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SPECIAL PAIRS OF PYTHAGOREAN TRIANGLES AND 3 –DIGITS HARSHAD NUMBER

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ABSTRACT
Here, we present pairs of Pythagorean triangles such that in each pair, the difference between their perimeters is four times the 3-digit Harshad number 108. Also we present the number of pairs of primitive and non- primitive Pythagorean triangles.

KEYWORDS: Pairs of Pythagorean Triangle, Harshad number, Prime numbers.

I. INTRODUCTION
Number theory is broad and diverse part of Mathematics that developed from the study of the integers. Mathematics all over the ages have been fascinated by Pythagorean Theorem and problem related to it there by developing Mathematics. Pythagorean triangle which first studied by the Pythagorean around 400 B.C., remains one of the fascinated topics for those who just adore the number. In this communication, we search for pairs of Pythagorean triangles, such that in each pair, the difference between their perimeters is 4 times the 3digit Harshad number 108.

II. BASIC DEFINITIONS
Definition 2.1

The ternary quadric Diophantine equation given by $x^2 + y^2 = z^2$ is known as Pythagorean equation where x, y, z are natural numbers. The above equation is also referred to as Pythagorean triangle and denote it by T(x ,y, z).

Also in Pythagorean triangle T(x ,y, z) = $x^2 + y^2 = z^2$, where x and y are legs and z is its hypotenuse.

Definition 2.2:
Sphenic number is a positive integer that is the product of three distinct prime numbers.

Definition 2.3:
The most cited solutions of the Pythagorean equation is $x = m^2 - n^2$, $y = 2mn, z = m^2 + n^2$, where m>n>0. This solution is called primitive, if m, n are of opposite parity and gcd(m,n)=1

Definition 2.4:
A positive integer which is divisible by the sum of its digits also called a (Niven) Harshad Number.

III. RESULTS AND DISCUSSION
Let PT_1 , PT_2 be two distinct Pythagorean triangles with generators $m, q(m > q > 0)$ and $p, q(p > q > 0)$ respectively. Let P_1,P_2 be the perimeters of PT_1 & PT_2

Such that $P_1 - P_2$ = 4 times the 3-digit Harshad number $\frac{P_1 - P_2}{4}$

Hence, The above relation leads to the equation

$$(2m+q)^2 - (2p+q)^2 = 864 \qquad (1)$$

Which simplifies to $(m-p)(m+p+q) = 216$ (2)

After completing the numerical computations, it is noted that there are 65 values of m, p & q are given in the following table.

S.NO	m	P	q	P_1	P_2	$\frac{P_1 - P_2}{4}$
1	108	107	1	23544	23112	108
2	107	106	3	23540	23108	108
3	106	105	5	23532	23100	108
4	105	104	7	23520	23088	108
5	104	103	9	23504	23072	108
6	103	102	11	23484	23052	108
7	102	101	13	23460	23028	108
8	101	100	15	23432	23000	108
9	100	99	17	23400	22968	108
10	99	98	19	23364	22932	108
11	98	97	21	23324	22892	108
12	97	96	23	23280	22848	108
13	96	95	25	23232	22800	108
14	95	94	27	23180	22748	108
15	94	93	29	23124	22692	108
16	93	92	31	23064	22632	108
17	92	91	33	23000	22568	108
18	91	90	35	22932	22500	108
19	90	89	37	22860	22428	108
20	89	88	39	22784	22352	108
21	88	87	41	22704	22272	108
22	87	86	43	22620	22188	108
23	86	85	45	22532	22100	108
24	85	84	47	22440	22008	108
25	84	83	49	22344	21912	108
26	83	82	51	22244	21812	108
27	82	81	53	22140	21708	108
28	81	80	55	22032	21600	108
29	80	79	57	21920	21488	108
30	79	78	59	21804	21372	108
31	78	77	61	21684	21252	108
32	77	76	63	21560	21128	108
33	76	75	65	21432	21000	108
34	75	74	67	21300	20868	108
35	74	73	69	21164	20732	108
36	73	72	71	21024	20592	108
37	54	52	2	6048	5616	108
38	53	51	4	6042	5610	108
39	52	50	6	6032	5600	108
40	51	49	8	6018	5586	108
41	50	48	10	6000	5568	108
42	49	47	12	5978	5546	108
43	48	46	14	5952	5520	108
44	47	45	16	5922	5490	108
45	46	44	18	5888	5456	108
46	45	43	20	5850	5418	108

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47	44	42	22	5808	5376	108
48	43	41	24	5762	5330	108
49	42	40	26	5712	5280	108
50	41	39	28	5658	5226	108
51	40	38	30	5600	5168	108
52	39	37	32	5538	5106	108
53	38	36	34	5472	5040	108
54	28	24	2	1680	1248	108
55	27	23	4	23544	23112	108
56	26	22	6	23540	23108	108
57	25	21	8	23532	23100	108
58	24	20	10	23520	23088	108
59	23	19	12	23504	23072	108
60	22	18	14	23484	23052	108
61	21	17	16	23460	23028	108
62	20	14	2	880	448	108
63	19	13	4	874	442	108
64	18	12	6	864	432	108
65	17	11	8	850	418	108

Thus, from the above table it is seen that there are 58 pairs of Pythagorean triangle such that in each pair the difference between the perimeters is 4 times the 3-digit Harshad number 108.

Also Out of 65 pairs, there are 37 pairs of primitive Pythagorean triangles, 16 pairs of non-primitive Pythagorean triangles and remaining 12 pairs, one is primitive and other is non-primitive.

IV. CONCLUSION

In this communication, it is observed that there are only finitely many Pythagorean Triangles satisfying the property under consideration. The total Pythagorean triangles are number of pairs of primitive and non-primitive Pythagorean triangle are also given. To conclude, one may search for the connection between the pairs of Pythagorean Triangle and other Harshad number of higher order

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