ECE 111 - Homework #2

Week #2: Matlab and Trigonometry Due 11am, Tuesday, September 6th

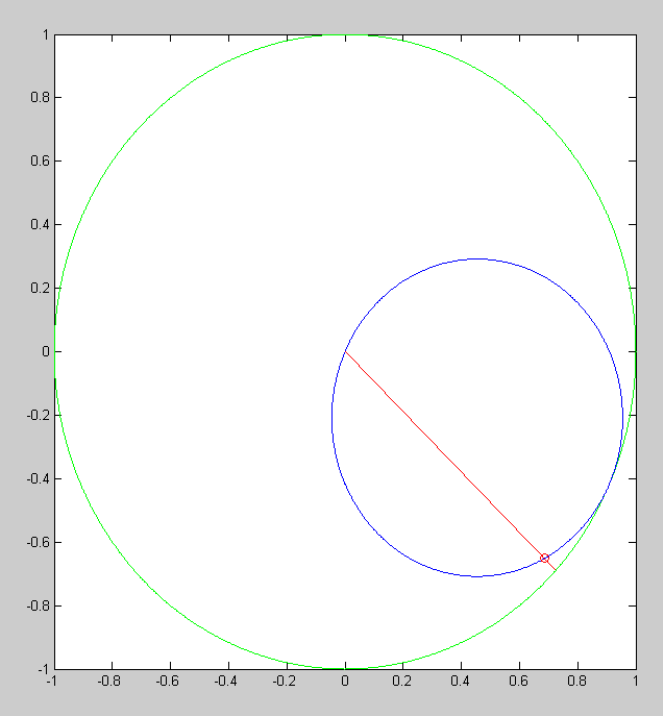
Plot the following functions in Matlab

1) $r = \sin(\theta + 2)$

```
q = [0:0.01:1]' * 2*pi;
r = sin(q + 2);
x = r .* cos(q);
y = r .* sin(q);
plot(x,y)
```

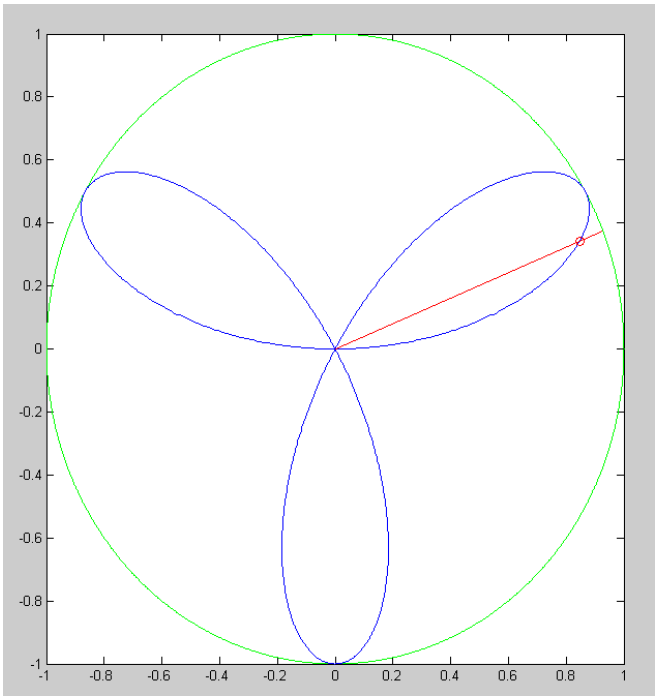
Matlab Code:

```
% problem 1: r = 1
q = [0:0.001:2]' * pi;
r = 1;
x1 = r .* cos(q);
y1 = r .* sin(q);

r = sin(q + 2);
x2 = r .* cos(q);
y2 = r .* sin(q);

for i=1:length(q)
   plot(x1,y1,'g-',x2,y2,'b-',x2(i),y2(i),'ro',[0,x1(i)],[0,y1(i)],'r-');
   pause(0.01);
end
```



2) $r = \sin(3\theta)$

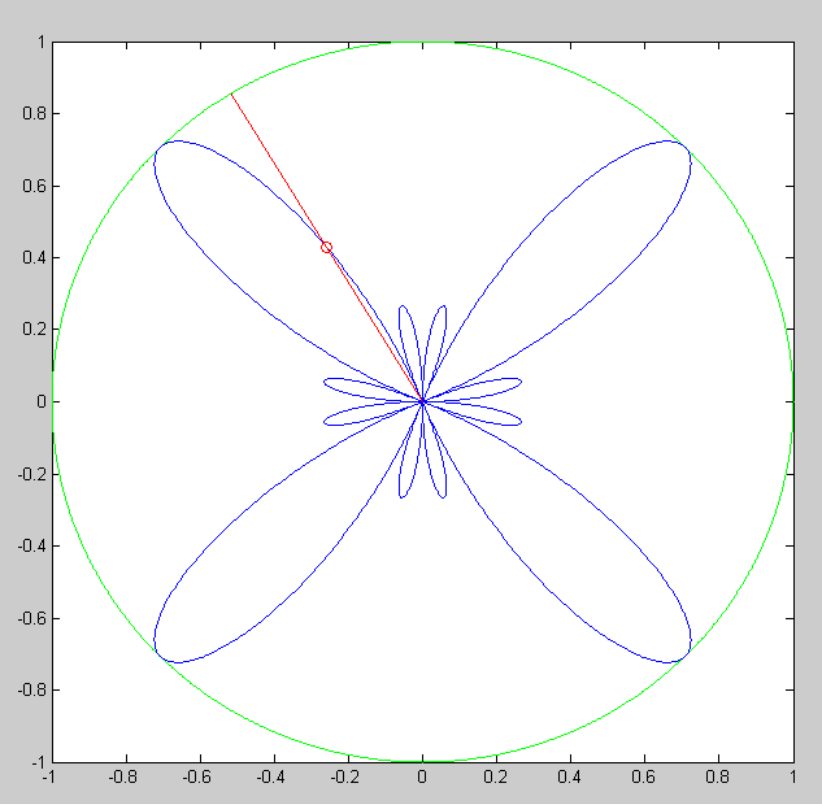
```
% problem 1: r = 1
q = [0:0.001:2]' * pi;
r = 1;
x1 = r .* cos(q);
y1 = r .* sin(q);

r = sin(3*q);
x2 = r .* cos(q);
y2 = r .* sin(q);

for i=1:length(q)
   plot(x1,y1,'g-',x2,y2,'b-',x2(i),y2(i),'ro',[0,x1(i)],[0,y1(i)],'r-');
   pause(0.01);
end
```



3) $r = \cos(4\theta) \cdot \sin(2\theta)$

Code;

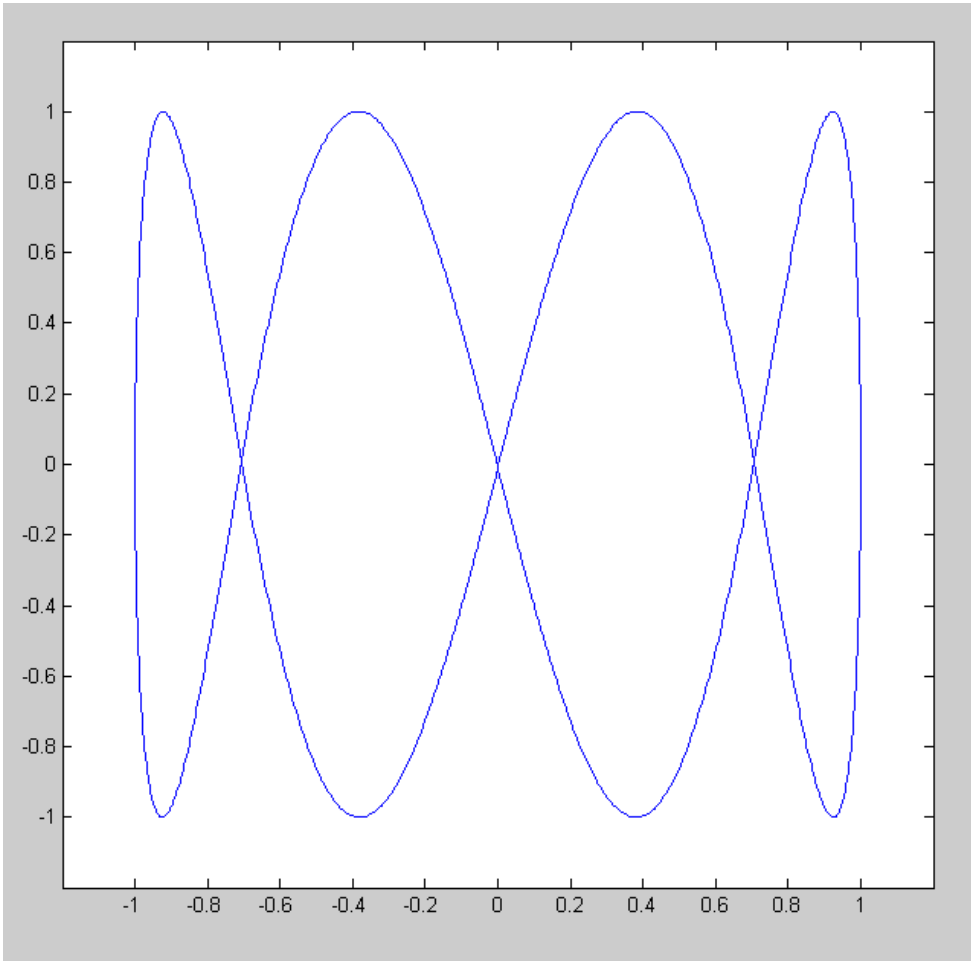
```
% problem 1: r = 1
q = [0:0.001:2]' * pi;
r = 1;
x1 = r .* cos(q);
y1 = r .* sin(q);

r = cos(4*q) .* sin(2*q);
x2 = r .* cos(q);
y2 = r .* sin(q);

for i=1:length(q)
   plot(x1,y1,'g-',x2,y2,'b-',x2(i),y2(i),'ro',[0,x1(i)],[0,y1(i)],'r-');
   pause(0.01);
end
```



4) Lissajous Figure:

- $x = \cos\theta$
- $y = \sin(4\theta)$

```
Q = [0:0.001:1]' * 2*pi;

for i=1:1000
   X = cos(Q);
   Y = sin(4*Q + 0.01*i);
   plot(X,Y);
   xlim([-1.2,1.2]);
   ylim([-1.2,1.2]);
   pause(0.01);
   end
```



f(x) = 0: Newton's Method

5) Use Newton's method to find the solutions to problem #4 for homework set #1

$$y = (x-2)(x)(x+2)$$

$$y = \tfrac{x}{2} - 2$$

or

$$f(x) = (x-2)(x)(x+2) - \left(\tfrac{x}{2} - 2\right) = 0$$

First, create a function to return f(x)

```
function [e] = Prob5(x)
   y1 = (x-2)*(x)*(x+2);
   y2 = x/2 - 2;
   e = y1 - y2;
   end
```

Next, use Newton's method to find where f(x) = 0

```
x1 = -2;

for i=1:10
    e1 = Prob5(x1);
    x2 = x1 + 0.01;
    e2 = Prob5(x2);
    x3 = x1 - (x2-x1)/(e2-e1) * e1;
    x1 = x3;
end
disp([x1, x1/2-2, e1])
```

Starting at x1 = -2

x = -2.3159 y = -3.1580 e = 0

Starting at x1 = 0

x = 0.4671 y = -1.7665 e = 1e-15

Starting at x = +2

1.8489 y = -1.0756 e = 1e-15

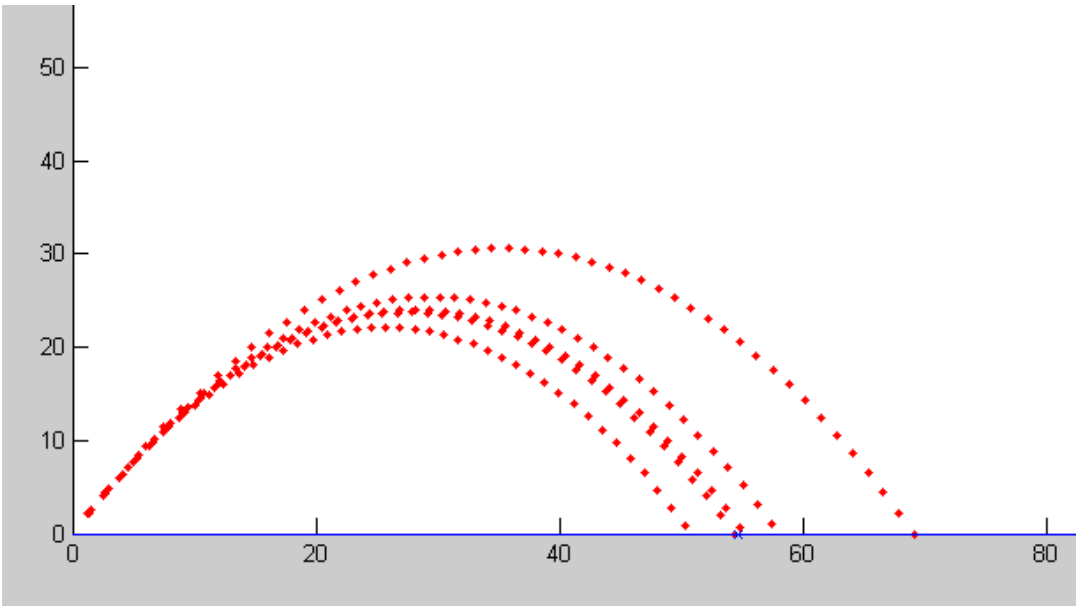
f(x) = 0: Shoot Game:

Pick a random number from 50 to 100 for your target.

Pick a random number from 30 to 70 for your firing angle

6) Use trial and error to find the initial velocity (X) to fire a tennis ball to hit the target (result is zero)

```
>> Target = 50*rand + 50

Target =   54.6428

>> Angle = 50*rand + 20

Angle =   59.2963

>> Shoot(30,Angle,Target)

ans =  -14.4655

>> Shoot(25,Angle,Target)

ans =    3.7603

>> Shoot(27,Angle,Target)

ans =   -3.4390

>> Shoot(26,Angle,Target)

ans =    0.1822

>> Shoot(26.2,Angle,Target)

ans =   -0.5389
```



7) Repeat using Newton's method to find the initial velocity (X) to fire the tenis ball to hit the target

```
>> x1 = 30;
>> y1 = Shoot(x1, Angle, Target)

y1 =  -14.4655

>> x2 = 25;
>> y2 = Shoot(x2, Angle, Target)

y2 =    3.7603

>> x3 = x2 - (x2-x1) / (y2-y1)*y2

x3 =   26.0316

>> y3 = Shoot(x3, Angle, Target)

y3 =    0.0685

>> x4 = x3 - (x3-x2) / (y3-y2)*y3

x4 =   26.0507

>> y4 = Shoot(x4, Angle, Target)

y4 = -4.7224e-004
```