

Multiple-Type Patterns in Pythagorean Triples

Inder J. Taneja¹

Abstract

The Pythagoras theorem is very famous in the literature of mathematics. This paper brings patterns obtained by multiplication of natural numbers to known pattern. In result we have more patterns of similar kins. The last two sections summarize patterns studied before. The construction and details of procedures can be seen in author's work [4, 5, 6, 7].

Contents

1	Introduction	1
2	Multiple-Type Patterns	3
3	Patterns Without Final Sum	19
4	Patterns With Final Sum	33

1 Introduction

By Pythagoras theorem it is understood that

$$a^2 + b^2 = c^2.$$

For simplicity, let's write it as (a, b, c) . If we talk of distances, then the numbers a , b and c are real positive, otherwise they can be any real number.

Let's consider the initial Pythagorean triple $(3,4,5)$. This means that $3^2 + 4^2 = 5^2$. The symmetric extensions of this triple we call **patterns in Pythagorean triples**. There two obvious ways of getting **patterns in Pythagorean triples**.

¹Formerly, Professor of Mathematics, Universidade Federal de Santa Catarina, Florianópolis, SC, Brazil (1978-2012). Also worked at Delhi University, India (1976-1978). E-mail: ijtaneja@gmail.com; Web-sites: <http://inderjtaneja.com>; <http://indertaneja.com>; Twitter: @IJTANEJA.

- **Multiplying (7) by 10, 100, 1000, ... :**

See following two examples

$$\begin{aligned} 3^2 + 4^2 &= 5^2 & := 25 \\ 30^2 + 40^2 &= 50^2 & := 2500 \\ 300^2 + 400^2 &= 500^2 & := 250000 \end{aligned} \tag{1}$$

$$\begin{aligned} 9^2 + 40^2 &= 41^2 & := 1681 \\ 90^2 + 400^2 &= 410^2 & := 168100 \\ 900^2 + 4000^2 &= 4100^2 & := 16810000 \end{aligned} \tag{2}$$

The difference in above two examples is that the first one is with single digit in each case, i.e., 3, 4 and 5, and in second example (2) not all the same digits are with same length, i.e., the first one is of length 1 and other two are with length 2. This process is generally true for all types of **Pythagorean triples**.

- **Repetition of Digits:**

$$\begin{aligned} 3^2 + 4^2 &= 5^2 & := 25 \\ 33^2 + 44^2 &= 55^2 & := 3025 \\ 333^2 + 444^2 &= 555^2 & := 308035 \end{aligned} \tag{3}$$

$$\begin{aligned} 12^2 + 35^2 &= 37^2 & := 1369 \\ 1212^2 + 3535^2 &= 3737^2 & := 13965169 \\ 121212^2 + 353535^2 &= 373737^2 & := 139679345169 \end{aligned} \tag{4}$$

$$\begin{aligned} 119^2 + 120^2 &= 169^2 & := 28561 \\ 119119^2 + 120120^2 &= 169169^2 & := 28618150561 \\ 119119119^2 + 120120120^2 &= 169169169^2 & := 28618207740150561 \end{aligned} \tag{5}$$

In the examples (3), (4) and (5), we observe that the repetition of digits give us patterned results when we work with same length triples. Here we have (3,4,5), (12, 35, 27) and (119, 120, 169). In the example (3, 4, 5) each digit is of length 1. In the example (12, 35, 27) each digit is of length 2, and the triple (119, 120, 169) each digit is of length 3. This theory doesn't work when the triples are with different lengths, for example, (5, 12, 13). This gives

$$\begin{aligned} 5^2 + 12^2 &= 13^2 & \Rightarrow 169 = 169 \\ 55^2 + 1212^2 &\neq 1313^2 & \Rightarrow 1471969 \neq 1723969 \end{aligned} \tag{6}$$

In this case, the pattern (6) is not extendable as in case examples (3), (4) and (5).

Remark 1. *Analysing the final sums, we observe that the examples (1) and (2) are good for **patterns with final sums**. The example (3) is not so good but acceptable. In case of examples (4) and (5), the patterns with final sums are not good. In this work, we shall write patterns with final sums only if they are good.*

The aim of this work is divided in two parts. First part given in Section 2 is to bring more pattern by multiplication with positive natural numbers. The part given in Sections Section 3 and Section 4 is to summarize the results on **patterns in Pythagorean triples** done before by author in [4, 5]. Obviously, we can write much more patterns. Theses sections give just an idea, how beautiful we can make Pythagoran triples.

2 Multiple-Type Patterns

In paper [5, 6], we worked with different Procedures to bring patterns in Pythagorean triples. Here our aim is to write new patterns multiplying by natural numbers. Also, to observe that the numbers or lines appearing in **brown color** don't give good patterns. See the examples below.

Example 2.1. *Let's consider following pattern:*

$$\begin{aligned}
 & (4, 3, 5) \\
 & (84, 13, 85) \\
 & (8844, 133, 8845) \\
 & (888444, 1333, 888445) \\
 & (88884444, 13333, 88884445) \\
 & (8888844444, 133333, 8888844445) \tag{7}
 \end{aligned}$$

It is understood that

$$\begin{aligned}
 (4, 3, 5) & \Rightarrow 4^2 + 3^2 = 5^2 \\
 (84, 13, 85) & \Rightarrow 84^2 + 13^2 = 55^2 \\
 \dots & \quad \dots \quad \dots
 \end{aligned}$$

The Example (7) is the same as (78) given in Section 3. Let's multiply the Example (7) by $n = 1, 2, 3, \dots, 9$, we get the following patterns:

► **Multiplying (7) by 2**

$$\begin{aligned}
 & (8, 6, 10) \\
 & (168, 26, 170) \\
 & (17688, 266, 17690) \\
 & (1776888, 2666, 1776890) \\
 & (177768888, 26666, 177768890) \\
 & (17777688888, 266666, 17777688890) \tag{8}
 \end{aligned}$$

► **Multiplying (7) by 3**

$$\begin{aligned}
 & (12, 9, 15) \\
 & (252, 39, 255) \\
 & (26532, 399, 26535) \\
 & (2665332, 3999, 2665335) \\
 & (266653332, 39999, 266653335) \\
 & (26666533332, 399999, 26666533335)
 \end{aligned} \tag{9}$$

► **Multiplying (7) by 4**

$$\begin{aligned}
 & (16, 12, 20) \\
 & (336, 52, 340) \\
 & (35376, 532, 35380) \\
 & (3553776, 5332, 3553780) \\
 & (355537776, 53332, 355537780) \\
 & (35555377776, 533332, 35555377780)
 \end{aligned} \tag{10}$$

► **Multiplying (7) by 5**

$$\begin{aligned}
 & (20, 15, 25) \\
 & (420, 65, 425) \\
 & (44220, 665, 44225) \\
 & (4442220, 6665, 4442225) \\
 & (444422220, 66665, 444422225) \\
 & (44444222220, 666665, 44444222225)
 \end{aligned} \tag{11}$$

► **Multiplying (7) by 6**

$$\begin{aligned}
 & (24, 18, 30) \\
 & (504, 78, 510) \\
 & (53064, 798, 53070) \\
 & (5330664, 7998, 5330670) \\
 & (533306664, 79998, 533306670) \\
 & (53333066664, 799998, 53333066670)
 \end{aligned} \tag{12}$$

► **Multiplying (7) by 7**

$$\begin{aligned}
 & (28, 21, 35) \\
 & (588, 91, 595) \\
 & (61908, 931, 61915) \\
 & (6219108, 9331, 6219115) \\
 & (622191108, 93331, 622191115) \\
 & (62221911108, 933331, 62221911115)
 \end{aligned} \tag{13}$$

► **Multiplying (7) by 8**

$$\begin{aligned}
 & (32, 24, 40) \\
 & (672, 104, 680) \\
 & (70752, 1064, 70760) \\
 & (7107552, 10664, 7107560) \\
 & (711075552, 106664, 711075560) \\
 & (71110755552, 1066664, 71110755560)
 \end{aligned} \tag{14}$$

► **Multiplying (7) by 9**

$$\begin{aligned}
 & (36, 27, 45) \\
 & (756, 117, 765) \\
 & (79596, 1197, 79605) \\
 & (7995996, 11997, 7996005) \\
 & (799959996, 119997, 799960005) \\
 & (79999599996, 1199997, 79999600005)
 \end{aligned} \tag{15}$$

The above expressions are obtained multiplying Example (7) by $n = 1, 2, 3, \dots, 9$. Let's see what happens if we multiply (7) by numbers more than 10:

► **Multiplying (7) by 19**

$$\begin{aligned}
 & (76, 57, 95) \\
 & (1596, 247, 1615) \\
 & (168036, 2527, 168055) \\
 & (16880436, 25327, 16880455) \\
 & (1688804436, 253327, 1688804455) \\
 & (168888044436, 2533327, 168888044455)
 \end{aligned} \tag{16}$$

► **Multiplying (7) by 43**

$$\begin{aligned}
 & (172, 129, 215) \\
 & (3612, 559, 3655) \\
 & (380292, 5719, 380335) \\
 & (38203092, 57319, 38203135) \\
 & (3822031092, 573319, 3822031135) \\
 & (382220311092, 5733319, 382220311135)
 \end{aligned} \tag{17}$$

The examples below are obtained multiplying (7) by power of 2, for example by 16, 32 and 64.

► **Multiplying (7) by 16**

$$\begin{aligned}
 & (64, 48, 80) \\
 & (1344, 208, 1360) \\
 & (141504, 2128, 141520) \\
 & (14215104, 21328, 14215120) \\
 & (1422151104, 213328, 1422151120) \\
 & (142221511104, 2133328, 142221511120)
 \end{aligned} \tag{18}$$

► **Multiplying (7) by 32**

$$\begin{aligned}
 & (128, 96, 160) \\
 & (2688, 416, 2720) \\
 & (283008, 4256, 283040) \\
 & (28430208, 42656, 28430240) \\
 & (2844302208, 426656, 2844302240) \\
 & (284443022208, 4266656, 284443022240)
 \end{aligned} \tag{19}$$

► **Multiplying (7) by 64**

$$\begin{aligned}
 & (256, 192, 320) \\
 & (5376, 832, 5440) \\
 & (566016, 8512, 566080) \\
 & (56860416, 85312, 56860480) \\
 & (5688604416, 853312, 5688604480) \\
 & (568886044416, 8533312, 568886044480)
 \end{aligned} \tag{20}$$

Remark 2. We observe that in some cases the first and/or second lines don't give good patterns. These lines are indicated by **brown color**. This process of multiplying (7) by continues. May be in some cases, non patterns lines increases from 2 to 3, 4, etc. Let's consider another example.

Example 2.2. Let's consider following pattern:

$$\begin{aligned}
 & (4, 3, 5) \\
 & (544, 33, 545) \\
 & (55444, 333, 55445) \\
 & (5554444, 3333, 5554445) \\
 & (555544444, 33333, 555544445) \\
 & (55555444444, 333333, 55555444445)
 \end{aligned} \tag{21}$$

The Example (21) is the same as (79) given in Section 3. Let's multiply the Example (21) by $n = 1, 2, 3, \dots, 9$, we get the following patterns:

► **Multiplying (21) by 2**

$$\begin{aligned}
 & (8, 6, 10) \\
 & (1088, 66, 1090) \\
 & (110888, 666, 110890) \\
 & (11108888, 6666, 11108890) \\
 & (1111088888, 66666, 1111088890) \\
 & (111110888888, 666666, 111110888890)
 \end{aligned} \tag{22}$$

► **Multiplying (21) by 3**

$$\begin{aligned}
 & (12, 9, 15) \\
 & (1632, 99, 1635) \\
 & (166332, 999, 166335) \\
 & (16663332, 9999, 16663335) \\
 & (1666633332, 99999, 1666633335) \\
 & (166666333332, 999999, 166666333335)
 \end{aligned} \tag{23}$$

► **Multiplying (21) by 4**

$$\begin{aligned}
 & (16, 12, 20) \\
 & (2176, 132, 2180) \\
 & (221776, 1332, 221780) \\
 & (22217776, 13332, 22217780) \\
 & (2222177776, 133332, 2222177780) \\
 & (222221777776, 1333332, 222221777780)
 \end{aligned} \tag{24}$$

► **Multiplying (21) by 5**

$$\begin{aligned}
 & (20, 15, 25) \\
 & (2720, 165, 2725) \\
 & (277220, 1665, 277225) \\
 & (27772220, 16665, 27772225) \\
 & (2777722220, 166665, 2777722225) \\
 & (277777222220, 1666665, 277777222225)
 \end{aligned} \tag{25}$$

► **Multiplying (21) by 6**

$$\begin{aligned}
 & (24, 18, 30) \\
 & (3264, 198, 3270) \\
 & (332664, 1998, 332670) \\
 & (33326664, 19998, 33326670) \\
 & (3333266664, 199998, 3333266670) \\
 & (333332666664, 1999998, 333332666670)
 \end{aligned} \tag{26}$$

► **Multiplying (21) by 7**

$$\begin{aligned}
 & (28, 21, 35) \\
 & (3808, 231, 3815) \\
 & (388108, 2331, 388115) \\
 & (38881108, 23331, 38881115) \\
 & (3888811108, 233331, 3888811115) \\
 & (388888111108, 2333331, 388888111115)
 \end{aligned} \tag{27}$$

► **Multiplying (21) by 8**

$$\begin{aligned}
 & (32, 24, 40) \\
 & (4352, 264, 4360) \\
 & (443552, 2664, 443560) \\
 & (44435552, 26664, 44435560) \\
 & (4444355552, 266664, 4444355560) \\
 & (444443555552, 2666664, 444443555560)
 \end{aligned} \tag{28}$$

► **Multiplying (21) by 9**

$$\begin{aligned}
 & (36, 27, 45) \\
 & (4896, 297, 4905) \\
 & (498996, 2997, 499005) \\
 & (49989996, 29997, 49990005) \\
 & (4999899996, 299997, 4999900005) \\
 & (499998999996, 2999997, 499999000005)
 \end{aligned} \tag{29}$$

The above expressions are obtained multiplying Example (21) by $n = 1, 2, 3, \dots, 9$. Let's see what happen's if we multiplying (21) by numbers more than 10:

► **Multiplying (21) by 13**

$$\begin{aligned}
 & (52, 39, 65) \\
 & (7072, 429, 7085) \\
 & (720772, 4329, 720785) \\
 & (72207772, 43329, 72207785) \\
 & (7222077772, 433329, 7222077785) \\
 & (722220777772, 4333329, 722220777785)
 \end{aligned} \tag{30}$$

► **Multiplying (21) by 31**

$$\begin{aligned}
& (124, 93, 155) \\
& (16864, 1023, 16895) \\
& (1718764, 10323, 1718795) \\
& (172187764, 103323, 172187795) \\
& (17221877764, 1033323, 17221877795) \\
& (1722218777764, 10333323, 1722218777795)
\end{aligned} \tag{31}$$

The examples below are obtained multiplying (21) by power of 2, for example by 16, 32 and 64.

► **Multiplying (21) by 16**

$$\begin{aligned}
& (64, 48, 80) \\
& (8704, 528, 8720) \\
& (887104, 5328, 887120) \\
& (88871104, 53328, 88871120) \\
& (8888711104, 533328, 8888711120) \\
& (888887111104, 5333328, 888887111120)
\end{aligned} \tag{32}$$

► **Multiplying (21) by 32**

$$\begin{aligned}
& (128, 96, 160) \\
& (17408, 1056, 17440) \\
& (1774208, 10656, 1774240) \\
& (177742208, 106656, 177742240) \\
& (17777422208, 1066656, 17777422240) \\
& (1777774222208, 10666656, 1777774222240)
\end{aligned} \tag{33}$$

► **Multiplying (21) by 64**

$$\begin{aligned}
& (256, 192, 320) \\
& (34816, 2112, 34880) \\
& (3548416, 21312, 3548480) \\
& (355484416, 213312, 355484480) \\
& (35554844416, 2133312, 35554844480) \\
& (3555548444416, 21333312, 3555548444480)
\end{aligned} \tag{34}$$

Remark 3. We observe that in some cases, the first, second, third, etc. lines don't follow the pattern. This process of multiplying (21) continues. May be in some cases, there are initial line as non pattern cases.

Example 2.3. *Let's consider following pattern:*

$$\begin{aligned}
 & (8, 15, 17) \\
 & (68, 1155, 1157) \\
 & (668, 111555, 111557) \\
 & (6668, 11115555, 11115557) \\
 & (66668, 1111155555, 1111155557) \\
 & (666668, 111111555555, 111111555557)
 \end{aligned} \tag{35}$$

The Example (35) is the same as (83). Let's multiply the Example (35) by $n = 2, 3, \dots, 9$, we get the following patterns:

► **Multiplying (35) by 2**

$$\begin{aligned}
 & (16, 30, 34) \\
 & (136, 2310, 2314) \\
 & (1336, 223110, 223114) \\
 & (13336, 22231110, 22231114) \\
 & (133336, 2222311110, 2222311114) \\
 & (1333336, 222223111110, 222223111114)
 \end{aligned} \tag{36}$$

► **Multiplying (35) by 3**

$$\begin{aligned}
 & (24, 45, 51) \\
 & (204, 3465, 3471) \\
 & (2004, 334665, 334671) \\
 & (20004, 33346665, 33346671) \\
 & (200004, 3333466665, 3333466671) \\
 & (2000004, 333334666665, 333334666671)
 \end{aligned} \tag{37}$$

► **Multiplying (35) by 4**

$$\begin{aligned}
 & (32, 60, 68) \\
 & (272, 4620, 4628) \\
 & (2672, 446220, 446228) \\
 & (26672, 44462220, 44462228) \\
 & (266672, 4444622220, 4444622228) \\
 & (2666672, 444446222220, 444446222228)
 \end{aligned} \tag{38}$$

► **Multiplying (35) by 5**

$$\begin{aligned}
& (40, 75, 85) \\
& (340, 5775, 5785) \\
& (3340, 557775, 557785) \\
& (33340, 55577775, 55577785) \\
& (333340, 5555777775, 5555777785) \\
& (3333340, 555557777775, 555557777785)
\end{aligned} \tag{39}$$

► **Multiplying (35) by 6**

$$\begin{aligned}
& (48, 90, 102) \\
& (408, 6930, 6942) \\
& (4008, 669330, 669342) \\
& (40008, 66693330, 66693342) \\
& (400008, 6666933330, 6666933342) \\
& (4000008, 666669333330, 666669333342)
\end{aligned} \tag{40}$$

► **Multiplying (35) by 7**

$$\begin{aligned}
& (56, 105, 119) \\
& (476, 8085, 8099) \\
& (4676, 780885, 780899) \\
& (46676, 77808885, 77808899) \\
& (466676, 7778088885, 7778088899) \\
& (4666676, 777780888885, 777780888899)
\end{aligned} \tag{41}$$

► **Multiplying (35) by 8**

$$\begin{aligned}
& (64, 120, 136) \\
& (544, 9240, 9256) \\
& (5344, 892440, 892456) \\
& (53344, 88924440, 88924456) \\
& (533344, 8889244440, 8889244456) \\
& (5333344, 888892444440, 888892444456)
\end{aligned} \tag{42}$$

► **Multiplying (35) by 9**

$$\begin{aligned}
& (72, 135, 153) \\
& (612, 10395, 10413) \\
& (6012, 1003995, 1004013) \\
& (60012, 100039995, 100040013) \\
& (600012, 10000399995, 10000400013) \\
& (6000012, 1000003999995, 1000004000013)
\end{aligned} \tag{43}$$

The above expressions are obtained multiplying Example (35) by $n = 1, 2, 3, \dots, 9$. Let's see what happens if we multiply (35) by numbers more than 10:

► **Multiplying (35) by 11**

$$\begin{aligned}
 & (88, 165, 187) \\
 & (748, 12705, 12727) \\
 & (7348, 1227105, 1227127) \\
 & (73348, 122271105, 122271127) \\
 & (733348, 12222711105, 12222711127) \\
 & (7333348, 1222227111105, 1222227111127)
 \end{aligned} \tag{44}$$

► **Multiplying (35) by 41**

$$\begin{aligned}
 & (328, 615, 697) \\
 & (2788, 47355, 47437) \\
 & (27388, 4573755, 4573837) \\
 & (273388, 455737755, 455737837) \\
 & (2733388, 45557377755, 45557377837) \\
 & (27333388, 4555573777755, 4555573777837)
 \end{aligned} \tag{45}$$

The examples below are obtained multiplying (35) by power of 2, for example by 16, 32 and 64.

► **Multiplying (35) by 16**

$$\begin{aligned}
 & (128, 240, 272) \\
 & (1088, 18480, 18512) \\
 & (10688, 1784880, 1784912) \\
 & (106688, 177848880, 177848912) \\
 & (1066688, 17778488880, 17778488912) \\
 & (10666688, 1777784888880, 1777784888912)
 \end{aligned} \tag{46}$$

► **Multiplying (35) by 32**

$$\begin{aligned}
 & (256, 480, 544) \\
 & (2176, 36960, 37024) \\
 & (21376, 3569760, 3569824) \\
 & (213376, 355697760, 355697824) \\
 & (2133376, 35556977760, 35556977824) \\
 & (21333376, 3555569777760, 3555569777824)
 \end{aligned} \tag{47}$$

► **Multiplying (35) by 64**

$$\begin{aligned}
 & (512, 960, 1088) \\
 & (4352, 73920, 74048) \\
 & (42752, 7139520, 7139648) \\
 & (426752, 711395520, 711395648) \\
 & (4266752, 71113955520, 71113955648) \\
 & (42666752, 7111139555520, 7111139555648)
 \end{aligned} \tag{48}$$

Remark 4. We observe that in some cases, the first and/or terms don't follow the pattern.

The above three examples, (7, 21, and 35 brings **multiple-type patterns** without considering final sums. The following two examples are with final sums:

Example 2.4. Let's consider following pattern:

$$\begin{aligned}
 & (99, 20, 101; 10201) \\
 & (9999, 200, 10001; 100020001) \\
 & (999999, 2000, 1000001; 1000002000001) \\
 & (99999999, 20000, 100000001; 10000000200000001) \\
 & (9999999999, 200000, 10000000001; 100000000020000000001) \\
 & (999999999999, 2000000, 1000000000001; 1000000000002000000000001)
 \end{aligned} \tag{49}$$

It is understood that

$$\begin{aligned}
 (99, 20, 101; 10201) & \Rightarrow 99^2 + 20^2 = 101^2 := 10201 \\
 (9999, 200, 10001; 100020001) & \Rightarrow 9999^2 + 200^2 = 10001^2 := 100020001 \\
 \dots & \dots \dots \dots
 \end{aligned}$$

The Example (49) is the same as (172) given in Section 4. Let's multiply the Example (49) by $n = 2, 3, \dots, 9$, we get the following patterns:

► **Multiplying (49) by 2**

$$\begin{aligned}
 & (198, 40, 202; 20402) \\
 & (19998, 400, 20002; 200040002) \\
 & (1999998, 4000, 2000002; 2000004000002) \\
 & (199999998, 40000, 200000002; 20000000400000002) \\
 & (19999999998, 400000, 20000000002; 200000000040000000002) \\
 & (1999999999998, 4000000, 2000000000002; 2000000000004000000000002)
 \end{aligned} \tag{50}$$

► **Multiplying (49) by 3**

$$\begin{aligned}
 & (297, 60, 303; 30603) \\
 & (29997, 600, 30003; 300060003) \\
 & (2999997, 6000, 3000003; 3000006000003) \\
 & (299999997, 60000, 300000003; 30000000600000003) \\
 & (29999999997, 600000, 30000000003; 300000000060000000003) \\
 & (2999999999997, 6000000, 3000000000003; 3000000000006000000000003)
 \end{aligned} \tag{51}$$

► **Multiplying (49) by 4**

$$\begin{aligned}
& (396, 80, 404; 40804) \\
& (39996, 800, 40004; 400080004) \\
& (3999996, 8000, 4000004; 4000008000004) \\
& (399999996, 80000, 400000004; 40000000800000004) \\
& (39999999996, 800000, 40000000004; 400000000080000000004) \\
& (3999999999996, 8000000, 4000000000004; 4000000000008000000000004) \quad (52)
\end{aligned}$$

► **Multiplying (49) by 5**

$$\begin{aligned}
& (495, 100, 505; 51005) \\
& (49995, 1000, 50005; 500100005) \\
& (4999995, 10000, 5000005; 5000010000005) \\
& (499999995, 100000, 500000005; 50000001000000005) \\
& (49999999995, 1000000, 50000000005; 500000000100000000005) \\
& (4999999999995, 10000000, 5000000000005; 5000000000010000000000005) \quad (53)
\end{aligned}$$

► **Multiplying (49) by 6**

$$\begin{aligned}
& (594, 120, 606; 61206) \\
& (59994, 1200, 60006; 600120006) \\
& (5999994, 12000, 6000006; 6000012000006) \\
& (599999994, 120000, 600000006; 60000001200000006) \\
& (59999999994, 1200000, 60000000006; 600000000120000000006) \\
& (5999999999994, 12000000, 6000000000006; 6000000000012000000000006) \quad (54)
\end{aligned}$$

► **Multiplying (49) by 7**

$$\begin{aligned}
& (693, 140, 707; 71407) \\
& (69993, 1400, 70007; 700140007) \\
& (6999993, 14000, 7000007; 7000014000007) \\
& (699999993, 140000, 700000007; 70000001400000007) \\
& (69999999993, 1400000, 70000000007; 700000000140000000007) \\
& (6999999999993, 14000000, 7000000000007; 7000000000014000000000007) \quad (55)
\end{aligned}$$

► **Multiplying (49) by 8**

$$\begin{aligned}
& (792, 160, 808; 81608) \\
& (79992, 1600, 80008; 800160008) \\
& (799992, 16000, 8000008; 8000016000008) \\
& (7999992, 160000, 800000008; 80000001600000008) \\
& (79999992, 1600000, 80000000008; 800000000160000000008) \\
& (799999992, 16000000, 8000000000008; 8000000000016000000000008)
\end{aligned} \tag{56}$$

► **Multiplying (49) by 9**

$$\begin{aligned}
& (891, 180, 909; 91809) \\
& (89991, 1800, 90009; 900180009) \\
& (899991, 18000, 9000009; 9000018000009) \\
& (8999991, 180000, 900000009; 90000001800000009) \\
& (89999991, 1800000, 90000000009; 900000000180000000009) \\
& (899999991, 18000000, 9000000000009; 9000000000018000000000009)
\end{aligned} \tag{57}$$

The above expressions are obtained multiplying Example (49) by $n = 1, 2, 3, \dots, 9$. Let's see what happen's if we multiplying (49) by numbers more than 10:

► **Multiplying (49) by 17**

$$\begin{aligned}
& (1683, 340, 1717; 173417) \\
& (169983, 3400, 170017; 1700340017) \\
& (1699983, 34000, 17000017; 17000034000017) \\
& (16999983, 340000, 1700000017; 170000003400000017) \\
& (169999983, 3400000, 170000000017; 1700000000340000000017) \\
& (1699999983, 34000000, 17000000000017; 17000000000034000000000017)
\end{aligned} \tag{58}$$

► **Multiplying (49) by 29**

$$\begin{aligned}
& (2871, 580, 2929; 295829) \\
& (289971, 5800, 290029; 2900580029) \\
& (2899971, 58000, 29000029; 29000058000029) \\
& (28999971, 580000, 2900000029; 290000005800000029) \\
& (289999971, 5800000, 290000000029; 2900000000580000000029) \\
& (2899999971, 58000000, 29000000000029; 29000000000058000000000029)
\end{aligned} \tag{59}$$

The examples below are obtained multiplying (49) by power of 2, for example by 16, 32 and 64.

► **Multiplying (49) by 16**

$$\begin{aligned}
& (1584, 320, 1616; 163216) \\
& (159984, 3200, 160016; 1600320016) \\
& (15999984, 32000, 16000016; 16000032000016) \\
& (1599999984, 320000, 1600000016; 160000003200000016) \\
& (159999999984, 3200000, 160000000016; 1600000000320000000016) \\
& (15999999999984, 32000000, 16000000000016; 16000000000032000000000016) \quad (60)
\end{aligned}$$

► **Multiplying (49) by 32**

$$\begin{aligned}
& (3168, 640, 3232; 326432) \\
& (319968, 6400, 320032; 3200640032) \\
& (31999968, 64000, 32000032; 32000064000032) \\
& (3199999968, 640000, 3200000032; 320000006400000032) \\
& (319999999968, 6400000, 320000000032; 3200000000640000000032) \\
& (31999999999968, 64000000, 32000000000032; 32000000000064000000000032) \quad (61)
\end{aligned}$$

► **Multiplying (49) by 64**

$$\begin{aligned}
& (6336, 1280, 6464; 652864) \\
& (639936, 12800, 640064; 6401280064) \\
& (63999936, 128000, 64000064; 64000128000064) \\
& (6399999936, 1280000, 6400000064; 640000012800000064) \\
& (639999999936, 12800000, 640000000064; 6400000001280000000064) \\
& (63999999999936, 128000000, 64000000000064; 64000000000128000000000064) \quad (62)
\end{aligned}$$

Example 2.5. *Let's consider following pattern:*

$$\begin{aligned}
& (220, 21, 221; 48841) \\
& (20200, 201, 20201; 408080401) \\
& (2002000, 2001, 2002001; 4008008004001) \\
& (200020000, 20001, 200020001; 40008000800040001) \\
& (20000200000, 200001, 20000200001; 400008000080000400001) \quad (63)
\end{aligned}$$

The Example (63) is the same as (174) given in Section ???. Let's multiply the Example (63) by $n = 2, 3, \dots, 9$, we get the following patterns:

► **Multiplying (63) by 2**

$$\begin{aligned}
& (440, 42, 442; 97682) \\
& (40400, 402, 40402; 816160802) \\
& (4004000, 4002, 4004002; 8016016008002) \\
& (400040000, 40002, 400040002; 80016001600080002) \\
& (40000400000, 400002, 40000400002; 800016000160000800002) \quad (64)
\end{aligned}$$

► **Multiplying (63) by 3**

$$\begin{aligned}
 & (660, 63, 663; 146523) \\
 & (60600, 603, 60603; 1224241203) \\
 & (6006000, 6003, 6006003; 12024024012003) \\
 & (600060000, 60003, 600060003; 120024002400120003) \\
 & (60000600000, 600003, 60000600003; 1200024000240001200003)
 \end{aligned} \tag{65}$$

► **Multiplying (63) by 4**

$$\begin{aligned}
 & (880, 84, 884; 195364) \\
 & (80800, 804, 80804; 1632321604) \\
 & (8008000, 8004, 8008004; 16032032016004) \\
 & (800080000, 80004, 800080004; 160032003200160004) \\
 & (80000800000, 800004, 80000800004; 1600032000320001600004)
 \end{aligned} \tag{66}$$

► **Multiplying (63) by 5**

$$\begin{aligned}
 & (1100, 105, 1105; 244205) \\
 & (101000, 1005, 101005; 2040402005) \\
 & (10010000, 10005, 10010005; 20040040020005) \\
 & (1000100000, 100005, 1000100005; 200040004000200005) \\
 & (100001000000, 1000005, 100001000005; 2000040000400002000005)
 \end{aligned} \tag{67}$$

► **Multiplying (63) by 6**

$$\begin{aligned}
 & (1320, 126, 1326; 293046) \\
 & (121200, 1206, 121206; 2448482406) \\
 & (12012000, 12006, 12012006; 24048048024006) \\
 & (1200120000, 120006, 1200120006; 240048004800240006) \\
 & (120001200000, 1200006, 120001200006; 2400048000480002400006)
 \end{aligned} \tag{68}$$

► **Multiplying (63) by 7**

$$\begin{aligned}
 & (1540, 147, 1547; 341887) \\
 & (141400, 1407, 141407; 2856562807) \\
 & (14014000, 14007, 14014007; 28056056028007) \\
 & (1400140000, 140007, 1400140007; 280056005600280007) \\
 & (140001400000, 1400007, 140001400007; 2800056000560002800007)
 \end{aligned} \tag{69}$$

► **Multiplying (63) by 8**

$$\begin{aligned}
 & (1760, 168, 1768; 390728) \\
 & (161600, 1608, 161608; 3264643208) \\
 & (16016000, 16008, 16016008; 32064064032008) \\
 & (1600160000, 160008, 1600160008; 320064006400320008) \\
 & (160001600000, 1600008, 160001600008; 3200064000640003200008)
 \end{aligned} \tag{70}$$

► **Multiplying (63) by 9**

$$\begin{aligned}
 & (1980, 189, 1989; 439569) \\
 & (181800, 1809, 181809; 3672723609) \\
 & (18018000, 18009, 18018009; 36072072036009) \\
 & (1800180000, 180009, 1800180009; 360072007200360009) \\
 & (180001800000, 1800009, 180001800009; 3600072000720003600009)
 \end{aligned} \tag{71}$$

The above expressions are obtained multiplying Example (63) by $n = 1, 2, 3, \dots, 9$. Let's see what happen's if we multiplying (63) by numbers more than 10:

► **Multiplying (63) by 23**

$$\begin{aligned}
 & (5060, 483, 5083; 1123343) \\
 & (464600, 4623, 464623; 9385849223) \\
 & (46046000, 46023, 46046023; 92184184092023) \\
 & (4600460000, 460023, 4600460023; 920184018400920023) \\
 & (460004600000, 4600023, 460004600023; 9200184001840009200023)
 \end{aligned} \tag{72}$$

► **Multiplying (63) by 37**

$$\begin{aligned}
 & (8140, 777, 8177; 1807117) \\
 & (747400, 7437, 747437; 15098974837) \\
 & (74074000, 74037, 74074037; 148296296148037) \\
 & (5400540000, 540027, 5400540027; 1080216021601080027) \\
 & (740007400000, 7400037, 740007400037; 14800296002960014800037)
 \end{aligned} \tag{73}$$

The examples below are obtained multiplying (21) by power of 2, for example by 16, 32 and 64.

► **Multiplying (63) by 16**

$$\begin{aligned}
 & (3520, 336, 3536; 781456) \\
 & (323200, 3216, 323216; 6529286416) \\
 & (32032000, 32016, 32032016; 64128128064016) \\
 & (3200320000, 320016, 3200320016; 640128012800640016) \\
 & (320003200000, 3200016, 320003200016; 6400128001280006400016)
 \end{aligned} \tag{74}$$

► **Multiplying (63) by 32**

$$\begin{aligned}
 & (7040, 672, 7072; 1562912) \\
 & (646400, 6432, 646432; 13058572832) \\
 & (64064000, 64032, 64064032; 128256256128032) \\
 & (6400640000, 640032, 6400640032; 1280256025601280032) \\
 & (640006400000, 6400032, 640006400032; 12800256002560012800032)
 \end{aligned} \tag{75}$$

► **Multiplying (63) by 64**

$$\begin{aligned}
 & (14080, 1344, 14144; 3125824) \\
 & (1292800, 12864, 1292864; 26117145664) \\
 & (128128000, 128064, 128128064; 256512512256064) \\
 & (12801280000, 1280064, 12801280064; 2560512051202560064) \\
 & (1280012800000, 12800064, 1280012800064; 25600512005120025600064)
 \end{aligned} \tag{76}$$

Remark 5. We observe that in some cases, the first and/or terms don't follow the pattern. These are specified by *brown color*.

3 Patterns Without Final Sum

This section brings **patterns in Pythagorean triples**. The pythagorean triple considered are primitive. The idea of total sum is considered in Section 4. The way of construction is given in [5, 6].

$$\begin{aligned}
 & 3^2 + 4^2 = 5^2 \\
 & 1023^2 + 64^2 = 1025^2 \\
 & 110223^2 + 664^2 = 110225^2 \\
 & 11102223^2 + 6664^2 = 11102225^2 \\
 & 1111022223^2 + 66664^2 = 1111022225^2
 \end{aligned} \tag{77}$$

$$\begin{aligned}
 & 4^2 + 3^2 = 5^2 \\
 & 84^2 + 13^2 = 85^2 \\
 & 8844^2 + 133^2 = 8845^2 \\
 & 888444^2 + 1333^2 = 888445^2 \\
 & 88884444^2 + 13333^2 = 88884445^2 \\
 & 8888844444^2 + 133333^2 = 8888844445^2
 \end{aligned} \tag{78}$$

$$\begin{aligned}
4^2 + 3^2 &= 5^2 \\
544^2 + 33^2 &= 545^2 \\
55444^2 + 333^2 &= 55445^2 \\
5554444^2 + 3333^2 &= 5554445^2 \\
555544444^2 + 33333^2 &= 555544445^2 \\
55555444444^2 + 333333^2 &= 55555444445^2
\end{aligned} \tag{79}$$

$$\begin{aligned}
4^2 + 3^2 &= 5^2 \\
1984^2 + 63^2 &= 1985^2 \\
219784^2 + 663^2 &= 219785^2 \\
22197784^2 + 6663^2 &= 22197785^2 \\
2221977784^2 + 66663^2 &= 2221977785^2
\end{aligned} \tag{80}$$

$$\begin{aligned}
4^2 + 3^2 &= 5^2 \\
7564^2 + 123^2 &= 7565^2 \\
875164^2 + 1323^2 &= 875165^2 \\
88751164^2 + 13323^2 &= 88751165^2 \\
8887511164^2 + 133323^2 &= 8887511165^2
\end{aligned} \tag{81}$$

$$\begin{aligned}
5^2 + 12^2 &= 13^2 \\
1085^2 + 132^2 &= 1093^2 \\
110885^2 + 1332^2 &= 110893^2 \\
11108885^2 + 13332^2 &= 11108893^2 \\
1111088885^2 + 133332^2 &= 1111088893^2 \\
111110888885^2 + 1333332^2 &= 111110888893^2
\end{aligned} \tag{82}$$

$$\begin{aligned}
8^2 + 15^2 &= 17^2 \\
68^2 + 1155^2 &= 1157^2 \\
668^2 + 111555^2 &= 111557^2 \\
6668^2 + 11115555^2 &= 11115557^2 \\
66668^2 + 1111155555^2 &= 1111155557^2 \\
666668^2 + 111111555555^2 &= 111111555557^2
\end{aligned} \tag{83}$$

$$\begin{aligned}
8^2 + 6^2 &= 10^2 \\
1088^2 + 66^2 &= 1090^2 \\
110888^2 + 666^2 &= 110890^2 \\
11108888^2 + 6666^2 &= 11108890^2 \\
1111088888^2 + 66666^2 &= 1111088890^2 \\
111110888888^2 + 666666^2 &= 111110888890^2
\end{aligned} \tag{84}$$

$$\begin{aligned}
9^2 + 40^2 &= 41^2 \\
3009^2 + 440^2 &= 3041^2 \\
308009^2 + 4440^2 &= 308041^2 \\
30858009^2 + 44440^2 &= 30858041^2
\end{aligned} \tag{85}$$

$$\begin{aligned}
12^2 + 5^2 &= 13^2 \\
812^2 + 125^2 &= 7813^2 \\
877812^2 + 1325^2 &= 877813^2 \\
88777812^2 + 13325^2 &= 88777813^2 \\
8887777812^2 + 133325^2 &= 8887777813^2
\end{aligned} \tag{86}$$

$$\begin{aligned}
12^2 + 5^2 &= 13^2 \\
2112^2 + 65^2 &= 2113^2 \\
221112^2 + 665^2 &= 221113^2 \\
22211112^2 + 6665^2 &= 22211113^2 \\
2222111112^2 + 66665^2 &= 2222111113^2
\end{aligned} \tag{87}$$

$$\begin{aligned}
12^2 + 5^2 &= 13^2 \\
17112^2 + 185^2 &= 17113^2 \\
1970112^2 + 1985^2 &= 1970113^2 \\
199700112^2 + 19985^2 &= 199700113^2 \\
19997000112^2 + 199985^2 &= 19997000113^2
\end{aligned} \tag{88}$$

$$\begin{aligned}
15^2 + 8^2 &= 17^2 \\
1155^2 + 68^2 &= 1157^2 \\
111555^2 + 668^2 &= 111557^2 \\
11115555^2 + 6668^2 &= 11115557^2 \\
1111155555^2 + 66668^2 &= 1111155557^2 \\
111111555555^2 + 666668^2 &= 111111555557^2
\end{aligned} \tag{89}$$

$$\begin{aligned}
16^2 + 12^2 &= 20^2 \\
2176^2 + 132^2 &= 2180^2 \\
221776^2 + 1332^2 &= 221780^2 \\
22217776^2 + 13332^2 &= 22217780^2 \\
2222177776^2 + 133332^2 &= 2222177780^2 \\
222221777776^2 + 1333332^2 &= 222221777780^2
\end{aligned} \tag{90}$$

$$\begin{aligned}
24^2 + 7^2 &= 25^2 \\
2244^2 + 67^2 &= 2245^2 \\
222444^2 + 667^2 &= 222445^2 \\
22224444^2 + 6667^2 &= 22224445^2 \\
2222244444^2 + 66667^2 &= 2222244445^2 \\
222222444444^2 + 666667^2 &= 222222444445^2
\end{aligned} \tag{91}$$

$$\begin{aligned}
24^2 + 7^2 &= 25^2 \\
2664^2 + 73^2 &= 2665^2 \\
226464^2 + 673^2 &= 226465^2 \\
22264464^2 + 6673^2 &= 22264465^2 \\
2222644464^2 + 66673^2 &= 2222644465^2
\end{aligned} \tag{92}$$

$$\begin{aligned}
35^2 + 12^2 &= 37^2 \\
4355^2 + 132^2 &= 4357^2 \\
443555^2 + 1332^2 &= 443557^2 \\
44435555^2 + 13332^2 &= 44435557^2 \\
4444355555^2 + 133332^2 &= 4444355557^2 \\
444443555555^2 + 1333332^2 &= 444443555557^2
\end{aligned} \tag{93}$$

$$\begin{aligned}
48^2 + 55^2 &= 73^2 \\
6148^2 + 555^2 &= 6173^2 \\
617148^2 + 5555^2 &= 617173^2 \\
61727148^2 + 55555^2 &= 61727173^2
\end{aligned} \tag{94}$$

$$\begin{aligned}
134^2 + 4488^2 &= 4490^2 \\
1334^2 + 444888^2 &= 444890^2 \\
13334^2 + 44448888^2 &= 44448890^2 \\
133334^2 + 4444488888^2 &= 4444488890^2 \\
1333334^2 + 444444888888^2 &= 444444888890^2 \\
13333334^2 + 44444448888888^2 &= 44444448888890^2
\end{aligned} \tag{95}$$

$$\begin{aligned}
140^2 + 1221^2 &= 1229^2 \\
1340^2 + 112221^2 &= 112229^2 \\
13340^2 + 11122221^2 &= 11122229^2 \\
133340^2 + 1111222221^2 &= 1111222229^2 \\
1333340^2 + 111112222221^2 &= 111112222229^2 \\
13333340^2 + 11111122222221^2 &= 11111122222229^2
\end{aligned} \tag{96}$$

$$\begin{aligned}
143^2 + 24^2 &= 145^2 \\
17423^2 + 264^2 &= 17425^2 \\
1774223^2 + 2664^2 &= 1774225^2 \\
177742223^2 + 26664^2 &= 177742225^2 \\
17777422223^2 + 266664^2 &= 17777422225^2
\end{aligned} \tag{97}$$

$$\begin{aligned}
207^2 + 2376^2 &= 2385^2 \\
2007^2 + 223776^2 &= 223785^2 \\
20007^2 + 22237776^2 &= 22237785^2 \\
200007^2 + 2222377776^2 &= 2222377785^2 \\
2000007^2 + 222223777776^2 &= 222223777785^2 \\
20000007^2 + 22222237777776^2 &= 22222237777785^2
\end{aligned} \tag{98}$$

$$\begin{aligned}
209^2 + 120^2 &= 241^2 \\
24009^2 + 1240^2 &= 24041^2 \\
2418009^2 + 12440^2 &= 2418041^2 \\
241958009^2 + 124440^2 &= 241958041^2
\end{aligned} \tag{99}$$

$$\begin{aligned}
221^2 + 60^2 &= 229^2 \\
24021^2 + 620^2 &= 24029^2 \\
2418021^2 + 6220^2 &= 2418029^2 \\
241958021^2 + 62220^2 &= 241958029^2
\end{aligned} \tag{100}$$

$$\begin{aligned}
255^2 + 32^2 &= 257^2 \\
27555^2 + 332^2 &= 27557^2 \\
2775555^2 + 3332^2 &= 2775557^2 \\
277755555^2 + 33332^2 &= 277755557^2
\end{aligned} \tag{101}$$

$$\begin{aligned}
355^2 + 2508^2 &= 2533^2 \\
3355^2 + 225108^2 &= 225133^2 \\
33355^2 + 22251108^2 &= 22251133^2 \\
333355^2 + 2222511108^2 &= 2222511133^2 \\
3333355^2 + 222225111108^2 &= 222225111133^2 \\
33333355^2 + 22222251111108^2 &= 22222251111133^2
\end{aligned} \tag{102}$$

$$\begin{aligned}
364^2 + 27^2 &= 365^2 \\
35644^2 + 267^2 &= 35645^2 \\
3556444^2 + 2667^2 &= 3556445^2 \\
355564444^2 + 26667^2 &= 355564445^2
\end{aligned} \tag{103}$$

$$\begin{aligned}
504^2 + 297^2 &= 585^2 \\
55404^2 + 2997^2 &= 55485^2 \\
5554404^2 + 29997^2 &= 5554485^2 \\
555544404^2 + 299997^2 &= 555544485^2 \\
55555444404^2 + 2999997^2 &= 55555444485^2
\end{aligned} \tag{104}$$

$$\begin{aligned}
512^2 + 55^2 &= 1513^2 \\
154012^2 + 555^2 &= 154013^2 \\
15429012^2 + 5555^2 &= 15429013^2 \\
1543179012^2 + 55555^2 &= 1543179013^2
\end{aligned} \tag{105}$$

$$\begin{aligned}
520^2 + 231^2 &= 569^2 \\
55420^2 + 2331^2 &= 55469^2 \\
5554420^2 + 23331^2 &= 5554469^2 \\
555544420^2 + 233331^2 &= 555544469^2 \\
55555444420^2 + 2333331^2 &= 55555444469^2
\end{aligned} \tag{106}$$

$$\begin{aligned}
532^2 + 165^2 &= 557^2 \\
55432^2 + 1665^2 &= 55457^2 \\
5554432^2 + 16665^2 &= 5554457^2 \\
555544432^2 + 166665^2 &= 555544457^2 \\
55555444432^2 + 1666665^2 &= 55555444457^2
\end{aligned} \tag{107}$$

$$\begin{aligned}
540^2 + 99^2 &= 549^2 \\
55440^2 + 999^2 &= 55449^2 \\
5554440^2 + 9999^2 &= 5554449^2 \\
555544440^2 + 99999^2 &= 555544449^2 \\
55555444440^2 + 999999^2 &= 55555444449^2
\end{aligned} \tag{108}$$

$$\begin{aligned}
685^2 + 9372^2 &= 9397^2 \\
6685^2 + 893772^2 &= 893797^2 \\
66685^2 + 88937772^2 &= 88937797^2 \\
666685^2 + 8889377772^2 &= 8889377797^2 \\
6666685^2 + 888893777772^2 &= 888893777797^2 \\
66666685^2 + 88888937777772^2 &= 88888937777797^2
\end{aligned} \tag{109}$$

$$\begin{aligned}
1025^2 + 528^2 &= 1153^2 \\
110825^2 + 5328^2 &= 110953^2 \\
11108825^2 + 53328^2 &= 11108953^2 \\
1111088825^2 + 533328^2 &= 1111088953^2 \\
111110888825^2 + 5333328^2 &= 111110888953^2
\end{aligned} \tag{110}$$

$$\begin{aligned}
1053^2 + 396^2 &= 1125^2 \\
110853^2 + 3996^2 &= 110925^2 \\
11108853^2 + 39996^2 &= 11108925^2 \\
1111088853^2 + 399996^2 &= 1111088925^2 \\
111110888853^2 + 3999996^2 &= 111110888925^2
\end{aligned} \tag{111}$$

$$\begin{aligned}
1073^2 + 264^2 &= 1105^2 \\
110873^2 + 2664^2 &= 110905^2 \\
11108873^2 + 26664^2 &= 11108905^2 \\
1111088873^2 + 266664^2 &= 1111088905^2 \\
111110888873^2 + 2666664^2 &= 111110888905^2
\end{aligned} \tag{112}$$

$$\begin{aligned}
1221^2 + 140^2 &= 1229^2 \\
112221^2 + 1340^2 &= 112229^2 \\
11122221^2 + 13340^2 &= 11122229^2 \\
1111222221^2 + 133340^2 &= 1111222229^2 \\
111112222221^2 + 1333340^2 &= 111112222229^2 \\
11111122222221^2 + 13333340^2 &= 11111122222229^2
\end{aligned} \tag{113}$$

$$\begin{aligned}
1419^2 + 380^2 &= 1469^2 \\
114219^2 + 3380^2 &= 114269^2 \\
11142219^2 + 33380^2 &= 11142269^2 \\
1111422219^2 + 333380^2 &= 1111422269^2 \\
111114222219^2 + 3333380^2 &= 111114222269^2 \\
11111142222219^2 + 33333380^2 &= 11111142222269^2
\end{aligned} \tag{114}$$

$$\begin{aligned}
1508^2 + 165^2 &= 1517^2 \\
154008^2 + 1665^2 &= 154017^2 \\
15429008^2 + 16665^2 &= 15429017^2 \\
1543179008^2 + 166665^2 &= 1543179017^2
\end{aligned} \tag{115}$$

$$\begin{aligned}
1551^2 + 560^2 &= 1649^2 \\
11551^2 + 4760^2 &= 115649^2 \\
1115551^2 + 46760^2 &= 11155649^2 \\
111155551^2 + 466760^2 &= 1111555649^2 \\
11111555551^2 + 4666760^2 &= 111115555649^2 \\
1111115555551^2 + 46666760^2 &= 11111155555649^2
\end{aligned} \tag{116}$$

$$\begin{aligned}
1617^2 + 656^2 &= 1745^2 \\
116217^2 + 5456^2 &= 116345^2 \\
11162217^2 + 53456^2 &= 11162345^2 \\
1111622217^2 + 533456^2 &= 1111622345^2 \\
111116222217^2 + 5333456^2 &= 111116222345^2 \\
11111162222217^2 + 53333456^2 &= 11111162222345^2
\end{aligned} \tag{117}$$

$$\begin{aligned}
4307^2 + 924^2 &= 4405^2 \\
443507^2 + 9324^2 &= 443605^2 \\
44435507^2 + 93324^2 &= 44435605^2 \\
4444355507^2 + 933324^2 &= 4444355605^2 \\
444443555507^2 + 9333324^2 &= 444443555605^2
\end{aligned} \tag{118}$$

$$\begin{aligned}
4331^2 + 660^2 &= 4381^2 \\
443531^2 + 6660^2 &= 443581^2 \\
44435531^2 + 66660^2 &= 44435581^2 \\
4444355531^2 + 666660^2 &= 4444355581^2 \\
444443555531^2 + 6666660^2 &= 444443555581^2
\end{aligned} \tag{119}$$

$$\begin{aligned}
4347^2 + 396^2 &= 4365^2 \\
443547^2 + 3996^2 &= 443565^2 \\
44435547^2 + 39996^2 &= 44435565^2 \\
4444355547^2 + 399996^2 &= 4444355565^2 \\
444443555547^2 + 3999996^2 &= 444443555565^2
\end{aligned} \tag{120}$$

$$\begin{aligned}
4275^2 + 1188^2 &= 4437^2 \\
443475^2 + 11988^2 &= 443637^2 \\
44435475^2 + 119988^2 &= 44435637^2 \\
4444355475^2 + 1199988^2 &= 4444355637^2 \\
444443555475^2 + 11999988^2 &= 444443555637^2
\end{aligned} \tag{121}$$

$$\begin{aligned}
6083^2 + 156^2 &= 6085^2 \\
636803^2 + 1596^2 &= 636805^2 \\
63968003^2 + 15996^2 &= 63968005^2 \\
6399680003^2 + 159996^2 &= 6399680005^2
\end{aligned} \tag{122}$$

$$\begin{aligned}
8064^2 + 127^2 &= 8065^2 \\
880464^2 + 1327^2 &= 880465^2 \\
88804464^2 + 13327^2 &= 88804465^2 \\
8888044464^2 + 133327^2 &= 8888044465^2
\end{aligned} \tag{123}$$

$$\begin{aligned}
9660^2 + 139^2 &= 9661^2 \\
896460^2 + 1339^2 &= 896461^2 \\
88964460^2 + 13339^2 &= 88964461^2 \\
8889644460^2 + 133339^2 &= 8889644461^2
\end{aligned} \tag{124}$$

$$\begin{aligned}
14859^2 + 1220^2 &= 14909^2 \\
1493259^2 + 12220^2 &= 1493309^2 \\
149377259^2 + 122220^2 &= 149377309^2 \\
14938217259^2 + 1222220^2 &= 14938217309^2
\end{aligned} \tag{125}$$

$$\begin{aligned}
17415^2 + 792^2 &= 17433^2 \\
1774215^2 + 7992^2 &= 1774233^2 \\
177742215^2 + 79992^2 &= 177742233^2 \\
17777422215^2 + 799992^2 &= 17777422233^2
\end{aligned} \tag{126}$$

$$\begin{aligned}
17484^2 + 187^2 &= 17485^2 \\
1974084^2 + 1987^2 &= 1974085^2 \\
199740084^2 + 19987^2 &= 199740085^2 \\
19997400084^2 + 199987^2 &= 19997400085^2
\end{aligned} \tag{127}$$

$$\begin{aligned}
27144^2 + 233^2 &= 27145^2 \\
2721444^2 + 2333^2 &= 2721445^2 \\
272214444^2 + 23333^2 &= 272214445^2 \\
27222144444^2 + 233333^2 &= 27222144445^2 \\
2722221444444^2 + 2333333^2 &= 2722221444445^2
\end{aligned} \tag{128}$$

$$\begin{aligned}
31500^2 + 251^2 &= 31501^2 \\
3127500^2 + 2501^2 &= 3127501^2 \\
312525000^2 + 25001^2 &= 312525001^2 \\
31250250000^2 + 250001^2 &= 31250250001^2 \\
3125002500000^2 + 2500001^2 &= 3125002500001^2
\end{aligned} \tag{129}$$

$$\begin{aligned}
44660^2 + 2691^2 &= 44741 \\
4496960^2 + 26991^2 &= 4497041 \\
449969960^2 + 269991^2 &= 449970041 \\
44999699960^2 + 2699991^2 &= 44999700041
\end{aligned} \tag{130}$$

$$\begin{aligned}
70755^2 + 532^2 &= 70757^2 \\
7107555^2 + 5332^2 &= 7107557^2 \\
711075555^2 + 53332^2 &= 711075557^2 \\
71110755555^2 + 533332^2 &= 71110755557^2
\end{aligned} \tag{131}$$

$$\begin{aligned}
92415^2 + 608^2 &= 92417^2 \\
9024015^2 + 6008^2 &= 9024017^2 \\
900240015^2 + 60008^2 &= 900240017^2 \\
90002400015^2 + 600008^2 &= 90002400017^2
\end{aligned} \tag{132}$$

$$\begin{aligned}
125500^2 + 501^2 &= 125501^2 \\
12505000^2 + 5001^2 &= 12505001^2 \\
1250050000^2 + 50001^2 &= 1250050001^2 \\
125000500000^2 + 500001^2 &= 125000500001^2
\end{aligned} \tag{133}$$

$$\begin{aligned}
184224^2 + 607^2 &= 184225^2 \\
18042024^2 + 6007^2 &= 18042025^2 \\
1800420024^2 + 60007^2 &= 1800420025^2 \\
180004200024^2 + 600007^2 &= 180004200025^2
\end{aligned} \tag{134}$$

$$\begin{aligned}
226440^2 + 4711^2 &= 226489^2 \\
22264440^2 + 46711^2 &= 22264489^2 \\
2222644440^2 + 466711^2 &= 2222644489^2 \\
222226444440^2 + 4666711^2 &= 222226444489^2 \\
22222264444440^2 + 46666711^2 &= 22222264444489^2
\end{aligned} \tag{135}$$

$$\begin{aligned}
230520^2 + 679^2 &= 230521^2 \\
22304520^2 + 6679^2 &= 22304521^2 \\
2223044520^2 + 66679^2 &= 2223044521^2
\end{aligned} \tag{136}$$

$$\begin{aligned}
411300^2 + 6349^2 &= 411349^2 \\
40563000^2 + 63049^2 &= 40563049^2 \\
4050630000^2 + 630049^2 &= 4050630049^2 \\
405006300000^2 + 6300049^2 &= 405006300049^2 \\
40500063000000^2 + 63000049^2 &= 40500063000049^2
\end{aligned} \tag{137}$$

$$\begin{aligned}
535823^2 + 1464^2 &= 535825^2 \\
53758223^2 + 14664^2 &= 53758225^2 \\
5377582223^2 + 146664^2 &= 5377582225^2 \\
537775822223^2 + 1466664^2 &= 537775822225^2
\end{aligned} \tag{138}$$

$$\begin{aligned}
828099^2 + 1820^2 &= 828101^2 \\
81180099^2 + 18020^2 &= 81180101^2 \\
8101800099^2 + 180020^2 &= 8101800101^2 \\
810018000099^2 + 1800020^2 &= 810018000101^2 \\
81000180000099^2 + 18000020^2 &= 81000180000101^2
\end{aligned} \tag{139}$$

$$\begin{aligned}
978600^2 + 1399^2 &= 978601 \\
97986000^2 + 13999^2 &= 97986001 \\
9799860000^2 + 139999^2 &= 9799860001 \\
979998600000^2 + 1399999^2 &= 979998600001
\end{aligned} \tag{140}$$

$$\begin{aligned}
1346440^2 + 1641^2 &= 1346441^2 \\
134496400^2 + 16401^2 &= 134496401^2
\end{aligned} \tag{141}$$

$$\begin{aligned}
1774103^2 + 29304^2 &= 1774345^2 \\
177742103^2 + 293304^2 &= 177742345^2 \\
17777422103^2 + 2933304^2 &= 17777422345^2 \\
1777774222103^2 + 29333304^2 &= 1777774222345^2
\end{aligned} \tag{142}$$

$$\begin{aligned}
1774143^2 + 23976^2 &= 1774305^2 \\
177742143^2 + 239976^2 &= 177742305^2 \\
17777422143^2 + 2399976^2 &= 17777422305^2 \\
1777774222143^2 + 23999976^2 &= 1777774222305^2
\end{aligned} \tag{143}$$

$$\begin{aligned}
1774175^2 + 18648^2 &= 1774273^2 \\
177742175^2 + 186648^2 &= 177742273^2 \\
17777422175^2 + 1866648^2 &= 17777422273^2 \\
1777774222175^2 + 18666648^2 &= 1777774222273^2
\end{aligned} \tag{144}$$

$$\begin{aligned}
1774199^2 + 13320^2 &= 1774249^2 \\
177742199^2 + 133320^2 &= 177742249^2 \\
17777422199^2 + 1333320^2 &= 17777422249^2 \\
1777774222199^2 + 13333320^2 &= 1777774222249^2
\end{aligned} \tag{145}$$

$$\begin{aligned}
3382600^2 + 2601^2 &= 3382601^2 \\
338026000^2 + 26001^2 &= 338026001^2 \\
33800260000^2 + 260001^2 &= 33800260001^2 \\
3380002600000^2 + 2600001^2 &= 3380002600001^2
\end{aligned} \tag{146}$$

$$\begin{aligned}
7096887^2 + 15984^2 &= 7096905^2 \\
71096887^2 + 159984^2 &= 710968905^2 \\
7110968887^2 + 1599984^2 &= 71109688905^2 \\
711109688887^2 + 15999984^2 &= 7111096888905^2
\end{aligned} \tag{147}$$

$$\begin{aligned}
7096892^2 + 10656^2 &= 7096900^2 \\
710968892^2 + 106656^2 &= 710968900^2 \\
71109688892^2 + 1066656^2 &= 71109688900^2 \\
7111096888892^2 + 10666656^2 &= 7111096888900^2
\end{aligned} \tag{148}$$

$$\begin{aligned}
7096895^2 + 5328^2 &= 7096897^2 \\
710968895^2 + 53328^2 &= 710968897^2 \\
71109688895^2 + 533328^2 &= 71109688897^2 \\
7111096888895^2 + 5333328^2 &= 7111096888897^2
\end{aligned} \tag{149}$$

$$\begin{aligned}
70968802^2 + 21312^2 &= 7096912^2 \\
7109688802^2 + 213312^2 &= 710968912^2 \\
711096888802^2 + 2133312^2 &= 71109688912^2 \\
71110968888802^2 + 21333312^2 &= 7111096888912^2
\end{aligned} \tag{150}$$

$$\begin{aligned}
70968712^2 + 26640^2 &= 7096921^2 \\
7109688712^2 + 266640^2 &= 710968921^2 \\
711096888712^2 + 2666640^2 &= 71109688921^2 \\
71110968888712^2 + 26666640^2 &= 7111096888921^2
\end{aligned}
\tag{151}$$

$$\begin{aligned}
1966144^2 + 1983^2 &= 1966145^2 \\
199660144^2 + 19983^2 &= 199660145^2 \\
19996600144^2 + 199983^2 &= 19996600145^2
\end{aligned}
\tag{152}$$

$$\begin{aligned}
24549024^2 + 7007^2 &= 24549025^2 \\
2450490024^2 + 70007^2 &= 2450490025^2 \\
245004900024^2 + 700007^2 &= 245004900025^2 \\
24500049000024^2 + 7000007^2 &= 24500049000025^2
\end{aligned}
\tag{153}$$

$$\begin{aligned}
1468943^2 + 2424^2 &= 1468945^2 \\
144288143^2 + 24024^2 &= 144288145^2 \\
14402880143^2 + 240024^2 &= 14402880145^2 \\
1440028800143^2 + 2400024^2 &= 1440028800145^2 \\
144000288000143^2 + 24000024^2 &= 144000288000145^2
\end{aligned}
\tag{154}$$

$$\begin{aligned}
1602755^2 + 2532^2 &= 1602757^2 \\
160427555^2 + 25332^2 &= 160427557^2 \\
16044275555^2 + 253332^2 &= 16044275557^2 \\
1604442755555^2 + 2533332^2 &= 1604442755557^2
\end{aligned}
\tag{155}$$

$$\begin{aligned}
1954403^2 + 2796^2 &= 1954405^2 \\
195944003^2 + 27996^2 &= 195944005^2 \\
19599440003^2 + 279996^2 &= 19599440005^2 \\
1959994400003^2 + 2799996^2 &= 1959994400005^2
\end{aligned}
\tag{156}$$

$$\begin{aligned}
3481955^2 + 3732^2 &= 3481957^2 \\
348419555^2 + 37332^2 &= 348419557^2 \\
34844195555^2 + 373332^2 &= 34844195557^2 \\
3484441955555^2 + 3733332^2 &= 3484441955557^2
\end{aligned}
\tag{157}$$

$$\begin{aligned}
3732623^2 + 3864^2 &= 3732625^2 \\
373726223^2 + 38664^2 &= 373726225^2 \\
37377262223^2 + 386664^2 &= 37377262225^2 \\
3737772622223^2 + 3866664^2 &= 3737772622225^2
\end{aligned} \tag{158}$$

$$\begin{aligned}
40581040^2 + 9009^2 &= 40581041^2 \\
4050810040^2 + 90009^2 &= 4050810041^2 \\
405008100040^2 + 900009^2 &= 405008100041^2 \\
40500081000040^2 + 9000009^2 &= 40500081000041^2
\end{aligned} \tag{159}$$

$$\begin{aligned}
10445823^2 + 6464^2 &= 10445825^2 \\
1026049023^2 + 64064^2 &= 1026049025^2 \\
102420481023^2 + 640064^2 &= 102420481025^2 \\
10240204801023^2 + 6400064^2 &= 10240204801025^2 \\
1024002048001023^2 + 64000064^2 &= 1024002048001025^2
\end{aligned} \tag{160}$$

$$\begin{aligned}
13448164000^2 + 164001^2 &= 13448164001^2 \\
1344801640000^2 + 1640001^2 &= 1344801640001^2 \\
134480016400000^2 + 16400001^2 &= 134480016400001^2 \\
13448000164000000^2 + 164000001^2 &= 13448000164000001^2
\end{aligned} \tag{161}$$

$$\begin{aligned}
1 20^2 + 22^2 &= 1 22^2 \\
123 20^2 + 222^2 &= 123 22^2 \\
12343 20^2 + 2222^2 &= 12343 22^2 \\
1234543 20^2 + 22222^2 &= 1234543 22^2 \\
123456543 20^2 + 222222^2 &= 123456543 22^2 \\
12345676543 20^2 + 2222222^2 &= 12345676543 22^2 \\
1234567876543 20^2 + 22222222^2 &= 1234567876543 22^2 \\
123456789876543 20^2 + 222222222^2 &= 123456789876543 22^2 \\
12345679009876543 20^2 + 2222222222^2 &= 12345679009876543 22^2
\end{aligned} \tag{162}$$

$$\begin{aligned}
099^2 + 20^2 &= 1 01^2 \\
12 099^2 + 220^2 &= 121 01^2 \\
1232 099^2 + 2220^2 &= 12321 01^2 \\
123432 099^2 + 22220^2 &= 1234321 01^2 \\
12345432 099^2 + 222220^2 &= 123454321 01^2 \\
1234565432 099^2 + 2222220^2 &= 12345654321 01^2 \\
123456765432 099^2 + 22222220^2 &= 1234567654321 01^2 \\
12345678765432 099^2 + 222222220^2 &= 123456787654321 01^2 \\
1234567898765432 099^2 + 2222222220^2 &= 12345678987654321 01^2
\end{aligned} \tag{163}$$

$$\begin{aligned}
 &0099^2 + 20^2 &&= 101^2 \\
 &1020099^2 + 2020^2 &&= 1020101^2 \\
 &10203020099^2 + 202020^2 &&= 10203020101^2 \\
 &102030403020099^2 + 20202020^2 &&= 102030403020101^2 \\
 &1020304050403020099^2 + 2020202020^2 &&= 1020304050403020101^2 \\
 &10203040506050403020099^2 + 202020202020^2 &&= 10203040506050403020101^2 \\
 &102030405060706050403020099^2 + 20202020202020^2 &&= 102030405060706050403020101^2 \\
 &1020304050607080706050403020099^2 + 2020202020202020^2 &&= 1020304050607080706050403020101^2 \\
 &10203040506070809080706050403020099^2 + 202020202020202020^2 &&= 10203040506070809080706050403020101^2
 \end{aligned}
 \tag{164}$$

Extended study of Examples (162), (163) and (164) can be seen in author’s work [7, 8]

4 Patterns With Final Sum

We saw that the Section 3 brings the patterns without final sums. This section bring **patterns in Pythagorean triples** and also in **final sums**. The Pythagorean triple considered are primitive. The way of construction is given in [5, 6]. We observe that the patterns in final sums starts from the second, third line, onwards. There are very few examples, where we have complete patterns with final sums.

$$\begin{aligned}
 &3^2 + 4^2 = 5^2 \\
 &143^2 + 24^2 = 145^2 \\
 &10403^2 + 204^2 = 10405^2 &&:= 108264025 \\
 &1004003^2 + 2004^2 = 1004005^2 &&:= 1008026040025 \\
 &100040003^2 + 20004^2 = 100040005^2 &&:= 10008002600400025 \\
 &10000400003^2 + 200004^2 = 10000400005^2 &&:= 100008000260004000025
 \end{aligned}
 \tag{165}$$

$$\begin{aligned}
 &4^2 + 3^2 = 5^2 \\
 &264^2 + 23^2 = 265^2 \\
 &20604^2 + 203^2 = 20605^2 &&:= 424566025 \\
 &2006004^2 + 2003^2 = 2006005^2 &&:= 4024056060025 \\
 &200060004^2 + 20003^2 = 200060005^2 &&:= 40024005600600025 \\
 &20000600004^2 + 200003^2 = 20000600005^2 &&:= 400024000560006000025
 \end{aligned}
 \tag{166}$$

$$\begin{aligned}
 &4^2 + 3^2 = 5^2 \\
 &544^2 + 33^2 = 545^2 \\
 &45904^2 + 303^2 = 45905^2 \\
 &4509004^2 + 3003^2 = 4509005^2 \\
 &450090004^2 + 30003^2 = 450090005^2 &&:= 202581012600900025 \\
 &45000900004^2 + 300003^2 = 45000900005^2 &&:= 2025081001260009000025 \\
 &4500009000004^2 + 3000003^2 = 4500009000005^2 &&:= 20250081000126000090000025
 \end{aligned}
 \tag{167}$$

$$\begin{aligned}
36^2 + 27^2 &= 45^2 \\
4896^2 + 297^2 &= 4905^2 & := 24059025 \\
498996^2 + 2997^2 &= 499005^2 & := 249005990025 \\
49989996^2 + 29997^2 &= 49990005^2 & := 2499000599900025 \\
4999899996^2 + 299997^2 &= 4999900005^2 & := 24999000059999000025 \\
499998999996^2 + 2999997^2 &= 499999000005^2 & := 249999000005999990000025
\end{aligned} \tag{168}$$

$$\begin{aligned}
40^2 + 9^2 &= 41^2 \\
4900^2 + 99^2 &= 4901^2 & := 24019801 \\
499000^2 + 999^2 &= 499001^2 & := 249001998001 \\
49990000^2 + 9999^2 &= 49990001^2 & := 2499000199980001 \\
4999900000^2 + 99999^2 &= 4999900001^2 & := 24999000019999800001 \\
499999000000^2 + 999999^2 &= 499999000001^2 & := 249999000001999998000001
\end{aligned} \tag{169}$$

$$\begin{aligned}
77^2 + 36^2 &= 85^2 \\
9797^2 + 396^2 &= 9805^2 & := 96138025 \\
997997^2 + 3996^2 &= 998005^2 & := 996013980025 \\
99979997^2 + 39996^2 &= 99980005^2 & := 9996001399800025 \\
9999799997^2 + 399996^2 &= 9999800005^2 & := 99996000139998000025 \\
999997999997^2 + 3999996^2 &= 999998000005^2 & := 999996000013999980000025
\end{aligned} \tag{170}$$

$$\begin{aligned}
91^2 + 60^2 &= 109^2 & := 11881 \\
9991^2 + 600^2 &= 10009^2 & := 100180081 \\
999991^2 + 6000^2 &= 1000009^2 & := 1000018000081 \\
99999991^2 + 60000^2 &= 100000009^2 & := 10000001800000081
\end{aligned} \tag{171}$$

$$\begin{aligned}
99^2 + 20^2 &= 101^2 & := 10201 \\
9999^2 + 200^2 &= 10001^2 & := 100020001 \\
999999^2 + 2000^2 &= 1000001^2 & := 1000002000001 \\
99999999^2 + 20000^2 &= 100000001^2 & := 10000000200000001 \\
9999999999^2 + 200000^2 &= 10000000001^2 & := 100000000020000000001 \\
999999999999^2 + 2000000^2 &= 1000000000001^2 & := 1000000000002000000000001
\end{aligned} \tag{172}$$

$$\begin{aligned}
180^2 + 19^2 &= 181^2 & := 32761 \\
19800^2 + 199^2 &= 19801^2 & := 392079601 \\
1998000^2 + 1999^2 &= 1998001^2 & := 3992007996001 \\
199980000^2 + 19999^2 &= 199980001^2 & := 39992000799960001 \\
19999800000^2 + 199999^2 &= 19999800001^2 & := 399992000079999600001
\end{aligned} \tag{173}$$

$$\begin{aligned}
220^2 + 21^2 &= 221^2 & := & 48841 \\
20200^2 + 201^2 &= 20201^2 & := & 408080401 \\
2002000^2 + 2001^2 &= 2002001^2 & := & 4008008004001 \\
200020000^2 + 20001^2 &= 200020001^2 & := & 40008000800040001 \\
20000200000^2 + 200001^2 &= 20000200001^2 & := & 400008000080000400001
\end{aligned} \tag{174}$$

$$\begin{aligned}
264^2 + 23^2 &= 265^2 \\
20604^2 + 203^2 &= 20605^2 & := & 424566025 \\
2006004^2 + 2003^2 &= 2006005^2 & := & 4024056060025 \\
200060004^2 + 20003^2 &= 200060005^2 & := & 40024005600600025
\end{aligned} \tag{175}$$

$$\begin{aligned}
319^2 + 360^2 &= 481^2 \\
39919^2 + 3600^2 &= 40081^2 & := & 1606486561 \\
3999919^2 + 36000^2 &= 4000081^2 & := & 16000648006561 \\
399999919^2 + 360000^2 &= 400000081^2 & := & 160000064800006561
\end{aligned} \tag{176}$$

$$\begin{aligned}
323^2 + 36^2 &= 325^2 \\
39203^2 + 396^2 &= 39205^2 \\
3992003^2 + 3996^2 &= 3992005^2 & := & 15936103920025 \\
399920003^2 + 39996^2 &= 399920005^2 & := & 159936010399200025 \\
39999200003^2 + 399996^2 &= 39999200005^2 & := & 1599936001039992000025
\end{aligned} \tag{177}$$

$$39999200003^2 + 399996^2 = 39999200005^2 := 1599936001039992000025 \tag{178}$$

$$\begin{aligned}
351^2 + 280^2 &= 449^2 \\
39951^2 + 2800^2 &= 40049^2 & := & 1603922401 \\
3999951^2 + 28000^2 &= 4000049^2 & := & 16000392002401 \\
399999951^2 + 280000^2 &= 400000049^2 & := & 160000039200002401
\end{aligned} \tag{179}$$

$$\begin{aligned}
391^2 + 120^2 &= 409^2 & := & 167281 \\
39991^2 + 1200^2 &= 40009^2 & := & 1600720081 \\
3999991^2 + 12000^2 &= 4000009^2 & := & 16000072000081 \\
399999991^2 + 120000^2 &= 400000009^2 & := & 160000007200000081
\end{aligned} \tag{180}$$

$$\begin{aligned}
399^2 + 40^2 &= 401^2 & := & 160801 \\
39999^2 + 400^2 &= 40001^2 & := & 1600080001 \\
3999999^2 + 4000^2 &= 4000001^2 & := & 16000008000001 \\
399999999^2 + 40000^2 &= 400000001^2 & := & 160000000800000001 \\
3999999999^2 + 400000^2 &= 40000000001^2 & := & 160000000008000000001 \\
39999999999^2 + 4000000^2 &= 4000000000001^2 & := & 1600000000000800000000001
\end{aligned} \tag{181}$$

$$\begin{aligned}
399^2 + 40^2 &= 401^2 \\
48399^2 + 440^2 &= 48401^2 \\
4080399^2 + 4040^2 &= 4080401^2 \\
400800399^2 + 40040^2 &= 400800401^2 \\
40008000399^2 + 400040^2 &= 40008000401^2 &:= 1600640096086416160801 \\
4000080000399^2 + 4000040^2 &= 4000080000401^2 &:= 16000640009608064160160801 \\
400000800000399^2 + 40000040^2 &= 400000800000401^2 &:= 160000640000960800641600160801
\end{aligned} \tag{182}$$

$$\begin{aligned}
480^2 + 31^2 &= 481^2 \\
45300^2 + 301^2 &= 45301^2 \\
4503000^2 + 3001^2 &= 4503001^2 \\
450030000^2 + 30001^2 &= 450030001^2 &:= 202527001800060001 \\
45000300000^2 + 300001^2 &= 45000300001^2 &:= 2025027000180000600001 \\
4500003000000^2 + 3000001^2 &= 4500003000001^2 &:= 20250027000018000006000001
\end{aligned} \tag{183}$$

$$\begin{aligned}
483^2 + 44^2 &= 485^2 \\
40803^2 + 404^2 &= 40805^2 \\
4008003^2 + 4004^2 &= 4008005^2 &:= 16064104080025 \\
400080003^2 + 40004^2 &= 400080005^2 &:= 160064010400800025 \\
40000800003^2 + 400004^2 &= 40000800005^2 &:= 1600064001040008000025
\end{aligned} \tag{184}$$

$$\begin{aligned}
612^2 + 10395^2 &= 10413^2 \\
6012^2 + 1003995^2 &= 1004013^2 &:= 1008042104169 \\
60012^2 + 100039995^2 &= 100040013^2 &:= 10008004201040169 \\
600012^2 + 10000399995^2 &= 10000400013^2 &:= 100008000420010400169 \\
6000012^2 + 1000003999995^2 &= 1000004000013^2 &:= 1000008000042000104000169 \\
60000012^2 + 100000039999995^2 &= 100000040000013^2 &:= 10000008000004200001040000169
\end{aligned} \tag{185}$$

$$\begin{aligned}
760^2 + 39^2 &= 761^2 \\
79600^2 + 399^2 &= 79601^2 &:= 6336319201 \\
7996000^2 + 3999^2 &= 7996001^2 &:= 63936031992001 \\
799960000^2 + 39999^2 &= 799960001^2 &:= 639936003199920001 \\
79999600000^2 + 399999^2 &= 79999600001^2 &:= 6399936000319999200001 \\
7999996000000^2 + 3999999^2 &= 7999996000001^2 &:= 63999936000031999992000001
\end{aligned} \tag{186}$$

$$\begin{aligned}
840^2 + 41^2 &= 841^2 \\
80400^2 + 401^2 &= 80401^2 &:= 6464320801 \\
8004000^2 + 4001^2 &= 8004001^2 &:= 64064032008001 \\
800040000^2 + 40001^2 &= 800040001^2 &:= 640064003200080001 \\
80000400000^2 + 400001^2 &= 80000400001^2 &:= 6400064000320000800001
\end{aligned} \tag{187}$$

$$\begin{aligned}
899^2 + 60^2 &= 901^2 &:= 811801 \\
89999^2 + 600^2 &= 90001^2 &:= 8100180001 \\
8999999^2 + 6000^2 &= 9000001^2 &:= 81000018000001 \\
899999999^2 + 60000^2 &= 900000001^2 &:= 810000001800000001
\end{aligned} \tag{188}$$

$$\begin{aligned}
1015^2 + 20592^2 &= 20617^2 \\
10015^2 + 2005992^2 &= 2006017^2 &:= 4024104204289 \\
100015^2 + 200059992^2 &= 200060017^2 &:= 40024010402040289 \\
1000015^2 + 20000599992^2 &= 20000600017^2 &:= 400024001040020400289 \\
10000015^2 + 2000005999992^2 &= 2000006000017^2 &:= 4000024000104000204000289 \\
100000015^2 + 200000059999992^2 &= 200000060000017^2 &:= 40000024000010400002040000289
\end{aligned} \tag{189}$$

$$\begin{aligned}
1599^2 + 80^2 &= 1601^2 &:= 2563201 \\
159999^2 + 800^2 &= 160001^2 &:= 25600320001 \\
15999999^2 + 8000^2 &= 16000001^2 &:= 256000032000001 \\
159999999^2 + 80000^2 &= 1600000001^2 &:= 2560000003200000001 \\
15999999999^2 + 800000^2 &= 160000000001^2 &:= 25600000000320000000001
\end{aligned} \tag{190}$$

$$\begin{aligned}
1740^2 + 59^2 &= 1741^2 \\
179400^2 + 599^2 &= 179401^2 &:= 32184718801 \\
17994000^2 + 5999^2 &= 17994001^2 &:= 323784071988001 \\
1799940000^2 + 59999^2 &= 1799940001^2 &:= 3239784007199880001 \\
179999400000^2 + 599999^2 &= 179999400001^2 &:= 32399784000719998800001
\end{aligned} \tag{191}$$

$$\begin{aligned}
1860^2 + 61^2 &= 1861^2 \\
180600^2 + 601^2 &= 180601^2 \\
18006000^2 + 6001^2 &= 18006001^2 &:= 324216072012001 \\
1800060000^2 + 60001^2 &= 1800060001^2 &:= 3240216007200120001 \\
180000600000^2 + 600001^2 &= 180000600001^2 &:= 32400216000720001200001
\end{aligned} \tag{192}$$

$$\begin{aligned}
1863^2 + 21384^2 &= 21465^2 \\
18063^2 + 2013984^2 &= 2014065^2 \\
180063^2 + 200139984^2 &= 200140065^2 &:= 40056045618204225 \\
1800063^2 + 20001399984^2 &= 20001400065^2 &:= 400056004560182004225 \\
18000063^2 + 2000013999984^2 &= 2000014000065^2 &:= 4000056000456001820004225 \\
180000063^2 + 200000139999984^2 &= 200000140000065^2 &:= 40000056000045600018200004225
\end{aligned} \tag{193}$$

$$\begin{aligned}
2484^2 + 400^2 &= 2516^2 \\
249984^2 + 4000^2 &= 250016^2 &:= 62508000256 \\
24999984^2 + 40000^2 &= 25000016^2 &:= 625000800000256 \\
2499999984^2 + 400000^2 &= 2500000016^2 &:= 6250000080000000256
\end{aligned} \tag{194}$$

$$\begin{aligned}
2491^2 + 300^2 &= 2509^2 \\
249991^2 + 3000^2 &= 250009^2 &:= 62504500081 \\
24999991^2 + 30000^2 &= 25000009^2 &:= 625000450000081 \\
2499999991^2 + 300000^2 &= 2500000009^2 &:= 6250000045000000081
\end{aligned} \tag{195}$$

$$\begin{aligned}
2499^2 + 100^2 &= 2501^2 &:= 6255001 \\
249999^2 + 1000^2 &= 250001^2 &:= 62500500001 \\
24999999^2 + 10000^2 &= 25000001^2 &:= 625000050000001 \\
2499999999^2 + 100000^2 &= 2500000001^2 &:= 6250000005000000001
\end{aligned} \tag{196}$$

$$\begin{aligned}
3280^2 + 81^2 &= 3281^2 \\
320800^2 + 801^2 &= 320801^2 \\
32008000^2 + 8001^2 &= 32008001^2 &:= 1024512128016001 \\
3200080000^2 + 80001^2 &= 3200080001^2 &:= 10240512012800160001 \\
320000800000^2 + 800001^2 &= 320000800001^2 &:= 102400512001280001600001
\end{aligned} \tag{197}$$

$$\begin{aligned}
3591^2 + 360^2 &= 3609^2 \\
359991^2 + 3600^2 &= 360009^2 &:= 129606480081 \\
35999991^2 + 36000^2 &= 36000009^2 &:= 1296000648000081 \\
3599999991^2 + 360000^2 &= 3600000009^2 &:= 12960000064800000081
\end{aligned} \tag{198}$$

$$\begin{aligned}
3599^2 + 120^2 &= 3601^2 &:= 12967201 \\
359999^2 + 1200^2 &= 360001^2 &:= 129600720001 \\
35999999^2 + 12000^2 &= 36000001^2 &:= 1296000072000001 \\
3599999999^2 + 120000^2 &= 3600000001^2 &:= 12960000007200000001
\end{aligned} \tag{199}$$

$$\begin{aligned}
4860^2 + 891^2 &= 4941^2 \\
498960^2 + 8991^2 &= 499041^2 &:= 249041919681 \\
49989960^2 + 89991^2 &= 49990041^2 &:= 2499004199181681 \\
4999899960^2 + 899991^2 &= 4999900041^2 &:= 24999000419991801681 \\
499998999960^2 + 8999991^2 &= 499999000041^2 &:= 249999000041999918001681
\end{aligned} \tag{200}$$

$$\begin{aligned}
4876^2 + 693^2 &= 4925^2 \\
498976^2 + 6993^2 &= 499025^2 &:= 249025950625 \\
49989976^2 + 69993^2 &= 49990025^2 &:= 2499002599500625 \\
4999899976^2 + 699993^2 &= 4999900025^2 &:= 24999000259995000625 \\
499998999976^2 + 6999993^2 &= 499999000025^2 &:= 249999000025999950000625
\end{aligned} \tag{201}$$

$$\begin{aligned}
4888^2 + 495^2 &= 4913^2 &:= 24137569 \\
498988^2 + 4995^2 &= 499013^2 &:= 249013974169 \\
49989988^2 + 49995^2 &= 49990013^2 &:= 2499001399740169 \\
4999899988^2 + 499995^2 &= 4999900013^2 &:= 24999000139997400169 \\
499998999988^2 + 4999995^2 &= 499999000013^2 &:= 249999000013999974000169
\end{aligned} \tag{202}$$

$$\begin{aligned}
4896^2 + 297^2 &= 4905^2 &:= 24059025 \\
498996^2 + 2997^2 &= 499005^2 &:= 249005990025 \\
49989996^2 + 29997^2 &= 49990005^2 &:= 2499000599900025 \\
4999899996^2 + 299997^2 &= 4999900005^2 &:= 24999000059999000025 \\
499998999996^2 + 2999997^2 &= 499999000005^2 &:= 249999000005999990000025
\end{aligned} \tag{203}$$

$$\begin{aligned}
4899^2 + 140^2 &= 4901^2 &:= 24019801 \\
489999^2 + 1400^2 &= 490001^2 &:= 240100980001 \\
48999999^2 + 14000^2 &= 49000001^2 &:= 2401000098000001 \\
4899999999^2 + 140000^2 &= 4900000001^2 &:= 2401000009800000001
\end{aligned} \tag{204}$$

$$\begin{aligned}
5100^2 + 101^2 &= 5101^2 \\
501000^2 + 1001^2 &= 501001^2 &:= 251002002001 \\
50010000^2 + 10001^2 &= 50010001^2 &:= 2501000200020001 \\
5000100000^2 + 100001^2 &= 5000100001^2 &:= 25001000020000200001 \\
500001000000^2 + 1000001^2 &= 500001000001^2 &:= 250001000002000002000001
\end{aligned} \tag{205}$$

$$\begin{aligned}
6399^2 + 160^2 &= 6401^2 \\
639999^2 + 1600^2 &= 640001^2 &:= 409601280001 \\
63999999^2 + 16000^2 &= 64000001^2 &:= 4096000128000001 \\
6399999999^2 + 160000^2 &= 6400000001^2 &:= 40960000012800000001 \\
639999999999^2 + 1600000^2 &= 640000000001^2 &:= 409600000001280000000001
\end{aligned} \tag{206}$$

$$\begin{aligned}
8075^2 + 900^2 &= 8125^2 \\
809975^2 + 9000^2 &= 810025^2 &:= 656140500625 \\
80999975^2 + 90000^2 &= 81000025^2 &:= 6561004050000625 \\
8099999975^2 + 900000^2 &= 8100000025^2 &:= 65610000405000000625 \\
809999999975^2 + 9000000^2 &= 810000000025^2 &:= 656100000040500000000625 \quad (207)
\end{aligned}$$

$$\begin{aligned}
8091^2 + 540^2 &= 8109^2 \\
809991^2 + 5400^2 &= 810009^2 &:= 656114580081 \\
80999991^2 + 54000^2 &= 81000009^2 &:= 6561001458000081 \\
8099999991^2 + 540000^2 &= 8100000009^2 &:= 65610000145800000081 \quad (208)
\end{aligned}$$

$$\begin{aligned}
8099^2 + 180^2 &= 8101^2 \\
809999^2 + 1800^2 &= 810001^2 &:= 656101620001 \\
80999999^2 + 18000^2 &= 81000001^2 &:= 6561000162000001 \\
8099999999^2 + 180000^2 &= 8100000001^2 &:= 65610000016200000001 \quad (209)
\end{aligned}$$

$$\begin{aligned}
9737^2 + 1584^2 &= 9865^2 \\
997937^2 + 15984^2 &= 998065^2 &:= 996133744225 \\
99979937^2 + 159984^2 &= 99980065^2 &:= 9996013397404225 \\
9999799937^2 + 1599984^2 &= 9999800065^2 &:= 99996001339974004225 \\
999997999937^2 + 15999984^2 &= 999998000065^2 &:= 999996000133999740004225 \quad (210)
\end{aligned}$$

$$\begin{aligned}
9765^2 + 1188^2 &= 9837^2 \\
997965^2 + 11988^2 &= 998037^2 &:= 996077853369 \\
99979965^2 + 119988^2 &= 99980037^2 &:= 9996007798521369 \\
9999799965^2 + 1199988^2 &= 9999800037^2 &:= 99996000779985201369 \\
999997999965^2 + 11999988^2 &= 999998000037^2 &:= 999996000077999852001369 \quad (211)
\end{aligned}$$

$$\begin{aligned}
9785^2 + 792^2 &= 9817^2 \\
997985^2 + 7992^2 &= 998017^2 &:= 996037932289 \\
99979985^2 + 79992^2 &= 99980017^2 &:= 9996003799320289 \\
9999799985^2 + 799992^2 &= 9999800017^2 &:= 99996000379993200289 \\
999997999985^2 + 7999992^2 &= 999998000017^2 &:= 999996000037999932000289 \quad (212)
\end{aligned}$$

$$\begin{aligned}
10593^2 + 824^2 &= 10625^2 \\
1005993^2 + 8024^2 &= 1006025^2 &:= 1012086300625 \\
100059993^2 + 80024^2 &= 100060025^2 &:= 10012008603000625 \\
10000599993^2 + 800024^2 &= 10000600025^2 &:= 100012000860030000625 \\
1000005999993^2 + 8000024^2 &= 1000006000025^2 &:= 1000012000086000300000625 \\
100000059999993^2 + 80000024^2 &= 100000060000025^2 &:= 10000012000008600003000000625 \quad (213)
\end{aligned}$$

$$\begin{aligned}
10791^2 + 1040^2 &= 10841^2 \\
1007991^2 + 10040^2 &= 1008041^2 &:= 1016146657681 \\
100079991^2 + 100040^2 &= 100080041^2 &:= 10016014606561681 \\
10000799991^2 + 1000040^2 &= 10000800041^2 &:= 100016001460065601681 \\
1000007999991^2 + 10000040^2 &= 1000008000041^2 &:= 1000016000146000656001681 \\
100000079999991^2 + 100000040^2 &= 100000080000041^2 &:= 10000016000014600006560001681
\end{aligned} \tag{214}$$

$$\begin{aligned}
11583^2 + 1944^2 &= 11745^2 \\
1015983^2 + 18144^2 &= 1016145^2 &:= 1032550661025 \\
100159983^2 + 180144^2 &= 100160145^2 &:= 10032054646421025 \\
10001599983^2 + 1800144^2 &= 10001600145^2 &:= 100032005460464021025 \\
1000015999983^2 + 18000144^2 &= 1000016000145^2 &:= 1000032000546004640021025 \\
100000159999983^2 + 180000144^2 &= 100000160000145^2 &:= 10000032000054600046400021025
\end{aligned} \tag{215}$$

$$\begin{aligned}
14399^2 + 240^2 &= 14401^2 \\
1439999^2 + 2400^2 &= 1440001^2 &:= 2073602880001 \\
143999999^2 + 24000^2 &= 144000001^2 &:= 20736000288000001 \\
1439999999^2 + 240000^2 &= 14400000001^2 &:= 207360000028800000001 \\
143999999999^2 + 2400000^2 &= 1440000000001^2 &:= 2073600000002880000000001
\end{aligned} \tag{216}$$

$$\begin{aligned}
18624^2 + 193^2 &= 18625^2 \\
1986024^2 + 1993^2 &= 1986025^2 &:= 3944295300625 \\
199860024^2 + 19993^2 &= 199860025^2 &:= 39944029593000625 \\
19998600024^2 + 199993^2 &= 19998600025^2 &:= 399944002959930000625
\end{aligned} \tag{217}$$

$$\begin{aligned}
19599^2 + 280^2 &= 19601^2 \\
1959999^2 + 2800^2 &= 1960001^2 &:= 3841603920001 \\
195999999^2 + 28000^2 &= 196000001^2 &:= 38416000392000001 \\
19599999999^2 + 280000^2 &= 19600000001^2 &:= 384160000039200000001
\end{aligned} \tag{218}$$

$$\begin{aligned}
22475^2 + 1500^2 &= 22525^2 \\
2249975^2 + 15000^2 &= 2250025^2 \\
224999975^2 + 150000^2 &= 225000025^2 &:= 50625011250000625 \\
22499999975^2 + 1500000^2 &= 22500000025^2 &:= 506250001125000000625 \\
2249999999975^2 + 15000000^2 &= 2250000000025^2 &:= 5062500000112500000000625
\end{aligned} \tag{219}$$

$$\begin{aligned}
22491^2 + 900^2 &= 22509^2 \\
2249991^2 + 9000^2 &= 2250009^2 &:= 5062540500081 \\
224999991^2 + 90000^2 &= 225000009^2 &:= 50625004050000081 \\
22499999991^2 + 900000^2 &= 22500000009^2 &:= 506250000405000000081 \\
2249999999991^2 + 9000000^2 &= 2250000000009^2 &:= 5062500000040500000000081 \quad (220)
\end{aligned}$$

$$\begin{aligned}
22499^2 + 300^2 &= 22501^2 \\
2249999^2 + 3000^2 &= 2250001^2 &:= 5062504500001 \\
224999999^2 + 30000^2 &= 225000001^2 &:= 50625000450000001 \\
22499999999^2 + 300000^2 &= 22500000001^2 &:= 506250000045000000001 \quad (221)
\end{aligned}$$

$$\begin{aligned}
25599^2 + 320^2 &= 25601^2 \\
2559999^2 + 3200^2 &= 2560001^2 &:= 6553605120001 \\
255999999^2 + 32000^2 &= 256000001^2 &:= 65536000512000001 \\
25599999999^2 + 320000^2 &= 25600000001^2 &:= 655360000051200000001 \\
255999999999^2 + 3200000^2 &= 256000000001^2 &:= 6553600000005120000000001 \quad (222)
\end{aligned}$$

$$\begin{aligned}
32399^2 + 360^2 &= 32401^2 \\
3239999^2 + 3600^2 &= 3240001^2 &:= 10497606480001 \\
323999999^2 + 36000^2 &= 324000001^2 &:= 104976000648000001 \\
32399999999^2 + 360000^2 &= 32400000001^2 &:= 1049760000064800000001 \quad (223)
\end{aligned}$$

$$\begin{aligned}
39179^2 + 1980^2 &= 39229^2 \\
3991979^2 + 19980^2 &= 3992029^2 &:= 15936295536841 \\
399919979^2 + 199980^2 &= 399920029^2 &:= 159936029595360841 \\
39999199979^2 + 1999980^2 &= 39999200029^2 &:= 1599936002959953600841 \\
3999991999979^2 + 19999980^2 &= 3999992000029^2 &:= 15999936000295999536000841 \quad (224)
\end{aligned}$$

$$\begin{aligned}
39155^2 + 2772^2 &= 39253^2 \\
3991955^2 + 27972^2 &= 3992053^2 \\
399919955^2 + 279972^2 &= 399920053^2 &:= 159936048791522809 \\
39999199955^2 + 2799972^2 &= 39999200053^2 &:= 1599936004879915202809 \\
3999991999955^2 + 27999972^2 &= 3999992000053^2 &:= 15999936000487999152002809 \quad (225)
\end{aligned}$$

$$\begin{aligned}
39195^2 + 1188^2 &= 39213^2 \\
3991995^2 + 11988^2 &= 3992013^2 &:= 15936167792169 \\
399919995^2 + 119988^2 &= 399920013^2 &:= 159936016797920169 \\
39999199995^2 + 1199988^2 &= 39999200013^2 &:= 1599936001679979200169 \\
3999991999995^2 + 11999988^2 &= 3999992000013^2 &:= 15999936000167999792000169 \quad (226)
\end{aligned}$$

$$\begin{aligned}
44700^2 + 299^2 &= 44701^2 \\
4497000^2 + 2999^2 &= 4497001^2 \\
449970000^2 + 29999^2 &= 449970001^2 := 202473001799940001 \\
44999700000^2 + 299999^2 &= 44999700001^2 := 2024973000179999400001 \quad (227)
\end{aligned}$$

$$\begin{aligned}
45300^2 + 301^2 &= 45301^2 \\
4503000^2 + 3001^2 &= 4503001^2 \\
450030000^2 + 30001^2 &= 450030001^2 := 202527001800060001 \\
45000300000^2 + 300001^2 &= 45000300001^2 := 2025027000180000600001 \quad (228)
\end{aligned}$$

$$\begin{aligned}
57575^2 + 2400^2 &= 57625^2 \\
5759975^2 + 24000^2 &= 5760025^2 \\
575999975^2 + 240000^2 &= 576000025^2 := 331776028800000625 \\
57599999975^2 + 2400000^2 &= 57600000025^2 := 3317760002880000000625 \\
5759999999975^2 + 24000000^2 &= 5760000000025^2 := 33177600000288000000000625 \quad (229)
\end{aligned}$$

$$\begin{aligned}
57584^2 + 1920^2 &= 57616^2 \\
5759984^2 + 19200^2 &= 5760016^2 \\
575999984^2 + 192000^2 &= 576000016^2 := 331776018432000256 \\
57599999984^2 + 1920000^2 &= 57600000016^2 := 3317760001843200000256 \\
5759999999984^2 + 19200000^2 &= 5760000000016^2 := 33177600000184320000000256 \quad (230)
\end{aligned}$$

$$\begin{aligned}
57591^2 + 1440^2 &= 57609^2 \\
5759991^2 + 14400^2 &= 5760009^2 := 33177703680081 \\
575999991^2 + 144000^2 &= 576000009^2 := 331776010368000081 \\
57599999991^2 + 1440000^2 &= 57600000009^2 := 3317760001036800000081 \\
5759999999991^2 + 14400000^2 &= 5760000000009^2 := 33177600000103680000000081 \quad (231)
\end{aligned}$$

$$\begin{aligned}
57596^2 + 960^2 &= 57604^2 \\
5759996^2 + 9600^2 &= 5760004^2 := 33177646080016 \\
575999996^2 + 96000^2 &= 576000004^2 := 331776004608000016 \\
57599999996^2 + 960000^2 &= 57600000004^2 := 3317760000460800000016 \\
5759999999996^2 + 9600000^2 &= 5760000000004^2 := 33177600000046080000000016 \quad (232)
\end{aligned}$$

$$\begin{aligned}
57599^2 + 480^2 &= 57601^2 \\
5759999^2 + 4800^2 &= 5760001^2 := 33177611520001 \\
575999999^2 + 48000^2 &= 576000001^2 := 331776001152000001 \\
57599999999^2 + 480000^2 &= 57600000001^2 := 3317760000115200000001 \\
5759999999999^2 + 4800000^2 &= 5760000000001^2 := 33177600000011520000000001 \quad (233)
\end{aligned}$$

$$\begin{aligned}
78399^2 + 560^2 &= 78401^2 \\
783999^2 + 5600^2 &= 7840001^2 &:= 61465615680001 \\
78399999^2 + 56000^2 &= 784000001^2 &:= 614656001568000001 \\
7839999999^2 + 560000^2 &= 78400000001^2 &:= 6146560000156800000001 \\
783999999999^2 + 5600000^2 &= 7840000000001^2 &:= 61465600000015680000000001
\end{aligned} \tag{234}$$

$$\begin{aligned}
78396^2 + 1120^2 &= 78404^2 \\
7839996^2 + 11200^2 &= 7840004^2 &:= 61465662720016 \\
783999996^2 + 112000^2 &= 784000004^2 &:= 614656006272000016 \\
78399999996^2 + 1120000^2 &= 78400000004^2 &:= 6146560000627200000016 \\
7839999999996^2 + 11200000^2 &= 7840000000004^2 &:= 61465600000062720000000016
\end{aligned} \tag{235}$$

$$\begin{aligned}
78391^2 + 1680^2 &= 78409^2 \\
7839991^2 + 16800^2 &= 7840009^2 \\
783999991^2 + 168000^2 &= 784000009^2 &:= 614656014112000081 \\
78399999991^2 + 1680000^2 &= 78400000009^2 &:= 6146560001411200000081 \\
7839999999991^2 + 16800000^2 &= 7840000000009^2 &:= 61465600000141120000000081
\end{aligned} \tag{236}$$

$$\begin{aligned}
78375^2 + 2800^2 &= 78425^2 \\
7839975^2 + 28000^2 &= 7840025^2 \\
783999975^2 + 280000^2 &= 784000025^2 &:= 614656039200000625 \\
78399999975^2 + 2800000^2 &= 78400000025^2 &:= 6146560003920000000625 \\
7839999999975^2 + 28000000^2 &= 7840000000025^2 &:= 61465600000392000000000625
\end{aligned} \tag{237}$$

$$\begin{aligned}
62491^2 + 1500^2 &= 62509^2 \\
6249991^2 + 15000^2 &= 6250009^2 \\
624999991^2 + 150000^2 &= 625000009^2 &:= 390625011250000081 \\
62499999991^2 + 1500000^2 &= 62500000009^2 &:= 3906250001125000000081 \\
6249999999991^2 + 15000000^2 &= 6250000000009^2 &:= 39062500000112500000000081
\end{aligned} \tag{238}$$

$$\begin{aligned}
78375^2 + 2800^2 &= 78425^2 \\
7839975^2 + 28000^2 &= 7840025^2 \\
783999975^2 + 280000^2 &= 784000025^2 &:= 614656039200000625 \\
78399999975^2 + 2800000^2 &= 78400000025^2 &:= 6146560003920000000625
\end{aligned} \tag{239}$$

$$\begin{aligned}
78399^2 + 560^2 &= 78401^2 \\
7839999^2 + 5600^2 &= 7840001^2 &:= 61465615680001 \\
783999999^2 + 56000^2 &= 784000001^2 &:= 614656001568000001 \\
78399999999^2 + 560000^2 &= 78400000001^2 &:= 6146560000156800000001 \\
7839999999999^2 + 5600000^2 &= 7840000000001^2 &:= 61465600000015680000000001
\end{aligned} \tag{240}$$

$$\begin{aligned}
79600^2 + 399^2 &= 79601^2 &:= 6336319201 \\
7996000^2 + 3999^2 &= 7996001^2 &:= 63936031992001 \\
799960000^2 + 39999^2 &= 799960001^2 &:= 639936003199920001 \\
79999600000^2 + 399999^2 &= 79999600001^2 &:= 6399936000319999200001
\end{aligned} \tag{241}$$

$$\begin{aligned}
81204^2 + 403^2 &= 81205^2 \\
8012004^2 + 4003^2 &= 8012005^2 &:= 64192224120025 \\
800120004^2 + 40003^2 &= 800120005^2 &:= 640192022401200025 \\
80001200004^2 + 400003^2 &= 80001200005^2 &:= 6400192002240012000025
\end{aligned} \tag{242}$$

$$\begin{aligned}
82012^2 + 405^2 &= 82013^2 \\
8020012^2 + 4005^2 &= 8020013^2 &:= 64320608520169 \\
800200012^2 + 40005^2 &= 800200013^2 &:= 640320060805200169 \\
80002000012^2 + 400005^2 &= 80002000013^2 &:= 6400320006080052000169
\end{aligned} \tag{243}$$

$$\begin{aligned}
94839^2 + 3080^2 &= 94889^2 \\
9048039^2 + 30080^2 &= 9048089^2 \\
900480039^2 + 300080^2 &= 900480089^2 &:= 810864390685447921 \\
90004800039^2 + 3000080^2 &= 90004800089^2 &:= 8100864039060854407921 \\
9000048000039^2 + 30000080^2 &= 9000048000089^2 &:= 81000864003906008544007921
\end{aligned} \tag{244}$$

$$\begin{aligned}
102399^2 + 640^2 &= 102401^2 \\
10239999^2 + 6400^2 &= 10240001^2 &:= 104857620480001 \\
1023999999^2 + 64000^2 &= 1024000001^2 &:= 1048576002048000001 \\
102399999999^2 + 640000^2 &= 102400000001^2 &:= 10485760000204800000001 \\
10239999999999^2 + 6400000^2 &= 10240000000001^2 &:= 104857600000020480000000001
\end{aligned} \tag{245}$$

$$\begin{aligned}
122499^2 + 700^2 &= 122501^2 \\
12249999^2 + 7000^2 &= 12250001^2 &:= 150062524500001 \\
1224999999^2 + 70000^2 &= 1225000001^2 &:= 1500625002450000001 \\
122499999999^2 + 700000^2 &= 122500000001^2 &:= 15006250000245000000001 \\
12249999999999^2 + 7000000^2 &= 12250000000001^2 &:= 150062500000024500000000001
\end{aligned} \tag{246}$$

$$\begin{aligned}
126500^2 + 1509^2 &= 126509^2 \\
12515000^2 + 15009^2 &= 12515009^2 \\
1250150000^2 + 150009^2 &= 1250150009^2 \\
125001500000^2 + 1500009^2 &= 125001500009^2 := 15625375004500027000081 \\
12500015000000^2 + 15000009^2 &= 12500015000009^2 := 156250375000450000270000081 \quad (247)
\end{aligned}$$

$$\begin{aligned}
129575^2 + 3600^2 &= 129625^2 \\
12959975^2 + 36000^2 &= 12960025^2 \\
1295999975^2 + 360000^2 &= 1296000025^2 := 1679616064800000625 \\
129599999975^2 + 3600000^2 &= 129600000025^2 := 1679616000648000000625 \\
12959999999975^2 + 36000000^2 &= 12960000000025^2 := 16796160000064800000000625 \quad (248)
\end{aligned}$$

$$\begin{aligned}
129599^2 + 720^2 &= 129601^2 \\
12959999^2 + 7200^2 &= 12960001^2 := 167961625920001 \\
1295999999^2 + 72000^2 &= 1296000001^2 := 1679616002592000001 \\
129599999999^2 + 720000^2 &= 129600000001^2 := 16796160000259200000001 \\
12959999999999^2 + 7200000^2 &= 12960000000001^2 := 167961600000025920000000001 \quad (249)
\end{aligned}$$

$$\begin{aligned}
156791^2 + 3960^2 &= 156841^2 \\
15967991^2 + 39960^2 &= 15968041^2 \\
1599679991^2 + 399960^2 &= 1599680041^2 := 2558976233573761681 \\
159996799991^2 + 3999960^2 &= 159996800041^2 := 25598976023359737601681 \\
15999967999991^2 + 39999960^2 &= 15999968000041^2 := 255998976002335997376001681 \quad (250)
\end{aligned}$$

$$\begin{aligned}
156807^2 + 2376^2 &= 156825^2 \\
15968007^2 + 23976^2 &= 15968025^2 \\
1599680007^2 + 239976^2 &= 1599680025^2 := 2558976182384000625 \\
159996800007^2 + 2399976^2 &= 159996800025^2 := 25598976018239840000625 \\
15999968000007^2 + 23999976^2 &= 15999968000025^2 := 255998976001823998400000625 \quad (251)
\end{aligned}$$

$$\begin{aligned}
156815^2 + 792^2 &= 156817^2 \\
15968015^2 + 7992^2 &= 15968017^2 \\
1599680015^2 + 79992^2 &= 1599680017^2 := 2558976156789120289 \\
159996800015^2 + 799992^2 &= 159996800017^2 := 25598976015679891200289 \\
15999968000015^2 + 7999992^2 &= 15999968000017^2 := 255998976001567998912000289 \quad (252)
\end{aligned}$$

$$\begin{aligned}
163215^2 + 808^2 &= 163217^2 \\
16032015^2 + 8008^2 &= 16032017^2 \\
1600320015^2 + 80008^2 &= 1600320017^2 &:= 2561024156810880289 \\
160003200015^2 + 800008^2 &= 160003200017^2 &:= 25601024015680108800289 \\
16000032000015^2 + 8000008^2 &= 16000032000017^2 &:= 256001024001568001088000289
\end{aligned} \tag{253}$$

$$\begin{aligned}
181804^2 + 603^2 &= 181805^2 \\
18018004^2 + 6003^2 &= 18018005^2 &:= 324648504180025 \\
1800180004^2 + 60003^2 &= 1800180005^2 &:= 3240648050401800025 \\
180001800004^2 + 600003^2 &= 180001800005^2 &:= 32400648005040018000025
\end{aligned} \tag{254}$$

$$\begin{aligned}
183012^2 + 605^2 &= 183013^2 \\
18030012^2 + 6005^2 &= 18030013^2 \\
1800300012^2 + 60005^2 &= 1800300013^2 &:= 3241080136807800169 \\
180003000012^2 + 600005^2 &= 180003000013^2 &:= 32401080013680078000169 \\
18000030000012^2 + 6000005^2 &= 18000030000013^2 &:= 324001080001368000780000169
\end{aligned} \tag{255}$$

$$\begin{aligned}
184200^2 + 4249^2 &= 184249^2 \\
18042000^2 + 42049^2 &= 18042049^2 \\
1800420000^2 + 420049^2 &= 1800420049^2 \\
180004200000^2 + 4200049^2 &= 180004200049^2 &:= 32401512035280411602401 \\
18000042000000^2 + 42000049^2 &= 18000042000049^2 &:= 324001512003528004116002401
\end{aligned} \tag{256}$$

$$\begin{aligned}
202499^2 + 900^2 &= 202501^2 \\
20249999^2 + 9000^2 &= 20250001^2 &:= 410062540500001 \\
2024999999^2 + 90000^2 &= 2025000001^2 &:= 4100625004050000001 \\
202499999999^2 + 900000^2 &= 202500000001^2 &:= 41006250000405000000001 \\
20249999999999^2 + 9000000^2 &= 20250000000001^2 &:= 410062500000040500000000001
\end{aligned} \tag{257}$$

$$\begin{aligned}
308024^2 + 1110^2 &= 308026^2 \\
30802499^2 + 11100^2 &= 30802501^2 \\
3080249999^2 + 111000^2 &= 3080250001^2 \\
308024999999^2 + 1110000^2 &= 308025000001^2 &:= 94879400625616050000001 \\
30802499999999^2 + 11100000^2 &= 30802500000001^2 &:= 948794006250061605000000001
\end{aligned} \tag{258}$$

$$\begin{aligned}
322400^2 + 2409^2 &= 322409^2 \\
32024000^2 + 24009^2 &= 32024009^2 \\
3200240000^2 + 240009^2 &= 3200240009^2 &:= 10241536115204320081 \\
320002400000^2 + 2400009^2 &= 320002400009^2 &:= 102401536011520043200081 \\
32000024000000^2 + 24000009^2 &= 32000024000009^2 &:= 1024001536001152000432000081
\end{aligned} \tag{259}$$

$$\begin{aligned}
367235^2 + 1212^2 &= 367237^2 \\
36072035^2 + 12012^2 &= 36072037^2 \\
3600720035^2 + 120012^2 &= 3600720037^2 := 12965184784853281369 \\
360007200035^2 + 1200012^2 &= 360007200037^2 := 129605184078480532801369 \quad (260)
\end{aligned}$$

$$\begin{aligned}
547591^2 + 4440^2 &= 547609^2 \\
54759991^2 + 44400^2 &= 54760009^2 \\
5475999991^2 + 444000^2 &= 5476000009^2 := 29986576098568000081 \\
547599999991^2 + 4440000^2 &= 547600000009^2 := 299865760009856800000081 \\
54759999999991^2 + 44400000^2 &= 54760000000009^2 := 2998657600000985680000000081 \quad (261)
\end{aligned}$$

$$\begin{aligned}
562464^2 + 9000^2 &= 562536^2 \\
56249964^2 + 90000^2 &= 56250036^2 \\
5624999964^2 + 900000^2 &= 5625000036^2 := 31640625405000001296 \\
562499999964^2 + 9000000^2 &= 562500000036^2 := 31640625004050000001296 \\
56249999999964^2 + 90000000^2 &= 56250000000036^2 := 316406250000405000000001296 \quad (262)
\end{aligned}$$

$$\begin{aligned}
562499^2 + 1500^2 &= 562501^2 \\
5624999^2 + 15000^2 &= 56250001^2 := 3164062612500001 \\
56249999^2 + 150000^2 &= 5625000001^2 := 31640625011250000001 \\
562499999^2 + 1500000^2 &= 562500000001^2 := 316406250001125000000001 \\
5624999999^2 + 15000000^2 &= 56250000000001^2 := 3164062500000112500000000001 \quad (263)
\end{aligned}$$

$$\begin{aligned}
652863^2 + 1616^2 &= 652865^2 \\
64128063^2 + 16016^2 &= 64128065^2 \\
6401280063^2 + 160016^2 &= 6401280065^2 \\
640012800063^2 + 1600016^2 &= 640012800065^2 := 409616384247041664004225 \\
64000128000063^2 + 16000016^2 &= 64000128000065^2 := 4096016384024704016640004225 \quad (264)
\end{aligned}$$

$$\begin{aligned}
721200^2 + 1201^2 &= 721201^2 \\
72012000^2 + 12001^2 &= 72012001^2 \\
7200120000^2 + 120001^2 &= 7200120001^2 := 51841728028800240001 \\
720001200000^2 + 1200001^2 &= 720001200001^2 := 518401728002880002400001 \\
72000012000000^2 + 12000001^2 &= 72000012000001^2 := 5184001728000288000024000001 \quad (265)
\end{aligned}$$

$$\begin{aligned}
981400^2 + 1401^2 &= 981401^2 \\
98014000^2 + 14001^2 &= 98014001^2 \\
9800140000^2 + 140001^2 &= 9800140001^2 &:= 96042744039200280001 \\
980001400000^2 + 1400001^2 &= 980001400001^2 &:= 960402744003920002800001 \\
98000014000000^2 + 14000001^2 &= 98000014000001^2 &:= 9604002744000392000028000001 \quad (266)
\end{aligned}$$

$$\begin{aligned}
1281600^2 + 1601^2 &= 1281601^2 \\
128016000^2 + 16001^2 &= 128016001^2 \\
12800160000^2 + 160001^2 &= 12800160001^2 &:= 163844096051200320001 \\
1280001600000^2 + 1600001^2 &= 1280001600001^2 &:= 1638404096005120003200001 \\
128000016000000^2 + 16000001^2 &= 128000016000001^2 &:= 16384004096000512000032000001 \quad (267)
\end{aligned}$$

$$\begin{aligned}
1562499^2 + 2500^2 &= 1562501^2 \\
156249999^2 + 25000^2 &= 156250001^2 \\
15624999999^2 + 250000^2 &= 15625000001^2 &:= 244140625031250000001 \\
156249999999^2 + 2500000^2 &= 156250000001^2 &:= 244140625000312500000001 \quad (268)
\end{aligned}$$

$$\begin{aligned}
1621800^2 + 1801^2 &= 1621801^2 \\
162018000^2 + 18001^2 &= 162018001^2 \\
16200180000^2 + 180001^2 &= 16200180001^2 &:= 262445832064800360001 \\
1620001800000^2 + 1800001^2 &= 1620001800001^2 &:= 2624405832006480003600001 \\
162000018000000^2 + 18000001^2 &= 162000018000001^2 &:= 26244005832000648000036000001 \quad (269)
\end{aligned}$$

$$\begin{aligned}
12525012^2 + 5005^2 &= 12525013^2 \\
1250250012^2 + 50005^2 &= 1250250013^2 \\
125002500012^2 + 500005^2 &= 125002500013^2 &:= 15625625009500065000169 \\
12500025000012^2 + 5000005^2 &= 12500025000013^2 &:= 156250625000950000650000169 \quad (270)
\end{aligned}$$

$$\begin{aligned}
64128063^2 + 16016^2 &= 64128065^2 \\
6401280063^2 + 160016^2 &= 6401280065^2 \\
640012800063^2 + 1600016^2 &= 640012800065^2 &:= 409616384247041664004225 \\
64000128000063^2 + 16000016^2 &= 64000128000065^2 &:= 4096016384024704016640004225 \quad (271)
\end{aligned}$$

$$\begin{aligned}
18078060^2 + 42091^2 &= 18078109^2 \\
1800780060^2 + 420091^2 &= 1800780109^2 \\
180007800060^2 + 4200091^2 &= 180007800109^2 &:= 32402808100081700411881 \\
18000078000060^2 + 42000091^2 &= 18000078000109^2 &:= 324002808010008017004011881 \quad (272)
\end{aligned}$$

$$\begin{aligned}
81306225^2 + 144272^2 &= 81306353^2 \\
8103060225^2 + 1440272^2 &= 8103060353^2 \\
810030600225^2 + 14400272^2 &= 810030600353^2 := 656149573508241603724609 \\
81000306000225^2 + 144000272^2 &= 81000306000353^2 := 6561049572150822216036124609 \quad (273)
\end{aligned}$$

$$\begin{aligned}
5062499^2 + 4500^2 &= 5062501^2 \\
506249999^2 + 45000^2 &= 506250001^2 \\
50624999999^2 + 450000^2 &= 50625000001^2 := 2562890625101250000001 \\
5062499999999^2 + 4500000^2 &= 5062500000001^2 := 25628906250010125000000001 \\
506249999999999^2 + 45000000^2 &= 506250000000001^2 := 256289062500001012500000000001 \quad (274)
\end{aligned}$$

$$\begin{aligned}
4928399^2 + 4440^2 &= 4928401^2 \\
492839999^2 + 44400^2 &= 492840001^2 \\
49283999999^2 + 444000^2 &= 49284000001^2 := 2428912656098568000001 \\
4928399999999^2 + 4440000^2 &= 4928400000001^2 := 24289126560009856800000001 \\
492839999999999^2 + 44400000^2 &= 492840000000001^2 := 242891265600000985680000000001 \quad (275)
\end{aligned}$$

$$\begin{aligned}
3422499^2 + 3700^2 &= 3422501^2 \\
342249999^2 + 37000^2 &= 342250001^2 \\
34224999999^2 + 370000^2 &= 34225000001^2 := 1171350625068450000001 \\
3422499999999^2 + 3700000^2 &= 3422500000001^2 := 11713506250006845000000001 \\
342249999999999^2 + 37000000^2 &= 342250000000001^2 := 117135062500000684500000000001 \quad (276)
\end{aligned}$$

$$\begin{aligned}
3991923^2 + 35964^2 &= 3992085^2 \\
39991923^2 + 359964^2 &= 399920085^2 := 159936074386407225 \\
399991923^2 + 3599964^2 &= 3999920085^2 := 1599936007439864007225 \\
3999991923^2 + 35999964^2 &= 399999200085^2 := 15999936000743998640007225 \quad (277)
\end{aligned}$$

$$\begin{aligned}
3991835^2 + 51948^2 &= 3992173^2 \\
39991835^2 + 519948^2 &= 399920173^2 \\
399991835^2 + 5199948^2 &= 39999200173^2 := 1599936014479723229929 \\
3999991835^2 + 51999948^2 &= 3999992000173^2 := 15999936001447997232029929 \quad (278)
\end{aligned}$$

$$\begin{aligned}
3991883^2 + 43956^2 &= 3992125^2 \\
39991883^2 + 439956^2 &= 399920125^2 := 159936106380015625 \\
399991883^2 + 4399956^2 &= 39999200125^2 := 1599936010639800015625 \\
3999991883^2 + 43999956^2 &= 3999992000125^2 := 15999936001063998000015625 \quad (279)
\end{aligned}$$

$$\begin{aligned}
3991779^2 + 59940^2 &= 3992229^2 \\
399919779^2 + 599940^2 &= 399920229^2 \\
39999199779^2 + 5999940^2 &= 39999200229^2 \quad := 1599936018959633652441 \\
3999991999779^2 + 59999940^2 &= 3999992000229^2 \quad := 15999936001895996336052441 \quad (280)
\end{aligned}$$

$$\begin{aligned}
3991715^2 + 67932^2 &= 3992293^2 \\
399919715^2 + 679932^2 &= 399920293^2 \\
39999199715^2 + 6799932^2 &= 39999200293^2 \quad := 1599936024079531285849 \\
3999991999715^2 + 67999932^2 &= 3999992000293^2 \quad := 15999936002407995312085849 \quad (281)
\end{aligned}$$

$$\begin{aligned}
14062491^2 + 22500^2 &= 14062509^2 \\
1406249991^2 + 225000^2 &= 1406250009^2 \\
140624999991^2 + 2250000^2 &= 140625000009^2 \quad := 39550781255062500000162 \\
14062499999991^2 + 22500000^2 &= 14062500000009^2 \quad := 395507812500506250000000162 \quad (282)
\end{aligned}$$

$$\begin{aligned}
76562499^2 + 17500^2 &= 76562501^2 \\
7656249999^2 + 175000^2 &= 7656250001^2 \\
765624999999^2 + 1750000^2 &= 765625000001^2 \quad := 586181640626531250000001 \\
76562499999999^2 + 17500000^2 &= 76562500000001^2 \quad := 5861816406250153125000000001 \\
7656249999999999^2 + 175000000^2 &= 7656250000000001^2 \quad := 58618164062500015312500000000001 \quad (283)
\end{aligned}$$

References

- [1] R. KNOTT, Pythagorean Right-Angled Triangles, <http://www.maths.surrey.ac.uk/hosted-sites/R.Knott/Pythag/pythag.html>.
- [2] Pythagorean triple - Wikipedia, <https://goo.gl/Zwu7sC>
- [3] I.J. TANEJA, Magic Squares with Perfect Square Number Sums, Research Report Collection, 20(2017), Article 11, pp.1-24, <http://rgmia.org/papers/v20/v20a11.pdf>.
- [4] I.J. TANEJA, Palindromic-Type Pandigital Patterns in Pythagorean Triples, RGMIA Research Report Collection, 21(2018), Art 76, pp. 1-11. <http://rgmia.org/papers/v21/v21a76.pdf>
- [5] I.J. TANEJA, Patterns in Pythagorean Triples Using Single Variable Procedures, RGMIA Research Report Collection, 21(2018), pp. 1-40, <http://rgmia.org/v21.php>
- [6] I.J. TANEJA, Patterns in Pythagorean Triples Using Double Variable Procedures, RGMIA Research Report Collection, 21(2018), pp. 1-93, <http://rgmia.org/v21.php>

- [7] I.J. TANEJA, Pandigital Palindromic-Type Patterns in Pythagorean Triples - I, RGMIA Research Report Collection, **21**(2018), pp. 1-91, <http://rgmia.org/v21.php>
- [8] I.J. TANEJA, Pandigital Palindromic-Type Patterns in Pythagorean Triples - II, RGMIA Research Report Collection, **21**(2018), <http://rgmia.org/v21.php>
-