Exercise 1.

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№1. $k = 36217$

$$h^2 \leq 36217 < (h+1)^2$$

h	36217	18109	9055	4529	2268	1141	586	323	217	191	190
b	18109	9055	4529	2268	1141	586	323	217	191	190	190

$$b = \frac{36217 + \frac{36217}{36217}}{2} = \frac{36217+1}{2} = 18109$$

$$b = \frac{18109 + \frac{36217}{18109}}{2} = \frac{18109+1}{2} = 9055$$

$$b = \frac{9055 + \frac{36217}{9055}}{2} = \frac{9055+3}{2} = 4529$$

$$b = \frac{4529 + \frac{36217}{4529}}{2} = \frac{4529+7}{2} = 2268$$

$$b = \frac{2268 + \frac{36217}{2268}}{2} = \frac{2268+15}{2} = 1141$$

$$b = \frac{1141 + \frac{36217}{1141}}{2} = \frac{1141+31}{2} = 586$$

$$b = \frac{586 + \frac{36217}{586}}{2} = \frac{586+61}{2} = 323$$

$$b = \frac{323 + \frac{36217}{323}}{2} = \frac{323+112}{2} = 217$$

$$b = \frac{217 + \frac{36217}{217}}{2} = \frac{217+166}{2} = 191$$

$$b = \frac{191 + \frac{36217}{191}}{2} = \frac{191+189}{2} = 190$$

$$b = \frac{190 + \frac{36217}{190}}{2} = \frac{190+190}{2} = 190$$

Тогда $190^2 \leq 36217 < 191^2$

$36100 \leq 36217 < 36481$ – верно

Ответ: $h = 190$.

$36217 : 1141 = 31,\ldots$ (3423; 1987; 1141; 846...)

$36217 : 586 = 61,\ldots$ (3516; 1057; 586; 471...)

$36217 : 323 = 112,\ldots$ (323; 391; 323; 787; 646; 141)

$36217 : 217 = 166,\ldots$ (217; 1451; 1302; 1497; 1302; 195)

$36217 : 191 = 189,\ldots$ (191; 1711; 1528; 1837; 1719; 118)

$36217 : 190 = 190,\ldots$ (190; 1721; 1710; 117)

№2. $a = 2002$

$\sqrt{a} = 44,..$

$\{2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43\}$ – все простые числа на $[2, 44)$

1. $a = 2 \cdot 1001$, $d_0 = 2$, $i = 1$, $a = 1001$
2. $a = 2 \cdot 500 + 1$, $k = 1$
3. $a = 3 \cdot 333 + 2$, $k = 2$
4. $a = 5 \cdot 200 + 1$, $k = 3$
5. $a = 7 \cdot 143$, $d_1 = 7$, $i = 2$, $a = 143$
6. $a = 7 \cdot 20 + 3$, $k = 4$
7. $a = 11 \cdot 13$, $d_2 = 11$, $i = 3$, $a = 13$
8. $a = 11 \cdot 1 + 2$, $k = 5$
9. $a = 13 \cdot 1$, $d_3 = 13$

Тогда $2002 = 2 \cdot 7 \cdot 11 \cdot 13$

Ответ: $2002 = 2 \cdot 7 \cdot 11 \cdot 13$

№3 $59x + 30y = 2002 \Rightarrow \begin{matrix} a = 59 \\ b = 30 \\ c = 2002 \end{matrix}$

	-1	0	1	2	3
r	59	30	29	1	0
q		1	1	29	
x	1	0	1	$\boxed{-1}$	
y	0	1	-1	$\boxed{2}$	

$x_1 = 1 - 0 \cdot 1 = 1$ $\qquad$ $x_2 = 0 - 1 \cdot 1 = -1$

$y_1 = 0 - 1 \cdot 1 = -1$ $\qquad$ $y_2 = 1 - (-1) \cdot 1 = 2$

Пусть d – НОД(a, b), тогда $d = 1$

x_0, y_0 – решения $59x + 30y = 1$

$x_0 = -1 \Rightarrow x_1 = x_0 \cdot \frac{c}{d} = -2002$
$y_0 = 2 \Rightarrow y_1 = y_0 \cdot \frac{c}{d} = 4004$ | частное решение

$x = x_1 + \frac{b}{d} \cdot k = -2002 + 30k$
$y = y_1 - \frac{a}{d} \cdot k = 4004 - 59k$ | общее решение

Ответ: $x = -2002 + 30k$
$y = 4004 - 59k$

№4. $3x + 112 = 346$ (7-ая СС)

I способ.

$3_7 = 3_{10}$

$112_7 = 1\cdot7^2 + 1\cdot7 + 2\cdot7^0 = 58_{10}$

$346_7 = 3\cdot7^2 + 4\cdot7 + 6\cdot7^0 = 147 + 28 + 6 = 181_{10}$

$\Rightarrow$ $3x + 112 = 346$ (7 СС)

$\downarrow$

$3x + 58 = 181$ (10 СС)

10 СС: $3x + 58 = 181$

$3x = 123$

$x = 41$

$$\begin{array}{r|l} 41 & 7 \\ \underline{35} & 5 \\ 6 & \end{array}$$

$41_{10} = \boxed{56_7}$

II способ

$$\begin{array}{r} 346_7 \\ -\;112_7 \\ \hline 234_7 \end{array}$$

$3x + 112 = 346$ (7 СС)

$3x = 346 - 112$

$3x = 234$

$\boxed{x = 56_7}$

$$\begin{array}{r|l} 234 & 3 \\ \underline{21} & 56 \\ 24 & \\ \underline{24} & \\ 0 & \end{array}$$

Ответ: 56_7.