

> # Max Mekhanikov - HW 19

# Question 1

>

```
Dis2 := proc(F, x, y, pt, h, A) local L, i :
```

```
L := Orb2([x + h * F[1], y + h * F[2]], x, y, pt, 0, trunc(A/h)) :
```

```
L := [seq([i * h, [L[i][1], L[i][2]]], i = 1 .. nops(L)) ] :
```

end:

```
Orb2 := proc(F, x, y, pt0, K1, K2) local pt, L, i :
```

```
pt := pt0 :
```

```
for i from 1 to K1-1 do
```

```
pt := subs({x = pt[1], y = pt[2]}, F) :
```

```
od:
```

```
L := [ ] :
```

```
for i from K1 to K2 do
```

```
L := [op(L), pt] :
```

```
pt := normal(subs({x = pt[1], y = pt[2]}, F)) :
```

```
od:
```

```
L :
```

```
end:
```

```
SIRS := proc(s, i, beta, gamma, nu, N) : [-beta * s * i + gamma * (N - s - i), beta * s * i - nu * i] :
```

```
end:
```

*#Dis2(F,x,y,pt,h,A): The approximate orbit of the Dynamical system approximating the 2D for the autonomous continuous dynamical process*

*#dx/dt=F[1](x(t),y(t))*

*#dy/dt=F[2](x(t),y(t)) , x(0)=pt[1], y(0)=pt[2] with mesh size h from t=0 to t=A*

```
Dis2 := proc(F, x, y, pt, h, A) local L, i :
```

```
L := Orb2([x + h * F[1], y + h * F[2]], x, y, pt, 0, trunc(A/h)) :
```

```
L := [seq([i * h, [L[i][1], L[i][2]]], i = 1 .. nops(L)) ] :
```

```
end:
```

```
SIRSDemo := proc(N, IN, gamma, nu, h, A) local L, beta, i :
```

*print('This is a numerical demonstration of the R0 phenomenon in the SIRS model using discretization with mesh size=', h, 'and letting it run until time t=', A) :*

*print('with population size', N, 'and fixed parameters nu=', nu, 'and gamma=', gamma) :*

*print('where we change beta from 0.2\*nu/N to 4\*nu/N') :*

```

print( `Recall that the epidemic will persist if beta exceeds nu/N, that in this case is`, nu/N ) :
print( `We start with`, IN, `infected individuals, 0 removed and hence`, N-IN, `susceptible` ) :
print( `We will show what happens once time is close to`, A ) :
for i from 1 by 2 to 40 do
beta := i/10 * (nu/N) :
print( `beta is`, i/10, `times the threshold value` ) :
L := Dis2(SIRS(s, i, beta, gamma, nu, N), s, i, [N-IN, IN], h, A) :
print( `the long-term behavior is` ) :
print( [op(nops(L)-3 ..nops(L), L)] ) :
od:

end:

```

> SIRSdemo(1000, 200, 3, 1, 0.01, 10)

*This is a numerical demonstration of the R0 phenomenon in the SIRS model using discretization with mesh size=, 0.01, and letting it run until time t=, 10*

*with population size, 1000, and fixed parameters nu=, 1, and gamma=, 3  
where we change beta from 0.2\*nu/N to 4\*nu/N*

*Recall that the epidemic will persist if beta exceeds nu/N, that in this case is,  $\frac{1}{1000}$*

*We start with , 200, infected individuals, 0 removed and hence, 800, susceptible  
We will show what happens once time is close to, 10*

*beta is,  $\frac{1}{10}$ , times the threshold value*

*the long-term behavior is*

*[[9.98, [998.9666995, 0.9909989667]], [9.99, [998.9666995, 0.9909989667]], [10.00, [998.9666995, 0.9909989667]], [10.01, [998.9666995, 0.9909989667]]]*

*beta is,  $\frac{3}{10}$ , times the threshold value*

*the long-term behavior is*

*[[9.98, [996.7009881, 2.978970309]], [9.99, [996.7009881, 2.978970309]], [10.00, [996.7009881, 2.978970309]], [10.01, [996.7009881, 2.978970309]]]*

*beta is,  $\frac{1}{2}$ , times the threshold value*

*the long-term behavior is*

*[[9.98, [994.1715221, 4.974854288]], [9.99, [994.1715221, 4.974854288]], [10.00, [994.1715221, 4.974854288]], [10.01, [994.1715221, 4.974854288]]]*

*beta is,  $\frac{7}{10}$ , times the threshold value*

*the long-term behavior is*

*[[9.98, [991.3807432, 6.978577656]], [9.99, [991.3807432, 6.978577656]], [10.00, [991.3807432, 6.978577656]], [10.01, [991.3807432, 6.978577656]]]*

*beta is,  $\frac{9}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [988.3315033, 8.990054852]], [9.99, [988.3315033, 8.990054852]], [10.00, [988.3315033, 8.990054852]], [10.01, [988.3315033, 8.990054852]]]

*beta is,  $\frac{11}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [985.0270559, 11.00918827]], [9.99, [985.0270559, 11.00918827]], [10.00, [985.0270559, 11.00918827]], [10.01, [985.0270559, 11.00918827]]]

*beta is,  $\frac{13}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [981.4710448, 13.03586861]], [9.99, [981.4710448, 13.03586861]], [10.00, [981.4710448, 13.03586861]], [10.01, [981.4710448, 13.03586861]]]

*beta is,  $\frac{3}{2}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [977.6674922, 15.06997519]], [9.99, [977.6674922, 15.06997519]], [10.00, [977.6674922, 15.06997519]], [10.01, [977.6674922, 15.06997519]]]

*beta is,  $\frac{17}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [973.6207848, 17.11137641]], [9.99, [973.6207848, 17.11137641]], [10.00, [973.6207848, 17.11137641]], [10.01, [973.6207848, 17.11137641]]]

*beta is,  $\frac{19}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [969.3356593, 19.15993017]], [9.99, [969.3356593, 19.15993017]], [10.00, [969.3356593, 19.15993017]], [10.01, [969.3356593, 19.15993017]]]

*beta is,  $\frac{21}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [964.8171858, 21.21548438]], [9.99, [964.8171858, 21.21548438]], [10.00, [964.8171858, 21.21548438]], [10.01, [964.8171858, 21.21548438]]]

*beta is,  $\frac{23}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [960.0707508, 23.27787743]], [9.99, [960.0707508, 23.27787743]], [10.00,

[960.0707508, 23.27787743 ], [ 10.01, [960.0707508, 23.27787743 ]]]

*beta is,  $\frac{5}{2}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [955.1020392, 25.34693877]], [9.99, [955.1020392, 25.34693877]], [10.00, [955.1020392, 25.34693877]], [10.01, [955.1020392, 25.34693877]]]

*beta is,  $\frac{27}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [949.9170149, 27.42248950]], [9.99, [949.9170149, 27.42248950]], [10.00, [949.9170149, 27.42248950]], [10.01, [949.9170149, 27.42248950]]]

*beta is,  $\frac{29}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [944.5219011, 29.50434292]], [9.99, [944.5219011, 29.50434292]], [10.00, [944.5219011, 29.50434292]], [10.01, [944.5219011, 29.50434292]]]

*beta is,  $\frac{31}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [938.9231598, 31.59230516]], [9.99, [938.9231598, 31.59230516]], [10.00, [938.9231598, 31.59230516]], [10.01, [938.9231598, 31.59230516]]]

*beta is,  $\frac{33}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [933.1274712, 33.68617582]], [9.99, [933.1274712, 33.68617582]], [10.00, [933.1274712, 33.68617582]], [10.01, [933.1274712, 33.68617582]]]

*beta is,  $\frac{7}{2}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [927.1417118, 35.78574860]], [9.99, [927.1417118, 35.78574860]], [10.00, [927.1417118, 35.78574860]], [10.01, [927.1417118, 35.78574860]]]

*beta is,  $\frac{37}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [920.9729335, 37.89081195]], [9.99, [920.9729335, 37.89081195]], [10.00, [920.9729335, 37.89081195]], [10.01, [920.9729335, 37.89081195]]]

*beta is,  $\frac{39}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [914.6283415, 40.00114971]], [9.99, [914.6283415, 40.00114971]], [10.00, [914.6283415, 40.00114971]], [10.01, [914.6283415, 40.00114971]]]

> *SIRSdemo*(1000, 200, 3, 2, 0.01, 10)

*This is a numerical demonstration of the R0 phenomenon in the SIRS model using discretization with mesh size=, 0.01, and letting it run until time t=, 10*

*with population size, 1000, and fixed parameters nu=, 2, and gamma=, 3  
where we change beta from 0.2\*nu/N to 4\*nu/N*

*Recall that the epidemic will persist if beta exceeds nu/N, that in this case is,  $\frac{1}{500}$*

*We start with , 200, infected individuals, 0 removed and hence, 800, susceptible*

*We will show what happens once time is close to, 10*

*beta is,  $\frac{1}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [998.9334028, 0.9819978668]], [9.99, [998.9334028, 0.9819978668]], [10.00, [998.9334028, 0.9819978668]], [10.01, [998.9334028, 0.9819978668]]]

*beta is,  $\frac{3}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [996.4021571, 2.957935239]], [9.99, [996.4021571, 2.957935239]], [10.00, [996.4021571, 2.957935239]], [10.01, [996.4021571, 2.957935239]]]

*beta is,  $\frac{1}{2}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [993.3444243, 4.949667221]], [9.99, [993.3444243, 4.949667221]], [10.00, [993.3444243, 4.949667221]], [10.01, [993.3444243, 4.949667221]]]

*beta is,  $\frac{7}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [989.7667603, 6.956997143]], [9.99, [989.7667603, 6.956997143]], [10.00, [989.7667603, 6.956997143]], [10.01, [989.7667603, 6.956997143]]]

*beta is,  $\frac{9}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [985.6773407, 8.979679729]], [9.99, [985.6773407, 8.979679729]], [10.00, [985.6773407, 8.979679729]], [10.01, [985.6773407, 8.979679729]]]

*beta is,  $\frac{11}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [981.0859054, 11.01742279]], [9.99, [981.0859054, 11.01742279]], [10.00, [981.0859054, 11.01742279]], [10.01, [981.0859054, 11.01742279]]]

*beta is,  $\frac{13}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [976.0036901, 13.06988925]], [9.99, [976.0036901, 13.06988925]], [10.00, [976.0036901, 13.06988925]], [10.01, [976.0036901, 13.06988925]]]

*beta is,  $\frac{3}{2}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [970.4433482, 15.13669951]], [9.99, [970.4433482, 15.13669951]], [10.00, [970.4433482, 15.13669951]], [10.01, [970.4433482, 15.13669951]]]

*beta is,  $\frac{17}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [964.4188616, 17.21743410]], [9.99, [964.4188616, 17.21743410]], [10.00, [964.4188616, 17.21743410]], [10.01, [964.4188616, 17.21743410]]]

*beta is,  $\frac{19}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [957.9454447, 19.31163661]], [9.99, [957.9454447, 19.31163661]], [10.00, [957.9454447, 19.31163661]], [10.01, [957.9454447, 19.31163661]]]

*beta is,  $\frac{21}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [951.0394389, 21.41881679]], [9.99, [951.0394389, 21.41881679]], [10.00, [951.0394389, 21.41881679]], [10.01, [951.0394389, 21.41881679]]]

*beta is,  $\frac{23}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [943.7182031, 23.53845386]], [9.99, [943.7182031, 23.53845386]], [10.00, [943.7182031, 23.53845386]], [10.01, [943.7182031, 23.53845386]]]

*beta is,  $\frac{5}{2}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [935.9999984, 25.67000000]], [9.99, [935.9999984, 25.67000000]], [10.00, [935.9999984, 25.67000000]], [10.01, [935.9999984, 25.67000000]]]

*beta is,  $\frac{27}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [927.9038703, 27.81288384]], [9.99, [927.9038703, 27.81288384]], [10.00, [927.9038703, 27.81288384]], [10.01, [927.9038703, 27.81288384]]]

*beta is,  $\frac{29}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [919.4495282, 29.96651411]], [9.99, [919.4495282, 29.96651411]], [10.00, [919.4495282, 29.96651411]], [10.01, [919.4495282, 29.96651411]]]

*beta is,  $\frac{31}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [910.6572255, 32.13028319]], [9.99, [910.6572255, 32.13028319]], [10.00, [910.6572255, 32.13028319]], [10.01, [910.6572255, 32.13028319]]]

*beta is,  $\frac{33}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [901.5476397, 34.30357076]], [9.99, [901.5476397, 34.30357076]], [10.00, [901.5476397, 34.30357076]], [10.01, [901.5476397, 34.30357076]]]

*beta is,  $\frac{7}{2}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [892.1417551, 36.48574730]], [9.99, [892.1417551, 36.48574730]], [10.00, [892.1417551, 36.48574730]], [10.01, [892.1417551, 36.48574730]]]

*beta is,  $\frac{37}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [882.4607475, 38.67617753]], [9.99, [882.4607475, 38.67617753]], [10.00, [882.4607475, 38.67617753]], [10.01, [882.4607475, 38.67617753]]]

*beta is,  $\frac{39}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [872.5258747, 40.87422371]], [9.99, [872.5258747, 40.87422371]], [10.00, [872.5258747, 40.87422371]], [10.01, [872.5258747, 40.87422371]]]

(2)

> *SIRSdemo(1000, 200, 7, 3, 0.01, 10)*

*This is a numerical demonstration of the R0 phenomenon in the SIRS model using discretization with mesh size=, 0.01, and letting it run until time t=, 10*

*with population size, 1000, and fixed parameters nu=, 3, and gamma=, 7*

*where we change beta from  $0.2 \cdot nu/N$  to  $4 \cdot nu/N$*

Recall that the epidemic will persist if beta exceeds  $\nu/N$ , that in this case is,  $\frac{3}{1000}$

We start with , 200, infected individuals, 0 removed and hence, 800, susceptible

We will show what happens once time is close to, 10

beta is,  $\frac{1}{10}$ , times the threshold value

the long-term behavior is

[[9.98, [998.9571869, 0.9729968716]], [9.99, [998.9571869, 0.9729968716]], [10.00, [998.9571869, 0.9729968716]], [10.01, [998.9571869, 0.9729968716]]]

beta is,  $\frac{3}{10}$ , times the threshold value

the long-term behavior is

[[9.98, [996.6155905, 2.936908621]], [9.99, [996.6155905, 2.936908621]], [10.00, [996.6155905, 2.936908621]], [10.01, [996.6155905, 2.936908621]]]

beta is,  $\frac{1}{2}$ , times the threshold value

the long-term behavior is

[[9.98, [993.9350689, 4.924545130]], [9.99, [993.9350689, 4.924545130]], [10.00, [993.9350689, 4.924545130]], [10.01, [993.9350689, 4.924545130]]]

beta is,  $\frac{7}{10}$ , times the threshold value

the long-term behavior is

[[9.98, [990.9190693, 6.935665103]], [9.99, [990.9190693, 6.935665103]], [10.00, [990.9190693, 6.935665103]], [10.01, [990.9190693, 6.935665103]]]

beta is,  $\frac{9}{10}$ , times the threshold value

the long-term behavior is

[[9.98, [987.5717147, 8.969979927]], [9.99, [987.5717147, 8.969979927]], [10.00, [987.5717147, 8.969979927]], [10.01, [987.5717147, 8.969979927]]]

beta is,  $\frac{11}{10}$ , times the threshold value

the long-term behavior is

[[9.98, [983.8977865, 11.02715490]], [9.99, [983.8977865, 11.02715490]], [10.00, [983.8977865, 11.02715490]], [10.01, [983.8977865, 11.02715490]]]

beta is,  $\frac{13}{10}$ , times the threshold value

the long-term behavior is

[[9.98, [979.9027040, 13.10681067]], [9.99, [979.9027040, 13.10681067]], [10.00, [979.9027040, 13.10681067]], [10.01, [979.9027040, 13.10681067]]]

*beta is,  $\frac{3}{2}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [975.5925002, 15.20852494]], [9.99, [975.5925002, 15.20852494]], [10.00, [975.5925002, 15.20852494]], [10.01, [975.5925002, 15.20852494]]]

*beta is,  $\frac{17}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [970.9737953, 17.33183428]], [9.99, [970.9737953, 17.33183428]], [10.00, [970.9737953, 17.33183428]], [10.01, [970.9737953, 17.33183428]]]

*beta is,  $\frac{19}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [966.0537675, 19.47623623]], [9.99, [966.0537675, 19.47623623]], [10.00, [966.0537675, 19.47623623]], [10.01, [966.0537675, 19.47623623]]]

*beta is,  $\frac{21}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [960.8401210, 21.64119148]], [9.99, [960.8401210, 21.64119148]], [10.00, [960.8401210, 21.64119148]], [10.01, [960.8401210, 21.64119148]]]

*beta is,  $\frac{23}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [955.3410529, 23.82612625]], [9.99, [955.3410529, 23.82612625]], [10.00, [955.3410529, 23.82612625]], [10.01, [955.3410529, 23.82612625]]]

*beta is,  $\frac{5}{2}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [949.5652167, 26.03043478]], [9.99, [949.5652167, 26.03043478]], [10.00, [949.5652167, 26.03043478]], [10.01, [949.5652167, 26.03043478]]]

*beta is,  $\frac{27}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [943.5216861, 28.25348193]], [9.99, [943.5216861, 28.25348193]], [10.00, [943.5216861, 28.25348193]], [10.01, [943.5216861, 28.25348193]]]

*beta is,  $\frac{29}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [937.2199158, 30.49460585]], [9.99, [937.2199158, 30.49460585]], [10.00,

[937.2199158, 30.49460585]], [10.01, [937.2199158, 30.49460585]]]

*beta is,  $\frac{31}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [930.6697029, 32.75312075]], [9.99, [930.6697029, 32.75312075]], [10.00, [930.6697029, 32.75312075]], [10.01, [930.6697029, 32.75312075]]]

*beta is,  $\frac{33}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [923.8811464, 35.02831970]], [9.99, [923.8811464, 35.02831970]], [10.00, [923.8811464, 35.02831970]], [10.01, [923.8811464, 35.02831970]]]

*beta is,  $\frac{7}{2}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [916.8646074, 37.31947743]], [9.99, [916.8646074, 37.31947743]], [10.00, [916.8646074, 37.31947743]], [10.01, [916.8646074, 37.31947743]]]

*beta is,  $\frac{37}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [909.6306685, 39.62585316]], [9.99, [909.6306685, 39.62585316]], [10.00, [909.6306685, 39.62585316]], [10.01, [909.6306685, 39.62585316]]]

*beta is,  $\frac{39}{10}$ , times the threshold value*

*the long-term behavior is*

[[9.98, [902.1900937, 41.94669340]], [9.99, [902.1900937, 41.94669340]], [10.00, [902.1900937, 41.94669340]], [10.01, [902.1900937, 41.94669340]]]

(3)

>

## # Question 2

> *IsStable* := **proc**(*M*) **local** *EiI*, *i* :

*EiI* := *Eigenvalues*(*evalf*(*Matrix*(*M*))) :

*evalb*(*max*(*seq*(*coeff*(*EiI*[*i*], *I*, 0), *i* = 1 ..*nops*(*M*))) < 0) :

**end** :

*RandNice* := **proc**(*var*, *K*) **local** *ra*, *i* :

*ra* := *rand*(1 ..*K*) :

[*seq*((*ra*( ) - *add*(*ra*( ) \* *var*[*i*], *i* = 1 ..*nops*(*var*))) \* (*ra*( ) - *add*(*ra*( ) \* *var*[*i*], *i* = 1 ..*nops*(*var*))), *i* = 1 ..*nops*(*var*))] :

**end** :

```
EquPts := proc(F, var) local sol, il :
```

```
if nops(F) ≠ nops(var) then
```

```
  RETURN(FAIL) :
```

```
fi:
```

```
sol := {solve({op(F)}, {op(var)})} :
```

```
{seq(subs(sol[il], var), il = 1..nops(sol))} :
```

```
end:
```

```
StEquPts := proc(F, var) local d, pt, E, S, J, i, j, J0, il, Ei0 :
```

```
d := nops(var) :
```

```
if nops(F) ≠ d then
```

```
  RETURN(FAIL) :
```

```
fi:
```

```
E := EquPts(F, var) :
```

```
S := {} :
```

```
J := [seq([seq(diff(F[i], var[j]), j = 1..d)], i = 1..d)] : #J is the general Jacobian
```

```
for pt in E do
```

```
  J0 := evalf(subs({seq(var[il] = pt[il], il = 1..d)}, J)) :
```

```
  if IsStable(J0) then
```

```
    S := S union {pt} :
```

```
  fi:
```

```
od:
```

```
S :
```

```
end:
```

```
f1 := RandNice([x, y], 8)
```

$$f1 := [(1 - 3x - 5y)(5 - 2x - 2y), (2 - 3x - 2y)(8 - 4x - 7y)] \quad (4)$$

```
> f2 := RandNice([x, y], 8)
```

$$f2 := [(5 - 3x - 8y)(1 - 8x - 5y), (2 - 3x - 2y)(2 - 4x - 8y)] \quad (5)$$

```
> f3 := RandNice([x, y], 8)
```

$$f3 := [(3 - 3x - y)(2 - 5x - 4y), (5 - 6x - 2y)(3 - 7x - 8y)] \quad (6)$$

```
> EquPts(f1, [x, y])
```

$$\left\{ \left[ 1, \frac{1}{7} \right], \left[ -\frac{19}{4}, \frac{17}{4} \right], \left[ -\frac{1}{26}, \frac{37}{26} \right], \left[ \frac{2}{5}, \frac{2}{5} \right] \right\} \quad (7)$$

```
>
```

$$LI := Dis2\left(fl, x, y, \left[1, \frac{1}{7}\right] + [0.1, 0.1], 0.01, 10\right)$$

$$LI := [ [0.01, [1.1, 0.2428571429]], [0.02, [1.153142857, 0.2180000000]], [0.03, [1.214189274, 0.1938513690]], [0.04, [1.286739448, 0.1699809021]], [0.05, [1.376313379, 0.1459352535]], [0.06, [1.491870430, 0.1212989155]], [0.07, [1.649006015, 0.09589250101]], [0.08, [1.877371535, 0.07042877780]], [0.09, [2.240250377, 0.04884309203]], [0.10, [2.895910203, 0.04777014036]], [0.11, [4.342690740, 0.1445253964]], [0.12, [8.830446821, 0.8222787195]], [0.13, [35.29828498, 7.489411812]], [0.14, [627.2690837, 217.8932591]], [0.15, [235295.6479, 101093.9026]], [0.16, [3.674730419 \times 10^{10}, 1.712301338 \times 10^{10}]], [0.17, [9.369027533 \times 10^{20}, 4.506727979 \times 10^{20}]], [0.18, [6.201090375 \times 10^{41}, 3.020930697 \times 10^{41}]], [0.19, [2.736435845 \times 10^{83}, 1.339882789 \times 10^{83}]], [0.20, [5.344400540 \times 10^{166}, 2.622218548 \times 10^{166}]], [0.21, [2.040996150 \times 10^{333}, 1.002235312 \times 10^{333}]], [0.22, [2.978080114 \times 10^{666}, 1.462877371 \times 10^{666}]], [0.23, [6.341740796 \times 10^{1332}, 3.115573839 \times 10^{1332}]], [0.24, [2.875983828 \times 10^{2665}, 1.412990921 \times 10^{2665}]], [0.25, [5.915016130 \times 10^{5330}, 2.906151692 \times 10^{5330}]], [0.26, [2.502075409 \times 10^{10661}, 1.229324489 \times 10^{10661}]], [0.27, [4.477045646 \times 10^{21322}, 2.199678393 \times 10^{21322}]], [0.28, [1.433423982 \times 10^{42645}, 7.042760961 \times 10^{42644}]], [0.29, [1.469404318 \times 10^{85290}, 7.219545235 \times 10^{85289}]], [0.30, [1.544097598 \times 10^{170580}, 7.586533453 \times 10^{170579}]], [0.31, [1.705067895 \times 10^{341160}, 8.377421106 \times 10^{341159}]], [0.32, [2.079100864 \times 10^{682320}, 1.021513817 \times 10^{682320}]], [0.33, [3.091315508 \times 10^{1364640}, 1.518839997 \times 10^{1364640}]], [0.34, [6.834061515 \times 10^{2729280}, 3.357743978 \times 10^{2729280}]], [0.35, [3.340027074 \times 10^{5458561}, 1.641038173 \times 10^{5458561}]], [0.36, [7.977966253 \times 10^{10917122}, 3.919772769 \times 10^{10917122}]], [0.37, [4.551731235 \times 10^{21834245}, 2.236378494 \times 10^{21834245}]], [0.38, [1.481649373 \times 10^{43668491}, 7.279711002 \times 10^{43668490}]], [0.39, [1.569940178 \times 10^{87336982}, 7.713505634 \times 10^{87336981}]], [0.40, [1.762618926 \times 10^{174673964}, 8.660184136 \times 10^{174673963}]], [0.41, [2.221821059 \times 10^{349347928}, 1.091635816 \times 10^{349347928}]], [0.42, [3.530289970 \times 10^{698695856}, 1.734519058 \times 10^{698695856}]], [0.43, [8.912775731 \times 10^{1397391712}, 4.379067866 \times 10^{1397391712}]], [0.44, [5.680913524 \times 10^{2794783425}, 2.791173772 \times 10^{2794783425}]], [0.45, [2.307961595 \times 10^{5589566851}, 1.133958798 \times 10^{5589566851}]], [0.46, [3.809336838 \times 10^{11179133702}, 1.871621708 \times 10^{11179133702}]], [0.47, [1.037745776 \times 10^{22358267405}, 5.098702485 \times 10^{22358267404}]], [0.48, [7.701479602 \times 10^{44716534809}, 3.783928020 \times 10^{44716534809}]], [0.49, [4.241705964 \times 10^{89433069619}, 2.084055388$$

(8)

$\times 10^{89433069619}]$ , [0.50, [ $1.286688267 \times 10^{178866139239}$ ,  $6.321818715 \times 10^{178866139238}$ ]],  
 [0.51, [ $1.183965105 \times 10^{357732278478}$ ,  $5.817114330 \times 10^{357732278477}$ ]], [0.52, [ $1.002466863$   
 $\times 10^{715464556956}$ ,  $4.925368439 \times 10^{715464556955}$ ]], [0.53, [ $7.186745614 \times 10^{1430929113911}$ ,  
 $3.531026443 \times 10^{1430929113911}$ ]], [0.54, [ $3.693658724 \times 10^{2861858227823}$ ,  $1.814786181$   
 $\times 10^{2861858227823}$ ]], [0.55, [ $9.756762953 \times 10^{5723716455646}$ ,  $4.793739731$   
 $\times 10^{5723716455646}$ ]], [0.56, [ $6.807752030 \times 10^{11447432911293}$ ,  $3.344817491$   
 $\times 10^{11447432911293}$ ]], [0.57, [ $3.314359991 \times 10^{22894865822587}$ ,  $1.628427302$   
 $\times 10^{22894865822587}$ ]], [0.58, [ $7.855820956 \times 10^{45789731645174}$ ,  $3.859759756$   
 $\times 10^{45789731645174}$ ]], [0.59, [ $4.413421175 \times 10^{91579463290349}$ ,  $2.168423331$   
 $\times 10^{91579463290349}$ ]], [0.60, [ $1.392973869 \times 10^{183158926580699}$ ,  $6.844026252$   
 $\times 10^{183158926580698}$ ]], [0.61, [ $1.387644313 \times 10^{366317853161398}$ ,  $6.817840818$   
 $\times 10^{366317853161397}$ ]], [0.62, [ $1.377046296 \times 10^{732635706322796}$ ,  $6.765770129$   
 $\times 10^{732635706322795}$ ]], [0.63, [ $1.356092467 \times 10^{1465271412645592}$ ,  $6.662818771$   
 $\times 10^{1465271412645591}$ ]], [0.64, [ $1.315136491 \times 10^{2930542825291184}$ ,  $6.461591895$   
 $\times 10^{2930542825291183}$ ]], [0.65, [ $1.236897971 \times 10^{5861085650582368}$ ,  $6.077186639$   
 $\times 10^{5861085650582367}$ ]], [0.66, [ $1.094107450 \times 10^{11722171301164736}$ ,  $5.375621379$   
 $\times 10^{11722171301164735}$ ]], [0.67, [ $8.560757037 \times 10^{23444342602329471}$ ,  $4.206112347$   
 $\times 10^{23444342602329471}$ ]], [0.68, [ $5.241029015 \times 10^{46888685204658943}$ ,  $2.575047599$   
 $\times 10^{46888685204658943}$ ]], [0.69, [ $1.964379300 \times 10^{93777370409317887}$ ,  $9.651482913$   
 $\times 10^{93777370409317886}$ ]], [0.70, [ $2.759579556 \times 10^{187554740818635774}$ ,  $1.355849909$   
 $\times 10^{187554740818635774}$ ]], [0.71, [ $5.446005290 \times 10^{375109481637271548}$ ,  $2.675757529$   
 $\times 10^{375109481637271548}$ ]], [0.72, [ $2.121037460 \times 10^{750218963274543097}$ ,  $1.042118332$   
 $\times 10^{750218963274543097}$ ]], [0.73, [ $3.217280290 \times 10^{1500437926549086194}$ ,  $1.580729635$   
 $\times 10^{1500437926549086194}$ ]], [0.74, [ $7.402356851 \times 10^{3000875853098172388}$ ,  $3.636961590$   
 $\times 10^{3000875853098172388}$ ]], [0.75, [ $3.918611928 \times 10^{6001751706196344777}$ ,  $1.925311270$   
 $\times 10^{6001751706196344777}$ ]], [0.76, [Float( $\infty$ ), Float( $\infty$ )]], [0.77, [Float( $\infty$ ), Float( $\infty$ )]],  
 [0.78, [Float( $\infty$ ), Float( $\infty$ )]], [0.79, [Float( $\infty$ ), Float( $\infty$ )]], [0.80, [Float( $\infty$ ),  
 Float( $\infty$ )]], [0.81, [Float( $\infty$ ), Float( $\infty$ )]], [0.82, [Float( $\infty$ ), Float( $\infty$ )]], [0.83, [  
 Float( $\infty$ ), Float( $\infty$ )]], [0.84, [Float( $\infty$ ), Float( $\infty$ )]], [0.85, [Float( $\infty$ ), Float( $\infty$ )]],  
 [0.86, [Float( $\infty$ ), Float( $\infty$ )]], [0.87, [Float( $\infty$ ), Float( $\infty$ )]], [0.88, [Float( $\infty$ ),  
 Float( $\infty$ )]], [0.89, [Float( $\infty$ ), Float( $\infty$ )]], [0.90, [Float( $\infty$ ), Float( $\infty$ )]], [0.91, [  
 Float( $\infty$ ), Float( $\infty$ )]], [0.92, [Float( $\infty$ ), Float( $\infty$ )]], [0.93, [Float( $\infty$ ), Float( $\infty$ )]],  
 [0.94, [Float( $\infty$ ), Float( $\infty$ )]], [0.95, [Float( $\infty$ ), Float( $\infty$ )]], [0.96, [Float( $\infty$ ),



















$$\begin{aligned}
L2 := & [ [0.01, [-4.650000000, 4.350000000]], [0.02, [-4.932000000, 4.450000000]], [0.03, \\
& [-5.055352600, 4.506087160]], [0.04, [-5.124125141, 4.551184594]], [0.05, \\
& [-5.186430169, 4.599074022]], [0.06, [-5.255712864, 4.654169311]], [0.07, \\
& [-5.336361871, 4.718704611]], [0.08, [-5.431317787, 4.794809160]], [0.09, \\
& [-5.543812187, 4.885055460]], [0.10, [-5.677905551, 4.992731634]], [0.11, \\
& [-5.838884670, 5.122136761]], [0.12, [-6.033780389, 5.279002071]], [0.13, \\
& [-6.272146346, 5.471133593]], [0.14, [-6.567286920, 5.709429258]], [0.15, \\
& [-6.938268509, 6.009549155]], [0.16, [-7.413356178, 6.394776868]], [0.17, \\
& [-8.036184826, 6.901171673]], [0.18, [-8.877518402, 7.587415072]], [0.19, \\
& [-10.05933604, 8.555043235]], [0.20, [-11.80879747, 9.993933996]], [0.21, \\
& [-14.59378717, 12.29698305]], [0.22, [-19.51853081, 16.39617867]], [0.23, \\
& [-29.74220033, 24.97308617]], [0.24, [-57.33553109, 48.33807610]], [0.25, \\
& [-176.2794365, 150.1114350]], [0.26, [-1463.118398, 1262.230053]], [0.27, \\
& [-99255.66453, 86322.31322]], [0.28, [-4.706695062 \times 10^8, 4.102786726 \times 10^8]], [0.29, \\
& [-1.070319476 \times 10^{16}, 9.334649370 \times 10^{15}]], [0.30, [-5.548840058 \times 10^{30}, 4.839936347 \\
& \times 10^{30}]], [0.31, [-1.492245213 \times 10^{60}, 1.301638921 \times 10^{60}]], [0.32, [-1.079393108 \\
& \times 10^{119}, 9.415277644 \times 10^{118}]], [0.33, [-5.647732104 \times 10^{236}, 4.926385049 \times 10^{236}]], \\
& [0.34, [-1.546204020 \times 10^{472}, 1.348718311 \times 10^{472}]], [0.35, [-1.158919192 \times 10^{943}, \\
& 1.010898745 \times 10^{943}]], [0.36, [-6.510676231 \times 10^{1884}, 5.679114342 \times 10^{1884}]], [0.37, \\
& [-2.054811760 \times 10^{3768}, 1.792365434 \times 10^{3768}]], [0.38, [-2.046745988 \times 10^{7535}, \\
& 1.785329845 \times 10^{7535}]], [0.39, [-2.030709305 \times 10^{15069}, 1.771341410 \times 10^{15069}]], [0.40, \\
& [-1.999011895 \times 10^{30137}, 1.743692480 \times 10^{30137}]], [0.41, [-1.937093632 \times 10^{60273}, \\
& 1.689682596 \times 10^{60273}]], [0.42, [-1.818951372 \times 10^{120545}, 1.586629799 \times 10^{120545}]], \\
& [0.43, [-1.603843697 \times 10^{241089}, 1.398996281 \times 10^{241089}]], [0.44, [-1.246935388 \\
& \times 10^{482177}, 1.087673301 \times 10^{482177}]], [0.45, [-7.537160526 \times 10^{964352}, 6.574493231 \\
& \times 10^{964352}]], [0.46, [-2.753819011 \times 10^{1928704}, 2.402093519 \times 10^{1928704}]], [0.47, \\
& [-3.676128219 \times 10^{3857407}, 3.206602817 \times 10^{3857407}]], [0.48, [-6.550903047 \\
& \times 10^{7714813}, 5.714203325 \times 10^{7714813}]], [0.49, [-2.080281982 \times 10^{15429626}, 1.814582529 \\
& \times 10^{15429626}]], [0.50, [-2.097800951 \times 10^{30859251}, 1.829863929 \times 10^{30859251}]], [0.51, \\
& [-2.133282750 \times 10^{61718501}, 1.860813896 \times 10^{61718501}]], [0.52, [-2.206056917 \\
& \times 10^{123437001}, 1.924293139 \times 10^{123437001}]], [0.53, [-2.359137714 \times 10^{246874001}, \\
& 2.057822022 \times 10^{246874001}]], [0.54, [-2.697903723 \times 10^{493748001}, 2.353319890
\end{aligned}$$

(9)

$\times 10^{493748001}]$ ,  $[0.55, [-3.528358942 \times 10^{987496001}, 3.077707042 \times 10^{987496001}]]$ ,  $[0.56,$   
 $[-6.034834812 \times 10^{1974992001}, 5.264048775 \times 10^{1974992001}]]$ ,  $[0.57, [-1.765430551$   
 $\times 10^{3949984002}, 1.539944807 \times 10^{3949984002}]]$ ,  $[0.58, [-1.510849275 \times 10^{7899968003},$   
 $1.317879365 \times 10^{7899968003}]]$ ,  $[0.59, [-1.106527327 \times 10^{15799936005}, 9.651985517$   
 $\times 10^{15799936004}]]$ ,  $[0.60, [-5.935320183 \times 10^{31599872008}, 5.177244430 \times 10^{31599872008}]]$ ,  
 $[0.61, [-1.707686585 \times 10^{63199744016}, 1.489576062 \times 10^{63199744016}]]$ ,  $[0.62,$   
 $[-1.413631444 \times 10^{126399488031}, 1.233078470 \times 10^{126399488031}]]$ ,  $[0.63, [-9.687066021$   
 $\times 10^{252798976060}, 8.449806764 \times 10^{252798976060}]]$ ,  $[0.64, [-4.548878989$   
 $\times 10^{505597952120}, 3.967883397 \times 10^{505597952120}]]$ ,  $[0.65, [-1.003063970$   
 $\times 10^{1011195904240}, 8.749498226 \times 10^{1011195904239}]]$ ,  $[0.66, [-4.877273615$   
 $\times 10^{2022391808478}, 4.254334539 \times 10^{2022391808478}]]$ ,  $[0.67, [-1.153118931$   
 $\times 10^{4044783616956}, 1.005839349 \times 10^{4044783616956}]]$ ,  $[0.68, [-6.445670140$   
 $\times 10^{8089567233910}, 5.622411066 \times 10^{8089567233910}]]$ ,  $[0.69, [-2.013984013$   
 $\times 10^{16179134467820}, 1.756752324 \times 10^{16179134467820}]]$ ,  $[0.70, [-1.966219071$   
 $\times 10^{32358268935639}, 1.715088049 \times 10^{32358268935639}]]$ ,  $[0.71, [-1.874060756$   
 $\times 10^{64716537871277}, 1.634700457 \times 10^{64716537871277}]]$ ,  $[0.72, [-1.702500299$   
 $\times 10^{129433075742553}, 1.485052183 \times 10^{129433075742553}]]$ ,  $[0.73, [-1.405058017$   
 $\times 10^{258866151485105}, 1.225600065 \times 10^{258866151485105}]]$ ,  $[0.74, [-9.569921610$   
 $\times 10^{517732302970208}, 8.347624366 \times 10^{517732302970208}]]$ ,  $[0.75, [-4.439526215$   
 $\times 10^{1035464605940416}, 3.872497468 \times 10^{1035464605940416}]]$ ,  $[0.76, [-9.554173277$   
 $\times 10^{2070929211880831}, 8.333887467 \times 10^{2070929211880831}]]$ ,  $[0.77, [-4.424926840$   
 $\times 10^{4141858423761662}, 3.859762767 \times 10^{4141858423761662}]]$ ,  $[0.78, [-9.491438846$   
 $\times 10^{8283716847523323}, 8.279165645 \times 10^{8283716847523323}]]$ ,  $[0.79, [-4.367007855$   
 $\times 10^{16567433695046646}, 3.809241354 \times 10^{16567433695046646}]]$ ,  $[0.80, [-9.244593271$   
 $\times 10^{33134867390093291}, 8.063847889 \times 10^{33134867390093291}]]$ ,  $[0.81, [-4.142814470$   
 $\times 10^{66269734780186582}, 3.613682583 \times 10^{66269734780186582}]]$ ,  $[0.82, [-8.319760697$   
 $\times 10^{132539469560373163}, 7.257137521 \times 10^{132539469560373163}]]$ ,  $[0.83, [-3.355378647$   
 $\times 10^{265078939120746326}, 2.926820267 \times 10^{265078939120746326}]]$ ,  $[0.84, [-5.457615486$   
 $\times 10^{530157878241492651}, 4.760553530 \times 10^{530157878241492651}]]$ ,  $[0.85, [-1.443862168$   
 $\times 10^{1060315756482985302}, 1.259448040 \times 10^{1060315756482985302}]]$ ,  $[0.86, [-1.010581489$   
 $\times 10^{2120631512965970603}, 8.815071842 \times 10^{2120631512965970602}]]$ ,  $[0.87, [-4.950653597$   
 $\times 10^{4241263025931941204}, 4.318342226 \times 10^{4241263025931941204}]]$ ,  $[0.88, [-1.188077969$

























Float(undefined) ]], [ 10.00, [Float(undefined), Float(undefined) ]], [ 10.01, [Float(undefined), Float(undefined) ]]]

$$> L3 := Dis2\left(fI, x, y, \left[-\frac{1}{26}, \frac{37}{26}\right] + [0.1, 0.1], 0.01, 10\right)$$

$$L3 := [[0.01, [0.06153846154, 1.523076923]], [0.02, [0.1112307692, 1.577846154]], [0.03, (10) [0.1959276694, 1.668080944]], [0.04, [0.3540615613, 1.827433119]], [0.05, [0.6931927405, 2.142704022]], [0.06, [1.600694362, 2.900354756]], [0.07, [5.148662806, 5.497030396]], [0.08, [33.40506280, 23.43572453]], [0.09, [1009.094820, 571.0177239]], [0.10, [793764.2705, 413046.2104]], [0.11, [4.661804660 \times 10^{11}, 2.344480074 \times 10^{11}]], [0.12, [1.575551638 \times 10^{23}, 7.814346357 \times 10^{22}]], [0.13, [1.785023454 \times 10^{46}, 8.803653211 \times 10^{45}]], [0.14, [2.283709664 \times 10^{92}, 1.123763059 \times 10^{92}]], [0.15, [3.733025634 \times 10^{184}, 1.835260360 \times 10^{184}]], [0.16, [9.969423399 \times 10^{368}, 4.899443069 \times 10^{368}]], [0.17, [7.108780324 \times 10^{737}, 3.493070015 \times 10^{737}]], [0.18, [3.614162733 \times 10^{1475}, 1.775799480 \times 10^{1475}]], [0.19, [9.341525799 \times 10^{2950}, 4.589798020 \times 10^{2950}]], [0.20, [6.240680676 \times 10^{5901}, 3.066221342 \times 10^{5901}]], [0.21, [2.785209045 \times 10^{11803}, 1.368445922 \times 10^{11803}]], [0.22, [5.547642683 \times 10^{23606}, 2.725697397 \times 10^{23606}]], [0.23, [2.200946323 \times 10^{47213}, 1.081380002 \times 10^{47213}]], [0.24, [3.464265997 \times 10^{94426}, 1.702080134 \times 10^{94426}]], [0.25, [8.582518070 \times 10^{188852}, 4.216804374 \times 10^{188852}]], [0.26, [5.267707980 \times 10^{377705}, 2.588155708 \times 10^{377705}]], [0.27, [1.984429210 \times 10^{755411}, 9.749993204 \times 10^{755410}]], [0.28, [2.816199686 \times 10^{1510822}, 1.383668789 \times 10^{1510822}]], [0.29, [5.671776561 \times 10^{3021644}, 2.786684560 \times 10^{3021644}]], [0.30, [2.300543494 \times 10^{6043289}, 1.130314101 \times 10^{6043289}]], [0.31, [3.784888743 \times 10^{12086578}, 1.859609753 \times 10^{12086578}]], [0.32, [1.024468140 \times 10^{24173157}, 5.033466172 \times 10^{24173156}]], [0.33, [7.505664276 \times 10^{48346313}, 3.687719094 \times 10^{48346313}]], [0.34, [4.028751596 \times 10^{96692627}, 1.979425623 \times 10^{96692627}]], [0.35, [1.160735326 \times 10^{193385255}, 5.702980666 \times 10^{193385254}]], [0.36, [9.635153216 \times 10^{386770509}, 4.733989848 \times 10^{386770509}]], [0.37, [6.639103990 \times 10^{773541019}, 3.261956524 \times 10^{773541019}]], [0.38, [3.152181119 \times 10^{1547082039}, 1.548744798 \times 10^{1547082039}]], [0.39, [7.105825658 \times 10^{3094164078}, 3.491268461 \times 10^{3094164078}]], [0.40, [3.610948685 \times 10^{6188328157}, 1.774148686 \times 10^{6188328157}]], [0.41, [9.324699703 \times 10^{12376656314}, 4.581456336 \times 10^{12376656314}]], [0.42, [6.218160535 \times 10^{24753312629}, 3.055136560 \times 10^{24753312629}]], [0.43, [2.765133356 \times 10^{49506625259}, 1.358578628 \times 10^{49506625259}]], [0.44, [5.467948095 \times 10^{99013250518}, 2.686538573 \times 10^{99013250518}]], [0.45, [2.138163875$$

$\times 10^{198026501037}$ ,  $1.050532964 \times 10^{198026501037}$  ], [0.46, [  $3.269446207 \times 10^{396053002074}$ ,  $1.606360043 \times 10^{396053002074}$  ]], [0.47, [  $7.644350880 \times 10^{792106004148}$ ,  $3.755859261 \times 10^{792106004148}$  ]], [0.48, [  $4.179010355 \times 10^{1584212008297}$ ,  $2.053251479 \times 10^{1584212008297}$  ]], [0.49, [  $1.248932927 \times 10^{3168424016595}$ ,  $6.136317359 \times 10^{3168424016594}$  ]], [0.50, [  $1.115502254 \times 10^{6336848033190}$ ,  $5.480739354 \times 10^{6336848033189}$  ]], [0.51, [  $8.898834402 \times 10^{12673696066379}$ ,  $4.372218143 \times 10^{12673696066379}$  ]], [0.52, [  $5.663155295 \times 10^{25347392132759}$ ,  $2.782448714 \times 10^{25347392132759}$  ]], [0.53, [  $2.293555021 \times 10^{50694784265519}$ ,  $1.126880490 \times 10^{50694784265519}$  ]], [0.54, [  $3.761928586 \times 10^{101389568531038}$ ,  $1.848328856 \times 10^{101389568531038}$  ]], [0.55, [  $1.012076439 \times 10^{202779137062077}$ ,  $4.972582666 \times 10^{202779137062076}$  ]], [0.56, [  $7.325189265 \times 10^{405558274124153}$ ,  $3.599047242 \times 10^{405558274124153}$  ]], [0.57, [  $3.837336826 \times 10^{811116548248307}$ ,  $1.885378797 \times 10^{811116548248307}$  ]], [0.58, [  $1.053057448 \times 10^{1622233096496615}$ ,  $5.173932531 \times 10^{1622233096496614}$  ]], [0.59, [  $7.930422935 \times 10^{3244466192993229}$ ,  $3.896413562 \times 10^{3244466192993229}$  ]], [0.60, [  $4.497642368 \times 10^{6488932385986459}$ ,  $2.209803292 \times 10^{6488932385986459}$  ]], [0.61, [  $1.446645297 \times 10^{12977864771972919}$ ,  $7.107727289 \times 10^{12977864771972918}$  ]], [0.62, [  $1.496636526 \times 10^{25955729543945838}$ ,  $7.353346597 \times 10^{25955729543945837}$  ]], [0.63, [  $1.601861270 \times 10^{51911459087891676}$ ,  $7.870341876 \times 10^{51911459087891675}$  ]], [0.64, [  $1.835025158 \times 10^{103822918175783352}$ ,  $9.015933916 \times 10^{103822918175783351}$  ]], [0.65, [  $2.408109696 \times 10^{207645836351566704}$ ,  $1.183164045 \times 10^{207645836351566704}$  ]], [0.66, [  $4.147102348 \times 10^{415291672703133408}$ ,  $2.037574283 \times 10^{415291672703133408}$  ]], [0.67, [  $1.229933776 \times 10^{830583345406266817}$ ,  $6.042969818 \times 10^{830583345406266816}$  ]], [0.68, [  $1.081821671 \times 10^{1661166690812533634}$ ,  $5.315258299 \times 10^{1661166690812533633}$  ]], [0.69, [  $8.369578267 \times 10^{3322333381625067267}$ ,  $4.112181474 \times 10^{3322333381625067267}$  ]], [0.70, [  $5.009557560 \times 10^{6644666763250134535}$ ,  $2.461319929 \times 10^{6644666763250134535}$  ]], [0.71, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.72, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.73, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.74, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.75, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.76, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.77, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.78, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.79, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.80, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.81, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.82, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.83, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.84, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.85, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.86, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.87, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.88, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.89, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.90, [Float( $\infty$ ), Float( $\infty$ ) ]], [0.91, [Float( $\infty$ ),



















$$> L4 := Dis2\left(fI, x, y, \left[\frac{2}{5}, \frac{2}{5}\right] + [0.1, 0.1], 0.01, 10\right)$$

$$L4 := [[0.01, [0.5000000000, 0.5000000000]], [0.02, [0.5000000000, 0.4700000000]], [0.03, (11)$$

[0.4980890000, 0.4451150000]], [0.04, [0.4948525010, 0.4251036745]], [0.05, [0.4907863820, 0.4095004224]], [0.06, [0.4862740291, 0.3977075511]], [0.07, [0.4815891868, 0.3890826309]], [0.08, [0.4769135553, 0.3830056454]], [0.09, [0.4723592148, 0.3789209391]], [0.10, [0.4679895760, 0.3763566651]], [0.11, [0.4638361069, 0.3749279654]], [0.12, [0.4599104209, 0.3743303968]], [0.13, [0.4562124256, 0.3743287459]], [0.14, [0.4527355348, 0.3747446273]], [0.15, [0.4494698636, 0.3754447726]], [0.16, [0.4464041123, 0.3763308807]], [0.17, [0.4435266320, 0.3773312739]], [0.18, [0.4408259970, 0.3783942754]], [0.19, [0.4382912874, 0.3794830785]], [0.20, [0.4359122082, 0.3805718403]], [0.21, [0.4336791188, 0.3816427446]], [0.22, [0.4315830168, 0.3826838144]], [0.23, [0.4296155007, 0.3836872942]], [0.24, [0.4277687255, 0.3846484612]], [0.25, [0.4260353570, 0.3855647541]], [0.26, [0.4244085297, 0.3864351385]], [0.27, [0.4228818081, 0.3872596456]], [0.28, [0.4214491532, 0.3880390385]], [0.29, [0.4201048921, 0.3887745704]], [0.30, [0.4188436921, 0.3894678122]], [0.31, [0.4176605372, 0.3901205278]], [0.32, [0.4165507079, 0.3907345864]], [0.33, [0.4155097620, 0.3913119001]], [0.34, [0.4145335183, 0.3918543805]], [0.35, [0.4136180408, 0.3923639087]], [0.36, [0.4127596249, 0.3928423155]], [0.37, [0.4119547839, 0.3932913679]], [0.38, [0.4112002368, 0.3937127611]], [0.39, [0.4104928967, 0.3941081143]], [0.40, [0.4098298599, 0.3944789685]], [0.41, [0.4092083957, 0.3948267863]], [0.42, [0.4086259366, 0.3951529530]], [0.43, [0.4080800691, 0.3954587785]], [0.44, [0.4075685249, 0.3957454997]], [0.45, [0.4070891727, 0.3960142835]], [0.46, [0.4066400103, 0.3962662296]], [0.47, [0.4062191571, 0.3965023736]], [0.48, [0.4058248473, 0.3967236902]], [0.49, [0.4054554228, 0.3969310964]], [0.50, [0.4051093272, 0.3971254543]], [0.51, [0.4047850997, 0.3973075744]], [0.52, [0.4044813695, 0.3974782181]], [0.53, [0.4041968504, 0.3976381008]], [0.54, [0.4039303356, 0.3977878942]], [0.55, [0.4036806931, 0.3979282291]], [0.56, [0.4034468613, 0.3980596975]], [0.57, [0.4032278445, 0.3981828551]], [0.58, [0.4030227089, 0.3982982232]], [0.59, [0.4028305792, 0.3984062911]], [0.60, [0.4026506346, 0.3985075177]], [0.61, [0.4024821056, 0.3986023334]], [0.62, [0.4023242710, 0.3986911420]], [0.63, [0.4021764547, 0.3987743220]], [0.64, [0.4020380230, 0.3988522283]], [0.65, [0.4019083822, 0.3989251937]], [0.66, [0.4017869757, 0.3989935303]], [0.67, [0.4016732820, 0.3990575305]], [0.68, [0.4015668124, 0.3991174684]], [0.69, [0.4014671091, 0.3991736009]], [0.70, [0.4013737431, 0.3992261689]], [0.71, [0.4012863125, 0.3992753980]], [0.72, [0.4012044408, 0.3993214996]], [0.73,

[0.4011277752, 0.3993646720]], [0.74, [0.4010559853, 0.3994051007]], [0.75, [0.4009887615, 0.3994429597]], [0.76, [0.4009258138, 0.3994784119]], [0.77, [0.4008668707, 0.3995116101]], [0.78, [0.4008116777, 0.3995426972]], [0.79, [0.4007599966, 0.3995718074]], [0.80, [0.4007116042, 0.3995990660]], [0.81, [0.4006662915, 0.3996245907]], [0.82, [0.4006238626, 0.3996484916]], [0.83, [0.4005841343, 0.3996708718]], [0.84, [0.4005469348, 0.3996918280]], [0.85, [0.4005121032, 0.3997114507]], [0.86, [0.4004794890, 0.3997298246]], [0.87, [0.4004489511, 0.3997470291]], [0.88, [0.4004203575, 0.3997631386]], [0.89, [0.4003935844, 0.3997782227]], [0.90, [0.4003685160, 0.3997923466]], [0.91, [0.4003450438, 0.3998055714]], [0.92, [0.4003230662, 0.3998179542]], [0.93, [0.4003024881, 0.3998295487]], [0.94, [0.4002832205, 0.3998404050]], [0.95, [0.4002651799, 0.3998505700]], [0.96, [0.4002482882, 0.3998600877]], [0.97, [0.4002324723, 0.3998689994]], [0.98, [0.4002176637, 0.3998773436]], [0.99, [0.4002037982, 0.3998851565]], [1.00, [0.4001908158, 0.3998924718]], [1.01, [0.4001786603, 0.3998993212]], [1.02, [0.4001672791, 0.3999057344]], [1.03, [0.4001566228, 0.3999117392]], [1.04, [0.4001466452, 0.3999173616]], [1.05, [0.4001373032, 0.3999226258]], [1.06, [0.4001285563, 0.3999275547]], [1.07, [0.4001203665, 0.3999321697]], [1.08, [0.4001126984, 0.3999364907]], [1.09, [0.4001055188, 0.3999405365]], [1.10, [0.4000987965, 0.3999443246]], [1.11, [0.4000925024, 0.3999478714]], [1.12, [0.4000866093, 0.3999511923]], [1.13, [0.4000810916, 0.3999543017]], [1.14, [0.4000759254, 0.3999572130]], [1.15, [0.4000710883, 0.3999599388]], [1.16, [0.4000665594, 0.3999624910]], [1.17, [0.4000623190, 0.3999648806]], [1.18, [0.4000583487, 0.3999671180]], [1.19, [0.4000546314, 0.3999692129]], [1.20, [0.4000511509, 0.3999711743]], [1.21, [0.4000478921, 0.3999730107]], [1.22, [0.4000448409, 0.3999747302]], [1.23, [0.4000419841, 0.3999763401]], [1.24, [0.4000393093, 0.3999778474]], [1.25, [0.4000368049, 0.3999792587]], [1.26, [0.4000344601, 0.3999805801]], [1.27, [0.4000322646, 0.3999818173]], [1.28, [0.4000302090, 0.3999829757]], [1.29, [0.4000282844, 0.3999840603]], [1.30, [0.4000264824, 0.3999850758]], [1.31, [0.4000247952, 0.3999860266]], [1.32, [0.4000232155, 0.3999869169]], [1.33, [0.4000217364, 0.3999877505]], [1.34, [0.4000203515, 0.3999885309]], [1.35, [0.4000190549, 0.3999892616]], [1.36, [0.4000178409, 0.3999899458]], [1.37, [0.4000167042, 0.3999905863]], [1.38, [0.4000156400, 0.3999911861]], [1.39, [0.4000146436, 0.3999917476]], [1.40, [0.4000137106, 0.3999922734]], [1.41, [0.4000128371, 0.3999927657]], [1.42, [0.4000120192, 0.3999932266]], [1.43, [0.4000112534, 0.3999936581]], [1.44, [0.4000105364, 0.3999940622]], [1.45, [0.4000098651, 0.3999944405]], [1.46, [0.4000092366, 0.3999947947]], [1.47, [0.4000086481, 0.3999951263]], [1.48, [0.4000080971, 0.3999954368]], [1.49,

[0.4000075812, 0.3999957275 ], [1.50, [0.4000070982, 0.3999959997]], [1.51, [0.4000066460, 0.3999962546]], [1.52, [0.4000062226, 0.3999964932]], [1.53, [0.4000058261, 0.3999967166]], [1.54, [0.4000054549, 0.3999969258]], [1.55, [0.4000051074, 0.3999971217]], [1.56, [0.4000047820, 0.3999973051]], [1.57, [0.4000044773, 0.3999974768]], [1.58, [0.4000041920, 0.3999976375]], [1.59, [0.4000039249, 0.3999977881]], [1.60, [0.4000036748, 0.3999979290]], [1.61, [0.4000034407, 0.3999980610]], [1.62, [0.4000032215, 0.3999981845]], [1.63, [0.4000030163, 0.3999983002]], [1.64, [0.4000028241, 0.3999984085]], [1.65, [0.4000026442, 0.3999985099]], [1.66, [0.4000024757, 0.3999986048]], [1.67, [0.4000023180, 0.3999986937]], [1.68, [0.4000021703, 0.3999987769]], [1.69, [0.4000020320, 0.3999988548]], [1.70, [0.4000019025, 0.3999989278]], [1.71, [0.4000017813, 0.3999989961]], [1.72, [0.4000016678, 0.3999990601]], [1.73, [0.4000015615, 0.3999991200]], [1.74, [0.4000014620, 0.3999991761]], [1.75, [0.4000013689, 0.3999992286]], [1.76, [0.4000012817, 0.3999992777]], [1.77, [0.4000012000, 0.3999993237]], [1.78, [0.4000011235, 0.3999993668]], [1.79, [0.4000010519, 0.3999994072]], [1.80, [0.4000009849, 0.3999994450]], [1.81, [0.4000009222, 0.3999994803]], [1.82, [0.4000008634, 0.3999995134]], [1.83, [0.4000008084, 0.3999995444]], [1.84, [0.4000007569, 0.3999995734]], [1.85, [0.4000007087, 0.3999996006]], [1.86, [0.4000006635, 0.3999996261]], [1.87, [0.4000006212, 0.3999996499]], [1.88, [0.4000005816, 0.3999996722]], [1.89, [0.4000005445, 0.3999996931]], [1.90, [0.4000005098, 0.3999997126]], [1.91, [0.4000004773, 0.3999997310]], [1.92, [0.4000004469, 0.3999997481]], [1.93, [0.4000004184, 0.3999997641]], [1.94, [0.4000003917, 0.3999997791]], [1.95, [0.4000003668, 0.3999997932]], [1.96, [0.4000003434, 0.3999998064]], [1.97, [0.4000003215, 0.3999998187]], [1.98, [0.4000003010, 0.3999998303]], [1.99, [0.4000002818, 0.3999998411]], [2.00, [0.4000002638, 0.3999998512]], [2.01, [0.4000002470, 0.3999998607]], [2.02, [0.4000002313, 0.3999998696]], [2.03, [0.4000002166, 0.3999998779]], [2.04, [0.4000002028, 0.3999998857]], [2.05, [0.4000001899, 0.3999998930]], [2.06, [0.4000001778, 0.3999998998]], [2.07, [0.4000001665, 0.3999999062]], [2.08, [0.4000001559, 0.3999999122]], [2.09, [0.4000001460, 0.3999999178]], [2.10, [0.4000001367, 0.3999999230]], [2.11, [0.4000001280, 0.3999999279]], [2.12, [0.4000001198, 0.3999999325]], [2.13, [0.4000001122, 0.3999999368]], [2.14, [0.4000001051, 0.3999999408]], [2.15, [0.4000000984, 0.3999999446]], [2.16, [0.4000000921, 0.3999999481]], [2.17, [0.4000000862, 0.3999999514]], [2.18, [0.4000000807, 0.3999999545]], [2.19, [0.4000000756, 0.3999999574]], [2.20, [0.4000000708, 0.3999999601]], [2.21, [0.4000000663, 0.3999999626]], [2.22, [0.4000000621, 0.3999999650]], [2.23, [0.4000000581, 0.3999999672]], [2.24, [0.4000000544, 0.3999999693]], [2.25,

[0.4000000509, 0.3999999713 ]], [2.26, [0.4000000477, 0.3999999731 ]], [2.27, [0.4000000447, 0.3999999748 ]], [2.28, [0.4000000419, 0.3999999764 ]], [2.29, [0.4000000392, 0.3999999779 ]], [2.30, [0.4000000367, 0.3999999793 ]], [2.31, [0.4000000344, 0.3999999806 ]], [2.32, [0.4000000322, 0.3999999819 ]], [2.33, [0.4000000301, 0.3999999830 ]], [2.34, [0.4000000282, 0.3999999841 ]], [2.35, [0.4000000264, 0.3999999851 ]], [2.36, [0.4000000247, 0.3999999860 ]], [2.37, [0.4000000231, 0.3999999869 ]], [2.38, [0.4000000216, 0.3999999878 ]], [2.39, [0.4000000202, 0.3999999886 ]], [2.40, [0.4000000189, 0.3999999893 ]], [2.41, [0.4000000177, 0.3999999900 ]], [2.42, [0.4000000166, 0.3999999906 ]], [2.43, [0.4000000155, 0.3999999912 ]], [2.44, [0.4000000145, 0.3999999918 ]], [2.45, [0.4000000136, 0.3999999923 ]], [2.46, [0.4000000127, 0.3999999928 ]], [2.47, [0.4000000119, 0.3999999933 ]], [2.48, [0.4000000111, 0.3999999937 ]], [2.49, [0.4000000104, 0.3999999941 ]], [2.50, [0.4000000097, 0.3999999945 ]], [2.51, [0.4000000091, 0.3999999948 ]], [2.52, [0.4000000085, 0.3999999951 ]], [2.53, [0.4000000080, 0.3999999954 ]], [2.54, [0.4000000075, 0.3999999957 ]], [2.55, [0.4000000070, 0.3999999960 ]], [2.56, [0.4000000066, 0.3999999963 ]], [2.57, [0.4000000062, 0.3999999965 ]], [2.58, [0.4000000058, 0.3999999967 ]], [2.59, [0.4000000054, 0.3999999969 ]], [2.60, [0.4000000051, 0.3999999971 ]], [2.61, [0.4000000048, 0.3999999973 ]], [2.62, [0.4000000045, 0.3999999975 ]], [2.63, [0.4000000042, 0.3999999977 ]], [2.64, [0.4000000039, 0.3999999978 ]], [2.65, [0.4000000037, 0.3999999979 ]], [2.66, [0.4000000035, 0.3999999981 ]], [2.67, [0.4000000033, 0.3999999982 ]], [2.68, [0.4000000031, 0.3999999983 ]], [2.69, [0.4000000029, 0.3999999984 ]], [2.70, [0.4000000027, 0.3999999985 ]], [2.71, [0.4000000025, 0.3999999986 ]], [2.72, [0.4000000023, 0.3999999987 ]], [2.73, [0.4000000022, 0.3999999988 ]], [2.74, [0.4000000021, 0.3999999988 ]], [2.75, [0.4000000020, 0.3999999989 ]], [2.76, [0.4000000019, 0.3999999990 ]], [2.77, [0.4000000018, 0.3999999990 ]], [2.78, [0.4000000017, 0.3999999991 ]], [2.79, [0.4000000016, 0.3999999991 ]], [2.80, [0.4000000015, 0.3999999991 ]], [2.81, [0.4000000014, 0.3999999992 ]], [2.82, [0.4000000013, 0.3999999993 ]], [2.83, [0.4000000012, 0.3999999993 ]], [2.84, [0.4000000011, 0.3999999993 ]], [2.85, [0.4000000010, 0.3999999994 ]], [2.86, [0.4000000009, 0.3999999994 ]], [2.87, [0.4000000009, 0.3999999994 ]], [2.88, [0.4000000009, 0.3999999994 ]], [2.89, [0.4000000009, 0.3999999994 ]], [2.90, [0.4000000009, 0.3999999994 ]], [2.91, [0.4000000009, 0.3999999994 ]], [2.92, [0.4000000009, 0.3999999994 ]], [2.93, [0.4000000009, 0.3999999994 ]], [2.94, [0.4000000009, 0.3999999994 ]], [2.95, [0.4000000009, 0.3999999994 ]], [2.96, [0.4000000009, 0.3999999994 ]], [2.97, [0.4000000009, 0.3999999994 ]], [2.98, [0.4000000009, 0.3999999994 ]], [2.99, [0.4000000009, 0.3999999994 ]], [3.00, [0.4000000009, 0.3999999994 ]], [3.01,



















```
[0.4000000009, 0.3999999994]], [9.86, [0.4000000009, 0.3999999994]], [9.87,
[0.4000000009, 0.3999999994]], [9.88, [0.4000000009, 0.3999999994]], [9.89,
[0.4000000009, 0.3999999994]], [9.90, [0.4000000009, 0.3999999994]], [9.91,
[0.4000000009, 0.3999999994]], [9.92, [0.4000000009, 0.3999999994]], [9.93,
[0.4000000009, 0.3999999994]], [9.94, [0.4000000009, 0.3999999994]], [9.95,
[0.4000000009, 0.3999999994]], [9.96, [0.4000000009, 0.3999999994]], [9.97,
[0.4000000009, 0.3999999994]], [9.98, [0.4000000009, 0.3999999994]], [9.99,
[0.4000000009, 0.3999999994]], [10.00, [0.4000000009, 0.3999999994]], [10.01,
[0.4000000009, 0.3999999994]]]
```

> # Stable

> EquPts(f2, [x, y])

$$\left\{ [-8, 13], \left[-3, \frac{7}{4}\right], \left[-\frac{1}{22}, \frac{3}{11}\right], \left[\frac{1}{3}, \frac{1}{2}\right] \right\} \quad (12)$$

> L5 := Dis2(f2, x, y, [-8, 13] + [0.1, 0.1], 0.01, 10) : print([op(nops(L5) - 5 ..nops(L5), L5)]) :

```
[[9.96, [Float(∞), Float(∞)]], [9.97, [Float(∞), Float(∞)]], [9.98, [Float(∞),
Float(∞)]], [9.99, [Float(∞), Float(∞)]], [10.00, [Float(∞), Float(∞)]], [10.01, [
Float(∞), Float(∞)]]] (13)
```

> L6 := Dis2(f2, x, y, [-3, 7/4] + [0.1, 0.1], 0.01, 10) : print([op(nops(L6) - 5 ..nops(L6), L6)]) :

```
[[9.96, [Float(∞), Float(∞)]], [9.97, [Float(∞), Float(∞)]], [9.98, [Float(∞),
Float(∞)]], [9.99, [Float(∞), Float(∞)]], [10.00, [Float(∞), Float(∞)]], [10.01, [
Float(∞), Float(∞)]]] (14)
```

> L7 := Dis2(f2, x, y, [-1/22, 3/11] + [0.1, 0.1], 0.01, 10) : print([op(nops(L7) - 5 ..nops(L7), L7)]) :

```
[[9.96, [-0.04545454593, 0.2727272734]], [9.97, [-0.04545454593, 0.2727272734]], [9.98, (15)
[-0.04545454593, 0.2727272734]], [9.99, [-0.04545454593, 0.2727272734]], [10.00,
[-0.04545454593, 0.2727272734]], [10.01, [-0.04545454593, 0.2727272734]]]
```

> # Stable

> L8 := Dis2(f2, x, y, [1/3, 1/2] + [0.1, 0.1], 0.01, 10) : print([op(nops(L8) - 5 ..nops(L8), L8)]) :

```
[[9.96, [Float(∞), Float(∞)]], [9.97, [Float(∞), Float(∞)]], [9.98, [Float(∞),
Float(∞)]], [9.99, [Float(∞), Float(∞)]], [10.00, [Float(∞), Float(∞)]], [10.01, [
Float(∞), Float(∞)]]] (16)
```

> EquPts(f3, [x, y])

$$\left\{ \left[ \frac{1}{3}, \frac{1}{12} \right], \left[ \frac{8}{7}, -\frac{13}{14} \right], \left[ \frac{21}{17}, -\frac{12}{17} \right] \right\} \quad (17)$$

```
> L9 := Dis2(f3, x, y, [1/3, 1/12] + [0.1, 0.1], 0.01, 10) : print([op(nops(L9) - 5 ..nops(L9),
L9)])
[[9.96, [0.3333333353, 0.08333333161]], [9.97, [0.3333333353, 0.08333333161]], [9.98,
[0.3333333353, 0.08333333161]], [9.99, [0.3333333353, 0.08333333161]], [10.00,
[0.3333333353, 0.08333333161]], [10.01, [0.3333333353, 0.08333333161]]]
```

> # Stable

```
> L10 := Dis2(f3, x, y, [8/7, -13/14] + [0.1, 0.1], 0.01, 10) : print([op(nops(L10) - 5
..nops(L10), L10)])
[[9.96, [Float(∞), Float(∞)]], [9.97, [Float(∞), Float(∞)]], [9.98, [Float(∞),
Float(∞)]], [9.99, [Float(∞), Float(∞)]], [10.00, [Float(∞), Float(∞)]], [10.01, [
Float(∞), Float(∞)]]]
```

```
> L11 := Dis2(f3, x, y, [21/17, -12/17] + [0.1, 0.1], 0.01, 10) : print([op(nops(L11) - 5
..nops(L11), L11)])
[[9.96, [Float(∞), Float(∞)]], [9.97, [Float(∞), Float(∞)]], [9.98, [Float(∞),
Float(∞)]], [9.99, [Float(∞), Float(∞)]], [10.00, [Float(∞), Float(∞)]], [10.01, [
Float(∞), Float(∞)]]]
```

> # Question 3

```
> EquPts(SIRS(s, i, beta, gamma, nu, N), [s, i])
[[N, 0], [v/beta, gamma(N*beta - v)/(beta*(gamma + v)]]]
```

> # Steady state about of suseptible and infected are the same

# Question 4

```
> Chemostat := proc(N, C, a1, a2) :
[a1 * (C/(1+C) * N) - N, -C/(1+C) * N - C + a2] :
end:
> EquPts(Chemostat(N, C, a1, a2), [N, C])
[[0, a2], [a1(a2*a1 - a2 - 1)/(a1 - 1), 1/(a1 - 1)]]]
```

Max Mekharikov - HW 19 - Okay to post

$$1. \text{ i) } \beta = 0.3 \cdot \frac{V}{N} \rightarrow R = N - IN - S$$

$$R = 1000 - 996.7 - 2979$$

$$R = 6.279$$

$$\beta = 0.9 \cdot \frac{V}{N} \rightarrow R = 1000 - 988.3315 - 8.99$$

$$R = 2.678$$

$$\beta = 3.9 \cdot \frac{V}{N} \rightarrow R = 1000 - 914.6283 - 40$$

$$R = 45.372$$

$$\text{ii) } \beta = 0.3 \frac{V}{N} \rightarrow R = 1000 - 996.402 - 2.958$$

$$R = 0.64$$

$$\beta = 0.9 \frac{V}{N} \rightarrow R = 1000 - 985.6773 - 8.9797$$

$$R = 5.343$$

$$\beta = 3.9 \frac{V}{N} \rightarrow R = 1000 - 872.5259 - 40.8742$$

$$R = 86.60$$

$$\text{iii) } \beta = 0.3 \frac{V}{N} \rightarrow 1000 - 946.62 - 2.94$$

$$R = 0.44$$

$$\beta = 0.9 \frac{V}{N} \rightarrow R = 3.46$$

$$\beta = 3.9 \frac{V}{N} \rightarrow R = 55.86$$