

久留島 義太さんの

平方零約術について

「学術を中心とした和算史上の人々」

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第3章 計算を友として §9 (267ページ〜278ページ)

を参考にしました。ありがとうございます。

文責 林 邦英

$$\sqrt{67} = 2112$$

$$67 = 8^2 + 3$$

$$\sqrt{67} = 8 + \frac{3}{16} +$$

$$\left(\frac{1}{0}\right) \begin{array}{r} 8 \\ 1 \end{array} \quad \begin{array}{r} 3/16 \\ 16 \end{array} \quad \begin{array}{r} 3/16 \\ 259 \end{array} \quad \begin{array}{r} 3/16 \\ 34313 \\ 4192 \end{array}$$

$$\frac{1 \times 3 + 8 \times 16}{0 \times 3 + 1 \times 16} \quad \frac{8 \times 3 + 131 \times 16}{1 \times 3 + 16 \times 16}$$

$$34313 = 8 \times 4192 + 777$$

$$4192 = 5 \times 777 + 307$$

$$777 = 2 \times 307 + 163$$

$$307 = 1 \times 163 + 144$$

$$163 = 1 \times 144 + 19$$

$$144 = 7 \times 19 + 11$$

$$19 = 1 \times 11 + 8$$

$$11 = 1 \times 8 + 3$$

$$\begin{array}{cccccccc} 8 & 5 & 2 & 1 & 1 & 7 & 1 & 1 \\ \left(\frac{1}{0}\right) \frac{8}{1} & \frac{41}{5} & \frac{90}{11} & \frac{131}{16} & \frac{221}{27} & \frac{1678}{205} & \frac{1899}{232} & \frac{3577}{437} \end{array}$$

$$(A) (+3) (-6) (+7) (-9) (+2) (-9) (+7) (-6)$$

$$\sqrt{67} = 8 + (5, 2, 1, 1, 7, 1, 1, 2, 5, 16)_n$$

$$\begin{array}{cccc} 1 & 1 & 2 & 5 \\ \frac{1899}{232} & \frac{3577}{437} & \frac{9053}{1106} & \frac{48842}{5967} \end{array}$$

$$48842^2 + A = 67 \times 5967^2 \quad A = -1$$

$$\begin{array}{ccc} 8 & 5 & 2 \\ \left(\frac{1}{0}\right) \frac{8}{1} & \frac{41}{5} & \frac{90}{11} \\ \frac{1 \times 1 + 8 \times 5}{0 \times 1 + 1 \times 5} & \frac{8 \times 1 + 41 \times 2}{1 \times 1 + 5 \times 2} \end{array}$$

$$\frac{131}{16} \text{ 使 } 2$$

$$131 = 8 \times 16 + 3$$

$$16 = 5 \times 3 + 1$$

$$\frac{2120}{259} \text{ 使 } 2$$

$$2120 = 8 \times 259 + 48$$

$$259 = 5 \times 48 + 19$$

$$48 = 2 \times 19 + 10$$

$$19 = 1 \times 10 + 9$$

$$10 = 1 \times 9 + 1$$

$$16 = 5 \times 3 + 1$$

$$= x +$$

$$= x +$$

$$10 = 1 \times 9 + 1$$

No. 5
Date _____

$$\begin{aligned}
 16 &= 5 \times 3 + 1 \\
 &= 2 \times 6 + \\
 &= 1 \times 7 + \\
 10 &= 1 \times 9 + 1
 \end{aligned}$$

No. 6
Date _____

$$\begin{aligned}
 16 &= 5 \times 3 + 1 \\
 15 &= 2 \times 6 + 3 \\
 13 &= 1 \times 7 + 6 \\
 10 &= 1 \times 9 + 1
 \end{aligned}$$

No. 7
Date _____

$$\begin{aligned}
 16 &= 5 \times 3 + 1 \\
 15 &= 2 \times 6 + 3 \\
 13 &= 1 \times 7 + 6 \\
 10 &= 1 \times 9 + 1
 \end{aligned}$$

2
9
7
6
3
1
3
6
7
9

No. 8
Date _____

$$\begin{aligned}
 16 &= 5 \times 3 + 1 \\
 15 &= 2 \times 6 + 3 \\
 13 &= 1 \times 7 + 6 \\
 10 &= 1 \times 9 + 1 \\
 15 &= 7 \times 2 + 1 \\
 15 &= 1 \times 9 + 6 \\
 10 &= 1 \times 7 + 3 \\
 13 &= 2 \times 6 + 1 \\
 15 &= 5 \times 3 + 0 \\
 16 &= 16 \times 1 + 0 \\
 16 &= 5 \times 3 + 1 \\
 15 &= 2 \times 6 + 3 \\
 13 &= 1 \times 7 + 6 \\
 10 &= 1 \times 9 + 1
 \end{aligned}$$

強弱	実	段数	段余
原3	16		
強6	15	5	1
弱7	13	2	3
強9	10	1	6
弱2	15	1	1
強9	15	7	1
弱7	10	1	6
強6	13	1	3
弱3	15	2	1
強1	16	5	0
弱3	16	16	0
強6	15	5	1
弱7	13	2	3

$$67 = 8^2 + 3$$

$$\frac{8}{1}$$

$$2 \times 8 = 5 \times 3 + 1$$

$$2 \times 8 - 1 = 15$$

$$\frac{15 \times 1 + 3}{3} = 6$$

$$\frac{8 \times 5 + 1}{1 \times 5} = \frac{41}{5}$$

$$15 = 2 \times 6 + 3$$

$$2 \times 8 - 3 = 13$$

$$\frac{13 \times 3 + 3}{6} = 7$$

$$\frac{41 \times 2 + 8}{5 \times 2 + 1} = \frac{90}{11}$$

$$\sqrt{13} = 3 + (1, 1, 1, 1, 6)_{2n}$$

$$K = 36 = 18 \times 2 \quad (A = +1)$$

$$\frac{18 \times 36 + 1}{5 \times 36} = \frac{649}{180}$$

$$649^2 + A = 13 \times 180^2 \quad (A = -1)$$

$$K = 1298 = 649 \times 2$$

$$\frac{649 \times 1298 - 1}{180 \times 1298} = \frac{842401}{233640}$$

3 1 1 1 1 6 1

($\frac{1}{0}$) $\frac{3}{1}$ $\frac{4}{1}$ $\frac{7}{2}$ $\frac{11}{3}$ $\frac{18}{5}$ $\frac{19}{33}$ $\frac{137}{38}$

(A) (+4)(-3)(+3)(-4)(+1)(-4)(+3)

6 1 1 1 1

(-4)(+3)(-3)(+4)(-1)

$\frac{119}{33}$ $\frac{137}{38}$ $\frac{256}{71}$ $\frac{393}{109}$ $\frac{649}{180}$

$$\frac{221}{27} \quad \frac{48842}{5967}$$

A (+2) (-1)

$$5967 \div 27 = 221$$

$$48842 \div 221 = 221.00452$$

$$221 \times 221 = 48841 = 48842 - 1$$

$$\frac{221 \times 2}{2} = 221$$

$$\frac{221 \times 221 + 1}{27 \times 221} = \frac{48842}{5967}$$