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1 -

```
import math #importing math library
import random #importing library for random numbers

#the function for the area under the graph
#it changes from graph to graph and depends on the the curve
def f(x):  #function defination
    return math.sin(x)**3+math.cos(x)

# define any xmin-xmax interval here! (xmin < xmax)
xmin = 0.0   #lower limit of x
xmax = 3.0 * math.pi #upper limit of x

# find ymin-ymax
numSteps = 1000000 # number of steps
ymin = f(xmin) #the minimum number of steps in the y axis using function f
ymax = ymin
for i in range(numSteps):
    x = xmin + (xmax - xmin) * float(i) / numSteps
    y = f(x)
    if y < ymin: ymin = y
    if y > ymax: ymax = y

# Monte Carlo
rectArea = (xmax - xmin) * (ymax - ymin) #the area of the graph
numPoints = 1000000 # number of points to observe on the graph
ctr = 0 #assigning the counter to zero
for j in range(numPoints):  #loop runs from 0 to
number of points

    x = xmin + (xmax - xmin) * random.random() #finding the x coordinate
    y = ymin + (ymax - ymin) * random.random() #random.random to increase randomness
    if math.fabs(y) <= math.fabs(f(x)):
        if f(x) > 0 and y > 0 and y <= f(x):
            ctr += 1 # area over x-axis is positive
        if f(x) < 0 and y < 0 and y >= f(x):
            ctr -= 1 # area under x-axis is negative
# this is the main part
# we calculate the area here
```

```
# this is the same algorithm we use to calculate the monte carlo approximate numerical solution without function
fnArea = rectArea * float(ctr) / numPoints  #calculating the area around the number of points
print("Numerical integration = " + str(fnArea)) #printing the numeric value of area
```

2 -

A -

$$\int_0^{\pi} x^2 \, dx$$

Integrating, we get

$$= \left[\frac{x^{2+1}}{2x+1}\right]_0^{\pi} + C$$

$$= \frac{\pi^3}{3} - \left(\frac{0}{3}\right)^3 = 10.31$$

b) I suck at Calculus - it’s too diffcult c)

$$\int_0^{\pi} \frac{\sin x}{x}\, dx$$

~~$\sin x = x$~~

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!}$$

$$\therefore \frac{\sin x}{x} = 1 - \frac{x^2}{3!} + \frac{x^4}{5!} + \cdots$$

$$= 1 - \frac{x^2}{6} + \frac{x^4}{120}$$

Taking upto 4th term

$$\int_0^{\pi} \left[1 - \frac{x^2}{6} + \frac{x^4}{120}\right] dx$$

$$= \left[x - \frac{x^3}{18} + \frac{x^5}{600}\right]_0^{\pi}$$

$$= \pi - \frac{\pi^3}{18} + \frac{\pi^5}{600}$$

$$= \pi - 1.71 + 0.50$$

$$= 1.9$$