quotient of 4.

Incidentally, as several of you observed, if you add or remove 9's from the middle of this number the property still remains.

The winning entry comes from Mr. Claes Malcolm from Sweden. Congratulations Claes (or is it Malcolm?), your prize is on its way.

NUMBERS

Problems with primes from Mike Mudge.

Definitions A Prime number is a positive whole number which is exactly divisible by itself and unity only. Thus the sequence of primes begins 2, 3, 5, 7, 11, 13, 17, 19, . . .

A truncatable prime number is a prime which yields a sequence of primes when successive digits are removed: always from the left (for a left-truncatable prime), always from the right (for a right-truncatable prime), or simultaneously from the left and right (for a shrinking prime). For example: 629137 is left truncatable since it is prime and so are 29137, 9137, 137, 37, & 7. 939133 is right-truncatable since it is prime and so are 39133, 9133, 133, 33, & 3.

The State of the Art Angell IO and Godwin HJ *1977 Mathematics of Computation*, vol 31 page 265, have tabulated, to base ten, the largest left-truncatable prime, L_a, with base a between 3 and 11 inclusive also the largest right-truncatable prime, R_a, with base a between 3 and 15 inclusive.

Keith Devlin in *The Guardian* (8/11/84) broadened the problem, base 10, by admitting 1 as a prime. He stated that there are 147 R_{10} the largest being 1979339339. (This reducing to 83 with largest 73939133 if 1 is excluded.)

Further Devlin counted 403 L_{10} less than 10^4 (this reducing to 308 with the exclusion of 1) together with a total of 24 shrinking-primes (reducing to 9 with the exclusion of 1).

The problems set are:

(i) Reproduce the above results.

(ii) Extend the range of a quoted by Angell & Godwin for L_a & R_a.

(iii) Consider shrinking-primes, S_a, in bases different from 10.

(iv) Investigate what happens if a given prime is to be successively truncated by the removal of primes from either or both ends.

Readers are invited to submit their program listings, together with hardware descriptions, run times, any comments and of course the output relating to some (or all) of the above problems. These will be judged for accuracy, originality and efficiency (not necessarily in that order), and a prize will be awarded to the 'best' entry received by 1 June 1985.

Please address all correspondence to Mike Mudge, 'Square Acre', Stourbridge Road, Penn, Nr Wolverhampton, Staffordshire WV4 5NF. Tel 0902 892141.

Please note that submissions can only be returned if a suitable stamped addressed envelope is provided.

Expanded reviews of previous problems together with, subject to the approval of the contributor, copies of detailed programmes from the prize winning entry may also be requested.

Prize winner

(Factorial n) + 1 is prime for the following n less than 231: 1,2,3,11, 27,37,41,73,77,116, & 154.

(Primorial p) + 1 is prime for the following p less than 1031: 2,3,5,7,11, 31,379,1019, & 1021.

This month's prizewinner is Gareth Suggett, Chichester, Sussex. Readers should be encouraged by the incompleteness of the winning submission. Gareth has put all of the primes up to 65063 on a data file and implemented some generalised arithmetic routines in Basic on his BBC Micro, in spite of recurring hardware problems. Primorials up to 101 digits and factorials up to 72 digits have been listed. However, the tests for N.T.P. are incomplete being conditional on extending the data file and efficiently coupling it to the remaining programme in a factorisation routine.

Two related areas remaining for investigation are:

a) Define $A_n = n! - (n-1)! + (n-2)! \ldots -(-1)^n 1!$ A_n is prime for n = 3,4,5,6,7,8,10,15,19 at least; whilst n = 27 yields the first A_n with a square factor. When are the A_n N.T.P.?

b) The left factorial function is defined by: $!n = 0! + 1! + 2! + 3! + \ldots + (n-1)!$ When is !n prime or N.T.P.?

MICROCHESS

Kevin O'Connell bets on Chaos in the North American Computer chess championship.

The game which follows was played in the last round of the 15th North American Computer Championship, held in San Francisco last October.

The game is proof of grandmother's old saying that one should never bet on a proposition.

White: Chaos. Black: Phoenix. Benoni Defence

1	d2–d4	c7–c5
2	d4–d5	e7–e5
3	e2–e4	d7–d6
4	c2–c4	g7–g6
5	Nb1–c3	Bf8–g7
6	Bf1–d3	Ng8–e7
7	Ng1–e2	O–O
8	Bc1–d2	

(A typical position out of the Old Benoni Defence, which shows the great progress made by programs in the last few years. It is very important here to retain freedom of movement for the f-pawns and both programs seem to understand this.)

8	. . .	f7–f5
9	f2–f3	Nb8–a6
10	Bd2–g5	Na6–b4
11	Bd3–b1	h7–h6
12	Bg5–h4	g6–g5
13	Bh4–f2	f5xe4
14	Bblxe4	

(Having e4 for his pieces promises White some advantage.)

14	. . .	Bc8–f5
15	O–O	Qd8–d7
16	a2–a3	Nb4–a6
17	Qd1–b3	Na6–c7
18	Be4xf5	

(The start of an interesting but very risky plan. This makes the c6 square available to White's queen. However, the net result of the whole manoeuvre is merely a very weak white pawn on c6.)

18	. . .	Ne7xf5
19	Qb3xb7	Rf8–b8
20	Qb7–c6	Qd7xc6
21	d5xc6	Rb8xb2
22	Ra1–b1	Ra8–b8
23	Ne2–g3	Rb2xb1
24	Rf1xb1	Rb8xb1+
25	Nc3xb1	Nf5–e7
26	Ng3–e4	Nc7–e8
27	Ne4xd6	

(A horrible decision to have to make, but against anything else Black simply removes the pawn on c6 and then builds up his central power-house.)

27	. . .	Ne8xd6
28	Bf2xc5	Ne7–c8
29	Nb1–d2	Kg8–f7