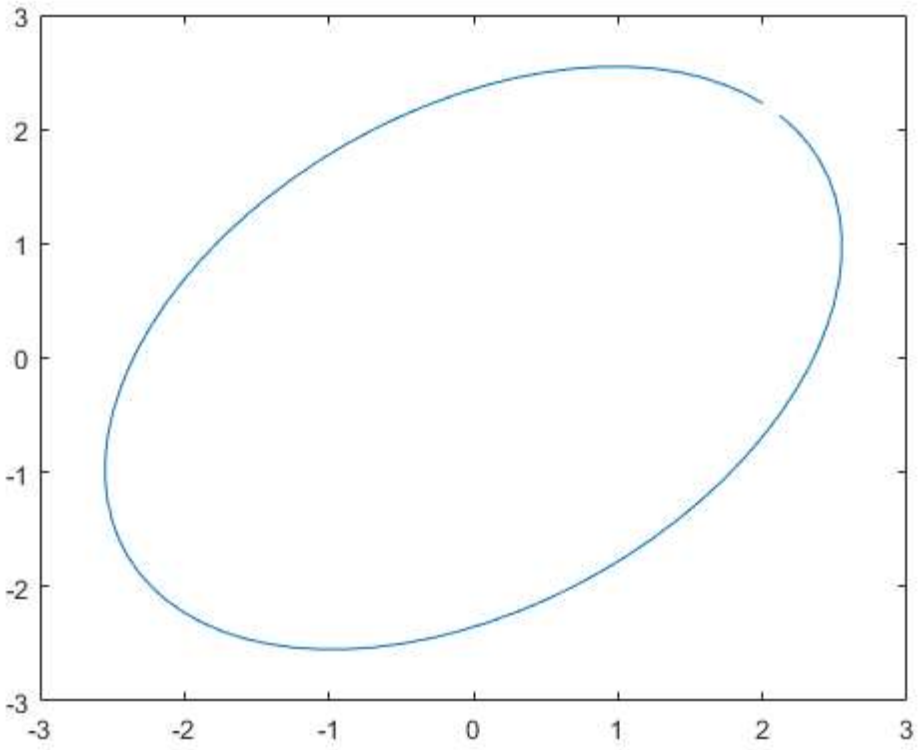
```
function S = P1(iter)
iter = 4;
k = zeros(iter,1);
n = zeros(iter,1);
enum = zeros(iter,1);
alpha = zeros(iter,1);
for l = 1:iter
    k(l) = l;
    n(l) = 2^(l-1)*10;
    theta = zeros(n(l),1);
    x = zeros(n(l),1);
    y = zeros(n(l),1);

    for i = 1:n(l)
        theta(i) = 2*i*pi/n(l);
        x(i) = (3*sqrt(2)/2)*cos(theta(i))-sqrt(2)*sin(theta(i));
        y(i) = (3*sqrt(2)/2)*cos(theta(i))+sqrt(2)*sin(theta(i));
    end
    plot(x,y);
    enum(l) = abs(6*pi-polyarea(x,y));
end
for l = 2:iter
    alpha(l) = log2(abs(enum(l-1)/enum(l)));
end

R = table(k,n,enum,alpha, 'VariableNames',{'k','n','error','accuracy'});
S = table(R,'VariableNames',{'Results'});
```

```
ans =

  4×1 table

              Results
    k    n      error      accuracy
    ____________________________________

    1    10       1.216          0
    2    20     0.30854     1.9786
    3    40     0.07742     1.9947
    4    80    0.019373     1.9987
```



Published with MATLAB® R2021b

Contents


```
function area = myarea(x,y)
```

```
%MYAREA - computes the area of a region with a curved boundary.
% input
% x - a vector for the x values of points on the boundary
% y - a vector for the y values of points on the boundary
% output
% area - area enclosed by a curved boundary defined by vectors x and y.
```

Find endpoints where curves will intersect

```
[mx,id1] = max(x);
[mn,id2] = min(x);
maxin = max(id1,id2);
minin = min(id1,id2);
polyleng = maxin-minin;
```

Create vectors for x and y values for top and bottom curves

```
polyx1 = zeros(polyleng+1,1);
polyy1 = zeros(polyleng+1,1);
polyx2 = zeros(length(x)-polyleng+1,1);
polyy2 = zeros(length(x)-polyleng+1,1);

for i = minin:maxin
    polyx1(i-minin+1) = x(i);
    polyy1(i-minin+1) = y(i);
end
for i = maxin:length(x)
    polyx2(length(polyx2)+maxin-i) = x(i);
    polyy2(length(polyx2)+maxin-i) = y(i);
end
for i = 1:minin
    polyx2(minin-i+1) = x(i);
    polyy2(minin-i+1) = y(i);
end
```

Create piecewise functions using piecewise cubic hermite interpolation

```
pp1 = pchip(polyx1,polyy1);
pp2 = pchip(polyx2,polyy2);
xq = mn:0.0001:mx;
```

```
plot(xq,ppval(pp1,xq),'red');
plot(xq,ppval(pp2,xq),'green');
```

Integrate top and bottom piecewise functions

```
[B1,C1] = unmkpp(pp1);
[B2,C2] = unmkpp(pp2);

Integral1 = 0;
for i = 1:length(B1)-1
    polyindv1 = @(x) C1(i,1).*(x-B1(i)).^3+C1(i,2).*(x-B1(i)).^2+C1(i,3).*(x-B1(i))+C1(i,4);
    a = B1(i);
    b = B1(i+1);
    I = integral(polyindv1,a,b);
    Integral1 = Integral1 + I;
end
Integral2 = 0;
for i = 1:length(B2)-1
    polyindv2 = @(x) C2(i,1).*(x-B2(i)).^3+C2(i,2).*(x-B2(i)).^2+C2(i,3).*(x-B2(i))+C2(i,4);
    a = B2(i);
    b = B2(i+1);
    I = integral(polyindv2,a,b);
    Integral2 = Integral2 + I;
end
```

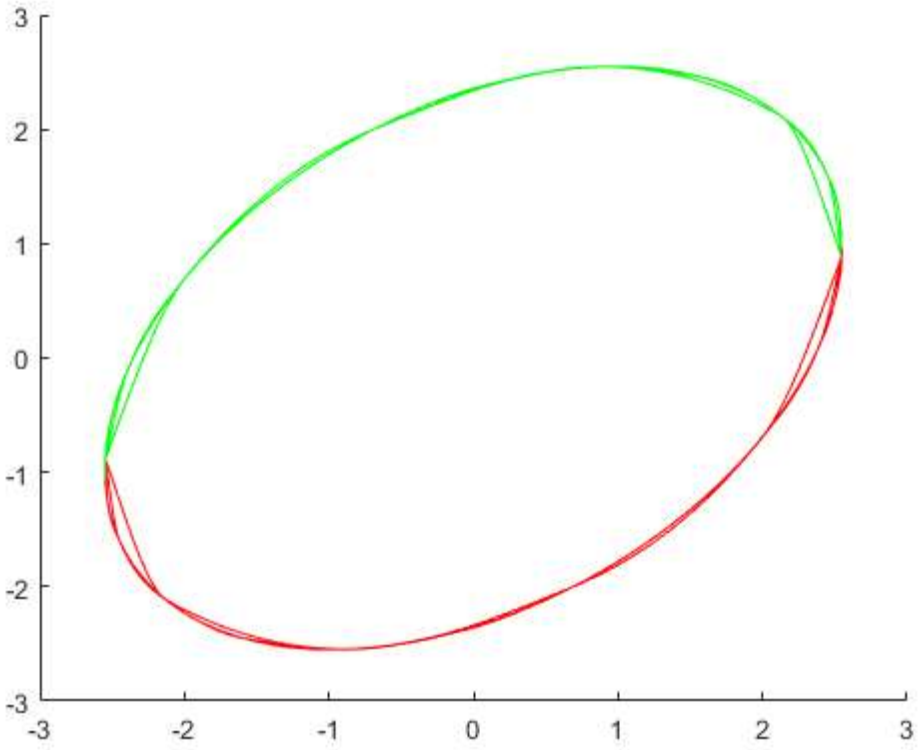
Find the total area

```
area = Integral2-Integral1;
```

Published with MATLAB® R2021b

```
function S = P2(iter)
iter = 4;
k = zeros(iter,1);
n = zeros(iter,1);
enum = zeros(iter,1);
alpha = zeros(iter,1);
for l = 1:iter
    k(l) = l;
    n(l) = 2^(l-1)*10;
    theta = zeros(n(l),1);
    x = zeros(n(l),1);
    y = zeros(n(l),1);

    for i = 1:n(l)
        theta(i) = 2*i*pi/n(l);
        x(i) = (3*sqrt(2)/2)*cos(theta(i))-sqrt(2)*sin(theta(i));
        y(i) = (3*sqrt(2)/2)*cos(theta(i))+sqrt(2)*sin(theta(i));
    end
    enum(l) = abs(6*pi-myarea(x,y));
end
for l = 2:iter
    alpha(l) = log2(abs(enum(l-1)/enum(l)));
end

R = table(k,n,enum,alpha, 'VariableNames',{'k','n','error','accuracy'});
S = table(R,'VariableNames',{'Results'});
```

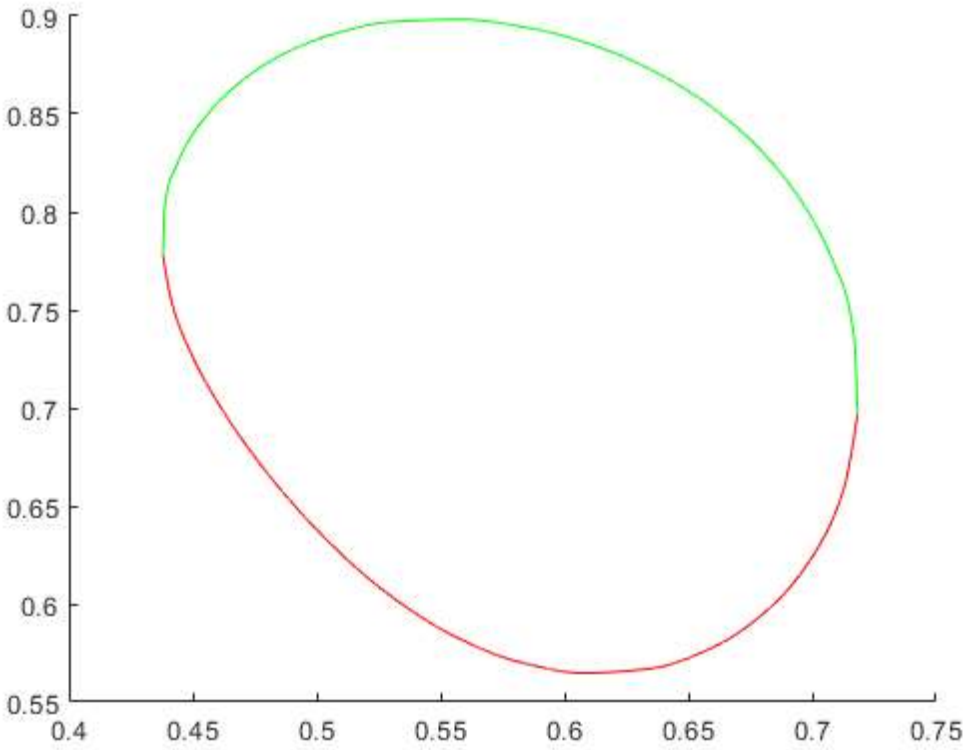
```
ans =

  4×1 table

               Results
    k    n       error       accuracy
    ____________________________________

    1    10       0.33616          0
    2    20      0.030214     3.4758
    3    40     0.0022574     3.7425
    4    80    0.00012505     4.1741
```



Published with MATLAB® R2021b

```
function S = P3
[x,y]=markers_Euler(32,0.1,0.0001);
    enum = abs(0.15^2*pi-polyarea(x,y));
    enum2 = abs(0.15^2*pi-myarea(x,y));
R = table(enum,enum2, 'VariableNames',{'polyerror','myerror'});
S = table(R,'VariableNames',{'Results'});
```

```
ans =

  table

          Results
    polyerror     myerror
    ____________________

    0.0004771    1.8951e-05
```



Published with MATLAB® R2021b