Math 152 – Python Lab 3

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0.1 MATH 152 Lab 3

MATH 152 Lab 3 Section Number: 571

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[1]:
```
from sympy import *
from sympy.plotting import (plot, plot_implicit)
```

0.1.1 Question 1

1a

[2]:
```
# find the region rotated about the x-axis
x, y = symbols('x y')
y1 = x * exp(1 - x / 2)
y2 = 2

x_intersections = (0, 2)

area = pi * integrate((y2 ** 2) - (y1 ** 2), (x, *x_intersections))

print(f"The region A about the x-axis has a volume of {area.simplify()} which␣
↪is approximately {area.evalf()} units cubed.")
```

```
The region A about the x-axis has a volume of 2*pi*(9 - exp(2)) which is
approximately 10.1218590498895 units cubed.
```

1b

[3]:
```
# find the region rotated about the y-axis
# I will use shell method to find the area

h = 2 - y1
R = x
```

```
area = 2 * pi * integrate(R * h, (x, *x_intersections))
print(f"The region A about the y-axis has a volume of {area.simplify()} which␣
↪is approximately {area.evalf()} units cubed.")
```

```
The region A about the y-axis has a volume of 8*pi*(11 - 4*E) which is
approximately 3.18865839034766 units cubed.
```

1c

[4]:
```
y1 = x * exp(1 - x / 2)
y2 = x

area = pi * integrate((y1 ** 2) - (y2 ** 2), (x, *x_intersections))

print(f"The region B about the x-axis has a volume of {area.simplify()} which␣
↪is approximately {area.evalf()} units cubed.")
```

```
The region B about the x-axis has a volume of 2*pi*(-19 + 3*exp(2))/3 which is
approximately 6.63330176925606 units cubed.
```

1d

[5]:
```
y = symbols('y')

x1 = sqrt(2 * y)
x2 = y

ax = 2.5

area = pi * integrate((ax - x2) ** 2 - (ax - x1) ** 2, (y, 0, 2))
print(f"The region C about the x = 2.5 has a volume of {area.simplify()} which␣
↪is approximately {area.evalf()} units cubed.")
```

```
The region C about the x = 2.5 has a volume of 2.0*pi which is approximately
6.28318530717958 units cubed.
```

0.1.2 Question 2

2a

[6]:
```
y = symbols('y')

distance = y + 1
density = 1000 * 9.8
volume = (3 / 2) * (2 - y) * 5
work = integrate(density * volume * distance, (y, 0, 2))

print(f"The work required to pump all the water out of the tank is {work.
↪simplify()} J.")
```

```
The work required to pump all the water out of the tank is 245000.000000000 J.
```

2b

[7]:
```
n = symbols('n')
res = integrate(1000 * 9.8 * (y + 1) * ((3 / 2) * (2 - y) * 5), (y, 0, n))
work = 3E4
height = nsolve(work - res, 0)

print(f"The height of the water in the tank when the work is 30,000 J is {2 -␣
↪height} m.")
```

```
The height of the water in the tank when the work is 30,000 J is
1.80424791991912 m.
```

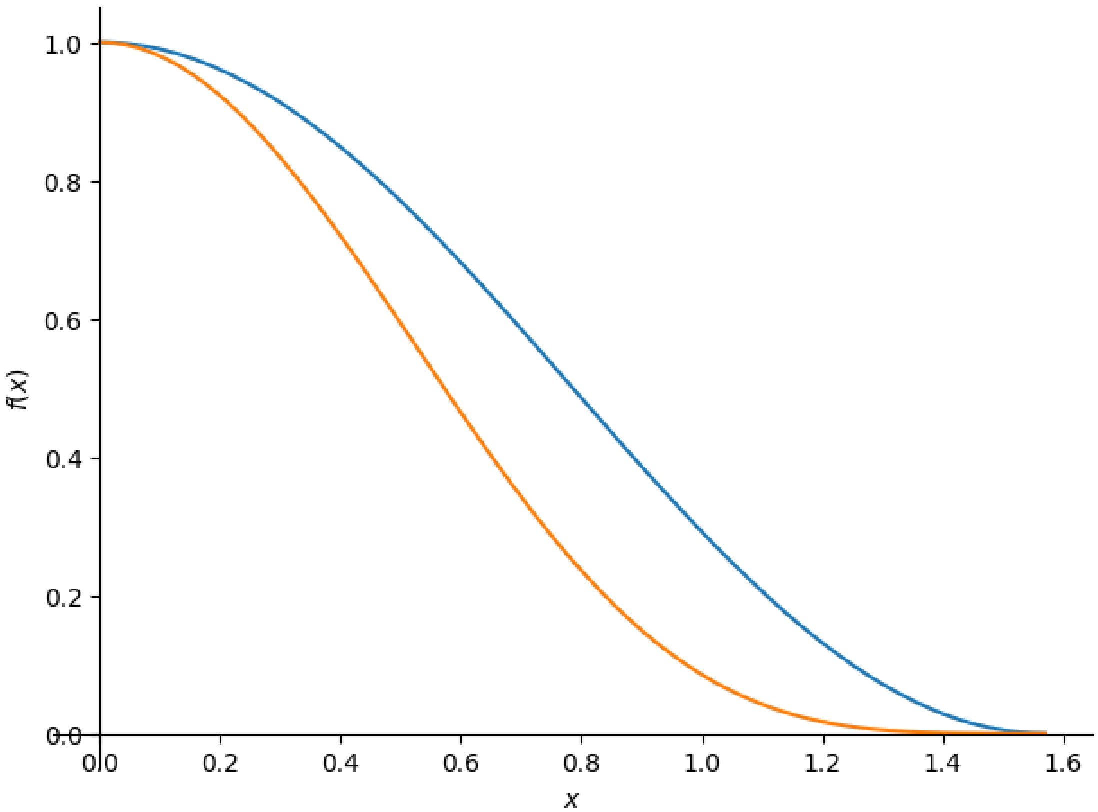
0.1.3 Question 3

3a

[8]:
```
x = symbols('x')
f1 = cos(x) ** 2
f2 = cos(x) ** 4

pcurve = plot(f1, (x, 0, pi / 2), show=False)
pcurve.extend(plot(f2, (x, 0, pi / 2), show=False))
pcurve.show()

volume = integrate(2 * pi * (pi / 2 - x) * (f1 - f2), (x, 0, pi / 2)).simplify()
print(f"The graph of {f1} and {f2} are shown above.")
print(f"The volume of the bounded region is {volume} which is approximently␣
↪{volume.evalf()}.")
```




```
The graph of cos(x)**2 and cos(x)**4 are shown above.
The volume of the bounded region is pi**3/32 which is approximently
0.968946146259369.
```

3b

[9]:
```python
A = integrate(f1 - f2, (x, 0, pi / 2))
print(f"The area of the bounded region is {A} which is approximently {A.
↪evalf()}.")
```

```
The area of the bounded region is pi/16 which is approximently
0.196349540849362.
```

3c

[10]:
```python
xp = 1 / A * integrate(x * (f1 - f2), (x, 0, pi / 2))
print(f"The center of mass of the bounded region is {xp} which is approximently␣
↪{xp.evalf()}.")

print(f"It makes sense because pi/4 is the midpoint of the area on the graph␣
↪which is a seemingly symetrical shape.")
```

```
The center of mass of the bounded region is pi/4 which is approximently
```

0.785398163397448.
It makes sense because pi/4 is the midpoint of the area on the graph which is a seemingly symetrical shape.

3d

[11]:
```
delta_x = pi / 4 * A
print(f"When the region roates about the x-axis, the center of mass will move␣
↪{delta_x} units.")
print(f"To go from this to the answer in part A, you multiply by 2pi. Which␣
↪makes sense because it should be a circle.")
```

When the region roates about the x-axis, the center of mass will move pi**2/64 units.
To go from this to the answer in part A, you multiply by 2pi. Which makes sense because it should be a circle.