

%%Tyler Fean Section:0232 May 6th, 2009

```
%%H(x,y)=.5*x^2+.5*y^2+d*(1+cos(x))
%%H_x=x-d*sin(x)
%%H_y=y
```

```
%% delte=.01
syms x y
sys1 = y;
sys2 = x-.01*sin(x);
[xo,yo] = solve(sys1,sys2,x,y);
disp('Critical points:');
disp([xo yo])
Critical points:
[ 0, 0]
```

```
figure
[X,Y] = meshgrid(-3:0.2:3,-3:0.2:3);
A = Y;
B = X-.01*sin(X);
C = sqrt((A/2).^2+(B/4.5).^2);
quiver(X,Y,A./C,B./C,.4);
axis tight
xlabel 'x'
ylabel 'y'
title 'Vector Field'
f = @(t,x) [x(2);x(1)-.01*sin(x(1))];
```

```
figure;
hold on
for a = -3:.5:3
    for b = -3:1:3
        [t,xa] = ode45(f, [0 10], [a b]);
        plot (xa(:,1),xa(:,2))
        [t, xa] = ode45(f, [0 -5], [a b]);
        plot (xa(:,1),xa(:,2))
    end
end
axis([-3 3 -3 3])
quiver(X, Y, U./L, V./L, .4);
title 'Vector Field and Phase Portrait'
hold off
```

```
%% delta .1
```

```
syms x y
sys1 = y;
sys2 = x-.1*sin(x);
[xo,yo] = solve(sys1,sys2,x,y);
disp('Critical points:');
disp([xo yo])
Critical points:
[ 0, 0]
```

```

figure
[X,Y] = meshgrid(-3:0.2:3,-3:0.2:3);
A = Y;
B = X-.1*sin(X);
C = sqrt((A/2).^2+(B/4.5).^2);
quiver(X,Y,A./C,B./C,.4);
axis tight
xlabel 'x'
ylabel 'y'
title 'Vector Field'
f = @(t,x) [x(2);x(1)-.1*sin(x(1))];

figure;
hold on
for a = -3:.5:3
    for b = -3:1:3
        [t,xa] = ode45(f, [0 10], [a b]);
        plot (xa(:,1),xa(:,2))
        [t, xa] = ode45(f, [0 -5], [a b]);
        plot (xa(:,1),xa(:,2))
    end
end
axis([-3 3 -3 3])
quiver(X, Y, U./L, V./L, .4);
title 'Vector Field and Phase Portrait'
hold off

```

```
%% delta=1
```

```

syms x y
sys1 = y;
sys2 = x-sin(x);
[xo,yo] = solve(sys1,sys2,x,y);
disp('Critical points:');
disp([xo yo])
Critical points:
[ 0, 0]

```

```

figure
[X,Y] = meshgrid(-3:0.2:3,-3:0.2:3);
A = Y;
B = X-sin(X);
C = sqrt((A/2).^2+(B/4.5).^2);
quiver(X,Y,A./C,B./C,.4);
axis tight
xlabel 'x'
ylabel 'y'
title 'Vector Field'
f = @(t,x) [x(2);x(1)-sin(x(1))];

```

```

figure;
hold on
for a = -3:.5:3
    for b = -3:.5:3
        [t,xa] = ode45(f, [0 10], [a b]);
        plot (xa(:,1),xa(:,2))
        [t, xa] = ode45(f, [0 -5], [a b]);
        plot (xa(:,1),xa(:,2))
    end
end
axis([-3 3 -3 3])
quiver(X, Y, U./L, V./L, .4);
title 'Vector Field and Phase Portrait'
hold off
%% delta=Pi/4

syms x y
sys1 = y;
sys2 = x-sin(x)*pi/4;
[xo,yo] = solve(sys1,sys2,x,y);
disp('Critical points:');
disp([xo yo])

figure
[X,Y] = meshgrid(-2.5:0.2:2.5,-2.5:0.2:2.5);
A = Y;
B = X-sin(X)*pi/4;
C = sqrt((A/2).^2+(B/4.5).^2);
quiver(X,Y,A./C,B./C,.8);
axis tight
xlabel 'x'
ylabel 'y'
title 'Vector Field'
f = @(t,x) [x(2);x(1)-sin(x(1))*pi/4];

figure;
hold on
for a = -2.5:.5:2.5
    for b = -2.5:.5:2.5
        [t,xa] = ode45(f, [0 10], [a b]);
        plot (xa(:,1),xa(:,2))
        [t, xa] = ode45(f, [0 -5], [a b]);
        plot (xa(:,1),xa(:,2))
    end
end
axis([-2.5 2.5 -2.5 2.5])
quiver(X, Y, U./L, V./L, .4);
Critical points:
[ 0, 0]

%% delta=Pi/2

syms x y
sys1 = y;
sys2 = x-sin(x)*pi/2;

```

```

[xo,yo] = solve(sys1,sys2,x,y);
disp('Critical points:');
disp([xo yo])

figure
[X,Y] = meshgrid(-5:0.4:5,-5:0.4:5);
A = Y;
B = X-sin(X)*pi/2;
C = sqrt((A/2).^2+(B/4.5).^2);
quiver(X,Y,A./C,B./C,.8);
axis tight
xlabel 'x'
ylabel 'y'
title 'Vector Field'
f = @(t,x) [x(2);x(1)-sin(x(1))*pi/2];

figure;
hold on
for a = -10:2:10
    for b = -10:2:10
        [t,xa] = ode45(f, [0 10], [a b]);
        plot (xa(:,1),xa(:,2))
        [t, xa] = ode45(f, [0 -5], [a b]);
        plot (xa(:,1),xa(:,2))
    end
end
axis([-10 10 -10 10])
quiver(X, Y, U./L, V./L, .4);
Critical points:
[ 0., 0.]

%% delta=2pi

syms x y
sys1 = y;
sys2 = x-2*pi*sin(x);
[xo,yo] = solve(sys1,sys2,x,y);
disp('Critical points:');
disp([xo yo])
Critical points:
[ 0., 0.]

figure
[X,Y] = meshgrid(-5:0.2:5,-5:0.2:5);
A = Y;
B = X-2*pi*sin(X);
C = sqrt((A/2).^2+(B/4.5).^2);
quiver(X,Y,A./C,B./C,.4);
axis tight
xlabel 'x'
ylabel 'y'
title 'Vector Field'
f = @(t,x) [x(2);x(1)-2*pi*sin(x(1))];

figure;
hold on

```

```

for a = -20:4:20
    for b = -20:4:20
        [t,xa] = ode45(f, [0 10], [a b]);
        plot (xa(:,1),xa(:,2))
        [t, xa] = ode45(f, [0 -5], [a b]);
        plot (xa(:,1),xa(:,2))
    end
end
axis([-20 20 -20 20])
quiver(X, Y, U./L, V./L, .4);

```

```
%% delta=3pi
```

```

syms x y
sys1 = y;
sys2 = x-3*pi*sin(x);
[xo,yo] = solve(sys1,sys2,x,y);
disp('Critical points:');
disp([xo yo])
Critical points:
[ 0., 0.]

```

```

figure
[X,Y] = meshgrid(-5:0.2:5,-5:0.2:5);
A = Y;
B = X-3*pi*sin(X);
C = sqrt((A/2).^2+(B/4.5).^2);
quiver(X,Y,A./C,B./C,.4);
axis tight
xlabel 'x'
ylabel 'y'
title 'Vector Field'
f = @(t,x) [x(2);x(1)-3*pi*sin(x(1))];

```

```

figure;
hold on
for a = -20:4:20
    for b = -20:4:20
        [t,xa] = ode45(f, [0 10], [a b]);
        plot (xa(:,1),xa(:,2))
        [t, xa] = ode45(f, [0 -5], [a b]);
        plot (xa(:,1),xa(:,2))
    end
end
axis([-20 20 -20 20])
quiver(X, Y, U./L, V./L, .4);

```

```
%% %% delta=100
```

```
syms x y
```

```

sys1 = y;
sys2 = x-100*sin(x);
[xo,yo] = solve(sys1,sys2,x,y);
disp('Critical points:');
disp([xo yo])

figure
[X,Y] = meshgrid(-5:0.4:5,-5:0.4:5);
A = Y;
B = X-100*sin(X);
C = sqrt((A/2).^2+(B/4.5).^2);
quiver(X,Y,A./C,B./C,.8);
axis tight
xlabel 'x'
ylabel 'y'
title 'Vector Field'
f = @(t,x) [x(2);x(1)-100*sin(x(1))];

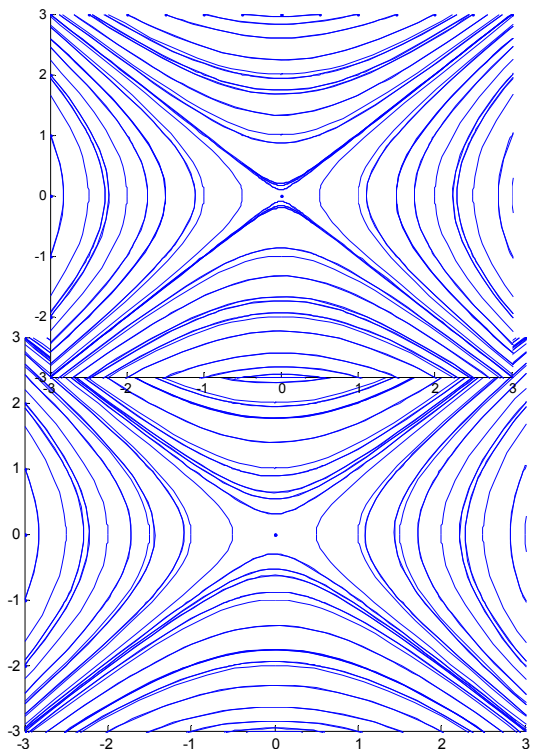
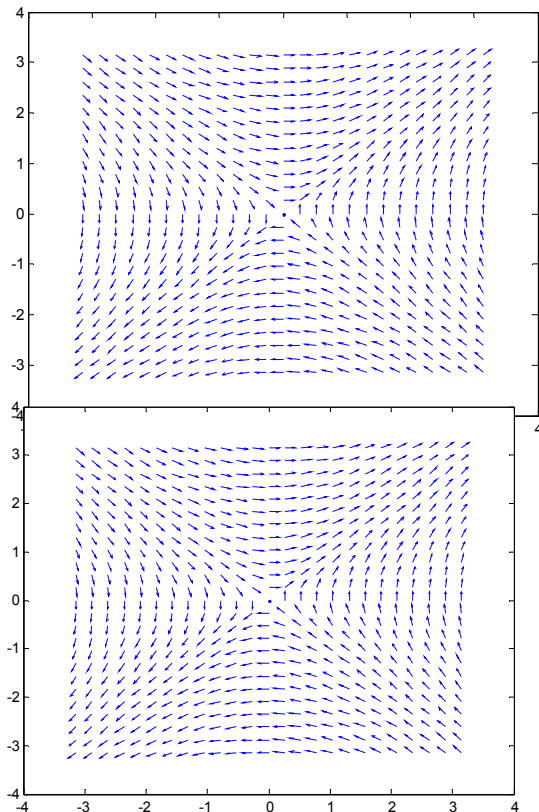
```

```

figure;
hold on
for a = -20:4:20
    for b = -20:4:20
        [t,xa] = ode45(f, [0 10], [a b]);
        plot (xa(:,1),xa(:,2))
        [t, xa] = ode45(f, [0 -5], [a b]);
        plot (xa(:,1),xa(:,2))
    end
end
axis([-20 20 -20 20])
quiver(X, Y, U./L, V./L, .4);
Critical points:
[ 0., 0.]

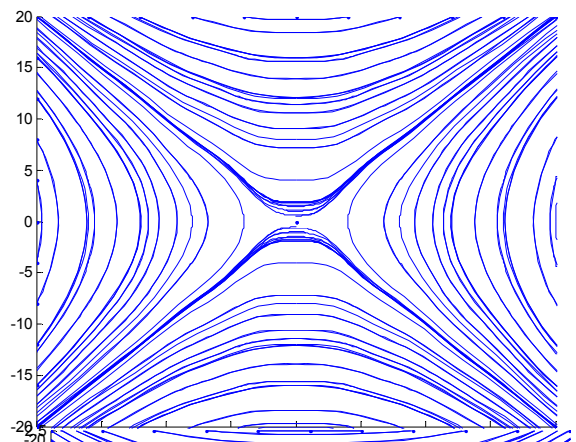
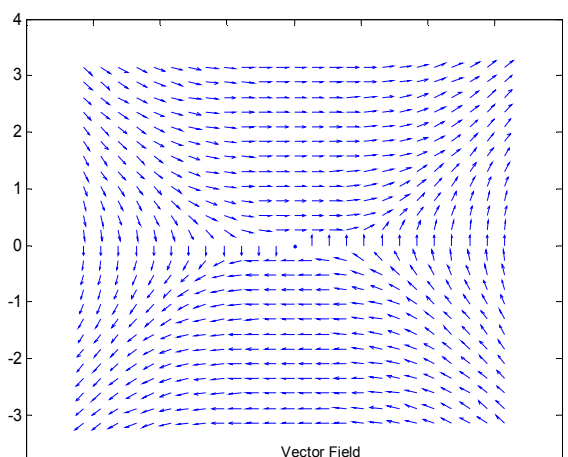
```

Delta=.01

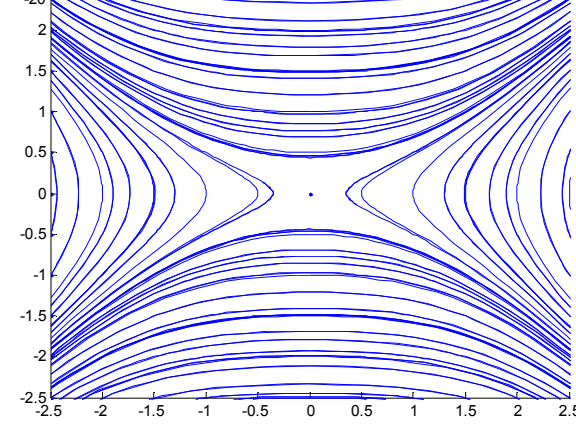
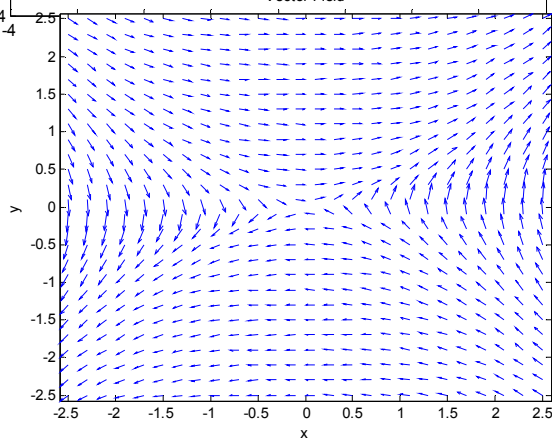


Delta=.1

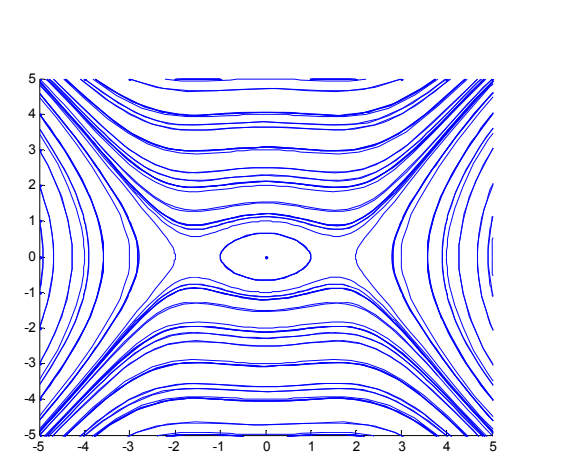
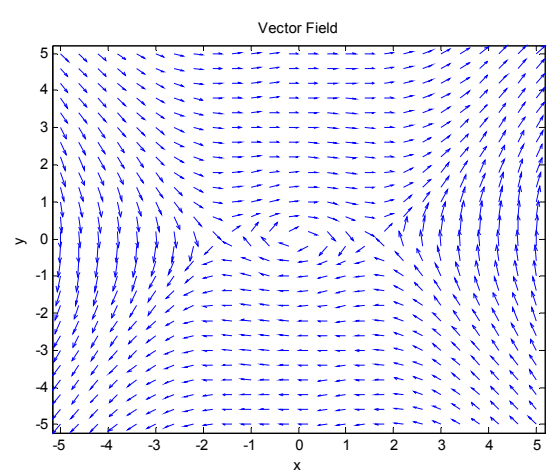
Delta=1



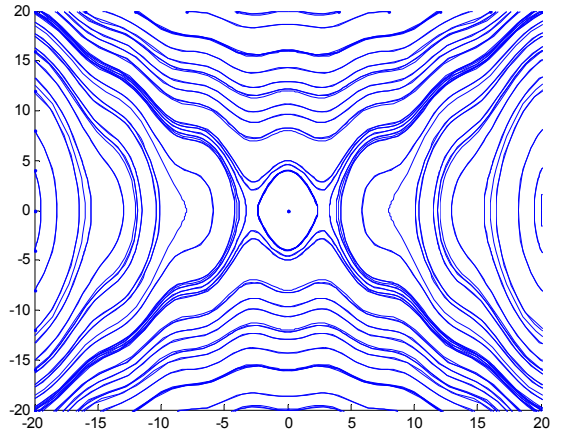
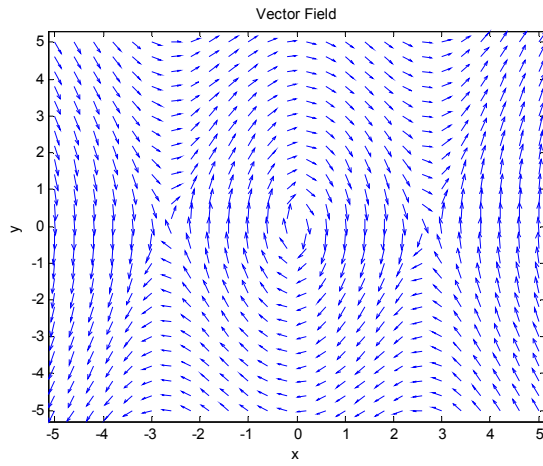
delat=pi/4



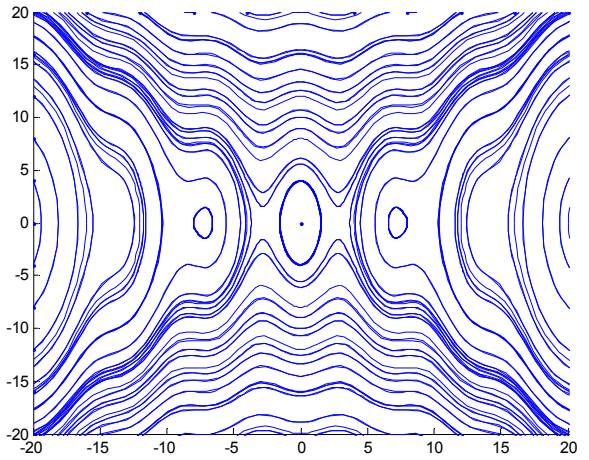
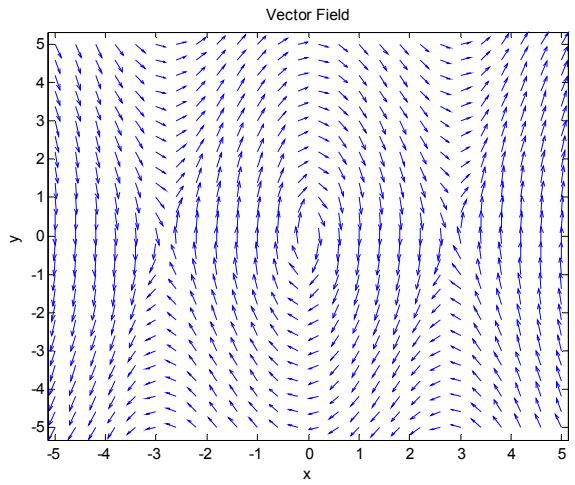
Delta=pi/2



Delta=2pi



Delta=3pi



Delta=100

