```
> restart;
> p := (z,w) -> z^3+w^3-1;
```
$$p := (z, w) \rightarrow z^3 + w^3 - 1 \tag{1}$$

```
> f := unapply(-diff(p(1+exp(I*t),w),t)/diff(p(1+exp(I*t),w),w),t,w);
```
$$f := (t, w) \rightarrow -\frac{I\left(1 + e^{It}\right)^2 e^{It}}{w^2} \tag{2}$$

```
> N:=100;
  u:=1.0;
  t:=-evalf(Pi);
  h:= evalf(2*Pi/N):
  for j from 1 to N do
  u:= u + f(t,u)*h:
  t:=t+h:
  od:
```

$$N := 100$$
$$u := 1.0$$
$$t := -3.141592654 \tag{3}$$

```
> u;
```
$$-0.4994017002 + 0.8664065008\ I \tag{4}$$

```
> evalf(exp(2*Pi*I/3));
```
$$-0.5000000000 + 0.8660254040\ I \tag{5}$$

```
> (-.5000000000+.8660254040*I)^3;
```
$$1.000000001 - 3.233738859\ 10^{-10}\ I \tag{6}$$

Unfortunately, the builtin Ruge-Kutta is confused by the complex numbers (I guess?)

```
> with(Student[NumericalAnalysis]):
```
```
> t:='t';
  RungeKutta(diff(w(t), t) = f(t,w(t)), w(-Pi) = 1.0, t = evalf(Pi),
  submethod = rk4);
```
$$t := t$$
$$-0.6667 + 0.7579\ I \tag{7}$$

So let's be more systematic now

```
> restart;
> p := (z,w) -> z^3+w^3-1;
```
$$p := (z, w) \rightarrow z^3 + w^3 - 1 \tag{8}$$

```
> omega:=evalf(exp(2*Pi*I/3));
  N:=100;
  h:= evalf(2*Pi/N):
```
$$\omega := -0.5000000000 + 0.8660254040\ I$$
$$N := 100 \tag{9}$$

```
> for k from 1 to 3 do
  f := unapply(-diff(p(omega^k+exp(I*t),w),t)/diff(p(omega^k+exp(I*t),w),w),
  t,w);
  for m from 1 to 3 do
  u:=omega^m;
  if k=1 then tt:= -evalf(Pi/3)
  elif k=2 then tt:= evalf(Pi/3)
  elif k=3 then tt:=  -evalf(Pi)
  end if;
  for j from 1 to N do
  u:= u + f(tt,u)*h:
```

```
tt:=tt+h:
od:
print(omega^k,omega^m,u):
od:
od:
```

$-0.5000000000 + 0.8660254040\,I,\ -0.5000000000 + 0.8660254040\,I,\ -0.5006291993 - 0.8656977886\,I$

$-0.5000000000 + 0.8660254040\,I,\ -0.5000000004 - 0.8660254040\,I,\ 1.000030879 - 0.0007087069736\,I$

$-0.5000000000 + 0.8660254040\,I,\ 1.000000001 - 3.233738859\ 10^{-10}\,I,\ -0.4994016819 + 0.8664064995\,I$

$-0.5000000004 - 0.8660254040\,I,\ -0.5000000000 + 0.8660254040\,I,\ -0.5006291980 - 0.8656977908\,I$

$-0.5000000004 - 0.8660254040\,I,\ -0.5000000004 - 0.8660254040\,I,\ 1.000030888 - 0.0007087066195\,I$

$-0.5000000004 - 0.8660254040\,I,\ 1.000000001 - 3.233738859\ 10^{-10}\,I,\ -0.4994016980 + 0.8664065041\,I$

$1.000000001 - 3.233738859\ 10^{-10}\,I,\ -0.5000000000 + 0.8660254040\,I,\ -0.5006291929 - 0.8656977945\,I$

$1.000000001 - 3.233738859\ 10^{-10}\,I,\ -0.5000000004 - 0.8660254040\,I,\ 1.000030877 - 0.0007087024967\,I$

$1.000000001 - 3.233738859\ 10^{-10}\,I,\ 1.000000001 - 3.233738859\ 10^{-10}\,I,\ -0.4994016972 + 0.8664064990\,I$ **(10)**