28	Kd2-e3	32	h2-h4	Kf6-e6
		33	Ke3-e4	Re7-f7
		34	g2-g3	Rf7-d7

(White has established a blockade on the e4 square and is trying to make life

e-pawn does not queen first (for example 41 g4xh5 Kd3-d2! and the e-pawn marches straight down to el.)

NUMBERS COUNT

Mike Mudge delves into Exponential Diophantine Equations and reveals a winner for Problems with Primes.

Exponential Diophantine Equations require the minimum of mathematical background; interesting results are readily found using simple search techniques. Theoretical results, using techniques of modular arithmetic are incomplete, however, because of the close relationship of the subject of Exponential Diophantine Equations to Character Theory of Finite Groups, it is currently an active research area.

Mathematical background

0) a,b,c,d,e and f are to denote non-negative integers. 0,1,2,3, . . .

1) x^a where a is greater than zero means the product of a-factors each equal to x. For example $3^4 = 3 \times 3 \times 3 \times 3 = 81$. $x^0 = 1$ by definition, whatever the value of x, this definition is made to guarantee consistency with the laws of indices which result from the above definition. For example $(x^a)(x^b) = x^{a+b}$ also $(x^a)^b = x^{ab}$.

2) A Diophantine Equation (after Diophantus of Alexandria, *circa* the third century of the Christian era) is one which is to be solved in integers, in general both negative and non-negative.

E Dubois and G Rhin (1976) together with H P Schlickewei (1977) have established that the equation: $w^a \pm x^b \pm y^c \pm z^d = 0$ has only a finite number of solutions for a,b,c and d when w,x,y and z are distinct prime numbers (given).

The problem

We shall confine our attention to the Exponential Diophantine Equation $1 + w^a = x^b y^c + w^d x^e y^f$ and in particular to the case where w,x and y are consecutive prime numbers in some order.

Disregard the trivial solution (a,b,c,d,e,f) = (a,0,0,a,0,0) which results immediately from the fact that $x^0 = 1$ for any x.

Case 1 w,x and y are the primes 2,3 and 5 in some order.

Order A w = 2, x = 3 and y = 5.

We wish to find non-trivial solutions of the equation:

$1 + 2^a = 3^b 5^c + 2^d 3^e 5^f$.

There are known to be 31 such solutions of which some are given here (a,b,c,d,e,f) = (3,0,1,2,0,0); (5,0,2,3,0,0); (6,0,2,3,0,1); (7,0,3,2,0,0); (10,0,4,4,0,2)

Determine the other 26 non-trivial solutions.

Order B w=3, x=2 and y=5.

We wish to find non-trivial solutions of the equation: $1+3^a=2^b5^c+2^d3^e5^f$.

There are known to be 24 such solutions of which some are given here (a,b,c,d,e,f) = (2,0,1,0,0,1); (3,0,2,0,1,0); (2,3,0,1,0,0); (8,8,2,1,4,0);

Determine the other 20 non-trivial solutions.

Order C w=5, x=2 and y=3.

We wish to find non-trivial solutions of the equation: $1+5^a=2^b3^c+2^d3^e5^f$.

There are known to be 20 such solutions of which some are given here (a,b,c,d,e,f) = (1,0,1,0,1,0); (3,0,4,0,2,1); (2,3,0,1,2,0); (5,10,1,1,3,0);

Determine the other 16 non-trivial solutions.

Case 2 w,x and y are three other consecutive primes in some order. How many solutions are there? What are they?

There is plenty of scope here using (w,x,y) = (3,5,7) or (5,7,11) or something much more ambitious such as (12911,12917,12919).

Readers are invited to submit their program listings, together with hardware descriptions, run times, any comments and of course the output relating to the above problem.

These results will be judged for accuracy, originality and efficiency (not necessarily in that order), and a prize will be awarded to the 'best' entry received at 'Square Acre', Stourbridge Road, Penn, Nr Wolverhampton, Staffs, WV4 5NF. Tel: (0902) 892141 by 1 December 1985.

NUMBERS COUNT

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 programs from the prize winning entry may also be requested.

Prize winner March

Problems with Primes contained a sequence of unfortunate typographical errors, which certainly discouraged some readers. The longest known left truncatable prime (in the sense of Angell and Godwin) is believed to be 357686312646216567629137 since . . . 137, 37, 7 are prime. The corresponding result for right truncatable primes is 73939133 since . . . 739, 73, 7 are prime.

These results are both for base 10. Readers interested in the extension to other number bases are referred to the article by Angell and Godwin in *Mathematics of Computation* Volume 31, Page 256, 1977 while those interested in the introduction of the smallest odd prime as 1 instead of the conventional 3, also in the truncation from both ends, are referred to Keith Devlin, *The Guardian*, 8 November 1984.

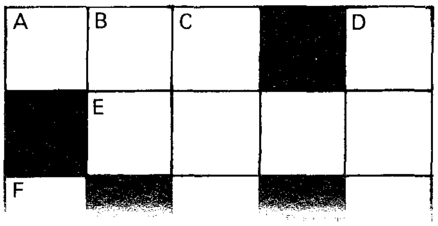
For interest and curiosity this month's prize winner is D W Richardson of Preston, Lancashire.

LEISURE LINES

Brain-teasers from J J Clessa

Quickie

A golden oldie this month, no prizes no answers. A water lily is growing in the centre of a circular pond. It doubles its size every day and on 16 June 1985 it exactly fills the pond. On what date did it half-fill the pond?



Prize Puzzle, September Leisure Lines, 32-34 Broadwick Street, London W1A 2HG. Entries to arrive not later than 30 September 1985.

June Prize Puzzle

'Find three positive numbers in arithmetical progression whose product is