the Ramanujan conjecture as quoted above.

Submit a program, or suite of programs, which tabulate p(n) as a function of n, together with its prime factors (and appropriate multiplicities). Interpret these within the context of the Ramanujan conjecture. All submissions should include program listings, hardware descriptions, run times and output; they will be judged for accuracy, originality and efficiency (not necessarily in that order). A prize of £10 will be awarded to the 'best' entry received.

Entries, to arrive by 1 November, to: Mr M R Mudge BSc FIMA FBCS, Room 560/A, Department of Mathematics, The University of Aston in Birmingham, Gosta Green, Birmingham B4 7ET.

Note: Submissions will only be returned if a suitable stamped addressed envelope is included.

Review—May 1983

The Triangular, Tetrahedral and Fibonacci Numbers introduced in May, produced responses from Belgium and Norway in addition to the UK.

There was complete agreement on the solution sets:
a) {1,10,120,1540,7140}
b) {1,3,21,55}
c) {1,8,13}

The completeness of the solution set for Problem a) has been established theoretically: AVANE SOU.B., ACTA. ARITH.,12,1967 pp 409-419.

There is, however, no such result for either b) or c) known to the present author; indeed some mathematicians have expressed an intuitive feeling that these have infinite solution sets in spite of the empirical evidence.

The competition was very close this month, the 'best' entry was ultimately considered to be that generated in Basic using an Epson HX-20 by Paul Fierens, of Paul Fredericqstraat 84, B9000, Gent, Belgium, to whom a suitable prize will be sent.