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1. $1099x + 889y = 35$

1) НОД(1099; 889) = 7

$1099 = 889 \cdot 1 + 210$

$889 = 210 \cdot 4 + 49$

$210 = 49 \cdot 4 + 14$

$49 = 14 \cdot 3 + 7$

$14 = \underline{7} \cdot 2$

2) Сократим на НОД

$1099/7 = 157$; $889/7 = 127$; $35/7 = 5$; $d = \frac{7}{7} = 1$

3) 1. $157x_0 + 127y_0 = \frac{7}{7} = 1$

$x_0 = -55$

$y_0 = 68$

2. $x_1 = x_0 \cdot \frac{c}{d} = -55 \cdot \frac{35}{7} = -275$

$y_1 = y_0 \cdot \frac{c}{d} = 68 \cdot \frac{35}{7} = 340$

4. $x = x_1 + \frac{b}{d} \cdot k = -275 + 127k, k \in Z$

$y = y_1 - \frac{a}{d} k = 340 - 157k, k \in Z$

Проверка

1. $k = 0 \Rightarrow x = -275;\ y = 340$

$1099 \cdot (-275) + 889 \cdot 340 = 35$

$35 = 35$ – верно

$k = 1 \Rightarrow x = -148;\ y = 183$

$1099 \cdot (-148) + 889 \cdot 183 = 35$

$35 = 35$ – верно

3 $x = 13 \bmod 33$

$x = 27 \bmod 31$

$x = 13 \bmod 17$

$x = 13 \bmod 20$

1. $M = m_1 m_2 m_3 m_4 =$
$= 33 \cdot 31 \cdot 17 \cdot 20 = 347820$

$M_1 = m_2 m_3 m_4 = 31 \cdot 17 \cdot 20 = 10540$

$M_2 = m_1 m_3 m_4 = 33 \cdot 17 \cdot 20 = 11220$

$M_3 = m_1 m_2 m_4 = 31 \cdot 33 \cdot 20 = 20460$

$M_4 = m_1 m_2 m_3 = 33 \cdot 31 \cdot 17 = 17391$

2. $M_1 x_1 = 1 \bmod 33$; $M_2 x_2 = 1 \bmod 31$; $M_3 x_3 = 1 \bmod 17$;
$M_4 x_4 = 1 \bmod 20$.

1) $10540 x_1 = 1 \bmod 33$

$10540 x_1 - 33y = 1 \Rightarrow x_1 = -5$

2) $11220 x_2 = 1 \bmod 31$

$11220 x_2 - 31y = 1 \Rightarrow x_2 = 15$

3) $20460 x_3 = 1 \bmod 17$

$20460 x_3 - 17y = 1 \Rightarrow x_3 = 2$

4) $17391 x_4 = 1 \bmod 20$

$17391 x_4 - 20y = 1 \Rightarrow x_4 = -9$

3. $x = (M_1 x_1 c_1 + M_2 x_2 c_2 + M_3 x_3 c_3 + M_4 x_4 c_4) \bmod M =$
$= A$

$x_1 = -5 \bmod 33 = 28 \bmod 33 \Rightarrow x_1 = 28$

$x_4 = -9 \bmod 20 = 11 \bmod 20 \Rightarrow x_4 = 11$

$A = (10540 \cdot 28 \cdot 13 + 11220 \cdot 15 \cdot 27 + 20460 \cdot 13 \cdot 2 + 17391 \cdot 11 \cdot 13) \bmod M$
$= 11399533 \bmod 347820 = 269293 \bmod 347820$

Ответ: 269293

Проверка:

$269293 / 33 = 8160(13)$

$269293 / 31 = 8686(27)$

$269293 / 17 = 15840(13)$

$269293 / 20 = 13464(13)$

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7 $2x_5 + 101_5 = 224_5$

I способ:

$2x + 101 = 224$

$2x = 123$

$x_5 = \frac{123}{2}$

$x_5 = 34$

Ответ: $34_5$

II способ:

$2_5 = 2_{10}$

$101_5 = 1\cdot5^2 + 0\cdot5 + 1\cdot5^0 = 26_{10}$

$224_5 = 2\cdot5^2 + 2\cdot5 + 4\cdot5^0 = 64_{10}$

$2x_{10} + 26_{10} = 64_{10}$

$2x = 38_{10}$

$x = 19_{10}$

Ответ: $19_{10}$

Проверка:

$34_5 = 3\cdot5^1 + 4\cdot5^0 = 15 + 4\cdot1 = 19_{10}$

$19_{10} = 19_{10}$ – верно

5 $\deg p \le 4$

$p(-2)=6$ 0

$p(-1)=3$ 1

$p(1)=3$ 2

$p(2)=42$ 3

$p(-3)=47$ 4

$$P(x) = -3\frac{(x+2)(x-1)(x-2)(x+3)}{(2-1)(-1-1)(-1-2)(3-1)} + 6\frac{(x+1)(x-1)(x-2)(x+3)}{(1-2)(-2-1)(-2-2)(3-2)} + 3\frac{(x+2)(x+1)(x-2)(x+3)}{(1+2)(1+1)(1-2)(1+3)}$$

$$+ 42\frac{(x+2)(x+1)(x-1)(x+3)}{(2+2)(2+1)(2-1)(2+3)} + 47\frac{(x+2)(x+1)(x-1)(x-2)}{(2-3)(1-3)(-3-1)(-2-3)} = \frac{1}{4}(x^4+2x^3-7x^2-8x+12) +$$

$$+\left(-\frac{1}{2}\right)(x^4+x^3-7x^2-x+6) + \left(-\frac{1}{8}\right)(x^4+4x^3-x^2-16x-12) + \frac{7}{10}(x^4+5x^3+5x^2-5x-6)$$

$$+\frac{47}{40}(x^4-5x^2+4) = x^4\left(-\frac{1}{4}-\frac{1}{2}-\frac{1}{8}+\frac{7}{10}+\frac{47}{40}\right) + x^3\left(-\frac{1}{2}-\frac{1}{2}-\frac{1}{2}+\frac{7}{2}\right)$$

$$+x^2\left(\frac{7}{4}+\frac{7}{2}+\frac{1}{8}+\frac{7}{2}-\frac{47}{8}\right) + x\left(2+\frac{1}{2}+2-\frac{7}{2}\right) + \left(-3-3+\frac{3}{2}-\frac{21}{5}+\frac{47}{10}\right) =$$

$$= x^4+2x^3+3x^2+x-4$$

Проверка

$p(-2) = 16-16+12-2-4 = 6$ - верно

$p(-1) = 1-2+3-1-4 = -3$ - верно

$p(1) = 1+2+3+1-4 = 3$ - верно

$p(2) = 16+16+12+2-4 = 42$ - верно

$p(-3) = 81-54+27-3-4 = 47$ - верно

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8 $x = \frac{30}{63} \mod 92$

$63x - 92y = 30$

$63x - 92y = 1$

$x_0 = 19 \Rightarrow x_1 = 19 \cdot 30 = 570$

$x = 570 \mod 92 = 18 \mod 92$

Ответ: $x = 18 \mod 92$

9 $\frac{156}{29}$;

I способ

$156 = 29\cdot\underline{5}+11$

$29 = 11\cdot\underline{2}+7$

$17 = 7\cdot\underline{1}+4$

$7 = 4\cdot\underline{1}+3$

$4 = 3\cdot\underline{1}+1$

$3 = 1\cdot\underline{3}$

[5, 2, 1, 1, 1, 3]

II способ:

$$\frac{156}{29} = 5+\frac{11}{29} = 5+\frac{1}{\frac{29}{11}} =$$

$$= 5+\frac{1}{2+\frac{7}{11}} = 5+\frac{1}{2+\frac{1}{\frac{11}{7}}} =$$

$$= 5+\frac{1}{2+\frac{1}{1+\frac{4}{7}}} = 5+\frac{1}{2+\frac{1}{1+\frac{1}{1+\frac{3}{4}}}} =$$

$$= 5+\frac{1}{2+\frac{1}{1+\frac{1}{1+\frac{1}{1+\frac{1}{3}}}}}$$

[5, 2, 1, 1, 1, 3]

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$$\begin{array}{l|l} 6x^5+3x^4+x^3+3x^2+4x & 5x^3+2x^2+x+2 \\ \cline{2-2} 6x^5+\frac{12}{5}x^4+\frac{6}{5}x^3+\frac{12}{5}x^2 & \frac{6}{5}x^2+\frac{3}{25}x-\frac{11}{125} \\ \cline{1-1} \frac{3}{5}x^4-\frac{1}{5}x^3+\frac{3}{5}x^2+4x & \\ \frac{3}{5}x^4+\frac{6}{25}x^3+\frac{3}{25}x^2+\frac{6}{25}x & \\ \cline{1-1} -\frac{11}{25}x^3+\frac{12}{25}x^2+\frac{94}{25}x & \\ -\frac{11}{25}x^3-\frac{22}{125}x^2-\frac{11}{125}x-\frac{22}{125} & \\ \cline{1-1} \frac{82}{125}x^2+\frac{481}{125}x+\frac{22}{125} & \end{array}$$

Проверка:

$(5x^3+2x^2+x+2)\left(\frac{6}{5}x^2+\frac{3}{25}x-\frac{11}{125}\right)+\frac{82}{125}x^2+\frac{481}{125}x+\frac{22}{125}=$

$=6x^5+3x^4+x^3+3x^2+4x$ – верно.

2. $$\sqrt{293} = 17 + (\sqrt{293} - 17) = 17 + \cfrac{1}{8 + \cfrac{\sqrt{293}-15}{4}} =$$

$$= 17 + \cfrac{1}{8 + \cfrac{1}{\cfrac{4}{\sqrt{293}-15}}} = 17 + \cfrac{1}{8 + \cfrac{1}{1 + \cfrac{\sqrt{293}-2}{17}}} =$$

$$= 17 + \cfrac{1}{8 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{\sqrt{293}-15}{17}}}} = 17 + \cfrac{1}{8 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{8 + \cfrac{\sqrt{293}-17}{4}}}}} =$$

$$= 17 + \cfrac{1}{8 + \cfrac{1}{1 + \cfrac{1}{1 + \cfrac{1}{8 + \cfrac{1}{34 + \sqrt{293} - 17}}}}}$$

$[17, \overline{8, 1, 1, 8, 34}]$

Проверка

$17 \cdot 2 = 34$ — верно

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4. $15^{49^{53}} \bmod 73$

$k = 49^{53} \Rightarrow 15^{k} \bmod 73$

$\varphi(73) = 72$

$k = 72n + b$; $b = 49^{53} \bmod 72$

$53_{10} = 110101_2$

$15^{72n+b} \bmod 73 = 15^{b} \bmod 73$

$15^{49} \bmod 73$

$49_{10} = 110001_2$

$c = 6 \bmod 73$

Ответ: $6 \bmod 73$.

1 $\begin{cases} x = -275 + 127k \\ y = 340 - 157k \end{cases}, k \in \mathbb{Z}$

2. $[17, \overline{8, 1, 1, 8, 34}]$

3. 269 293

4 6 mod 73

5 $x^4 + 2x^3 + 3x^2 + x - 4$

6 —

7. $34_5$, $19_{10}$

8 $x = 18 \bmod 92$

9. $[5, 2, 1, 1, 1, 3]$

10 $\frac{82}{125}x^2 + \frac{481}{125}x + \frac{22}{125}$

P.s. Таблицы с решением в некоторых заданиях опущены для упрощения, если потребуются могу отдельным pdf-файлом загрузить