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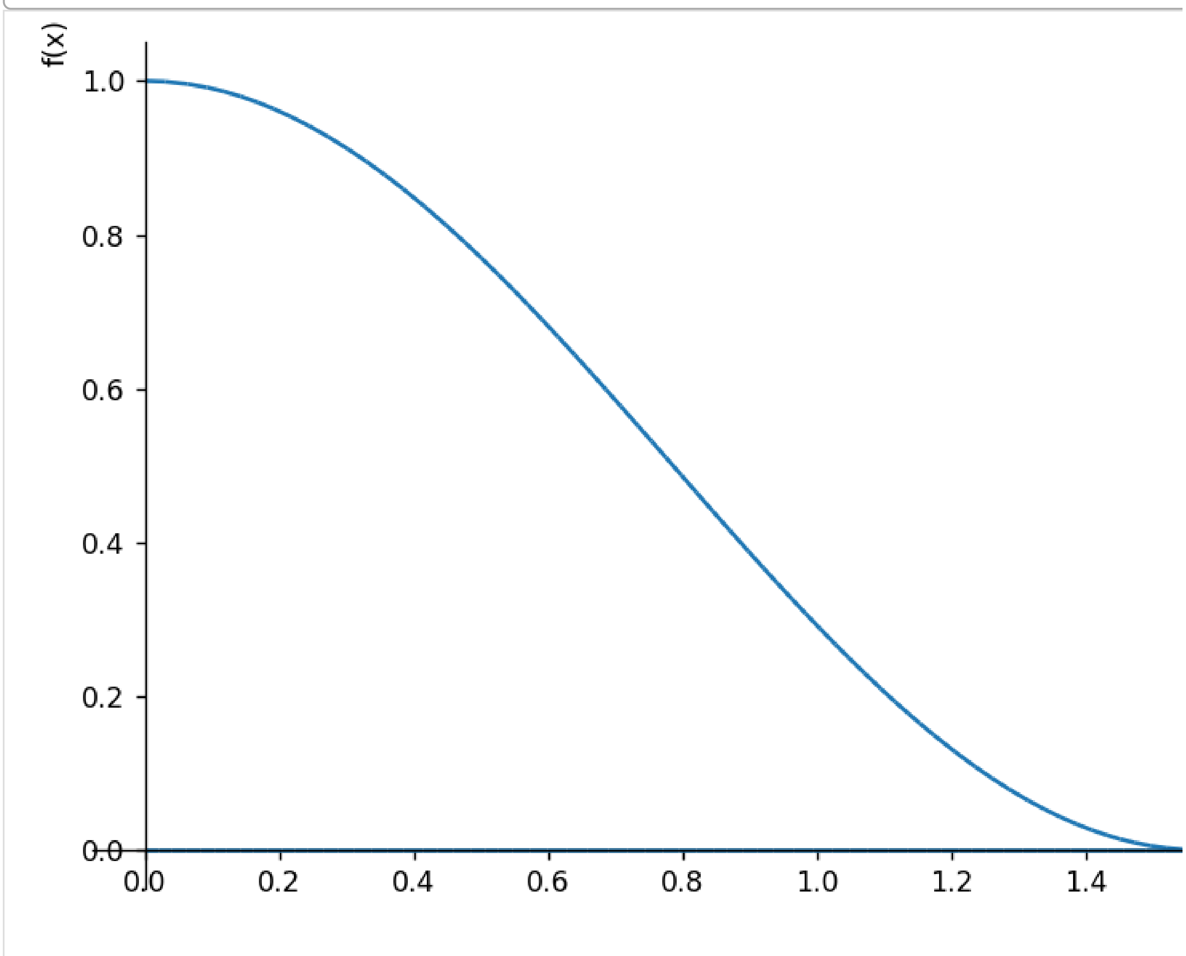
In [17]:
```
from sympy import *
from sympy.plotting import (plot, plot_parametric)
```

#1a Graph and area

In [18]:
```
matplotlib notebook
```

In [19]:
```
x = symbols('x')
f = (cos(x))**2
plot(f,0,(x,0,pi/2))
area = integrate(f,(x,0,pi/2))
print("The area of the region R is",area)
```

Figure 1




```
The area of the region R is pi/4
```

#1b Volume about the x-axis

In [83]:

```
A = pi*((cos(x))**2)**2
volume = integrate(A,(x,0,pi/2))
print("The volume of the solid formed by rotating R about the x-axis is:"
      ,volume,"or, in decimal:",volume.evalf())
```

```
The volume of the solid formed by rotating R about the x-axis is: 3*pi**2/1
6 or, in decimal: 1.85055082520425
```

#1c Volume about x=pi/2

In [84]:

```
A = 2*pi*(((cos(x))**2)**2)*(pi/2-x)
volume = integrate(A,(x,0,pi/2))
print("The volume of the solid formed by rotating R about the line x=pi/2 is:
      ,volume,"or, in decimal:",volume.evalf())
```

```
The volume of the solid formed by rotating R about the line x=pi/2 is: 5*p
i/16 + 2*pi*(3/32 + 3*pi**2/64) or, in decimal: 4.47763476557301
```

#2a u-substitution

In [59]:

```
x = symbols('x', real = true)
gx = x**3/(4-x**2) #expression
w = 4-x**2 #substitute w into the equation
u = sqrt(4-w)
gx2 = (u**3/(4-u**2))/(-2*u)
integrate(gx2,x) #take the integral
print(gx2) #answer
```

```
-x**2/(2*(4 - x**2))
```

#2b Integration by parts

In [82]:

```
u = x**2 #find the different components
dv = x/sqrt(4-x**2)
du = diff(u,x)
v = integrate(dv,x)
gx31 = (u*v) #plug components into IBP formula
gx32 = integrate(v*du,x)
gx3 = gx31-gx32
print(gx3)
```

```
-x**2*sqrt(4 - x**2)/3 - 8*sqrt(4 - x**2)/3
```

#2c Trig substitution

In [53]:
```
t = symbols('t', real = true)
gx = x**3/(4-x**2)
trig1 = 2*sin(t) #setup trig function
trig2 = diff(trig1, t) #derivative of the trig function
trigfx = gx.subs(x,trig1) #substitution
trigfx2 = trigfx*trig2 #multiplying by the derivative
trigfx3 = integrate(trigfx2, t) #integrating the expression
trigfx4 = trigfx3.subs(t,asin(x/2))
print(trigfx4)
```

```
-x**2/2 - 2*log(x/2 - 1) - 2*log(x/2 + 1)
```

#2d Simplify answers to show equivalence

In [81]:
```
print(simplify(gx2))
print(simplify(gx3))
print(simplify(trigfx4))
```

```
x**2/(2*(x**2 - 4))
-sqrt(4 - x**2)*(x**2 + 8)/3
-x**2/2 - 2*log(x/2 - 1) - 2*log(x/2 + 1)
```

#3a Partial fractions, then integrate

In [26]:
```
x=symbols('x')
f=((x**3)+2)/(x*((x**2)+4)**2)
fpd=apart(f,x)
print(fpd)
fpdint=integrate(fpd,x)
print(fpdint)
```

```
-(x - 8)/(8*(x**2 + 4)) - (x + 8)/(2*(x**2 + 4)**2) + 1/(8*x)
(1 - 2*x)/(4*x**2 + 16) + log(x)/8 - log(x**2 + 4)/16 + atan(x/2)/4
```

#3b Integrate f directly

In [27]:
```
fint=integrate(f,x)
print(fint)
```

```
(1 - 2*x)/(4*x**2 + 16) + log(x)/8 - log(x**2 + 4)/16 + atan(x/2)/4
```

#4a Partial fractions by hand: part 1

In [28]:
```
x,A,B,C,D,E=symbols('x A B C D E')
y=(A*x**2)*(1+x**3)+(B*x)*(1+x**3)+C*(1+x**3)+(E+D*x)*(x**3)
yexp=expand(y)
print(yexp)
cyexp=collect(yexp,x)
print(cyexp)
```

```
A*x**5 + A*x**2 + B*x**4 + B*x + C*x**3 + C + D*x**4 + E*x**3
A*x**5 + A*x**2 + B*x + C + x**4*(B + D) + x**3*(C + E)
```

#4b Solve system of equations

In [29]:
```
eq1=C+E-1
eq2=C
eq3=A+A+B+B+D
coeffs=solve([eq1,eq2,eq3],[A,B,C,D,E])
print(coeffs)
```

```
{C: 0, E: 1, A: -B - D/2}
```

#4c partial fractions directly in Python

In [30]:
```
apart(cyexp,x)
```

Out[30]: $Ax^5 + Ax^2 + Bx + C + x^4(B + D) + x^3(C + E)$