In[ ]:= **Исходные данные;**

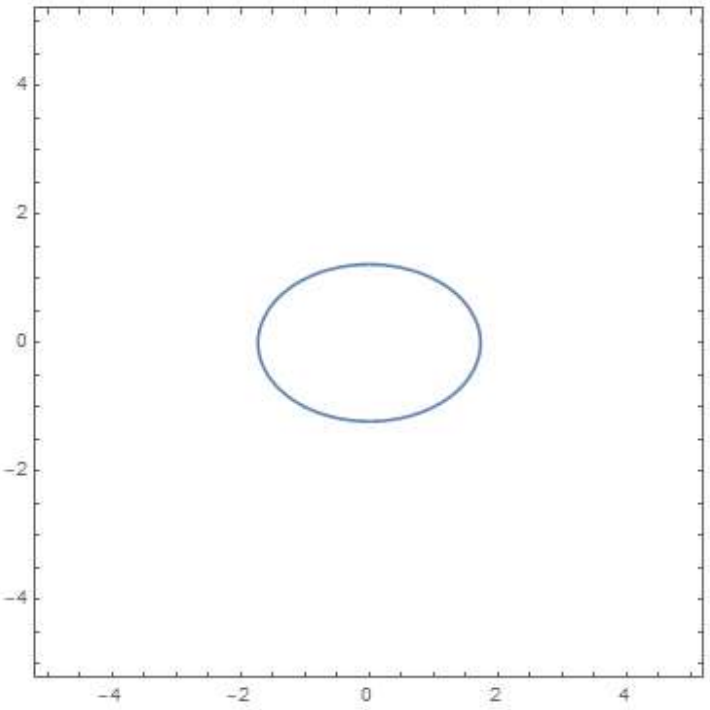
```
p = 73;
a = 25;
b = 25;
n = 8;
```

Задание 1;

```
ContourPlot[x^2 + 2 * y^2 == 3, {x, -5, 5}, {y, -5, 5}]
```

контурный график

Out[ ]=

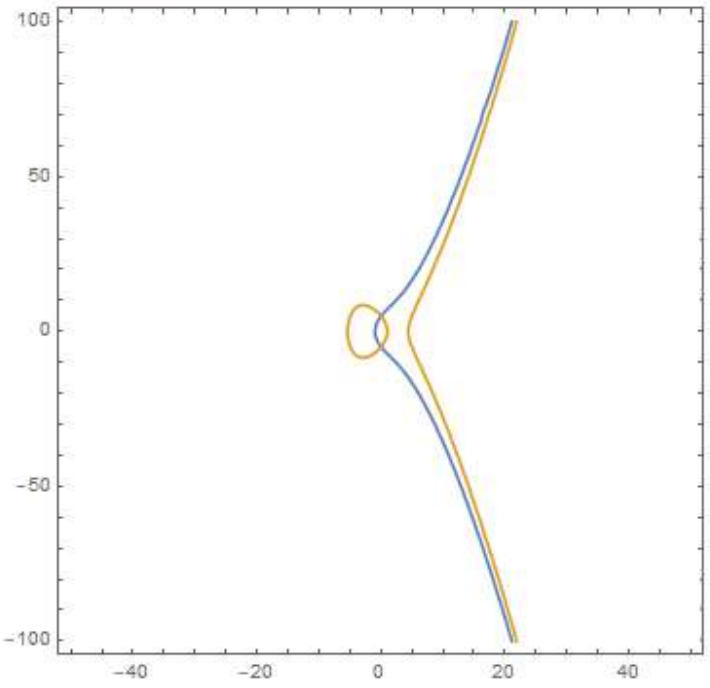


In[ ]:= **Задание 2;**

```
ContourPlot[{y^2 == x^3 + a * x + b, y^2 == x^3 + (-a) * x + b}, {x, -50, 50}, {y, -100, 100}]
```

контурный график

Out[ ]=



In[ ]:= `Mod[4 * a^3 + 27 * b^2, p] ≠ 0`

остаток от деления

Out[ ]= True

In[ ]:= `Factor[x^3 + a * x + b]`

факторизовать

Out[ ]= $25 + 25\,x + x^3$

In[-]= **Задание 3;**

```
Clear[x, y];
```
очистить

```
g1o = {x, y} /. Flatten[Table[ Solve[ {y^2 == x^3 + a*x + b, x == u, Modulus == p}, Reals], {u, 0, p - 1}] , 1]
```
уплост… табл… решить уравнения модуль множество действительных чисе

Out[-]= {{0, -5}, {0, 5}, {1, -√51}, {1, √51}, {2, -√83}, {2, √83}, {3, -√127}, {3, √127}, {4, -3√21}, {4, 3√21}, {5, -5√11}, {5, 5√11}, {6, -√391}, {6, √391}, {7, -√543}, {7, √543}, {8, -√737}, {8, √737}, {9, -√979}, {9, √979}, {10, -5√51}, {10, 5√51}, {11, -√1631}, {11, √1631}, {12, -√2053}, {12, √2053}, {13, -3√283}, {13, 3√283}, {14, -√3119}, {14, √3119}, {15, -5√151}, {15, 5√151}, {16, -√4521}, {16, √4521}, {17, -√5363}, {17, √5363}, {18, -√6307}, {18, √6307}, {19, -√7359}, {19, √7359}, {20, -5√341}, {20, 5√341}, {21, -√9811}, {21, √9811}, {22, -3√1247}, {22, 3√1247}, {23, -√12767}, {23, √12767}, {24, -√14449}, {24, √14449}, {25, -5√651}, {25, 5√651}, {26, -√18251}, {26, √18251}, {27, -√20383}, {27, √20383}, {28, -√22677}, {28, √22677}, {29, -√25139}, {29, √25139}, {30, -5√1111}, {30, 5√1111}, {31, -3√3399}, {31, 3√3399}, {32, -√33593}, {32, √33593}, {33, -√36787}, {33, √36787}, {34, -√40179}, {34, √40179}, {35, -5√1751}, {35, 5√1751}, {36, -√47581}, {36, √47581}, {37, -√51603}, {37, √51603}, {38, -√55847}, {38, √55847}, {39, -7√1231}, {39, 7√1231}, {40, -255}, {40, 255}, {41, -√69971}, {41, √69971}, {42, -√75163}, {42, √75163}, {43, -√80607}, {43, √80607}, {44, -√86309}, {44, √86309}, {45, -5√3691}, {45, 5√3691}, {46, -√98511}, {46, √98511}, {47, -√105023}, {47, √105023}, {48, -√111817}, {48, √111817}, {49, -3√13211}, {49, 3√13211}, {50, -5√5051}, {50, 5√5051}, {51, -√133951}, {51, √133951}, {52, -11√1173}, {52, 11√1173}, {53, -√150227}, {53, √150227}, {54, -√158839}, {54, √158839}, {55, -5√6711}, {55, 5√6711}, {56, -√177041}, {56, √177041}, {57, -√186643}, {57, √186643}, {58, -9√2427}, {58, 9√2427}, {59, -√206879}, {59, √206879}, {60, -5√8701}, {60, 5√8701}, {61, -√228531}, {61, √228531}, {62, -√239903}, {62, √239903}, {63, -√251647}, {63, √251647}, {64, -√263769}, {64, √263769}, {65, -5√11051}, {65, 5√11051}, {66, -√289171}, {66, √289171}, {67, -3√33607}, {67, 3√33607}, {68, -√316157}, {68, √316157}, {69, -√330259}, {69, √330259}, {70, -5√13791}, {70, 5√13791}, {71, -√359711}, {71, √359711}, {72, -√375073}, {72, √375073}}

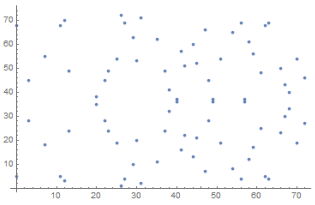
In[-]=
```
Clear[x, y];
```
очистить

```
g1 = {x, y} /. Flatten[Table[ FindInstance[y^2 == x^3 + a*x + b && x == u, {x, y}, 2, Modulus -> p], {u, 0, p - 1}] , 1]
```
уплост… табл… найти частный случай модуль

Out[-]= {{0, 5}, {0, 68}, {3, 28}, {3, 45}, {7, 18}, {7, 55}, {11, 5}, {11, 68}, {12, 3}, {12, 70}, {13, 24}, {13, 49}, {20, 35}, {20, 38}, {22, 28}, {22, 45}, {23, 24}, {23, 49}, {25, 19}, {25, 54}, {26, 1}, {26, 72}, {27, 4}, {27, 69}, {29, 10}, {29, 63}, {30, 20}, {30, 53}, {31, 2}, {31, 71}, {35, 11}, {35, 62}, {37, 24}, {37, 49}, {38, 32}, {38, 41}, {40, 36}, {40, 37}, {41, 16}, {41, 57}, {42, 22}, {42, 51}, {44, 13}, {44, 60}, {45, 21}, {45, 52}, {47, 7}, {47, 66}, {48, 28}, {48, 45}, {49, 36}, {49, 37}, {51, 19}, {51, 54}, {54, 8}, {54, 65}, {56, 4}, {56, 69}, {57, 36}, {57, 37}, {58, 12}, {58, 61}, {59, 17}, {59, 56}, {61, 25}, {61, 48}, {62, 5}, {62, 68}, {63, 4}, {63, 69}, {66, 23}, {66, 50}, {67, 30}, {67, 43}, {68, 33}, {68, 40}, {70, 19}, {70, 54}, {72, 27}, {72, 46}}

In[-]=
```
ListPlot[g1]
```
диаграмма разброса данных

Out[-]=



In[ ]:= **Задание 4;**

```
EllipticAdd[p_, a_, b_, c_, P_List, Q_List] :=
 Module[{lam, x3, y3, P3},
  программный модуль
  Which[
   условный оператор с множественными ветвями
   P == {0}, Q,
    О большое
   Q == {0}, P,
    О большое
   P[[1]] != Q[[1]],
    lam = Mod[(Q[[2]] - P[[2]]) PowerMod[Q[[1]] - P[[1]], p - 2, p], p];
     остаток от деления   степень по модулю
    x3 = Mod[lam^2 - a - P[[1]] - Q[[1]], p];
     остаток от деления
    y3 = Mod[-(lam (x3 - P[[1]]) + P[[2]]), p];
     остаток от деления
    {x3, y3},
   (P == Q) ∧ (P[[2]] == 0), {O},
    О большое
   (P == Q) ∧ (P != {0}),
    О большое
    lam = Mod[(3 * P[[1]]^2 + 2 a * P[[1]] + b) PowerMod[2 P[[2]], p - 2, p], p];
     остаток от деления   степень по модулю
    x3 = Mod[lam^2 - a - P[[1]] - Q[[1]], p];
     остаток от деления
    y3 = Mod[-(lam (x3 - P[[1]]) + P[[2]]), p];
     остаток от деления
    {x3, y3},
   (P[[1]] == Q[[1]]) ∧ (P[[2]] != Q[[2]]), {O}]]
    О большое

EllipticAdd[p, 0, a, b, {0, 5}, {3, 28}]
```

Out[ ]= {72, 27}

In[ ]:= **Задание 5;**

```
p2 = 11;
a2 = 0;
b2 = 6;
c2 = 3;
EllipticAdd[p2, a2, b2, c2, {4, 6}, {9, 4}]
EllipticAdd[p2, a2, b2, c2, {9, 4}, {9, 4}]
EllipticAdd[p2, a2, b2, c2, {4, 6}, {4, 6}]
EllipticAdd[p2, a2, b2, c2, {4, 6}, {0}]
                                    О больц
EllipticAdd[p2, a2, b2, c2, {4, 6}, {4, 5}]
EllipticAdd[p2, a2, b2, c2, {0}, {9, 4}]
                                 О большое
```

Out[ ]= {3, 9}

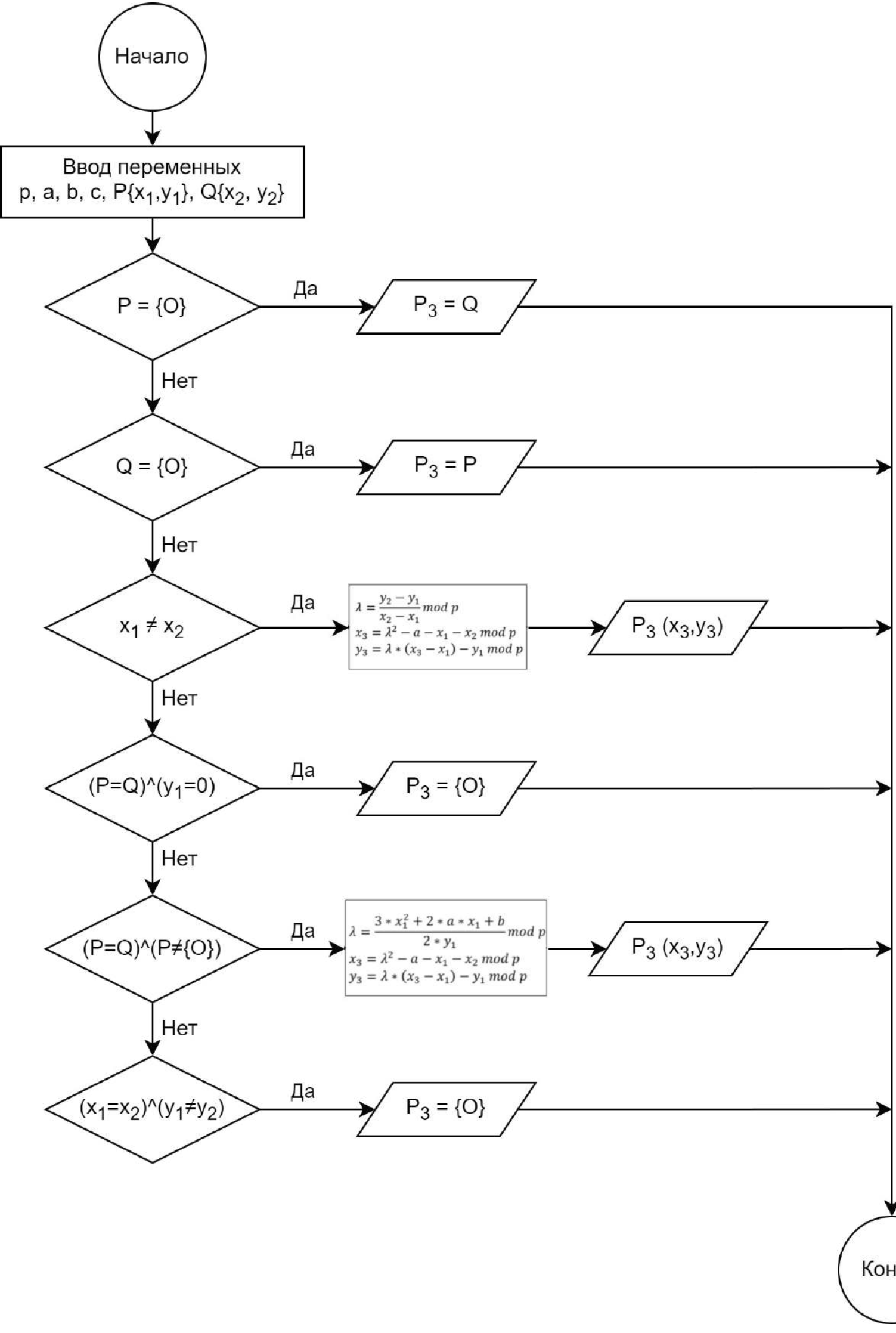
Out[ ]= {7, 6}

Out[ ]= {4, 5}

Out[ ]= {4, 6}

Out[ ]= {0}

Out[ ]= {9, 4}


Начало
Ввод переменных
p, a, b, c, P{x1,y1}, Q{x2, y2}
P = {O}
Да
P3 = Q
Нет
Q = {O}
Да
P3 = P
Нет
x1 ≠ x2
Да
$\lambda = \frac{y_2 - y_1}{x_2 - x_1} mod\ p$
$x_3 = \lambda^2 - a - x_1 - x_2\ mod\ p$
$y_3 = \lambda * (x_3 - x_1) - y_1\ mod\ p$
P3 (x3,y3)
Нет
(P=Q)^(y1=0)
Да
P3 = {O}
Нет
(P=Q)^(P≠{O})
Да
$\lambda = \frac{3 * x_1^2 + 2 * a * x_1 + b}{2 * y_1} mod\ p$
$x_3 = \lambda^2 - a - x_1 - x_2\ mod\ p$
$y_3 = \lambda * (x_3 - x_1) - y_1\ mod\ p$
P3 (x3,y3)
Нет
(x1=x2)^(y1≠y2)
Да
P3 = {O}
Конец

Задание 7;

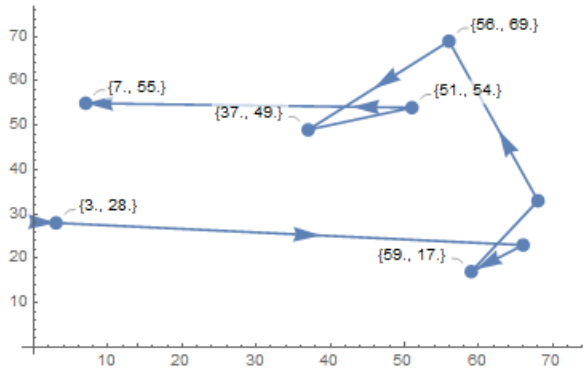
```
In[•]:= Clear[Pnt1];
        очистить
        Pnt = {9, 4};
        myFun[1] = Pnt;
        myFun[n_] := myFun[n] = EllipticAdd[p2, a2, b2, c2, Pnt, myFun[n - 1]];
        Table[myFun[n], {n, 1, 5}]
        таблица значений
Out[•]= {{9, 4}, {7, 6}, {7, 5}, {9, 7}, {0}}

In[•]:= Pnt = {3, 28};
        myFun2[1] = Pnt;
        myFun2[n_] := myFun2[n] = EllipticAdd[p, 0, a, b, Pnt, myFun2[n - 1]];
        myTable = Table[myFun2[n], {n, 1, 8}]
                  таблица значений
Out[•]= {{3, 28}, {66, 23}, {59, 17}, {68, 33}, {56, 69}, {37, 49}, {51, 54}, {7, 55}}

In[•]:= EllipticPointMultiply[p_, a_, b_, c_, Q_, n_] :=
         Module[{i = n - 1, q = Q, pl = p, al = a, bl = b, cl = c},
         программный модуль
          pnt = q;
          While[i > 0, i--; q = EllipticAdd[pl, al, bl, cl, pnt, q]];
          цикл–пока
          q
         ]
        EllipticPointMultiply[p, 0, a, b, {3, 28}, 1]
Out[•]= {3, 28}

In[•]:= ListLinePlot[myTable, PlotMarkers → {Automatic, 10}, LabelingFunction → (#1 &)] /. Line[x_] -> {Arrowheads[Table[.05, 7]], Arrow[x]}
        линейный график данных  маркеры на гра···  автоматический  функция создания отметки  (ломаная) линия  наконечники  таблица значений  стрелка
```

Out[•]=



Задание 8;

```
In[•]:= s = {}; i = 1;
        For[j = 1, j ≤ Length[g1], j++, {While[EllipticPointMultiply[p, 0, a, b, g1[[j]], i] ≠ {0}, i++], AppendTo[s, i], i = 1}];
        цикл ДЛЯ  длина  цикл–пока  О большое  добавить в конец к
        {Tally[s], Histogram[s, 39]}
        подсчитать  гистограмма
```

Out[•]=